科目：電路學(5009)　　校系所組：清大電機工程學系(甲組)
清大動力機械工程學系(電機控制組)

一. (10%) Please select 5 correct (including most-likely) statements from the followings

A. While finding Thevenin's equivalent impedance, we would "open" all the current sources while "short" all the voltage sources.

B. While doing mesh current analysis, we always apply Kirchhoff's Current Law.

C. While doing nodal voltage analysis, we always apply Kirchhoff's Voltage Law.

D. If the distance between two plates is increased then the effective capacitance is decreased inversely.

E. The energy stored in the electromagnetic field of a coil is a function of inductor current.

F. The output from an RL integrator is taken across the inductor.

G. If an LC tank circuit is operating below its resonant frequency, the circuit is inductive in nature.

H. The resonant frequency is equal to the algebraic average of two half-power frequencies for infinitively large quality factor.

I. If the real power is 100 W and the reactive power is 100 VAR(ind.), the power factor is 0.707 lagging.

J. In a series resonant RLC circuit, the impedance is at its maximum, while the current is at its minimum.

二. For the circuit in Fig. P2, using the following methods to obtain the power delivered or dissipated by the 12-A current source.

(a) (3%) Thevenin's equivalent method.
(b) (3%)Source Transformation Method.
(c) (3%)Superposition method.
(d) (3%)Nodal voltage analysis method.
(e) (3%)Mesh current analysis method.

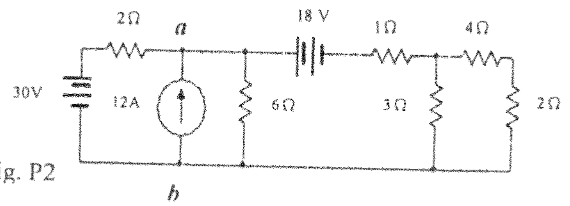

Fig. P2

三. (10%) Given a series RLC circuit as shown in Figure P.3, at t=0⁻, $i_L(0^-)$= 1 mA, $v_C(0^-)$= 5V. Obtain the differential equations for i_L, v_L, i_C and v_C respectively, and also find initial conditions $v_L(0^+)$, $i_C(0^+)$, $\frac{di_L}{dt}(0^+)$, $\frac{dv_L}{dt}(0^+)$, $\frac{di_C}{dt}(0^+)$, and $\frac{dv_C}{dt}(0^+)$. <Note: You need not to solve the equations.>

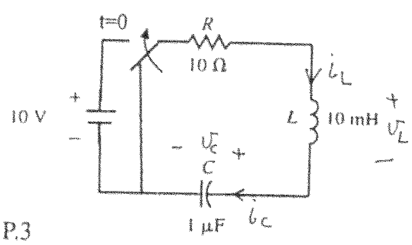

Fig. P.3

注意：背面有試題

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四. (10%) A simplified power transmission circuit is as given. Three-phase voltages are as follows:

$$V_{An} = 100\angle 0^{\circ}; V_{Bn} = 100\angle(-120^{\circ}); V_{Cn} = 100\angle(120^{\circ})$$

Note that all voltages are expressed in RMS line-to-neutral values. The three-phase load of the customer consumes 3 kW with a power factor of 0.6 (lagging).

(a) Calculate the equivalent impedance *Zload*, and the current phasors of all three phases.

(b) *Rline* represents the equivalent resistance of the transmission line. As the electricity is delivered to the customer, *Rline* results in transmission power losses. For the given circuit, what can you do to reduce the transmission losses? Please justify your design by circuit analysis.

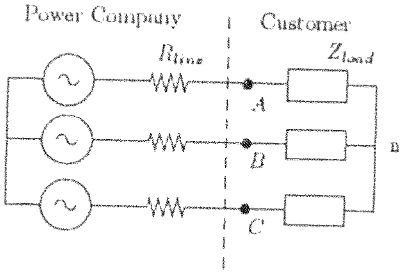

Fig. P4

五. (10%) The given circuit is driven by three phase voltage sources, their time domain representations are

$$v_a(t) = 6\cos(10t); v_b(t) = 5\cos(10t-120^{\circ}) + \cos(10t+120^{\circ}); v_c(t) = 5\cos(10t+120^{\circ}) + \cos(10t-120^{\circ})$$

All these voltages are expressed in volt. Each phase is loaded by a 5 ohm resistor and a 0.866H inductor in series. Please find the time-domain steady state representation of the current $i_a(t)$, $i_b(t)$, and $i_c(t)$ respectively.

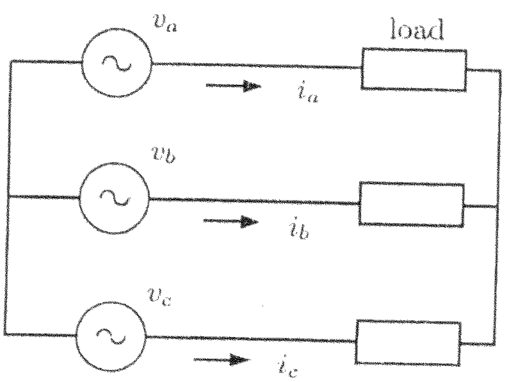

Fig. P5

注意：背面有試題

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六.(15%)

(a) (5%) Please explain why an inductor behaves like a short circuit at DC steady state and why a capacitor behaves like an open circuit in DC steady state?

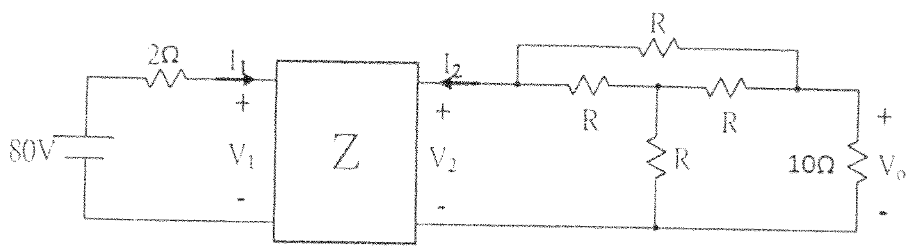
(b) (5%) Can you express this signal $i(t)=100\cos(10t)+50\cos(20t)$ in the phasor domain (Yes/No)? If yes, please write it down. If no, please explain why.

(c) (5%) Circuit analysis can be carried out in the time domain, the phasor domain, and the s domain. Indicate if the analysis in a certain domain can provide results in the transient state and the steady state.

	Time domain	Phasor domain	S domain
Transient	(Yes/No)	(Yes/No)	(Yes/No)
Steady state	(Yes/No)	(Yes/No)	(Yes/No)

七.(15%) The Z parameters in ohm in the following circuit is given as shown. Find Vo for R=9 ohms.

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 6 & 4 \\ 4 & 7 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$



八.(15%)

(a) Find the first two terms of the Fourier series of the following periodic function $V_{in}(t)$ as shown.

(b) Calculate the average power dissipated in R due to these two components.