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Question Paper Code : 60032

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

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. Ten coulombs of charge flow past a given point in a wire in 2s. How many amperes of current is flowing?
2. Define active and passive elements and give examples.
3. State Maximum power transfer theorem.
4. Draw the dual of the network shown in Figure 1 [Figure 1: 10 V source in series with a 5 H inductor feeding a node; a 2 ohm resistor from that node to the return line; from the same node a 5 F capacitor in series with a 1 ohm resistor to the return line]
5. Determine the average power delivered to the circuit consisting of an impedance $z = (5 + j8)$ ohm when the current flowing through the circuit is $I = 5 \angle 30$ Amps.
6. For the circuit shown in Figure 2, find the average power delivered by the dependent current source. [Figure 2: source $20\cos 50t$ in series with a 10 ohm resistor (voltage V_1 across it, + on the source side) to node V; a dependent current source $0.5V_1$ (arrow pointing up into node V) from the return line to node V; a 20 ohm resistor from node V to the return line]
7. Write the mathematical expression for unit step function and draw the pattern of it.
8. Determine the Quality factor of a coil for the series circuit consisting of $R = 10$ ohm, $L = 0.1$ H and $C = 10$ microF.
9. Two inductively coupled coils have self inductances $L_1 = 50$ mH and $L_2 = 200$ mH. If the co-efficient of coupling is 0.5, find the value of mutual inductance between the coils.
10. List out the properties of tree of a graph.

PART B — (5 × 13 = 65 marks)

11. (a) Using mesh analysis determine the voltage V_s which given a voltage of 50 V across the 10 ohm resistor as shown in Figure 3 [Figure 3: 60 V source (+ at top) on the left; its top goes through 3 ohm to node X, its bottom goes to node Z; 10 ohm from X to the top-right corner (marked - on the X side, + on the right), then source V_s down to node Y; 5 ohm from X to Y; 1 ohm from X to Z; 2 ohm from Z to Y; a bottom branch of 4 ohm in series with a 50 V source (+ toward the 4 ohm side) from Z to Y]

Or

- (b) Using nodal analysis, find the currents through the resistances R_3 and R_4 for the circuit shown in Figure 4 [Figure 4: 50 V battery on the left and 20 V battery on the right; top line has $R_1 = 5$ ohm, $R_2 = 5$ ohm and $R_3 = 5$ ohm in series; a 10 ohm shunt resistor (labelled R_3) from the R_1 - R_2 junction to the bottom line and a 10 ohm shunt resistor R_4 from the R_2 - R_3 junction to the bottom line]
12. (a) Find the voltage across the 2 ohm resistor shown in Figure 5 using superposition theorem. [Figure 5: 10 V source (+ at top) in series with 10 ohm to node A; 20 ohm from A to ground; 2 ohm from A to node B; from B a 3 ohm resistor in series with a 2 A current source (arrow up) to ground; from B a 5 ohm resistor in series with a 20 V source (+ at top) to ground]

Or

- (b) (i) Determine the resistance between nodes A and B in the circuit shown in Figure 6 [Figure 6: from A, resistors 1 ohm, 2 ohm, 3 ohm, 2 ohm, 1 ohm in series to B, with junctions P (after the first 1 ohm), Q, R, S (before the last 1 ohm); a 4 ohm resistor connected from P to R and another 4 ohm resistor connected from Q to S]
- (ii) Consider the bridge circuit shown in Figure 7. Determine the resistance between nodes A and B and the current supplied by the 24V supply. [Figure 7: 24 V source between A and E; 2 ohm from A to B; 3 ohm from B to C; 2 ohm from B to D; 1 ohm from C to D; 2 ohm from C to E; 4 ohm from D to E]
13. (a) A coil has a resistance of 5 ohm and an inductance of 31.8 mH.
- (i) Calculate the current taken by the coil and power factor when connected to 200 V, 50 Hz supply.
- (ii) Draw the phasor diagram.
- (iii) If a non-inductive resistance of 10 ohm is then connected in series with coil, calculate the new value of current and its power factor.

Or

- (b) The data for the two mesh circuit are $V_1 = 110$ angle 0 deg V and $V_2 = -120$ angle 45 deg V, $R = 4$ ohm, $X_L = 4$ ohm, $X_C = 3$ ohm. Determine the current through and voltage across the capacitance [Figure 8: source V_1 on the left in series with X_L to a middle node; X_C from the middle node to the bottom line; R from the middle node to source V_2 on the right]

14. (a) In the circuit shown in Figure 9, determine the complete solution for the current when the switch S is closed at $t = 0$. Applied voltage is $v(t) = 50 \cos(10^2 t + \pi/4)$ volts, Resistance $R = 10$ ohm and capacitance $C = 1 \mu\text{F}$. [Figure 9: source $50 \cos(100t + \pi/4)$, switch S , 10 ohm resistor and $1 \mu\text{F}$ capacitor in series; loop current $i(t)$]

Or

- (b) (i) Find the value of L at which the circuit resonates at a frequency of 1000 rad/sec in the circuit shown in Figure 10. [Figure 10: two parallel branches across the terminals: 5 ohm in series with L , and 10 ohm in series with a capacitor of $-j12$ ohm]
- (ii) Explain parallel resonance and derive the resonance frequency.
15. (a) With relevant diagrams explain the characteristics of an ideal transformer.

Or

- (b) For the electrical network shown in Figure 11, draw its topological graph and any four possible trees. [Figure 11: 15 V source between A and J ; 5 ohm from A to B ; 10 mH from B to C ; $2 \mu\text{F}$ from B to I ; 100 ohm from C to H ; C joined to D ; 5 A current source from G up to D ; 25 ohm from D to E ; 15 mH from E to F ; $5 \mu\text{F}$ from F to G ; bottom line J - I - H - G]

PART C — (1 × 15 = 15 marks)

16. (a) A resistance of 100 ohm is connected in series with a $50 \mu\text{F}$ capacitor. When the supply voltage is 200V , 50 Hz, find the
- (i) Impedance, current and power factor
- (ii) The voltage across the resistor and across capacitor. Draw the phasor diagram.

Or

- (b) A coil of resistance 10 ohm and inductance 0.1 H is connected in series with $150 \mu\text{F}$ capacitor across 200V , 50 Hz supply. Calculate :
- (i) Inductive reactance; capacitive reactance, impedance, current and power factor and
- (ii) The voltage across the coil and capacitor.
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