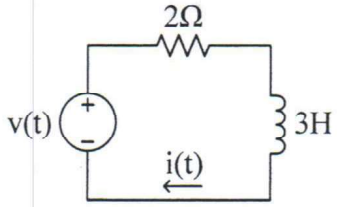
13 Spring Exam 2

Problem 3

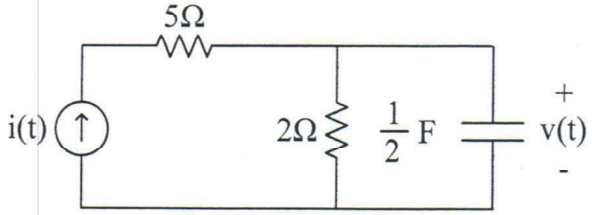
(a) The circuit below has frequency response $H(\omega) = \frac{I}{V}$.



i) Determine $H(\omega)$: _____

ii) Determine the maximum value for $|H(\omega)|$: _____

(b) The circuit below has frequency response $H(\omega) = \frac{V}{I}$.



i) Determine $H(\omega)$: _____

ii) Determine $|H(\omega)|$ as $\omega \to \infty$: _____

iii) Determine $\angle H(\omega)$ as $\omega \to \infty$: _____

(c) An LTI system with input f(t) and output y(t) is described by the ODE

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 3y(t) = f(t)$$

The frequency response for the system $H(\omega) = \frac{Y}{F}$.

i) Determine $H(\omega)$: _____

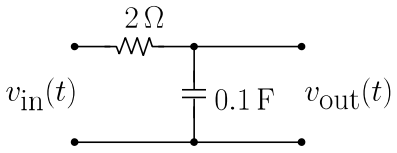
ii) Determine the value of ω ($\omega > 0$) such that $\angle H(\omega) = -\frac{\pi}{4}$: _____

10 Fall Exam 2

1. Problem 1 (25 points)

These problems are intended to be quick and easy:

(a) For the following circuit.



(3 pt)

i. Find the frequency response $H(\omega)$.

(1 pt)

ii. Is $H(\omega)$ the frequency response of a high pass, low pass or a band pass filter?

(3 pt)

iii. If $v_{in}(t) = 2 + \cos(5t + \frac{\pi}{4})$, then $v_{out}(t) =$?

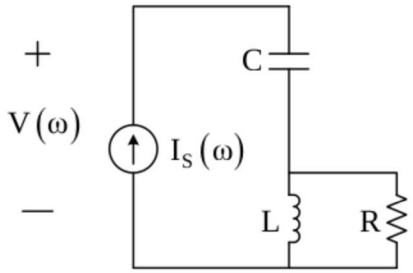
(2 pt)

(b) What is the resonance frequency of the following circuit.

Problem 3 (25 points)

All parts of this problem are independent.

a) (5 points) In the circuit below, $H(\omega) = V(\omega)/I_S(\omega)$. Find $H(\omega)$. Your answer may include the variables, R, C, L and ω.



$H(\omega) =$ _____

b) A particular circuit is characterized by $H(\omega) = \dfrac{15j\omega}{25j\omega + (1 - \omega^2 64)}$

i) (4points) What is the frequency ω_p, at which $|H(\omega)|$ is maximum?

$\omega_p =$ _____

ii) (4 points) What is $|H(\omega_p)|$?

$|H(\omega_p)| =$ _____

Problem 3 (continued)

c) A circuit has input $f(t)$, output $y(t)$, and frequency response $H(\omega)$ given by

$$H(\omega) = \frac{a + j\omega b}{c + j\omega d}$$

You may answer each of the following sub-parts in terms of the variables a, b, c, and d if you wish. You may assume that a, b, c, and d are all positive real constants.

i) (4 points) If $f(t) = 6\cos(35t)$, then $y(t) = A\cos(35t + \theta)$ for what value of A?

A = _____

ii) (4 points) If $f(t) = 6\cos(35t)$, then $y(t) = A\cos(35t + \theta)$ for what value of θ?

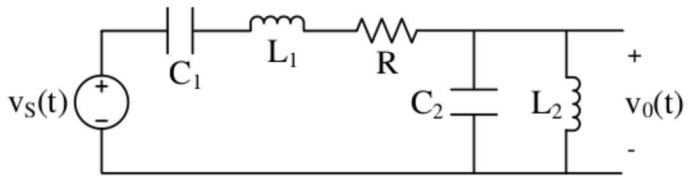
θ = _____

iii) (4 points) If $f(t) = 10$, what is $y(t)$?

$y(t)$ = _____

Problem 3

(a) Determine the frequency response $H(\omega)=\dfrac{V_0(\omega)}{V_S(\omega)}$ of the following circuit. Give the answer in terms of ω, C_1, C_2, L_1, L_2 and R. Do not simplify your answer.



$H(\omega)$ = _____

(b) A linear system with the input f(t) and output y(t) is described by ODE

$$3\frac{d^2y}{dt^2}+2\frac{dy}{dt}+y(t)=2\frac{df}{dt}+f(t)$$

Determine the frequency response $H(\omega)=\dfrac{Y(\omega)}{F(\omega)}$ of the system.

$H(\omega)$ = _____

(c) Given an input $f(t)=2\cos\omega_1 t+\sin(\omega_2 t+\theta_2)$ and $H(\omega)=\dfrac{1+j\omega}{2+j\omega}$ determine the steady-state response $y_{ss}(t)$ of the system $H(\omega)$.

$y_{ss}(t)$ = _____