ET Tutorial Sheet 2

1. A resistance R is connected in series with an iron core choke coil. The circuit draws a current of 5 A with a source of 240 V, 50 Hz. The voltage across R and the coil are 120 V and 200 V, respectively. Calculate

   (a) the resistance, reactance, and impedance of the coil,

   (b) power absorbed in the coil.

   (c) power factor of the input current. [Ans: 2.68 Ω, 39.91 Ω, 40 Ω, 66. 75 W, 0.556]

2. Find V_s for the circuit shown in Fig. 2. [Ans: $123\angle 1.43^0$]

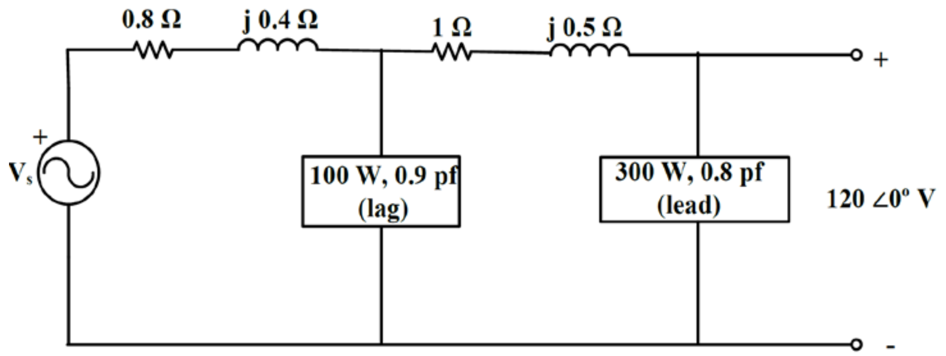

Fig. 2

3. For the circuit shown in Fig. 3, find the current through capacitor using superposition theorem. [Ans: $0.59\angle 103.3^0$]

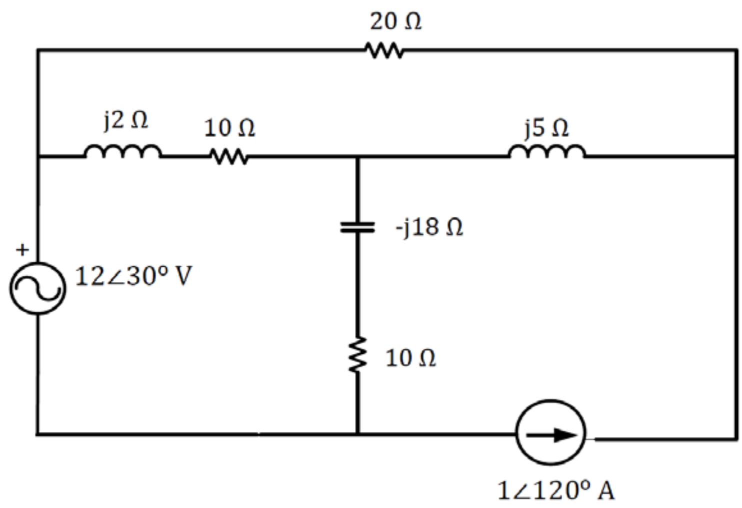

Fig. 3

4. For the circuit shown in Fig. 4, determine I_L using (i) Thevenin theorem, (ii) Norton theorem. [Ans: $2.26\angle -9.03^0$]

