



--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Question Paper Code : 20922

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

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. In a circuit consisting of two 50 ohm resistors connected in series and third resistor R is connected across the series resistors. The equivalent resistance is found to be 60 ohm. Calculate the resistance value, R.
2. Find the value of the current I, for the circuit shown in Fig. 1 [Fig. 1: 5 V source in series with 5 ohm to a node; a 1 A current source (arrow up) from that node to the bottom line; a second 5 ohm from the node to a 10 ohm resistor carrying current I downward to the bottom line]
3. Recall the statement of Norton's theorem.
4. Draw the dual of the network shown in Fig. 2 [Fig. 2: 10 A current source (arrow up) in parallel with a 5 F capacitor; a 0.5 ohm series resistor in the top line; then a 5 H inductor and a 1 mho conductance in parallel]
5. Show the waveform representation of applied voltage across inductor, and the resulting current and the power.
6. A voltage of $240 \sin 377t$ is applied to a 6 ohm resistor. Find the instantaneous power and average power.
7. Calculate the impedance at resonance for an RLC series circuit, having $R = 20$ ohm, $L = 50$ mH, and $C = 1$ microF.
8. An RC series circuit has $R = 20$ ohm and $C = 400$ microF. What is its time constant?
9. Two 2H inductance coils are connected in series and are also magnetically coupled to each other, the coefficient of coupling being 0.1. Find the total inductance of the combination.
10. List the properties of incidence matrix.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Determine the potential difference across A and B, V_{AB} in the circuit shown in Fig. 3. [Fig. 3: left loop of a 6 V battery (+ at bottom), 6 ohm and 4 ohm with A at the 6 ohm - 4 ohm junction; a 12 V battery (+ toward the left loop) links the bottom of the left loop to the right loop; right loop of 4 ohm, a 12 V battery (+ on the left) and 10 ohm, with B at the bottom of the 4 ohm] (9)
- (ii) Calculate the equivalent resistance between the terminals A and B of circuit shown in Fig. 4. [Fig. 4: ladder network: from A, four 1 ohm series resistors along the top, five 1 ohm shunt resistors to the bottom line B (one at the input and one after each series resistor)] (4)

Or

- (b) (i) Determine the voltage drop across all the resistances for the circuit shown in Fig. 5. using nodal analysis [Fig. 5: 4 V battery (+ at top) in series with 2 ohm to node A; 2 ohm (voltage V_0) from A to the bottom line; 2 ohm from A to a 2 V battery (+ at bottom) on the right] (6)
- (ii) Determine the current passing through 15 ohm resistor in the circuit shown in Fig. 6 using mesh analysis. [Fig. 6: left branch 40 ohm in series with a 10 V battery; middle: 30 ohm with a 40 V battery from the top line to a middle node, and 5 ohm from the middle node to the bottom line; right: 25 ohm with a 30 V battery from the top line to a right node, and 20 ohm with a 20 V battery from the right node to the bottom line; the 15 ohm resistor joins the middle node and the right node] (7)
12. (a) Determine the value of R_L for maximum power transfer in Fig. 7. Also find the maximum power. [Fig. 7: 3 ohm from the left node to A and 4 ohm from A to the right node; R_L from A to B; a 10 A current source in parallel with 2 ohm between the left node and B; a 12 V battery in series with 2.5 ohm between the right node and B] (7)

Or

- (b) (i) Determine i_x for the following network shown in Fig. 8. [Fig. 8: 4 A current source (arrow up), 10 ohm, 5 ohm (current i_x downward) and a -3 A current source (arrow up) all between the top and bottom lines; a 20 ohm resistor and a dependent current source $3i_x$ (arrow to the right) both connected between the top of the 10 ohm and the top of the 5 ohm] (7)
- (ii) Using Thevenin's theorem, Calculate the power loss in R_L in Fig. 9. [Fig. 9: 5 A current source in parallel with 5 ohm; then 1 ohm in series with a 10 V battery to $R_L = 10$ ohm] (6)
13. (a) In the circuit, source voltage is $v = 200 \sin [314t + (\pi/6)]$ and the current is $i = 20 \sin [314t - (\pi/3)]$ Find
- frequency
 - Maximum values of voltage and current
 - RMS value of voltage and current
 - Average values of both
 - Draw the phasor diagram
 - Circuit element and its values

Or

- (b) (i) By nodal analysis determine V in Fig. 10. [Fig. 10: 50 V source in series with 10 ohm; voltage V across a capacitor of $-j5$ ohm; in parallel a branch of 3 ohm in series with an inductor marked $-j5$ ohm] (6)
- (ii) For the network shown in Fig. 11, Calculate the voltage across 7 ohm using Nortons theorem. [Fig. 11: 30 V source in series with 3 ohm; $j4$ ohm shunt; then $(1 + j1)$ ohm series; 2 ohm shunt; then 6 ohm series to the 7 ohm load] (7)
14. (a) (i) Show that $\omega_1 \omega_2 = \omega_r^2$ for a series resonant circuit. (6)
- (ii) A coil has a resistance of 20 ohm and inductance of 80 mH and is connected in series with a 100 microF capacitor across 200 V, 50 Hz supply, Determine the resonant frequency. Also determine, at resonance, the circuit impedance and BW. (7)

Or

- (b) (i) Examine the transient response of RC series circuit for unit step input.
- (ii) In the circuit of Fig. 12, the switch S has been in position 1 for sufficient time to establish steady-state conditions. The switch is then moved to position 2. Determine the current transient. [Fig. 12: switch S connects a series 20 ohm - 0.5 H branch either to position 1 (100 V battery) or to position 2 (40 ohm resistor)]
15. (a) (i) Two identical coupled coils have an equivalent inductance of 80 mH when connected series aiding, and 35 mH series opposing. Calculate the self inductance of the coils, mutual inductance between them, and coefficient of coupling.
- (ii) For the coupled circuit shown in Fig. 13, Show the ratio V_2/V_1 which results in zero current I_1 . [Fig. 13: mesh 1: source V_1 , 5 ohm and a coil; mesh 2: source V_2 , 2 ohm and a coil of $j2$ ohm; mutual reactance $j2$ ohm between the coils, dots at the top of both coils; mesh currents I_1 and I_2]

Or

- (b) (i) The oriented graph of a network is shown in Fig. 14. Obtain the incidence matrix. [Fig. 14: oriented graph with nodes 1 to 6 and branches 1- $\rightarrow$ 2, 1- $\rightarrow$ 6, 2- $\rightarrow$ 3, 2- $\rightarrow$ 6, 2- $\rightarrow$ 5, 6- $\rightarrow$ 5, 5- $\rightarrow$ 3, 3- $\rightarrow$ 4, 5- $\rightarrow$ 4] (5)
- (ii) For the graph shown in Fig. 14, select a tree of your own choice and Determine the tie-set schedule. (8)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Determine equivalent resistance across the terminals a and b for the circuit shown in Fig. 15. [Fig. 15: outer triangle with 5 ohm on each side, its top corner joined to terminal a and its bottom-left corner to terminal b; an inner triangle with 15 ohm on each side; each outer corner joined to the nearest inner corner by 10 ohm] (8)
- (ii) Find the voltage across the 2 ohm resistor by using superposition theorem for the circuit shown in Fig. 16. [Fig. 16: 10 V battery in series with 10 ohm; 20 ohm shunt; 2 ohm series; then a resistor in series with a 2 A current source (arrow up) as a shunt branch, and 5 ohm in series with a 20 V battery as the last branch] (7)

Or

- (b) Analyze the transient response of RLC Series circuit for sinusoidal excitation.
-