電路學期末考

10:20-12:00, 1/14/2011

1. Find $\mathcal{L}$ [t sin βt] using the known transform of sin βt ,where $\mathcal{L}$ is the Laplace transform. (5%)

2. For the s-domain function below,

$$F(s)=\frac{3s^3+9s^2+5s+16}{s(s+1)(s^2+9)}$$

evaluate $f(0^+)$ and $f'(0^+)$ given $f(0^-) = 3$. (5%)
And evaluate $f(\infty)$ or indicate the reason why the final value doesn't exist. (5%)

3. For the circuit shown in Fig.1 with $v_s(t)$ = 10 V for $t < 0$, $v_s(t)$ = 0 V for $t \geqq 0$, and $\beta = 9$,
   (a) find the initial values for inductor current, $i_L(0^-)$, and capacitor voltage, $v_C(0^-)$. (5%)
   (b) use mesh analysis to determine the inductor current in s-domain $I_L(s)$. (10%)
   (c) obtain the zero-input response of the inductor current in time domain, $i_L(t)$. (10%)

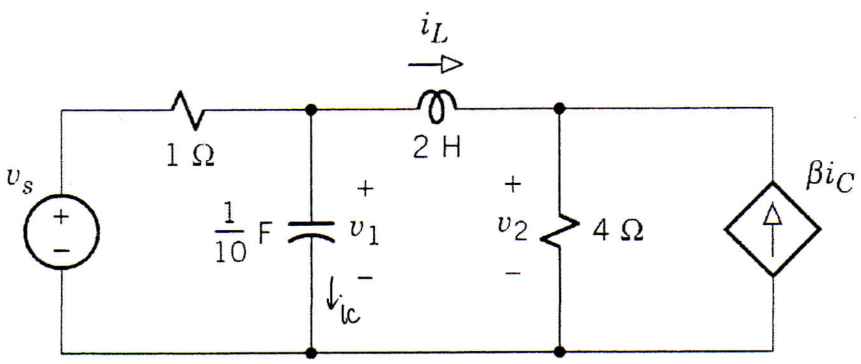

Fig. 1

4. Draw the asymptotic Bode plot of the gain and phase for

$$H(s)=\frac{-2000s^2}{(s+50)(s+200)(s+400)}$$

Then add the dB corrections to find the maximum value of a(ω) and the ω_l and ω_u at which the gain drops 3dB below the maximum. Please mark these values on the plot. (15%)

5. The load impedance Z_L for the circuit shown in Fig. 2 is adjusted until maximum average power is delivered to Z_L. Find the load impedance Z_L that draws the maximum average power and calculate the resulting value of P_{max}. (15%)

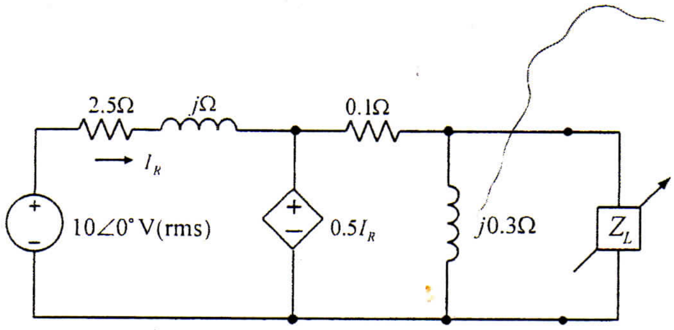

Fig. 2

6. Please use mesh analysis to find I_2 shown in Fig. 3 (15%)

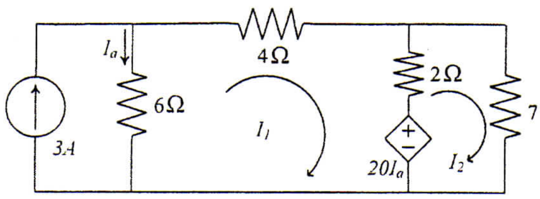

Fig. 3

7. The second-order equation of the series LRC circuit shown in Fig. 4 can be expressed as: $i_L''(t) + Ai_L'(t) + Bi_L(t) = Cv_S'(t)$.

   Please a) determine the values of A, B, and C. (5%) b) find the transient inductor current $i_L(t)$ for $t > 0$, where $v_s(t) = 30$ V, $t < 0$; and $v_s(t) = 0$ V, $t \geqq 0$. (10%)

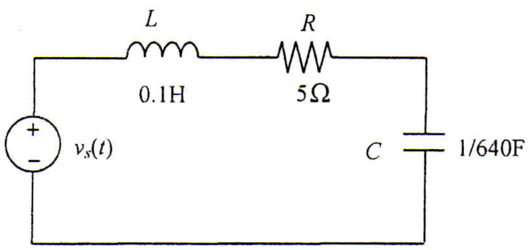

Fig. 4

TABLE 13.1 Laplace Transform Properties

Operation	Time Function	Laplace Transform
Linear combination	$Af(t) + Bg(t)$	$AF(s) + BG(s)$
Multiplication by e^{-at}	$e^{-at}f(t)$	$F(s + a)$
Multiplication by t	$tf(t)$	$-dF(s)/ds$
Time delay	$f(t - t_0)u(t - t_0)$	$e^{-st_0}F(s)$
Differentiation	$f'(t)$	$sF(s) - f(0^-)$
	$f''(t)$	$s^2F(s) - sf(0^-) - f'(0^-)$
Integration	$\int_{0^-}^{t} f(\lambda)\, d\lambda$	$\frac{1}{s} F(s)$

TABLE 13.2 Laplace Transform Pairs

$f(t)$	$F(s)$
A	$\frac{A}{s}$
$u(t) - u(t - D)$	$\frac{1 - e^{-sD}}{s}$
t	$\frac{1}{s^2}$
t^r	$\frac{r!}{s^{r+1}}$
e^{-at}	$\frac{1}{s + a}$
te^{-at}	$\frac{1}{(s + a)^2}$
$t^r e^{-at}$	$\frac{r!}{(s + a)^{r+1}}$
$\sin \beta t$	$\frac{\beta}{s^2 + \beta^2}$
$\cos (\beta t + \phi)$	$\frac{s \cos \phi - \beta \sin \phi}{s^2 + \beta^2}$
$e^{-at} \cos (\beta t + \phi)$	$\frac{(s + a) \cos \phi - \beta \sin \phi}{(s + a)^2 + \beta^2}$