系所組別： 系統及船舶機電工程學系丁組
考試科目： 電路學


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*A total of six problems are given in this exam paper.*

1. (24%) A circuit is shown in Fig. 1-1, where the voltage and the current have been given. Answer the following questions:

(a) Find the *complex power* into the load. (5%)

(b) Draw a *power triangle* showing the numerical values of the apparent, real and reactive powers. What is the *power factor*? (5%)

(c) What is the peak energy *stored* in the load? (4%)

(d) As shown in Fig. 1-2, assuming the power factor correction (PFC) is applied to improve the power factor by using capacitance, what value (and unit) will make the power factor as seen by the source to be *0.866 lagging*? (5%)

(e) Following (d), draw a *phasor diagram* for phasors $V$, $I$, $I_{load}$, and $I_{PFC}$ to indicate how you achieve PFC, using the voltage $V$ as the phase reference. (5%)

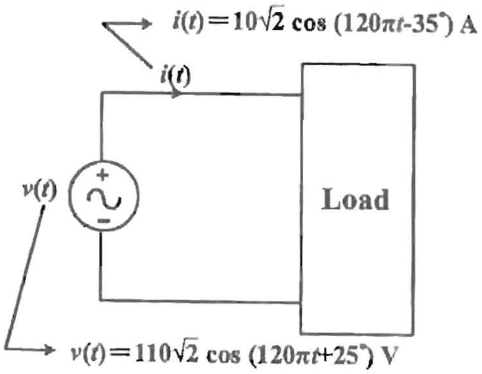


Fig. 1-1

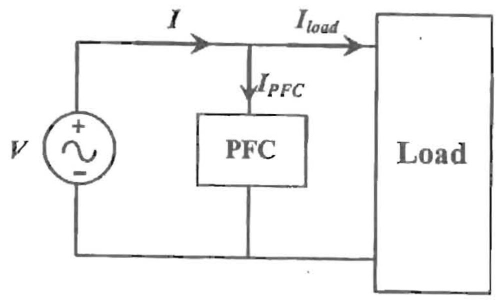


Fig. 1-2

2. (10%) A schematic of a relay is given in Fig. 2. The relay is excited by a 24 V battery and controlled by a switch *S1*. It can be modeled using an *inductance* of 50 mH and a *coil resistance* of 200 Ω. To switch on the AC electric appliance (by closing *S2*), the minimum relay *coil current* required is 80 mA.

(a) Calculate the relay *delay time* to reach the required current when *S1* is closed at t=0. (7%)

(b) For the same copper wire, if the number of turns is doubled, how is the time constant affected? (3%)

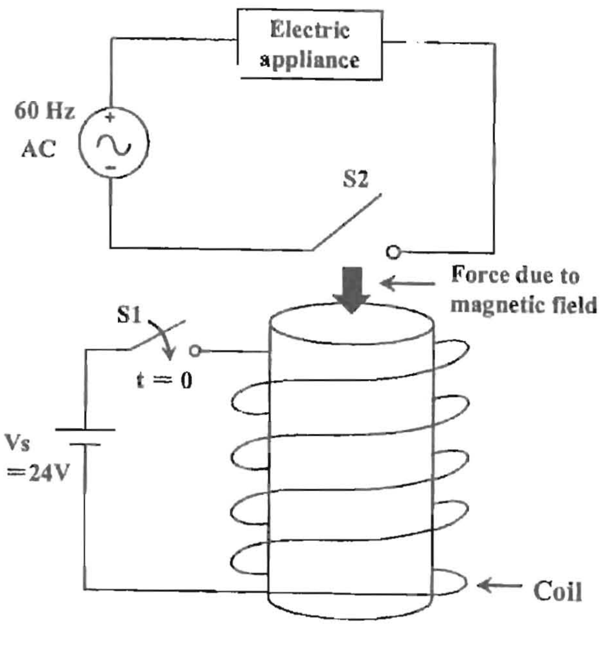


Fig. 2

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3. (16%) Calculate $v(t)$ for $t>0$ in the circuit of Fig. 3.

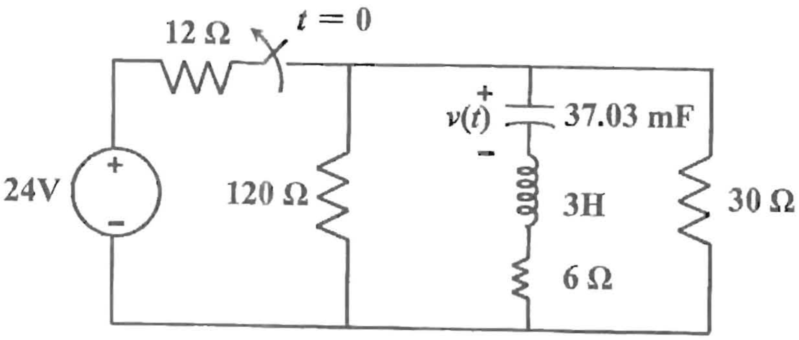


Fig. 3

4. (20%) Find the Thevenin equivalent for the circuit shown in Fig. 4, as seen from:
(a) terminals a-b. (10%), and
(b) terminals c-d. (10%)