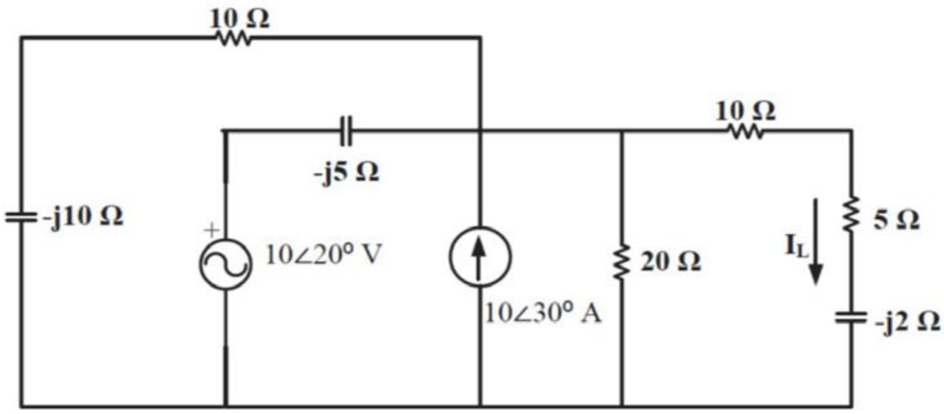

Fig. 4

5. Determine the frequency at which the maximum power is transferred from Block-1 to Block-2, shown in Fig. 5. Also find the maximum delivered power at this frequency if V_S = $3.8\angle 0^0$. [Ans: 1.59 kHz, 0.45 W]

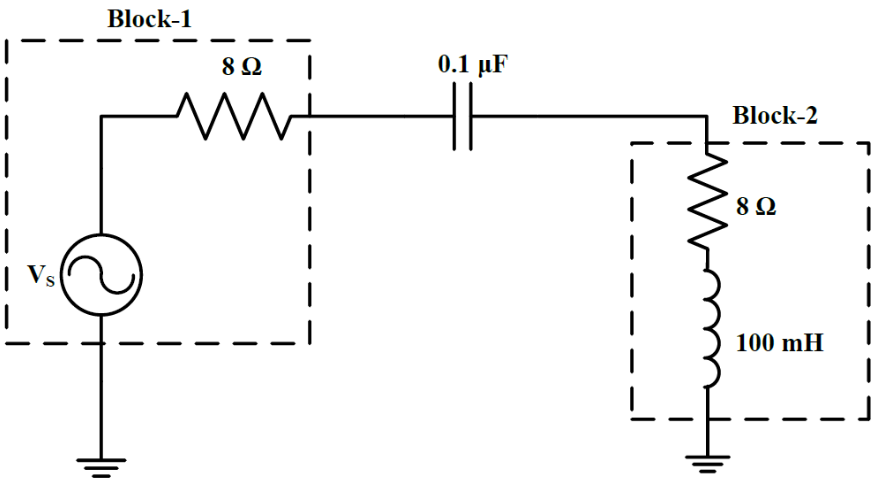

Fig. 5

6. A resistor of 50 Ω in parallel with an inductor of 30 mH is connected in series with a capacitor. A voltage of 220 V, 50 Hz is applied to the circuit. Find (a) the value of the capacitor to give unity power factor, (b) the current delivered by the source, and (c) the current in the inductor. [Ans: 349 µF, 128 A, 125.78 A]

7. Determine what value of capacitor in Fig. 6 is required to bring the source power factor up to 0.85 (lag). Also find I before and after the power factor correction. The supply frequency is 50 Hz.

[Ans: C=366.5 μF, I(before)=$328.04\angle -42.1°$ A, I(after)=$286.4\angle -31.8°$ A]

