Ref. No.: Ex/PE/PC/B/T/215/2025

B. POWER ENGINEERING EXAMINATION -2025

(2nd Year – 1st Semester)

SUBJECT – Circuit Theory

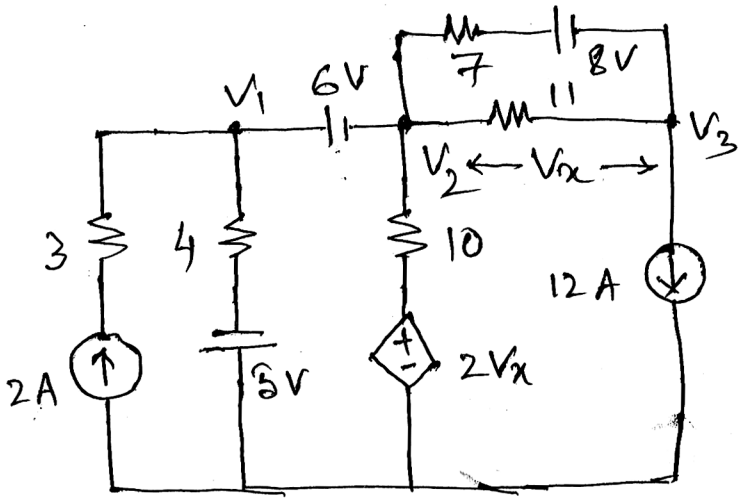
Time: Three hours | Full Marks: 100

Answer any ***five*** questions as directed under each group

Assume suitable value for missing data, if any

All the values of resistors are in Ω.

All parts of a question to be answered at one place.

No. of Question		Marks
	Group A (CO1) Answer **any one** questions	
1.(a)	What is a supernode? Explain the techniques for the solution of networks having supernodes with suitable example.	6
(b)	For the network as shown below, Find the node voltages and hence find current through the 4 Ω resistor using nodal analysis.	14
	 Fig. 1	
2. (a)	State and explain Reciprocity Theorem with suitable example.	8
(b)	Find the voltage V and verify the reciprocity theorem for the circuit shown below.	12

[Turn over

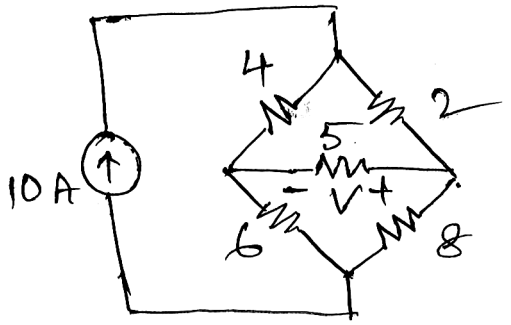


Fig-2

Group B (CO2)

Answer ***any one*** question

3. (a) Define and explain the following with suitable examples: 4+3+3

(i) Distinguish between Cut set and fundamental cut set matrix
(ii) Tie set matrix
(iii) Isomorphic graph

(b) The incidence matrix of a directed graph is shown below. Draw the directed graph. Select a particular tree of your choice and write down the fundamental cut set matrix for the same. 10

$$[A] = \begin{bmatrix} 0 & -1 & 0 & 1 & -1 & 0 & 1 & 0 \\ -1 & 0 & -1 & 0 & 0 & +1 & 0 & -1 \\ 0 & -1 & 1 & 0 & 1 & -1 & -1 & 0 \\ 1 & 0 & 0 & -1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

4. For the network as shown below, draw the directed graph and write down the fundamental tie set matrix for a particular tree of your choice. Use it to determine loop currents. Source conversion is not permitted. 20

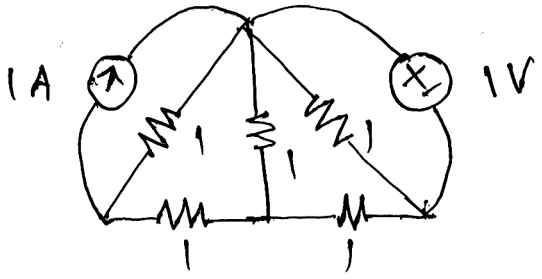


Fig-3

Group C (CO3)

Answer **any one** question

5. (a) State and prove Final Value Theorem and Initial Value Theorem. 5+5

(b) Using final value theorem, find the steady state value of current *i(t)* for the network shown below. The switch is closed at *t=0*. The initial current through the inductor current is assumed to be zero. 10

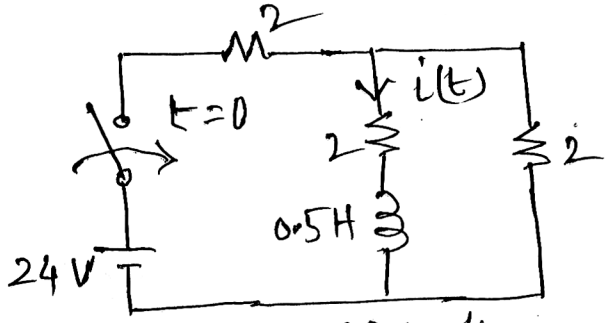


Fig. 4

6. Consider the circuit shown in the figure below. The switch is closed at time $t = 0$. The input to the circuit is the voltage of the voltage source, 24 V. The output of this circuit, the voltage across the 6 Ω resistor is given by 20

$v_o(t) = 12 - 6e^{-0.35t}$ V for $t > 0$

Determine the value of inductance L and of the resistances R_1 and R_2.

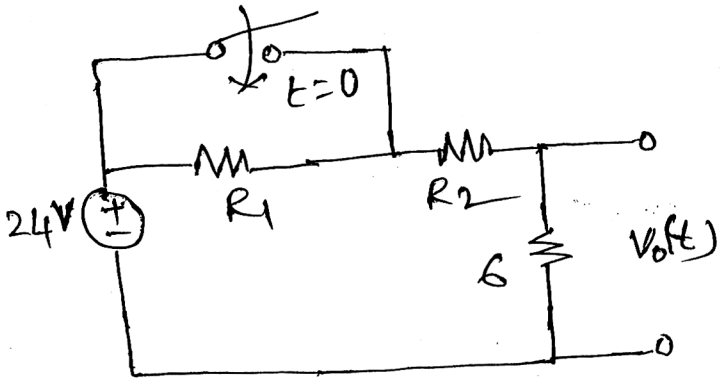


Fig. 5

	Group D (C04) Answer ***any one*** question	
7.	Discuss the half wave symmetry of a periodic function with suitable example. Determine the Fourier Series coefficients for such functions	5+15
8.	A 6.36 μF capacitor is connected in parallel with a resistance of $500\,\Omega$ and the combination is connected in series with a $500\,\Omega$ resistor. The whole circuit is connected across an ac voltage given by $v = 300\sin\omega t + 100\sin(3\omega t + \pi/6)$. If $\omega = 314\ rad/\sec$, determine (i) power (ii)expression for voltage across the series resistance (iii) % harmonic content in the resultant current.	20
	Group E (C05) Answer ***any one*** question	
(9)	What is reciprocity and symmetry of two port network? Derive the conditions for reciprocity and symmetry in terms of transmission (*A, B, C, D*) parameter and *h*-parameter representation of a two port network.	4+16
10. (a)	Find z-parameters in terms of in transmission (*A, B, C, D*) parameters and *h*-parameters	10
(b)	Two two port networks *A* and *B* are connected in parallel. Find the *y*-parameters of the resultant network in terms of *y*-parameters of the networks A and B.	10