EI 181302

22/2/22 2021

B.Tech. 3rd Semester End-Term Examination

EE, IE, EEE

ELECTRICAL CIRCUIT ANALYSIS

(New Syllabus & New Regulation)

Full Marks – 70   Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1.   Answer the following (MCQ/ Fill in the blanks) : $(10 \times 1 = 10)$

(i)   'The algebraic sum of the powers in all branches of the network at any instant is zero' is valid when

(a)   The network obeys KCL

(b)   The network obeys KVL

(c)   The network obeys both KCL and KVL

(d)   None of the above

(ii) The coupling between two magnetically coupled coils is said to be ideal if the coefficient of coupling is

(a)   Zero   (b)   2

(c)   1   (d)   0.5

(iii) A resistance having rating 10 ohms, 10 W is likely to be a

(a)   Metallic resistor   (b)   Carbon resistor

(c)   Wire wound resistor   (d)   Variable resistor

[Turn over

(iv) In Thevenin's theorem applied to A.C. circuit, any linear network can be replaced by a voltage source

(a) In series with an impedance

(b) In parallel with an impedance

(c) In series with a resistance

(d) In parallel with a resistance

(v) The inductance of an iron-core coil decreases if

(a) The number of turns is decreased

(b) The iron core is removed

(c) The length of the coil decreases

(d) None of the above

(vi) The graph of an electrical network has n nodes and b branches. The number of links with respect to the choice of a tree is————

(vii) If the flux of two mutually coupled coils oppose each other then the equivalent inductance is given by

(a) $L = L_1 + L_2 + 2M$ (b) $L = L_1 + L_2 - 2M$

(c) $L = L_1 + L_2 + 4M$ (d) $L = L_1 + L_2 - 4M$

(viii) A two port network has transmission parameters A, B, C, D. The condition of reciprocity is

(a) $AC-BD = 1$ (b) $AD-3C = 1$

(c) $AB-DC = 1$ (d) $BC-AD = 1$

(ix) Which one of the following is a true for an incidence matrix?

(a) Algebraic sum of the column entries of an incidence matrix is zero

(b) Determinant of the incidence matrix of a closed loop is zero

(c) Both the above statements are true

(d) None of the above

(x) For an R-C driving point impedance function, the poles and zeros

(a) should alternate on the real axis

(b) should alternate on the negative real axis

(c) should alternate on the imaginary axis

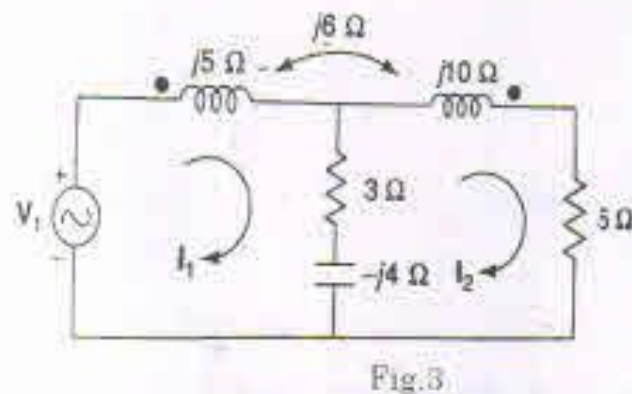(d) can lie anywhere on the left half-plane

2. (a) Find the Millman's equivalent circuit for the circuit in Fig.1 on the left of the terminals A & B (4)

Fig.1
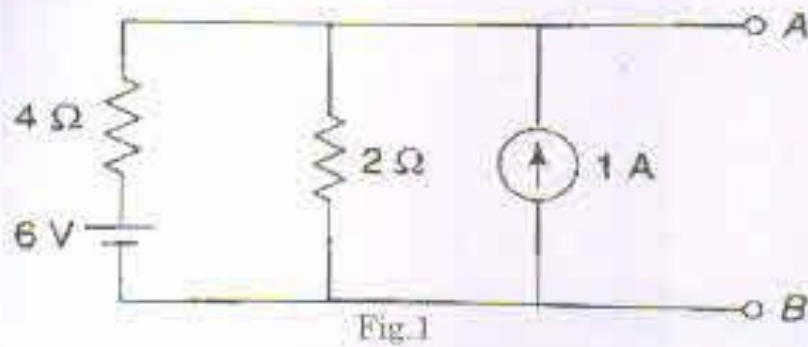
(b) In the network of Fig. 2 the resistance of 4 Ohm is changed to 2 Ohm. Verify the compensation theorem. (6)

Fig.2
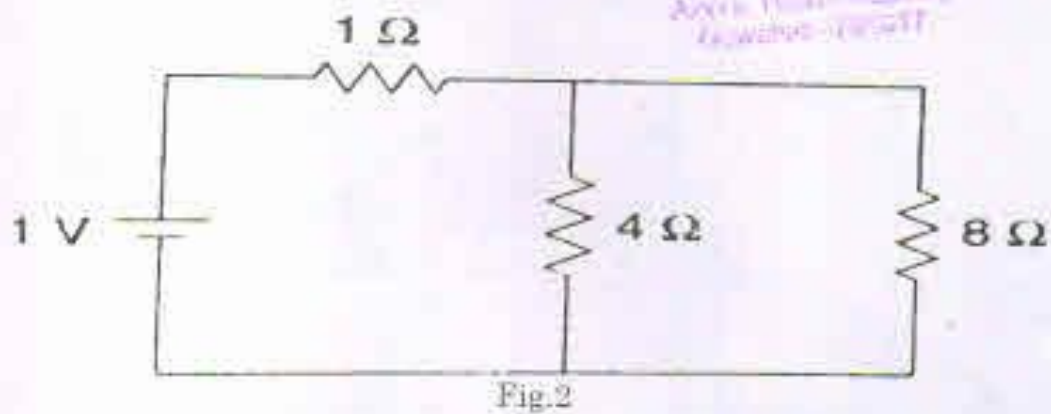
(c) Draw the conductively coupled equivalent circuit for the circuit of Fig.3 (5)

Fig.3

3. (a) The reduced incidence matrix of an oriented graph is (5)

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

(i) Draw the oriented graph
(ii) How many trees are possible for this graph?

