Group – E

8. (a) Draw the ideal and practical characteristics of a band - pass and a stop-band filter.

   (b) The driving point impedance of a circuit is given by

$$Z(s)=\frac{(s+1)}{s(s+2)}$$

   Realize a circuit using Cauer form-I.

(2 + 2) + 8 = 12

9. (a) The driving point impedance of a circuit is given by

$$Z(s)=\frac{(s+1)}{s(s+2)}$$

   Realize a circuit using Foster's form-II.

   (b) A filter circuit, as shown in the Fig. 5, receives a signal from a rectifier having certain frequency. Analyse the circuit to know the type of the filter.

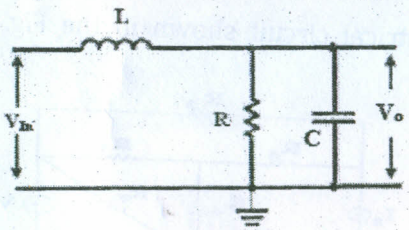


Fig. 5

8 + 4 = 12

CIRCUIT THEORY AND NETWORKS
(AEIE 2102)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) When two inductive coils having self-inductance L1, L2 and mutual inductance M in between them are connected in series aiding, the equivalent inductance across the series combination will be
   (a) L1+L2+2M (b) L1+L2-2M (c) L1+L2+M (d) L1+L2-M.

   (ii) A reciprocal circuit should have only
   (a) one independent source (b) at least two independent sources
   (c) dependent source (d) independent and dependent sources.

   (iii) In an oriented graph, the reduced incidence matrix is used to find the number of
   (a) valid trees (b) KVL equations
   (c) KCL equations (d) all of the above.

   (iv) Superposition theorem is not applicable for
   (a) voltage calculations (b) current calculations
   (c) power calculations (d) none of the above.

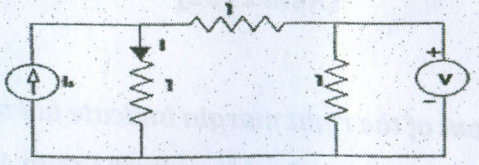
   (v) A voltage dependent current source is realized using a/an
   (a) inductor (b) bipolar junction transistor
   (c) unity (d) zero.

   (vi) In an RLC series circuit the power factor at resonance is
   (a) lagging (b) leading (c) unity (d) Not easy to predict.

   (vii) A galvanic cell is used for the conversion of
   (a) (n - 1) (b) n (c) (b - n + 1) (d) (n + 1).

(viii) In the circuit given, I = 1 A for I_s = 0 A. What is the value of I for I_s = 2 A?

(a) 1A (b) 2A (c) 3A (d) 4A.



(ix) A network, described by ABCD paramaters, will be reciprocal if

(a) A = D (b) (AD – BC)=1 (c) (AC – BD) = 1 (d) (AD – BC) = 0.

(x) Laplace transform of sinαt is

(a) $\frac{\alpha}{s^2+\alpha^2}$ (b) $\frac{s}{s^2+\alpha^2}$

(c) $\frac{\alpha}{s^2-\alpha^2}$ (d) $\frac{s}{s^2-\alpha^2}$.

Group – B

2.(a) Derive the condition of resonance of a series RLC circuit. If the resistance in that circuit is doubled then what change in the resonating frequency will be observed?

(b)

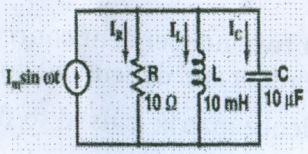


Fig. 1

The Fig. 1 shows an RLC circuit with a sinusoidal current source. Find the ratio of the magnitudes of the IL and IR at resonance.

(5 + 1) + 6 = 12

3.(a) Two identical coupled inductors are connected in series. The measured inductances for the two possible series connections are 380H and 240H. Find their mutual inductance.

(b) What is the co-efficient of coupling in a magnetically coupled circuit? What is its practical range? Find the output voltage of the ideal transformer with the polarities and dots shown in the Fig. 2.

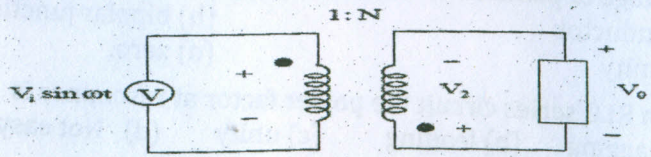


Fig. 2

6 + (1 + 1 + 4) = 12

Group – C

4.(a) An impulse voltage excites an RC circuit. Derive an expression of voltage across the capacitor using the concepts of Laplace transform. Assume that the circuit is initially relaxed.

(b) In an RLC circuit, find the condition of the critically damped response.

6 + 6 = 12

5.(a) Find the inverse Laplace transform of the following function

$$F(s)=\frac{(s+2)}{s(s+1)(s+2)}$$

Using the initial value theorem, find the value of the above function at t = 0.

(b) Write the Laplace transforms of the following time domain functions:
(i) unit impulse (ii) unit step (iii) exponentially decaying and (iv) unit parabola.

(6 + 2) + 4 = 12

Group – D

6. (a) Consider the electrical circuit shown in the Fig. 3. Obtain the reduced incidence matrix.

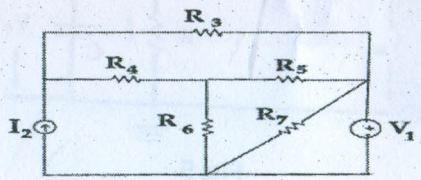


Fig. 3

(b) Find the total number of valid trees that may be obtained from the above circuits.

6 + 6 = 12

7. (a) The elements in the Z-parameter matrix are: Z_{11} = 1Ω, Z_{12} = 2Ω, Z_{21} = 2Ω, and Z_{22} = 4Ω. Find Z_a, Z_b, and Z_c in the circuit of Fig. 4.

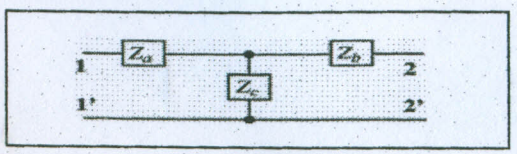


Fig.4

(b) Express ABCD parameters in terms of Z-parameters.

6 + 6 = 12