台灣科技大學一百零九學年度下學期期末考

科目名稱：電路學(二)　開課系所：電子系 ET2103301　地點：視聽館 AU101

考試時間：110 年 6 月 17 日　下午 13:20 至 15:20 (可使用工程計算機)

1. (8%) Assume the following two circuits in Figs. 1(a) and Fig. 1(b) have the same driving point impedances, please determine R_{eq} and L_{eq} in terms of L_1, L_2 and R. The mutual inductance M is assumed to be the maximum value.

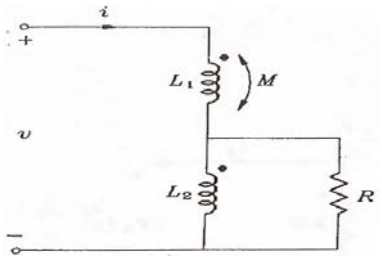


Fig. 1(a).

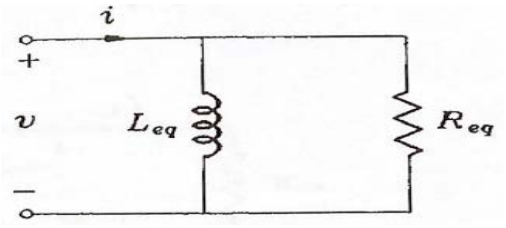


Fig. 1(b).

2. (20%) There is a critically-damped RLC 2nd order parallel resonant circuit. The R is the equivalent resistor R_{ab} in Fig. 2(a), the L is the equivalent inductor L_{ae} of the three-winding structure transformer in Fig. 2(b), and the C is the equivalent capacitor C_{eq} in Fig. 2(c), please answer the following questions:
(7%) (a) Please derive the equivalent inductor L_{ae} in Fig. 2(b) and the equivalent capacitor C_{eq} in Fig. 2(c).
(3%) (b) Please design the approximate value of R_x in Fig. 2(a) for this system.
(10%) (c) What is the resonant angular frequency ω_0, quality factor Q, bandwidth B_w, impedance pole-zero locations, half-power angular frequency ω_H and ω_L of this system?

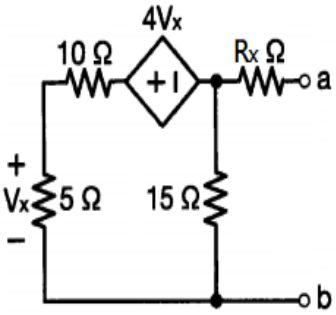


Fig. 2(a).

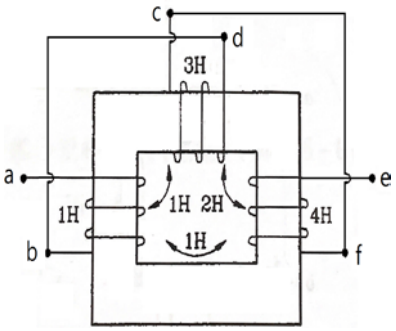


Fig. 2(b).

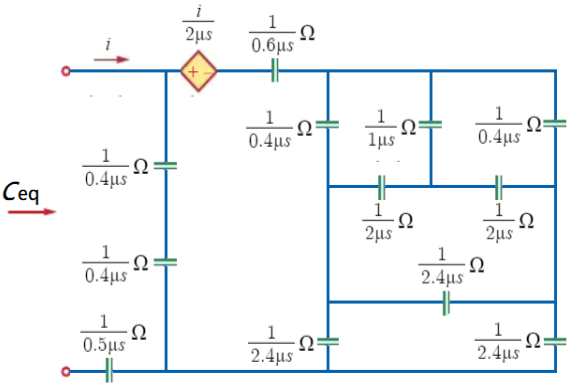
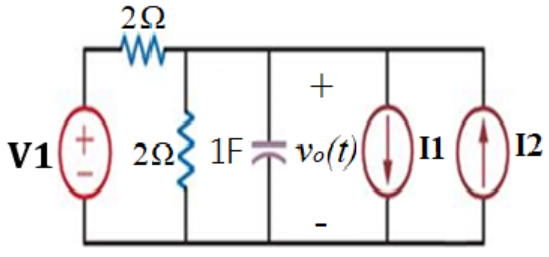


Fig. 2(c).

3. (14%) Consider a circuit arrangement where two same values R of the resistors and one reactance value jX_L of the inductor as the three-phase Y-connected load. Two resistors form the loads in two lines A and B; while the inductor forms a load in line C. All line impedances are negligible. Let $V_{AB}=V_A-V_B=V\angle 45°$ V, $V_{BC}=V_B-V_C=V\angle -75°$ V and $V_{CA}=V_C-V_A=V\angle 165°$ V. Please answer the following questions:
(2%) (a) Please draw three-phase load with the appropriate circuit parameter data. Note that the symbol and parameter must be specified clearly.
(8%) (b) Assume that $X_L=R$. Please calculate the total apparent power consumptions at the three-phase load side and verify that whether the neutral current is zero or not.
(4%) (c) Please determine the appropriate reactive power to upgrade the overall power factor of the load to 0.98 for $X_L=R=1$. Moreover, what's the advantage or disadvantage of raising the load power factor?

