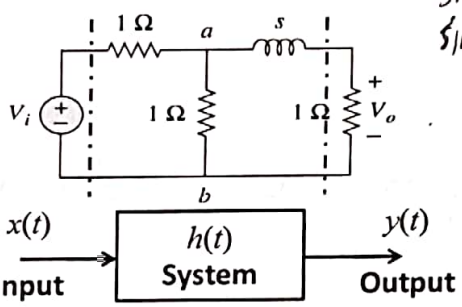
E927500
Circuit Analysis
June 22, 2016

Final Exam

A. (4×8=32 points) Answer each of the following statements.

1. Comparison between "causal system" and "causal input".
2. Comparison between "Fourier series" and "Fourier transform".
3. Comparing Fourier series in "trigonometric" and "amplitude-phase" forms.
4. Comparison between "Amplitude-phase Fourier series" and "Complex Fourier series"
5. Comparison between "Laplace transform" and "Fourier transform" in steady-state response.
6. Comparison between the Fourier transforms of "$\cos\omega_0 t$" and "$\cos(\omega_0 t+\theta)$".
7. Comparison between "$\delta(t)$" and "1" in time-domain by Fourier transform.
8. Comparison between the "magnitude spectrum" and "phase spectrum" of frequency response.

B. Signal & System for Circuit (6×3=18 points): Describe the relativities among the (a) Figures, (b) Equations, and (c) Terms in the following table.



$y(t)=\int_0^t h(\lambda)x(t-\lambda)d\lambda$	convolution ⟹ time-domain	$x(t)$	*	$h(t)$ = impulse response	$y(t)$
$F(s)=\int_{0^-}^{\infty} f(t)e^{-st}dt$, $s=\sigma+j\omega$	Laplace xform ⟹ s-domain	$X(s)$	×	$H(s)$ = transfer function	$Y(s)$
$s=0+j\omega$, $F(\omega)=\int_{-\infty}^{\infty} f(t)e^{-j\omega t}dt$	Fourier xform ⟹ frequency-domain	$X(\omega)$	×	$H(\omega)$ = frequency response	$Y(\omega)$

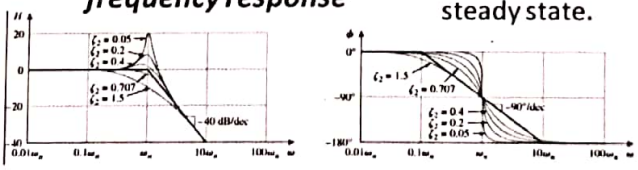
Convolution: is to find the response $y(t)$ of a system to an excitation $x(t)$.

Laplace xform: is better for the analysis of transient response involving initial conditions.

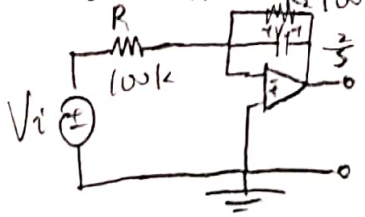
Fourier xform: is especially useful for problems in the steady state.

$H(\omega)=|H(\omega)|e^{j\angle H(\omega)}$ (magnitude, phase)

Bode plots ⟹



C. Op Amp Circuit (9+5+6=20 points): $v_i(t)=5\cos 100t\,u(t)$ V voltage is applied to the op amp circuit with R_1 = 100 kΩ, R_2 = 100 kΩ, and C = 0.5 μF from t = 0 in Fig. 1. Assume that the initial capacitor voltage was 1 V. (a) Derive the transfer function $H(s)$ between $V_o(s)$ and $V_i(s)$. (b) Find the impulse response $h(t)$ between $v_o(t)$ and $v_i(t)$. (c) Compute the closed-loop gain and phase shift.



Ïhý uú

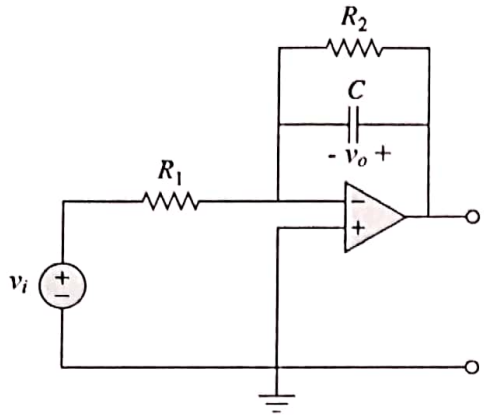


Fig. 1

D. Fourier transform (10+10=20 points) (a) Determine the Fourier transform of a single rectangular pulse of wide τ and height B in Fig. 2. (b) Plot the magnitude spectrum and phase spectrum.

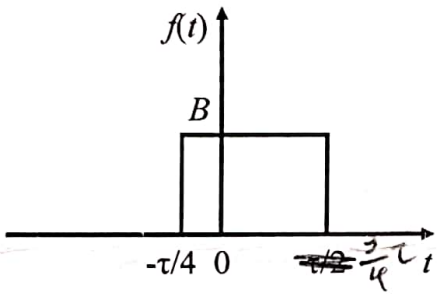


Fig. 2

E. Matlab (5×4=20 points): (a) Find the frequency response $I_0(\omega)/I_s(\omega)$ for the circuit of Fig. 3. And write a MATLAB code to draw (b) a Bode plot, whose x-axis is 1000 points from 10^{-1} to 10^3 Hz, (c) a step response, and (d) a time response with a sinusoidal input at 100 rad/s. Function hint: bode(num,den), logspace(a,b,n), step(num,den), lsim(num,den,x,t).

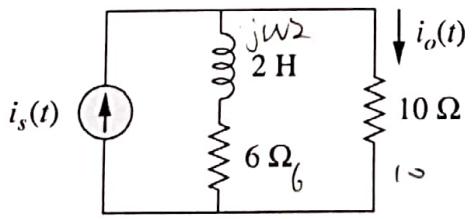


Fig. 3

Have a Nice Summer!

Ïhý uú