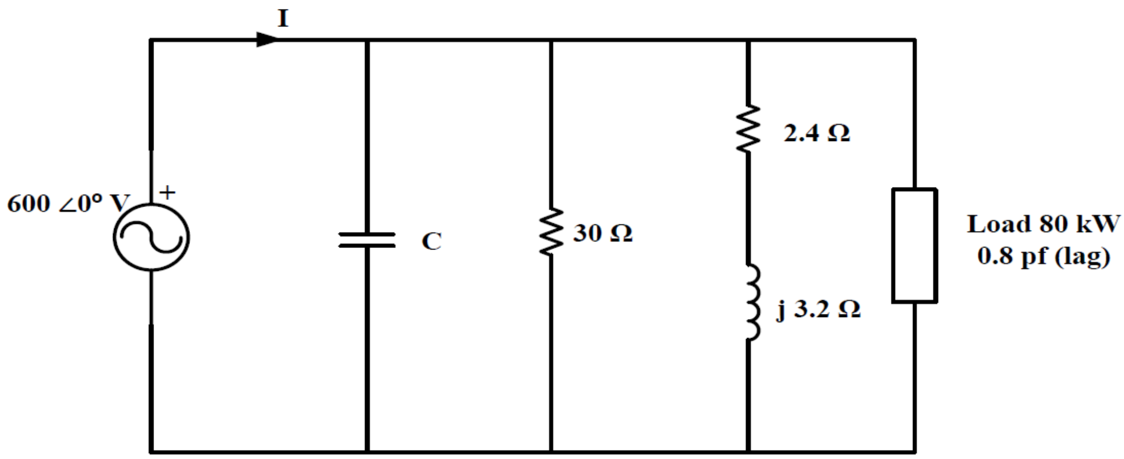

Fig. 6

8. A voltage of 200 V is applied to a series circuit consisting of a resistor, a coil and a capacitor. The respective voltages across these components are 170, 150, and 100 V and the current is 4 A. Find the p.f. of the coil, and of the circuit. Draw a suitable phasor diagram of the circuit. [Ans: 0.16, 0.97]

9. In a series RLC circuit, L is varied to produce resonance keeping the supply frequency and C fixed. The circuit contains R=100 Ω, the capacitive reactance $X_C = 200\ \Omega$, $f = 50$ Hz and the supply is 1000 V. Find the voltage drop across L at resonance and also when the drop across it is a maximum. [Ans: 2 kV, 2.236 kV]

10. In the circuit of Fig. 7, the switch was open and the circuit was operating at steady state. At $t = 0$, the switch is closed. Derive the expression for inductor current $i(t)$ for $t > 0$.
[Ans: $\frac{10}{63}e^{-6t} + \frac{5}{9}$ A]

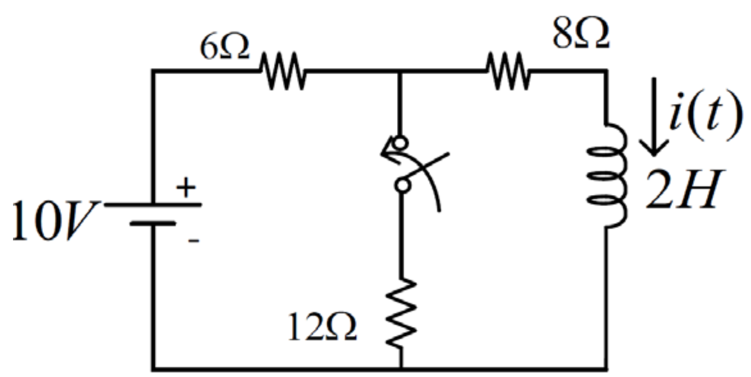

Fig. 7

11. The circuit in Fig. 8 was in steady state and the switch S was open. At $t = 0$, and the switch is closed. Find the expression of the current i(t) through the inductor of 2 H for $t > 0$. [Ans: $\frac{7}{6} - \frac{1}{6}e^{-12t}\ A$]

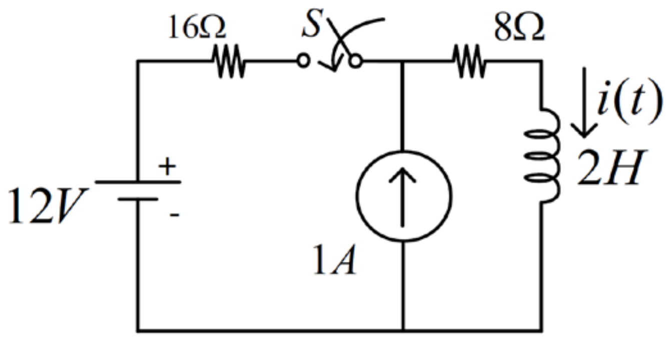

Fig. 8

12. The circuit in Fig. 9 was in steady-state for t<0, and the position of the switch is changed at t = 0. Find the capacitor voltage Vc(t) and the current $i(t)$ in the 100 Ω resistor for $t > 0$. [Ans: $v_c(t) = \frac{175}{3}e^{-0.8t} + 25\,V,\ i(t) = \frac{7}{12}e^{-0.8t} + \frac{1}{4}\,A$]

