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**Question Paper Code : 90978**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

Second Semester

Electronics and Communication Engineering

EC 3251 — CIRCUIT ANALYSIS

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(Common to : Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Kirchhoff's Law.
2. Find the equivalent resistance of circuit with three resistors connected in parallel, each having a resistance value of 2 Ohms.
3. State the conditions for maximum power transfer in DC circuits.
4. State Norton theorem.
5. Define instantaneous power in an AC circuit.
6. A sinusoidal voltage is given by  $v(t) = 50 \sin(100\pi t + 30^\circ)$ . What are the amplitude, angular frequency, and phase angle of the signal?
7. A source-free RL circuit has  $R = 5\Omega$  and  $L = 2$  H. Calculate the time constant.
8. What is the voltage across an inductor at  $t = 0+$  in a source-free RL circuit?
9. Define a tree in network topology.
10. Two coils have  $L_1 = 10$  mH,  $L_2 = 20$  mH and mutual inductance  $M = 5$  mH. Calculate the coefficient of coupling ( $k$ ).

PART B — ( $5 \times 13 = 65$  marks)

11. (a) Using mesh analysis calculate
- (i) equivalent resistance across the terminal of the supply (7)
  - (ii) total current supplied by the source (3)
  - (iii) power delivered to  $5\ \Omega$  resistors in the circuit shown in Figure 11 (a) (3)

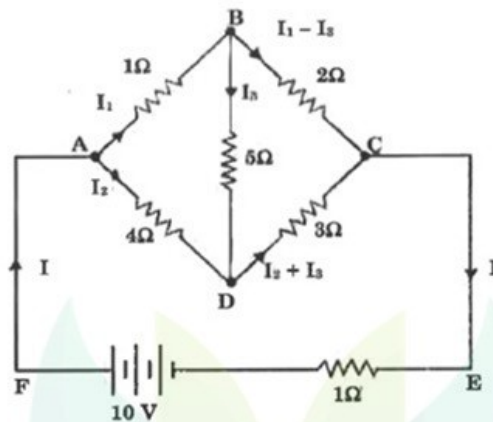


Figure 11 (a)

Or

- (b) (i) A 100 watt, 250 V lamp is connected in series with a 100 watt, 200 V lamp across 250 V supply. Calculate (1) circuit current and (2) voltage across each lamp. Assume the lamp resistances to remain unaltered. (9)
- (ii) Explain the features and advantages of parallel circuits. (4)
12. (a) Using superposition theorem, Estimate the current in  $23\ \Omega$  resistor in the circuit shown in Figure. 12 (a)

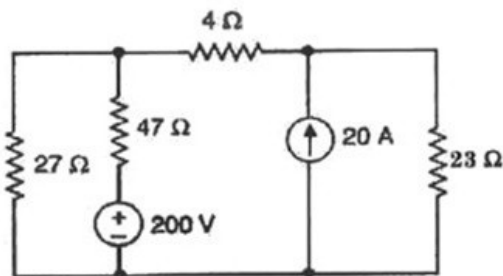


Figure. 12 (a)

Or

- (b) Using Thevenin's theorem, find the current in  $10\ \Omega$  resistor in the circuit shown in Figure. 12 (b)

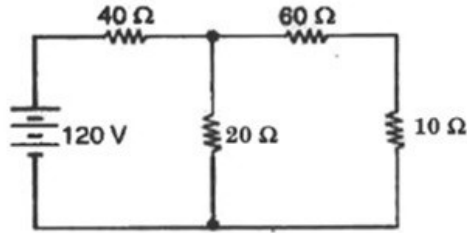


Figure. 12 (b)

13. (a) A coil having a resistance of  $7\ \Omega$  and an inductance of  $31.8\ \text{mH}$  is connected to  $230\ \text{V}$ ,  $50\ \text{Hz}$  supply. Calculate
- the circuit current and phase angle (5)
  - power factor and power consumed and (4)
  - voltage drop across resistor and inductor (4)

Or

- (b) A coil of resistance  $50\ \Omega$  and inductance  $318\ \text{mH}$  is connected in parallel with a circuit consisting of a  $75\ \Omega$  resistor in series with a  $159\ \mu\text{F}$  capacitor. The circuit is connected to a  $230\ \text{V}$ ,  $50\ \text{Hz}$  supply. Determine the supply current and circuit power factor.

14. (a) Explain the concept of resonance in a series RLC circuit.

Or

- (b) A parallel LC circuit has an inductance  $L = 100\ \mu\text{H}$  which has a coil resistance of  $12\ \Omega$ . The capacitor  $C$  is adjustable over the range  $200\ \text{pF}$  to  $300\ \text{pF}$ . Find (i) the maximum and minimum resonance frequencies for the circuit (ii) the Q-factor and (iii) bandwidth of the circuit at the two resonance frequency extremes. (5 + 4 + 4)

15. (a) Coils A and B in a magnetic circuit have 600 and 500 turns respectively. A current of  $8\ \text{A}$  in coil A produces a flux of  $0.04\ \text{Wb}$ . If the coefficient of coupling is 0.2, calculate:
- Self-inductance of coil A, with B open-circuited. (5)
  - The average e.m.f. induced in coil B when the flux with it changes from zero to full value in  $0.02\ \text{second}$ . (4)
  - Mutual inductance. (4)

Or

- (b) Explain the concept of magnetically coupled circuits with a detailed derivation of the voltage equations in terms of self-inductance ( $L_1$ ,  $L_2$ ) and mutual inductance ( $M$ ).

## PART C — (1 × 15 = 15 marks)

16. (a) Using nodal analysis, estimate the voltages at nodes A, B and C w.r.t. the reference node shown by the ground symbol in Figure . 16 (a)

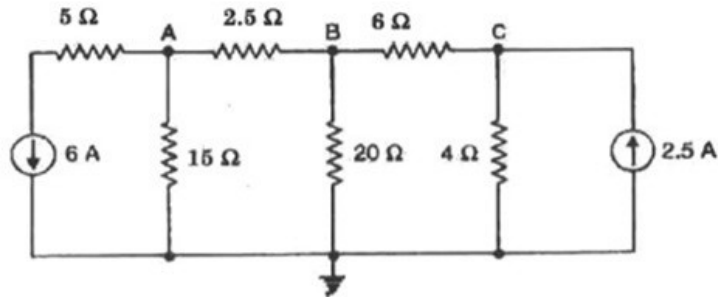


Figure. 16 (a)

Or

- (b) With the help of star/delta transformation, obtain the value of current supplied by the battery in the circuit shown in Figure. 16 (b).

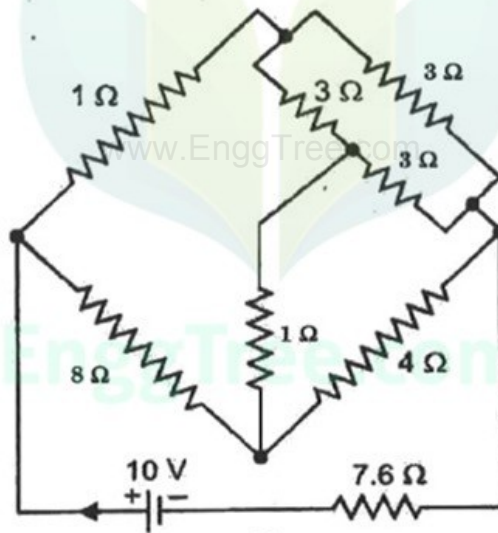


Figure. 16 (b)