

**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  $R_A$ ,  $R_B$  and  $R_C$  are connected in series to a 220 V source as shown in Fig. 1. Determine the value of resistors,  $R_B$ , and  $R_C$ .

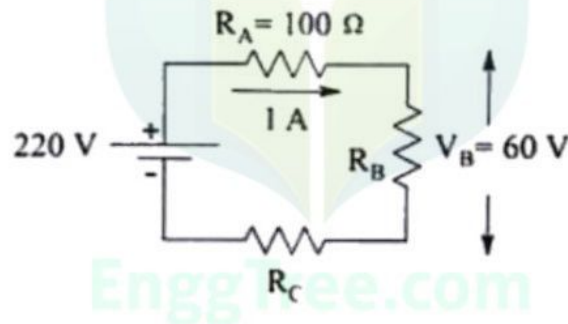


Figure - 1

3. State Reciprocity Theorem.
4. Determine the voltage across the 10 Ω resistor in Fig.2.

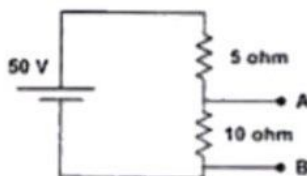


Figure - 2

5. Define the time constant of RL circuit.
6. A series RC circuit consists of resistor of  $10\ \Omega$  and capacitor of  $0.1\ \text{F}$ . A constant voltage  $10$  of  $20\ \text{V}$  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,  $L = 0.03\ \text{H}$ . 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,  $V_L$  and current,  $I_L$  if the power factor is unity.
10. What is power factor leading and power factor lagging?

PART B — ( $5 \times 13 = 65$  marks)

11. (a) (i) Determine the mesh currents  $I_1$  and  $I_2$  in the circuit shown in the Fig. 3. (7)

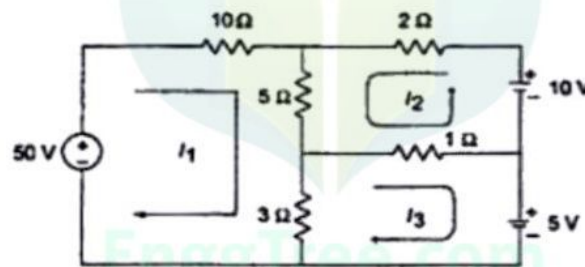


Figure - 3

- (ii) Three lamps are connected to a  $9\ \text{V}$  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. (6)

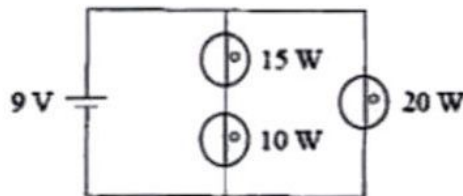


Figure - 4

Or

- (b) (i) Using node voltage method, determine the voltages at node 1 and 2 in the circuit shown in Fig. 5. (7+6)

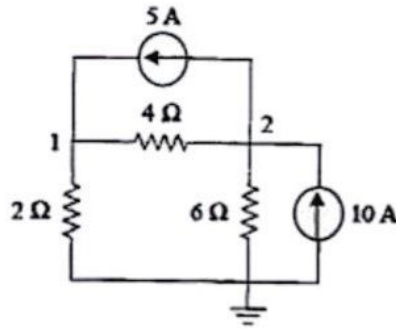


Figure - 5

- (ii) If  $R_{eq} = 50\Omega$ , in the circuit shown in Fig. 6, determine the value of R. (7+6)

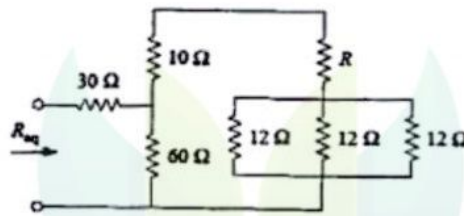


Figure - 6

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. (13)

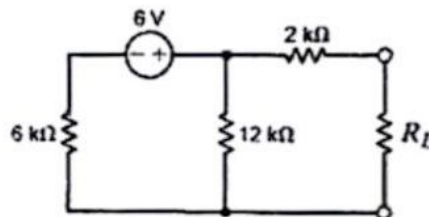


Figure - 7

Or

- (b) Determine the current,  $I$  in the circuit shown in Fig. 8 using the superposition theorem. (13)

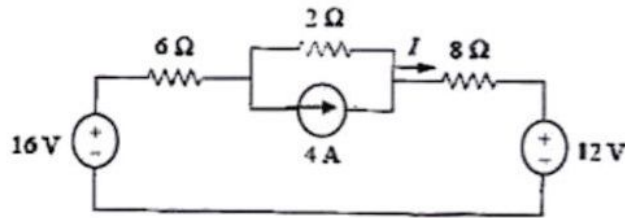


Figure - 8

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 (13)

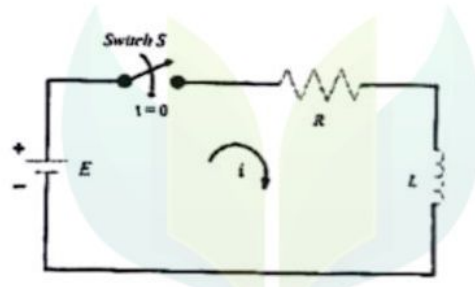


Figure - 9

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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. (13)

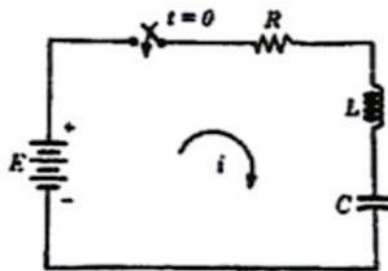


Figure - 10

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. (13)

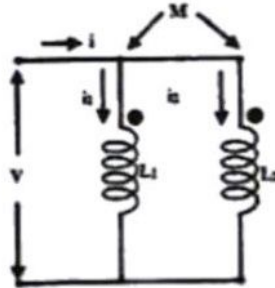


Figure – 11

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,  $L$ . (13)
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. (13)

Or

- (b) Three coils of resistance  $4 \Omega$  and inductive reactance  $3 \Omega$  are connected in delta across 400 V, 50 Hz supply. Find the current in the coil, line current, active, reactive and apparent power. (13)

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  $3\phi$  load is fed from  $3\phi$ , 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  $3\phi$  star connected load is fed from 400V,  $3\phi$ , 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)