4. (13%) Please write the output voltage $v_o(t)$ in Fig. 3 if the initial voltage in the capacitor is zero.



$$\begin{cases} V1 = \sin\left[3\left(4t-\frac{\pi}{6}\right)\right]u(4t-6\pi)\ \ V \\ I1 = \frac{\sin(4t)}{t}u(t)\ \ A \\ I2 = \frac{t-10}{4}\sin[2(t-10)]\,u(t-10)\ \ A \end{cases}$$

Fig. 3.

5. (18%) In Fig. 4, a system is composed of an active filter and a convolution operation unit. Please answer the following questions:
(6%) (a) Please construct asymptotic Bode plot of the magnitude for the transfer function G(s). Note that the critical points, slopes and amplitude gain in dB must be specified clearly.
(3%) (b) Please identify the filter properties. Let the coefficient n is a positive real variable to modulate the resistance value.
(3%) (c) Please design the first coner frequency to be 50 Hz with passband gain to be 21. Let the coefficient n be in the range of 0.001 to 12, all the resistors be in the range of 15 to 150 k Ω and the capacitors be in the range of 35 to 350 nF.
(6%) (d) If n=1, C=1mF, R=10kΩ, $X(t)=t^2\delta(t-2)$V and change $g(t)$ to 5u(t-1)u(t+1), what's the value of $Z(3)$?

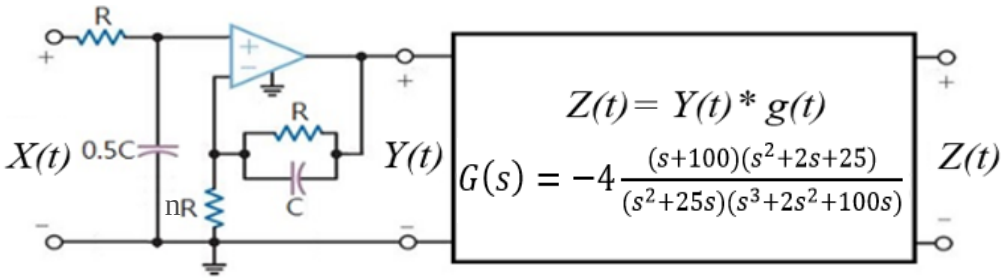


Fig. 4.

6. (7%) In Fig. 5, $v_2(0^+)$=20V and there is no initial energy stored in the inductor. For $t < 2$, what's the value range of μ making the circuit stable and s-domain circuit? For $t \geq 2$, please find the voltage $v_1(t)$ as μ=4.

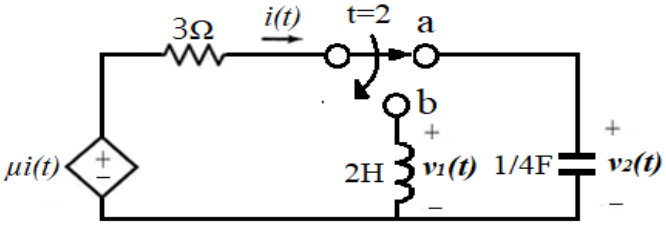


Fig. 5.

7. (13%) As for Fig. 6(b), two-port A and two-port B are connected in series, two-port B is also the network in Fig. 6(a), and the angular frequency is two radians per second. Please answer the following questions:
(2%) (a) Please sketch an equivalent circuit by using one dependent current source and one dependent voltage source to model the ideal transformer of Fig. 6(a).
(11%) (b) What is the total Z parameters of the series two-port network and the maximum active power transferred to R_L?

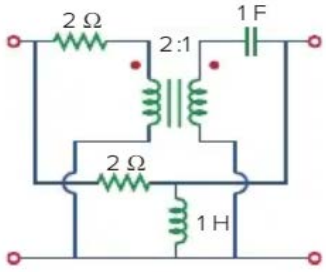


Fig. 6(a).

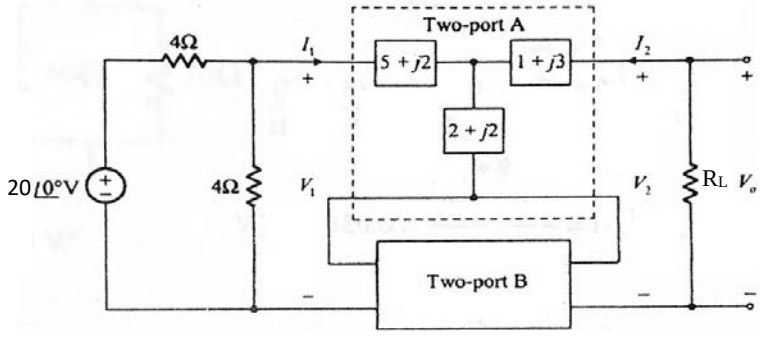


Fig. 6(b).

8. (7%) Please plot the waveform of the inverse transform $f(t)$ for the following frequency domain function.

$$F(j\omega) = \frac{1}{j\omega(1-e^{\frac{j\omega\pi}{2}})} + \frac{j\omega e^{\frac{-j\omega\pi}{2}} - 1}{(1-\omega^2)(1-e^{\frac{-j\omega\pi}{2}})}$$