Principles of Electrical Engineering

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Tutorial + Assignment - 2

1. A pure inductive coil allows a current of 10 A to flow from a 230 V, 50 Hz supply. Find (i) inductive reactance (ii) inductance of the coil (iii) power absorbed. Write down the equations for voltage and current.

2. The current through an $80mH$ inductor is $0.1sin(440t - 25°)$ volts. Write the mathematical expression for the voltage across it.

3. The voltage across and current through a circuit element are :
   $v = 100sin(314t + 45°)$ volts
   $i = 10sin(314t + 315°)$ amperes
   (i) Identify the circuit element. (ii) Find the value. (iii) Obtain expression for power.

4. A resistance of 20 W and a coil of inductance 31·8 mH and negligible resistance are connected in parallel across 230 V, 50 Hz supply. Find (i) the line current (ii) power factor and power consumed by the circuit.

5. How much capacitance is needed to produce 1200Ω of reactance when the system frequency is 2.3 MHz ?

6. A coil having a resistance of 7 Ω and an inductance of 31.8 mH is connected to 230 V, 50 Hz supply. Calculate (i) the circuit current (ii) phase angle (iii) power factor (iv) power consumed and (v) voltage drop across resistor and inductor.

7. A 230 V, 50 Hz a.c. supply is applied to a coil of 0.06 H inductance and 2.5 Ω resistance connected in series with a $6.8\mu F$ capacitor. Calculate (i) impedance (ii) current (iii) phase angle between current and voltage (iv) power factor and (v) power consumed (vi) Draw the phasor diagram.

8. In a series circuit containing pure resistance and a pure inductance, the current and the voltage are expressed as :
   $i(t) = 5sin(314t + 2\pi/3)$
   $v(t) = 15sin(314t + 5\pi/6)$
   Find (i) impedance of the circuit (ii) resistance value (iii) inductance value (iv) average power drawn by the circuit (v) circuit power factor.

9. When 1A flows through three air-cored coils A, B and C in series, the voltage drops are 6V, 3V and 8V on d.c. and 7V, 5V and 10V on a.c. Find (i) power factor and power dissipated in each coil (ii) power factor of entire circuit.

10. A 100 volt, 60 W lamp is to be operated on 220 V, 50 Hz mains. Find what value of (i) non-inductive resistance (ii) pure inductance would be required in order that the lamp is run on the correct voltage. Which method is preferable and why ?

11. An AC voltage source is connected to a "black box" which contains a circuit, as shown in Figure 1.

Figure 1: A "black box" connected to an AC voltage source

The elements in the circuit and their arrangement, however, are unknown. Measurements outside the black box provide the following information:

$V(t) = 80sin\omega t$
$I(t) = 1.6sin(\omega t + 45)$

(a) Does the current lead or lag the voltage?

(b) Is the circuit in the black box largely capacitive or inductive?

(c) Is the circuit in the black box at resonance?

(d) What is the power factor?

(e) Does the box contain a resistor? A capacitor? An inductor?

(f) Compute the average power delivered to the black box by the AC source.

12. A single phase motor operating from 400 V, 50 Hz supply is developing 7·46 kW output with an efficiency of 84% and p.f. of 0·7 lagging. Calculate (i) input kVA (ii) active and reactive components of current and (iii) reactive kVAR.

13. Determine the potential difference across the capacitor in Figure below when there is a current input of $10sin(1000t + 30°)$ A.

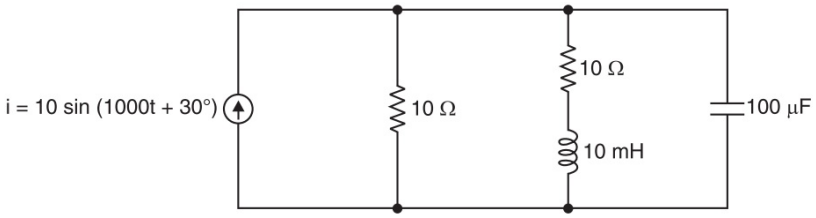

Figure 2: Parallel AC circuit

14. An 8 mF capacitor is connected in series with a 0.5 MΩresistor across a 200 V d.c. supply. Calculate: (a) the time constant; (b) the initial charging current; (c) the time taken for the p.d. across the capacitor to grow to 160 V; (d) the current and the p.d. across the capacitor 4.0 s after it is connected to the supply.

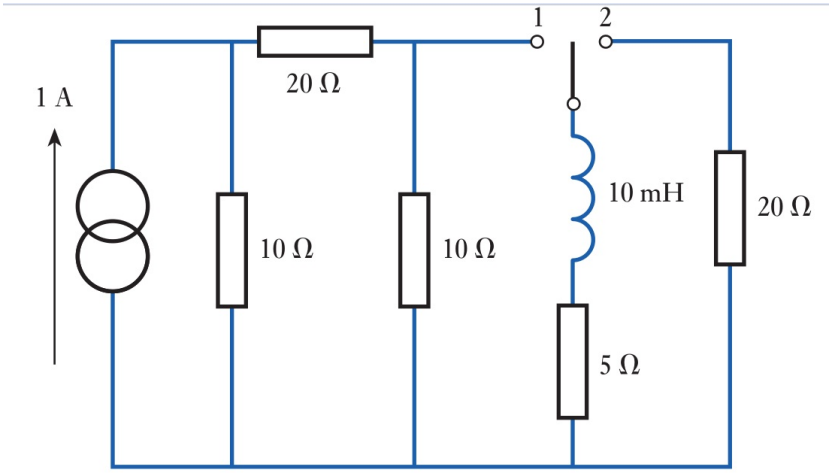

Figure 3: 15

15. For the network shown in Figure 3, the switch is closed on to position 1 when t = 0 and then moved to position 2 when t = 1.5 ms. Determine the current in the inductor when t = 2.5 ms.