Group - E

8. (a) Find the maximum power transferred to the resistor R in the circuit of Fig. 6 .

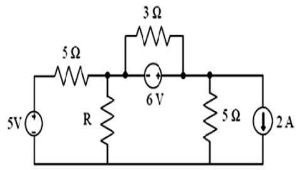

Fig. 6

(b) Analyze the circuit in Fig. 7 to determine the type of the filter.

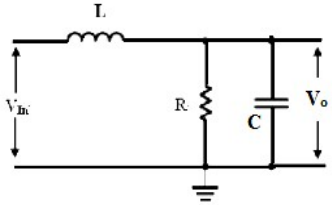

Fig. 7

4 + 8 =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) Find the Norton's equivalent resistance across the terminals a and b of the circuit in Fig. 8.

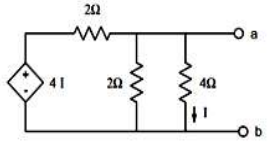

Fig. 8

6 + 6 = 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 opposing , 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) Current division rule is valid for
(a) series circuit (b) parallel Circuit
(c) resonant circuit (d) all of these.

(iii) If the RMS value of current is 12.25 A, its peak value is
(a) 17.3A (b) 8.66 A (c) 12.25A (d) none of these.

(iv) In a parallel RLC circuit, the currents through the capacitor and the inductor are equal. What is the power factor of the circuit?
(a) lagging (b) leading (c) unity (d) 0.5.

(v) The property of an electrical circuit that dissipates electric energy is callad
(a) resistance (b) reactance (c) conductance (d) inductance.

(vi) For a network with b branches and n nodes, the number of twigs for a selected tree and the number of links with respect to this tree are
(a) (n+1) and (b-1) (b) (n-1) and (b-n+1)
(c) n and b (d) (1/n) and (b+1).

(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) A current dependent current source is realized using a/an
(a) inductor (b) bipolar junction transistor
(c) field effect transistor (d) diode.

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

Group - B

2. (a) Show that the resonating frequency of a series RLC circuit is independent of resistance(R).

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

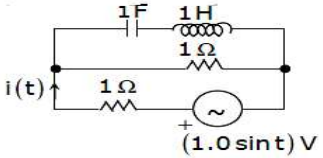

Fig. 1

6 + 6= 12

3. (a) Derive an expression of the bandwidth (BW) of a series resonant circuit in terms of R, L and C showing the current frequency curve for the series RLC circuit.

(b) Derive an expression of the quality factor (Q_0) of a series resonant circuit in terms of R, L and C. Express quality factor in terms of BW.

(5 + 1) + (5 + 1) = 12

Group - C

4. (a) Find the steady state values of the following functions.

(a) $F(s)=\frac{(s+1)}{s(s+1)}$ (b) $G(s)=\frac{e^{-st}}{s(s+1)}$.

(b) A current i(t) flows through the circuit of Fig. 2, when the switch is closed at t=0 sec. Find the expressions of (a) current i (t), and (b) rate of change of current (di(t)/dt) for t>0.

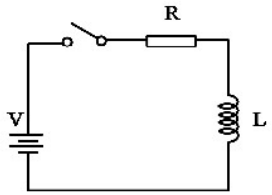

Fig.2

(3 + 3) + (4 + 2) = 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 (iv) unit parabola.

(6 + 2) + 4 = 12

Group - D

6. (a) Derive z-parameters of the network shown in the Fig. 3.

where, Z1= (4+j3)Ω, and Z2= (3-j3)Ω. Is the network symmetrical and reciprocal?

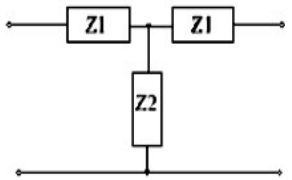

Fig. 3

(b) Find the current through the resistor R in the circuit shown in Fig. 4.

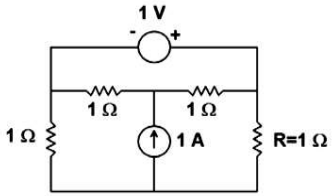

Fig. 4

(4 + 1 + 1) + 6 = 12

7. (a) Consider the electrical circuit shown in the Fig. 5. Obtain the incidence and tie-set matrices.

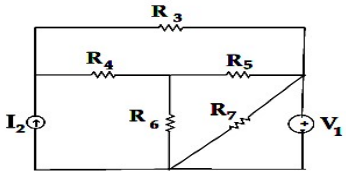

Fig. 5.

(b) What is a reduced incidence matrix? How does one find the number of possible trees using a reduced incidence matrix? Explain with an example.

(4 + 4) + 4 = 12