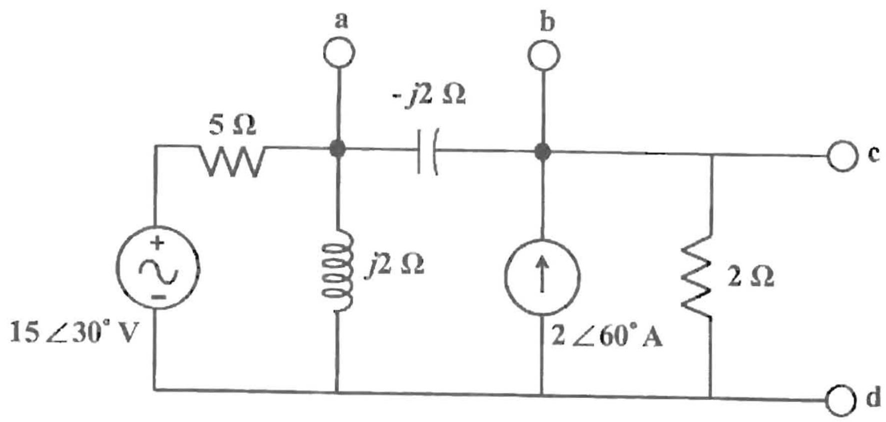


Fig. 4

5. (6%) Translate the following paragraph into Chinese.

*Today it is obvious that ac generation is well established as the form of electric power that makes widespread distribution of electric power efficient and economical. However, at the end of the 19th century, which was the better- ac or dc- was hotly debated and had extremely outspoken supporters on both sides.*

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6. (24%) A wye-connected three-phase generator, as shown in Fig. 6, operated at a certain rotational speed gives an electrical frequency of $\omega$=100 rad/s. The induced back electromotive forces (EMFs) act as the balanced three-phase ac sources to supply electric power to the load. The winding of each phase has a resistance of 0.1 Ω and inductance of 4 mH, as indicated in Fig. 6. A three-phase load is directly connected to the generator windings.

(a) Calculate the real power absorbed by the load. (8%)

(b) Calculate the total complex power output from the sources (back EMFs). (8%)

(c) Calculate the generator efficiency based on the output power of the sources (back EMFs). Note that only real power is used for efficiency calculation. (8%)

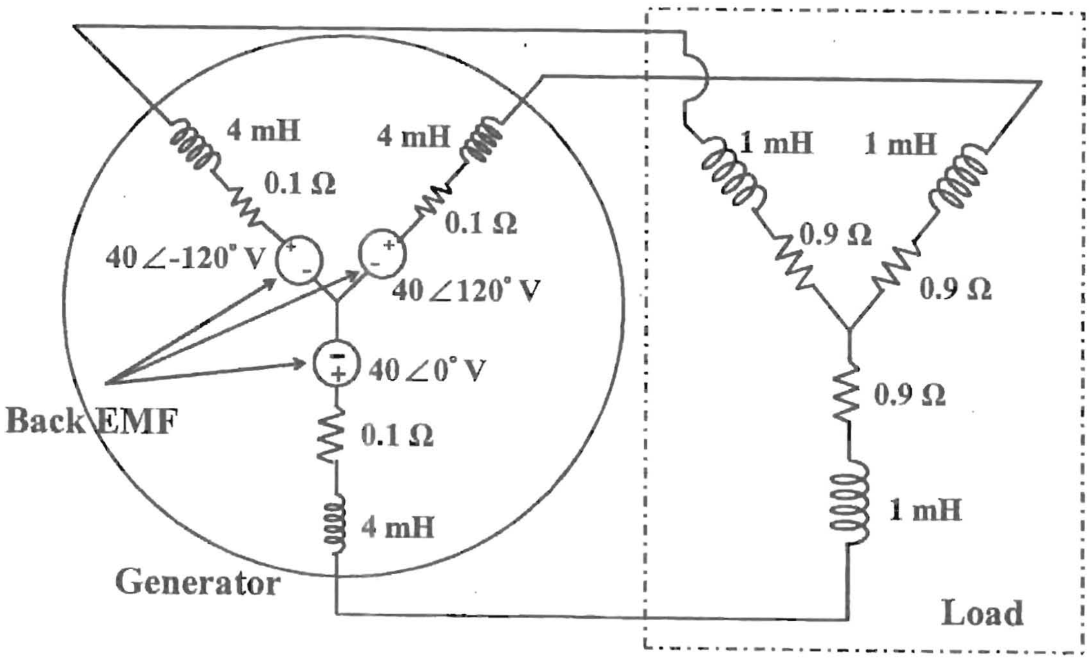


Fig. 6