

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

Question Paper Code : 60033

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

Second Semester

Electrical and Electronics Engineering

EE 3251 — ELECTRIC CIRCUIT ANALYSIS

(Common to : Electronics and Instrumentation Engineering/Instrumentation and Control Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State ohm's Law and specify the limitations of ohm's Law.
2. Three resistors RA, RB and RC are connected in series to a 220 V source as shown in Fig. 1. Determine the value of resistors, RB, and RC. [Figure 1: 220 V source in series with RA = 100 ohm, RB and RC; current 1 A; voltage across RB is VB = 60 V]
3. State Reciprocity Theorem.
4. Determine the voltage across the 10 ohm resistor in Fig.2. [Figure 2: 50 V source across 5 ohm and 10 ohm in series; terminals A and B across the 10 ohm resistor]
5. Define the time constant of RL circuit.
6. A series RC circuit consists of resistor of 10 ohm and capacitor of 0.1 F. A constant voltage 10 of 20 V is applied to the circuit at time t = 0. Obtain the current equation.
7. Define Quality factor of the coil.
8. Two identical coils, each have self-inductance, L = 0.03 H. If coefficient of coupling, k is 0.8, determine the value of mutual inductance between the coils, M.
9. In two wattmeter method of three phase power measurement, compute the readings of wattmeters in terms of voltage, VL and current, IL if the power factor is unity.
10. What is power factor leading and power factor lagging?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Determine the mesh currents I_1 and I_2 in the circuit shown in the Fig. 3. (7)
 [Figure 3: 50 V source on the left with 10 ohm in the top line to a middle node; 5 ohm and 3 ohm in series down the middle branch; 2 ohm in the top line to the right; 1 ohm from the junction of the 5 ohm and 3 ohm to the right side; 10 V source (upper) and 5 V source (lower) on the right side; mesh currents I_1 , I_2 and I_3]
- (ii) Three lamps are connected to a 9 V battery as shown in Fig.4. Draw the resistive circuit equivalent model by modelling each lamp as a resistor. Calculate the total current supplied by the battery. [Figure 4: 9 V battery supplying a 15 W lamp in series with a 10 W lamp, this pair being in parallel with a 20 W lamp] (6)

Or

- (b) (i) Using node voltage method, determine the voltages at node 1 and 2 in the circuit shown in Fig. 5. [Figure 5: 2 ohm from node 1 to ground; 4 ohm between node 1 and node 2; 5 A current source between node 2 and node 1 (arrow towards node 1); 6 ohm from node 2 to ground; 10 A current source from ground into node 2]
- (ii) If $R_{eq} = 50$ ohm, in the circuit shown in Fig. 6, determine the value of R . [Figure 6: from the input terminals, 30 ohm in series to a node; 60 ohm from that node to the bottom line; 10 ohm from that node up to the top line, then R down to a group of three 12 ohm resistors drawn in parallel, returning to the bottom line]
12. (a) For the circuit shown in Fig.7, find the Thevenin's equivalent circuit and find the value of (i) R_L for maximum power transfer and (ii) the maximum power transferred to R_L using maximum power transfer theorem. [Figure 7: 6 kohm on the left; 6 V source (- + from left to right) in the top line; 12 kohm shunt; 2 kohm series to the load R_L]

Or

- (b) Determine the current, I in the circuit shown in Fig. 8 using the superposition theorem. [Figure 8: 16 V source, 6 ohm in series, then 2 ohm in parallel with a 4 A current source (arrow to the right), then 8 ohm carrying current I to a 12 V source]
13. (a) A series RL circuit as shown in Fig. 9, has a dc input voltage, E applied to it at $t = 0$ seconds through switch. At the instant of switching, the current, i is zero. Derive and find the expression for the transient current, $i(t)$. Also, draw the transient response of the current [Figure 9: battery E , switch S closing at $t = 0$, R and L in series, loop current i]

Or

- (b) A series RLC circuit as shown in Fig. 10 has a dc input voltage of E applied to it at $t = 0$ seconds through switch. Derive and find the expression for the transient current, $i(t)$ for the overdamped condition. Assume initial relaxed circuit conditions. [Figure 10: battery E , switch closing at $t = 0$, R , L and C in series, loop current i]
14. (a) Derive the expression for equivalent inductance, L for the circuit shown in Fig. 11. L_1 , L_2 are the self inductances and M is the mutual inductance. [Figure 11: voltage V applied across L_1 and L_2 in parallel, total current i dividing into i_1 and i_2 , mutual inductance M , dots at the top of both coils]

Or

- (b) Draw the frequency response of a series RLC circuit and derive the expression for bandwidth, B and Quality factor, Q in terms of resistance, R and inductance, L.
15. (a) A balanced star connected load takes 9 kW at a lagging power factor of 0.8 when connected to a three phase, star connected 400 V, 50 Hz supply. Find the per phase values of load elements. Given supply voltage is line voltage.

Or

- (b) Three coils of resistance 4 ohm and inductive reactance 3 ohm are connected in delta across 400 V, 50 Hz supply. Find the current in the coil, line current, active, reactive and apparent power.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Why an unbalanced star connected load is not normally used in 3 wire 3 phase system? (6)
- (ii) A balanced delta connected 3phi load is fed from 3phi, 400 V supply. The line current is 20 A and total power absorbed by load is 10 kw. Calculate (1) The impedance in each branch (2) The power factor (3) Total power consumed if some impedance are star connected. (9)

Or

- (b) (i) Three single phase loads can be connected in either star or in delta to form a 3 phase load. Which of these connections results in higher current when connected to a 3 phase supply? (6)
- (ii) A balanced 3phi star connected load is fed from 400V, 3phi, 50 Hz supply. The current per phase is 25 A (lagging) and total active power observed by load is 13.86 KW. Determine (1) Resistance and inductance of load per phase (2) Total reactive power (3) Total apparent power. (9)
-