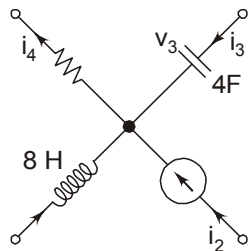


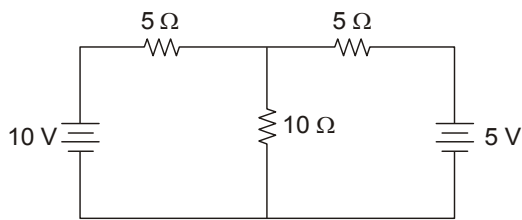
Solved Paper 2015

Electrical Engineering (Paper II)

1. (a) Two conductors, one of copper and the other of iron, are connected in parallel and carry equal currents at 30°C. What proportion of current will pass through each, if the temperature is raised to 90°C? The temperature coefficients of resistance at 0°C are 0.0043/°C and 0.0063/°C for copper and iron respectively. (10)
- (b) Determine the resistance and the power dissipation of a resistor that must be placed in series with a 50 ohm resistor across a 220 V source in order to limit the power dissipation in the 50 ohm resistor to 200 watts. (10)
- (c) In the network shown in Figure 1, the different currents and voltages are as under:
 $i_2 = 10 e^{-4t}$; $i_4 = 6 \sin t$; $v_3 = 8e^{-4t}$
 Using Kirchoff's Current Law, find the voltage v_1 . (10)



- (d) In figure, find the current in the 10 ohm resistor using Thevenin's theorem. (20)



- (e) A variable air capacitor has 10 movable plates and 11 stationary plates. The area of each plate is 0.002 m² and separation between opposite plates is 0.001m. Determine the maximum capacitance of this variable capacitor. (10)
2. (a) An iron ring has a cross-sectional area of 200 mm² and a mean diameter of 20 cm. It is wound with 1000 turns. If the value of relative permeability is 250. Find the total flux set up in the ring. The coil resistance is 500Ω and the supply voltage is 220 V. (10)
- (b) Define the following terms: (5+5+5+5)
- Coefficient of magnetic coupling
 - Self-inductance
 - Electromagnetic induction
 - Time constant
- (c) A capacitor of 10μF takes a current of 2 A when alternating voltage applied across it is 220V. Calculate:
- the frequency of the applied voltage
 - the resistance to be connected in series with the capacitor to reduce the current in the circuit to 1 A at the same frequency. (5+10)
- (d) An RLC series circuit has $R = 5\Omega$, $C = 50 \mu\text{F}$ and a variable inductance. The applied voltage is 220 V at 100 rad/sec. The inductance is varied till the voltage across resistance is maximum. Under this condition, find the
- value of inductance
 - Q-factor
 - voltages across resistance, capacitance and inductance (5+5+5)

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3. (a) Two voltmeters have the same range 0 – 400 V. The internal impedances are $32\text{k}\Omega$ and $18\text{k}\Omega$ respectively. If they are connected in series and 500 V be applied across them, what will be their readings? (10)
- (b) Define the following terms: (5+5+5+5)
- (i) Deflecting torque
 - (ii) Voltmeter sensitivity
 - (iii) Shading rings
 - (iv) Power factor
- (c) Three 3-phase balanced loads are connected in parallel across a 440 V, 3-phase 3-wire balanced supply.
- Load 1 :** 12,000 W, delta connected, power factor = 1.0
- Load 2 :** 10,000 VA, star connected, power factor = 0.9 lag
- Load 3 :** 10,000 VAR, delta connected, power factor = 0.0 lead
- Calculate:
- (i) the total power
 - (ii) the combined power factor
 - (iii) the current drawn from the line (10+7+8)
- (d) What is phantom loading? With a neat diagram, explain how it is carried out. (5)
4. (a) A $160\ \Omega$ source is to be matched to a $40\ \Omega$, $2\ \Omega$ load by means of a transformer. What is the turns ratio? Determine the primary and secondary voltages and current. (20)
- (b) Explain the various losses in a transformer. Derive the condition for maximum efficiency of a transformer. (20)
- (c) A direct current shunt motor develops 10 HP at 8000 rpm when drawing a line current of 40 A at 220V. Find the efficiency at this load and the useful torque. (10)
- (d) Explain the effect of frequency variation on torque-speed characteristics of a 3-phase induction motor. (10)
5. (a) Explain the causes of low power factor in a power system. (10)
- (b) Explain why a three-phase induction motor is self-starting and a single-phase induction motor is not. (15)
- (c) Explain why a synchronous motor develops torque at synchronous speed, whereas an induction motor develops torque at all speeds except the synchronous speed. (15)
- (d) Which fault in a power system is more severe as compared to other faults and why? (10)
- (e) What are the necessary conditions to operate two alternators in parallel to supply a common load? (10)
6. (a) What are the advantages and disadvantages of BJT over JFET? (10)
- (b) Explain clearly how a fuse rating is selected for the following: (20)
- (i) Lighting circuit
 - (ii) Power circuit
- (c) Name the different types of domestic wiring and compare their performance briefly. (15)
- (d) What are the advantages and disadvantages of electric drives over conventional drives? (15)