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(b) The fundamental cut set matrix of a network is given as follows :   (5)

	Twigs			Links		
	a	c	e	b	d	f
	1	0	0	1	0	1
	0	1	0	0	1	1
	0	0	1	1	1	1

Draw the oriented graph

(c) For the graph shown in Fig.5 , write the tie-set matrix and f-cut set matrix.

(5)

Fig.4

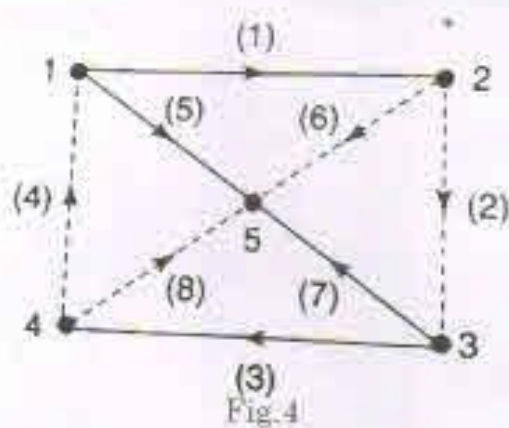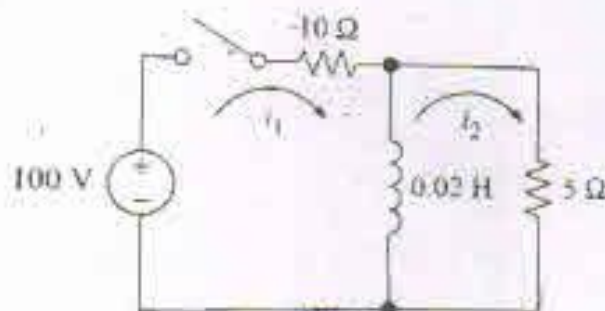4. (a) In the two mesh network shown in Fig.5, find the currents which result when the switch is closed.   (5)

Fig.5

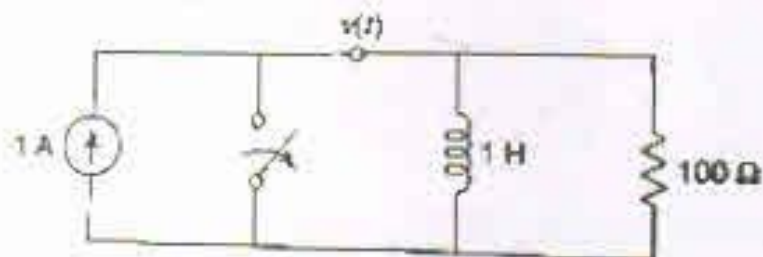(b) In the network shown in Fig.6, at t = 0 , the switch is opened. Calculate v , dv/dt and d²v/ dt² at t = 0

Fig.6

(c) A parallel circuit comprises of two branches is excited by a current source of 10u(t)A through a switch. First branch is a resistance of 3Ω and the second is a resistance 2Ω in series with an inductance of 1H. At t=0 sec the circuit is energized by closing the switch. After t=0.5sec, the switch is opened again. Derive the expression of current in the circuit. And plot current Vs time.

5. (a) Derive the condition of reciprocity for ABCD parameters. (4)

(b) Draw the h-parameter model of a 2-port network. Define the parameters with respective units and give the model equations. (5)

(c) The following readings are obtained experimentally for an unknown two port network : (6)

	V_1	V_2	I_1	I_2
Output open	100V	60 V	10A	0
Input open	30V	40V	0	3A

Compute the Z parameters. Also draw the Z parameter equivalent circuit for the above circuit.

6. (a) Determine the range of values of 'k' so that the polynomial (5)

$P(s) = s^3 + 3s^2 + 2s + k$ is Hurwitz?

(b) Test whether $F(s) = (s^2 + 1) / (s^3 + 4s)$ is a positive real function ? (5)

(c) Realize the network having admittance function $Y(s) = (4s^2 + 6s) / (s + 1)$ (5)

7. (a) Compare the properties of different traditional and modern dielectric materials used in capacitors. (5)

(b) Write short notes on the following : (3 × 2 = 6)

(i) Metal film resistors.

(ii) Tolerance and temperature stability of resistors

(iii) Properties of inductor core

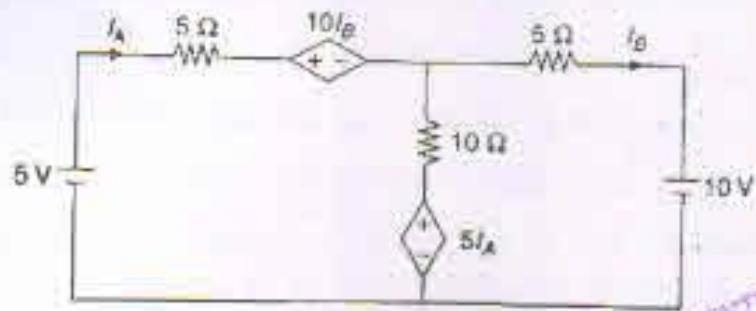(c) For the circuit shown Fig.7, obtain the branch currents   (4)

Fig.7