$N1 = \begin{bmatrix} 1 & 5 \\ 0 & 1 \end{bmatrix}$ and $N2 = \begin{bmatrix} 1 & 0 \\ 0.2 & 1 \end{bmatrix}$. Find the ABCD parameters of the combined network.

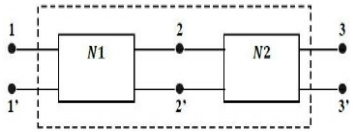


*Fig.7*

(b) Calculate z-parameters of the network shown in the Fig.8.

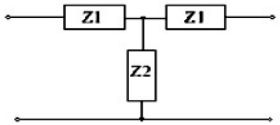


*Fig. 8*

where, Z1 = 2 Ω, and Z2 = 4 Ω.
Is the network symmetrical and reciprocal?

**6 + 6 = 12**

## Group – E

8. (a) Draw the oriented graph, one tree and its co-tree for an electrical circuit as shown in the Fig.9.

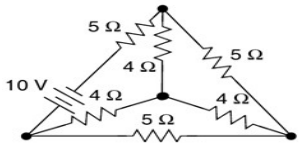


*Fig. 9*

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

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

Realize a circuit using any one of the Foster's forms or any of the Cauer's forms.

**4 + (4 + 4) = 12**

9. (a) Design a low-pass active filter at a cut-off frequency of 1 kHz with a pass band gain of 2.

(b) Propose the type of the filter circuit as shown in Fig.10.

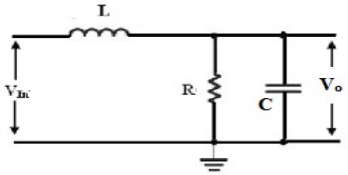


*Fig. 10*

**6 + 6 = 12**



B.TECH/AEIE/3RD SEM/AEIE 2102 (BACKLOG)/2019

# 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) Voltage divider rule is valid for
(a) series circuit (b) parallel circuit
(c) resonant circuit (d) all of these.

(ii) Two coils having self-inductances L1, L2 and mutual inductance M in between them are connected in series, adding 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.

(iii) A voltage source is described by v(t) = 1. cost volts. The RMS value of v(t) in volts is
(a) $\sqrt{\frac{3}{2}}$ (b) $\sqrt{\frac{2}{3}}$ (c) 1 (d) $\sqrt{\frac{1}{2}}$

(iv) The electrical component that dissipates electric energy
(a) resistor (b) capacitor (c) inductor (d) all of the.

(v) If the number of nodes is n, then the number of twigs is t,
(a) (n + 1) (b) (n - 1) (c) n (d) (1/n).

(vi) Time constant of an RC circuit is
(a) RC (b) R/C (c) 1/RC (d) C/R.

(vii) Which of the followings is correct for $Z_{21}$ in a two-port network?
(a) $\frac{Y_{21}}{\det Y}$ (b) $\frac{Y_{12}}{\det Y}$ (c) $-\frac{Y_{21}}{\det Y}$ (d) $\frac{-Y_{12}}{\det Y}$

(viii) Thevenin's voltage of a circuit comprising of dependent source and resistive components is
(a) finite value (b) $0A < V_{th} < 1V$
(c) 0 V (d) cannot be determined.

(ix) The most elementary form of a loop which cannot be further divided into other loops is called
(a) node (b) branch (c) loop (d) mesh.

(x) In an RLC series circuit, the power factor at resonance is
(a) lagging (b) leading (c) unity (d) zero.

## Group – B

2. (a) What are the half power points of a series RLC circuit? Show the current versus frequency curve for the series RLC circuit. How does the resonating current relate with the cut-off frequencies?

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

**(2 + 2 + 2) + 6 = 12**

3. (a) Calculate the resonating frequency of a series RLC circuit.

(b) Find the RMS value of the current i (t) in the circuit shown in Fig.1.

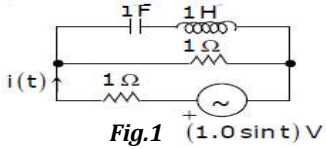


*Fig.1*

**6 + 6 = 12**

## Group – C

4. (a) In the circuit shown in the Fig.2 the initial charge on the capacitor is 0 (zero) coulomb. Find an expression of the current through the capacitor after the switch is closed at t = 0 second.

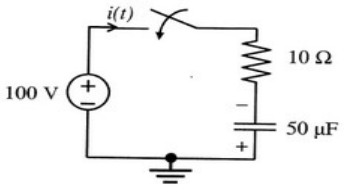


*Fig.2*

(b) Find the steady state values of the following functions.





(i) $F(s)=\frac{(s+2)}{s(s+3)}$ (ii) $G(s)=\frac{e^{-2st}}{s(s+4)}$.

**6 + (3 + 3) = 12**

5. (a) Find current flowing through the resistor $R_2$ in the circuit of Fig.3.

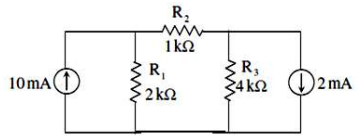


*Fig.3*

(b) Find the time-constant of the circuit across the terminals A and B as shown in Fig.4.

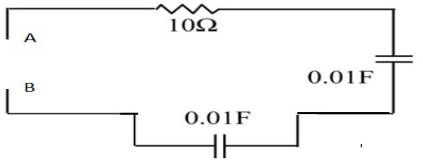


*Fig.4*

**6 + 6 = 12**

## Group – D

6. (a) Draw the Thevenin's equivalent circuit across the load $R_2$ of the circuit shown in the Fig.5.

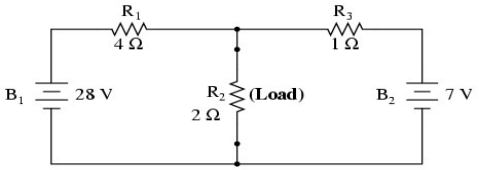


*Fig. 5*

(b) Find the Maximum power transferred to the load resistor $R_L$ in the circuit of Fig.6.

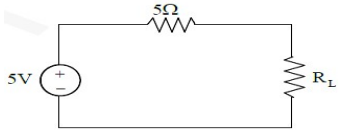


*Fig. 6*

**6 + 6 = 12**

7. (a) Two 2-port networks N1 and N2 are connected as shown in Fig.7. The ABCD parameters are given as