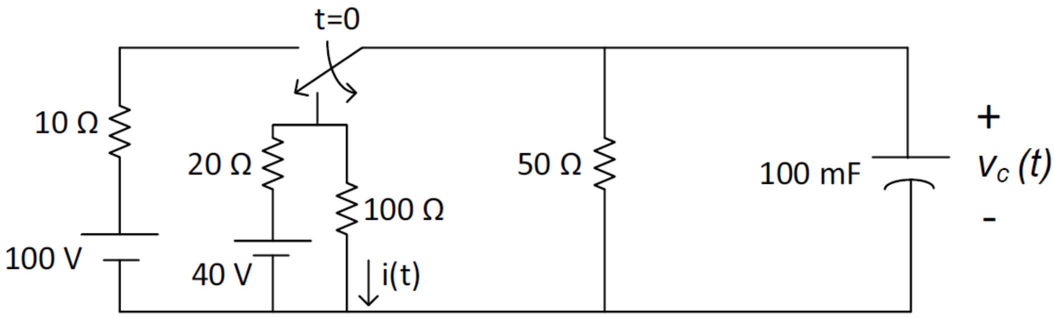

Fig. 9

13. The network of Fig. 10 consists of a current source of value I_0 (a constant), two resistors, and a capacitor. At t=0, the switch 'K' is opened. For the element values given on the figure, determine $v_2(t)$ for t≥0. [Ans: $v_2(t) = I_0(1 - 0.67e^{-2t})$ V]

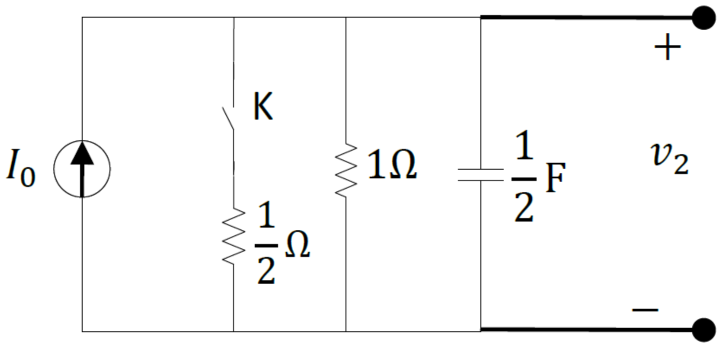

Fig. 10

14. In the network given in Fig. 11, the switch K is opened at t=0. At t=0+, solve for the values of v, $\frac{dv}{dt}$, and $\frac{d^2v}{dt^2}$ at t=0+ if I=10 A, R=1000Ω, and C=1μF.

[Ans: 0, 10^7 V/s, -10^{10} V/s^2]

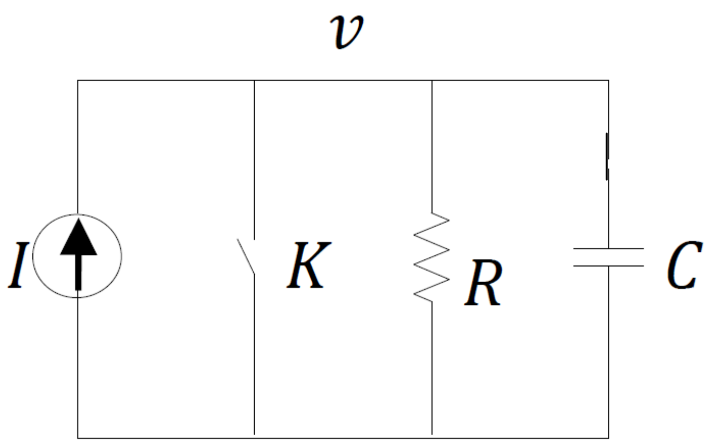

Fig. 11

15. The network shown in Fig. 12 has the switch ‘K’ opened at $t = 0$. Solve for v, $\frac{dv}{dt}$, and $\frac{d^2v}{dt^2}$ at t=0+ if I=1 A, R=100 Ω, r=10 Ω, and L=1 H. [Ans: 100 V, -10^4 V/s, 10^6 V/s^2]

