Name : Solution Section:_____ CWRU e-mail:_____

Department of Electrical Engineering and Computer Science
ENGR 210. Introduction to Circuits and Instruments (4)

Quiz No. 12 **4/15/05**

PUT ANSWERS IN THE SPACE PROVIDED AND, IF APPROPRIATE, SHOW YOUR WORK. BE SURE TO STATE ANY ASSUMPTIONS

Problem 1 Transfer functions (10 points)

3 pt-setting up phasor analysis 1 pt for ohm's law

(a) Determine the transfer function $T_V(j\omega)=\frac{v_o(j\omega)}{v_i(j\omega)}$ of the following circuit. Be sure to put the denominator of your transfer function in standard form.

$T_V(j\omega)=$ $\frac{j\omega/2000}{1+j\omega/2000}$ OR $\frac{j\omega}{2000+j\omega}$

1 knew it or not

(b) What is the cutoff frequency ω_c for this filter? $\omega_c=$ 2000 rad/s ≈ 318. Hz

1 same as (b)

(c) What is $T_V(j\omega)=\frac{v_o(j\omega)}{v_i(j\omega)}$ for $\omega=2\omega_c$?

$T_V(j2\omega_c)=$ $\frac{j2\omega_c}{2000+j2\omega_c}=\frac{j4000}{2000+j4000}=\frac{j2}{1+j2}$

2 for math, 1 for answer

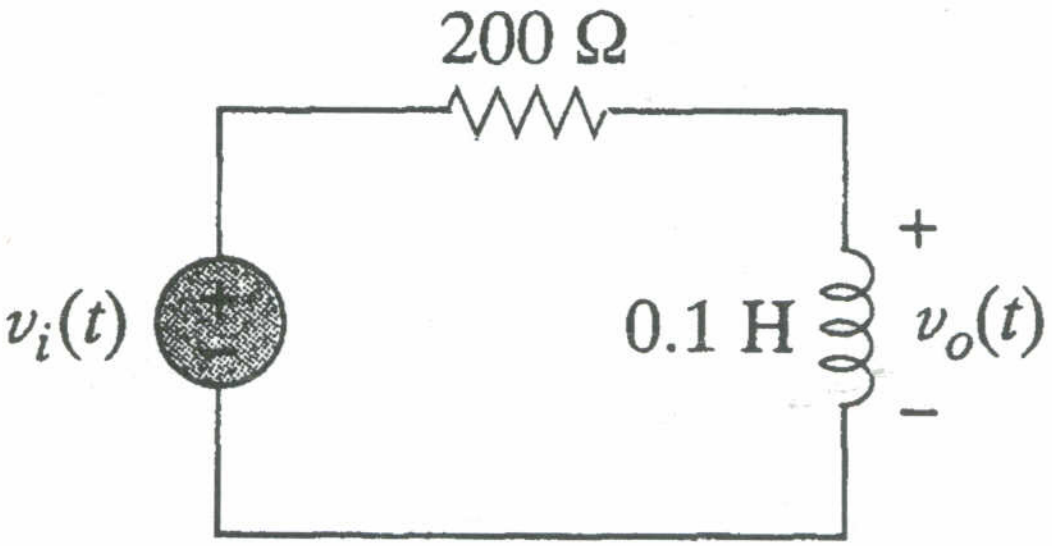
(d) If $v_i(t)=10\cos(\omega t)$ write the steady state expression for $v_o(t)$ when $\omega=2\omega_c$.

$v_o(t)=$ $8.94\cos(\omega t+26.6^\circ)$

2 same as (b)

(e) What kind of filter is this? High-pass, low-pass, band-pass, band-reject, notch, something else?

Type = high pass



$T_V(j4000\ \text{rad/s})=\frac{j2}{1+j2}\cdot\frac{(1-j2)}{(1-j2)}$

$=\frac{j2+4}{1+4}=\frac{j2+4}{5}$

$=0.8+0.4j=0.894\cos(\omega t+26.6^\circ)$

$=8.94\cos(\omega t+26.6^\circ)$

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Problem 2 Frequency dependent transfer functions (10 points)

2 for math, 1 for answer

(a) What is the cutoff frequency ω_c for the filter described by

$$T_v(j\omega) = \frac{v_o(j\omega)}{v_i(j\omega)} = \frac{4}{2 + j\omega 10}$$

$\omega_c =$ 0.2 rad/s

(b) Using the chart below plot the frequency dependence of this filter. Be sure to label your axes.

(c) What is the passband gain of this filter in decibels.

same as (a)

Passband gain = 6 dB

1 pt for axis, 1 pt for points, 2 pts for line

(A) $\frac{4}{2+j\omega 10} = \frac{0.4}{0.2+j\omega}$ $\omega_C = 0.2$ rad/s

(C) $20\log_{10}|2| =$ 6 dB