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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

(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 $R = 5 \text{ ohm}$ and $L = 2 \text{ H}$. 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 $L_1 = 10 \text{ mH}$, $L_2 = 20 \text{ mH}$ and mutual inductance $M = 5 \text{ mH}$. Calculate the coefficient of coupling (k).

PART B — (5 × 13 = 65 marks)

11. (a) Using mesh analysis calculate [Figure 11(a): bridge A-B-C-D: 1 ohm from A to B (current I_1), 2 ohm from B to C (current $I_1 - I_3$), 4 ohm from A to D (current I_2), 3 ohm from D to C (current $I_2 + I_3$), 5 ohm from B to D (current I_3); A is joined to F and C to E; a 10 V battery between F and the 1 ohm resistor leading to E; supply current I]
 - (i) equivalent resistance across the terminal of the supply (7)
 - (ii) total current supplied by the source (3)
 - (iii) power delivered to 5 ohm resistors in the circuit shown in Figure 11 (a) (3)

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 ohm resistor in the circuit shown in Figure. 12 (a) [Figure 12(a): from left to right between top and bottom lines: 27 ohm; 47 ohm in series with a 200 V source (+ at top); then 4 ohm in the top line; 20 A current source (arrow up); 23 ohm]

Or

- (b) Using Thevenin's theorem, find the current in 10 ohm resistor in the circuit shown in Figure. 12 (b) [Figure 12(b): 120 V battery in series with 40 ohm; 20 ohm shunt; then 60 ohm in series to the 10 ohm resistor]
13. (a) A coil having a resistance of 7W and an inductance of 31.8 mH is connected to 230 V, 50 Hz supply. Calculate
- (i) the circuit current and phase angle (5)
- (ii) power factor and power consumed and (4)
- (iii) voltage drop across resistor and inductor (4)

Or

- (b) A coil of resistance 50W and inductance 318 mH is connected in parallel with a circuit consisting of a 75W resistor in series with a 159 microF capacitor. The circuit is connected to a 230 V, 50 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 $L = 100 \text{ microH}$ which has a coil resistance of 12W. The capacitor C is adjustable over the range 200 pF to 300 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 A in coil A produces a flux of 0.04 Wb. If the coefficient of coupling is 0.2, calculate:
- (i) Self-inductance of coil A, with B open-circuited. (5)
- (ii) The average e.m.f. induced in coil B when the flux with it changes from zero to full value in 0.02 second. (4)
- (iii) 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): 6 A current source (arrow down) on the left in series with 5 ohm to node A; 15 ohm from A to ground; 2.5 ohm from A to B; 20 ohm from B to ground; 6 ohm from B to C; 4 ohm from C to ground; 2.5 A current source (arrow up) on the right feeding C]

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): 10 V battery in series with 7.6 ohm between the left node and the right node; 1 ohm from the left node to the top node; 8 ohm from the left node to the bottom node; 4 ohm from the right node to the bottom node; a delta of three 3 ohm resistors between the top node, the right node and an inner node; 1 ohm from the inner node to the bottom node]