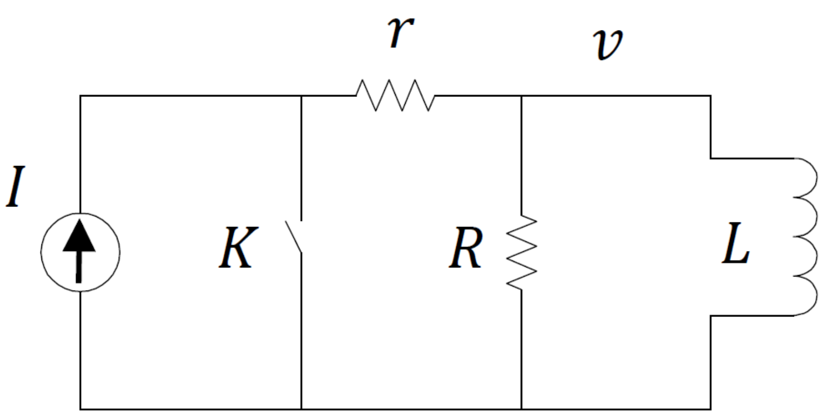

Fig. 12

16. In the circuit shown in Fig. 13, the switch is caused to snap back and forth between the two positions A and B at regular intervals equal to L/R sec. After a large number of cycles the current becomes periodic, as shown in the accompanying plot. Determine the current levels I_1 and I_2 characterizing this periodic waveform.

[Ans: I_1=$\frac{E}{E(1+e)}$, $I_2 = \frac{Ee}{E(1+e)}$]

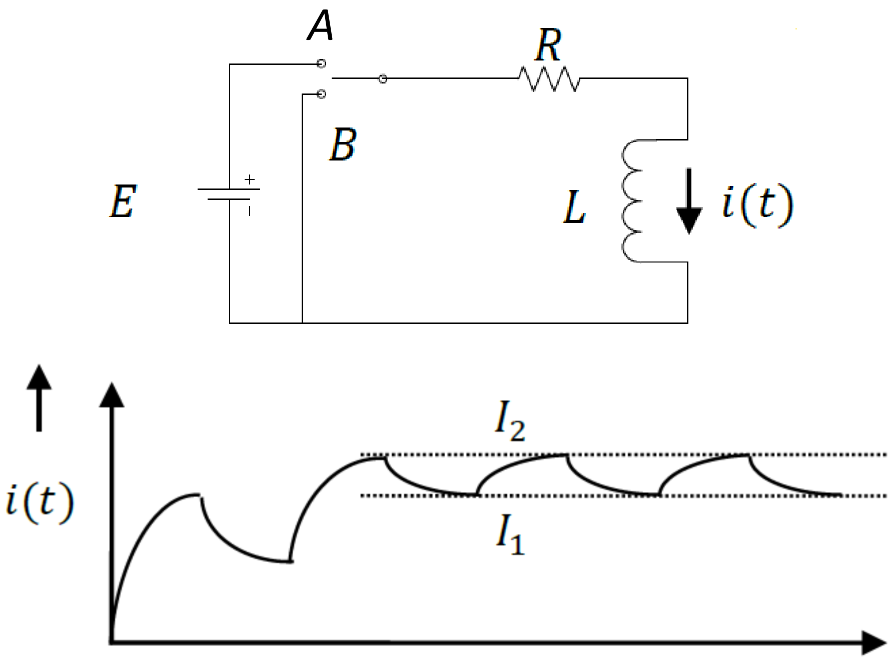

Fig. 13