B.Tech/ECE/EE/3rd Sem/ELEC-2102/2015

2015

CIRCUIT THEORY

(ELEC 2102)

Time Alloted : 3 Hours   *Full Marks : 70*

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and <u>any 5 (five)</u>
from Group B to E, taking <u>at least one</u> 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 alternatives for the following :   [10×1=10]

   i)   Laplace transform of delayed unit impulse function
        $\delta(t - 1)$ is
        (a) 1   (b) e^{-s}
        (c) 0   (d) s

   ii) When two inductive coils having self-inductance L_1, L_2 and
        mutual inductance M in between them are connected in
        series aiding , the equivalent inductance across the series
        combination will be
        (a) $L_1 + L_2 + 2M$ (b) $L_1 + L_2 - 2M$
        (c) $L_1 + L_2 + M$ (d) $L_1 + L_2 - M$

   iii) If a graph has n number of nodes and b number of
        branches then the number of links of the graph is equal
        to
        (a) n – 1   (b) b – 1
        (c) b – n + 1   (d) b + n – 1

   iv) '.TRAN' statement in SPICE is used to study the network
        in
        (a) frequency domain   (b) time domain
        (c) both frequency and time domain
        (d) none of these

   v)   Transient current in an RLC circuit is oscillatory when
        (a) $R = 2\sqrt{\dfrac{L}{c}}$ (b) $R > 2\sqrt{\dfrac{L}{c}}$
        (c) $R < 2\sqrt{\dfrac{L}{c}}$ (d) $R = 0$

   vi) The initial value of f(t) with Laplace transform
        $F(s) = \dfrac{(s+1)}{(s+2)(s+3)}$ is
        (a) non-existent   (b) ∞
        (c) 0   (d) 1

   vii) The cut-set matrix gives the relation between
        (a) branch voltages and branch currents
        (b) branch voltages and twig branch voltages
        (c) branch voltages and link currents
        (d) link voltages and link currents

viii) The condition of reciprocity for h-parameters is

(a) $h_{11} = h_{22}$

(b) $h_{12} = -h_{21}$

(c) $h_{12}h_{21} = h_{11}h_{22}$

(d) $h_{12} = h_{21}$

ix) The dc gain of a system having transfer function

$$H(s) = \frac{12}{(s+1)(s+2)} \text{ is}$$

(a) 12

(b) 6

(c) 3

(d) 2

x) KVL is related to

(a) conservation of charge

(b) conservation of energy

(c) both of the above

(d) none of these

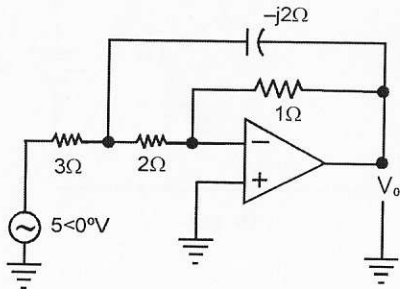## GROUP - B

2. (a) In the Op-Amp circuit shown in (fig.2a), find V_0 using nodal analysis. 6

Fig. 2a

(b) In the circuit (fig.2b), find Norton's equivalent circuit looking from terminal x–y. Assume K = – 0.15

Fig. 2b

6
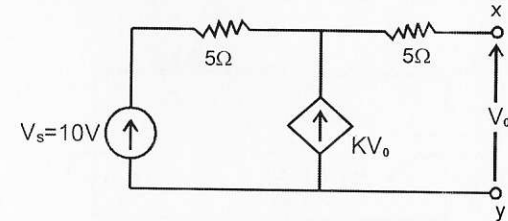
3. (a) What will be the value of Z_L for the circuit shown in (Fig. 3a) to have maximum power transfer from source to load.
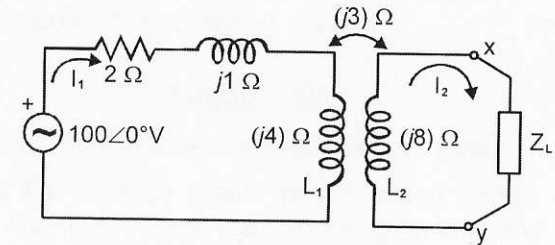

Fig. 3a

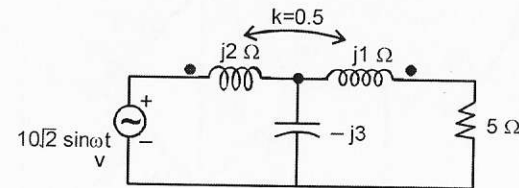(b) Calculate the mesh currents for the circuit of (Fig.3b).Also calculate power delivered by the source.

Fig. 3b

6+6=12

GROUP - C

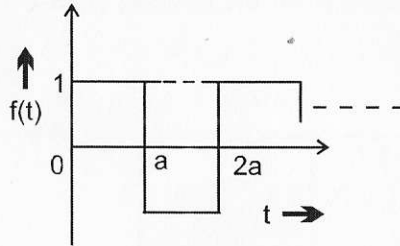4. (a) Find Laplace transform of the following periodic waveform shown in (Fig.4a)

Fig. 4a

(b) A 10 volts steps voltage is applied across a RC series circuit at t = 0. Find i(t) at t = 0+ and obtain the value of $\frac{di}{dt}$ at t = 0+. Assume R = 100Ω, C =100μF.

(c) In the circuit shown in (Fig.4c) switch 'S' is moved from position 1 to position 2 at t = 0. Find i(t). Assume that switch 'S' was in position 1 for long time.
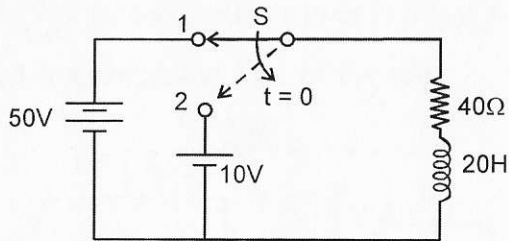

Fig. 4c

4+4+4=12

5. (a) In the circuit shown in (Fig.5a), switch 'S' is in position I for a long time and moved to position 2 at t = 0. Find the voltage across the capacitor V_c(t) for t > 0.
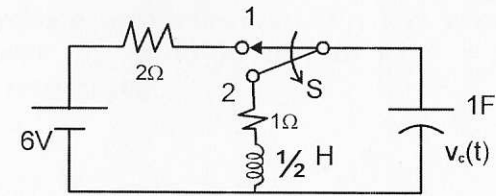

Fig. 5a

(b) A capacitor of 5μF being charged initially to 10V is connected to a resistance of 10kΩ and is allowed to discharge through it by switching off a switch. Find the expression of discharging current.   **7+5 = 12**

Group - D

6. (a) What is tree? State the properties of tree.

(b) Draw the directed graph for the circuit shown in (Fig. 6b). Compute Complete Incidence matrix and Tie-set matrix. Assume the sub-graph shown in figure below as a tree. Find mesh equilibrium equations for the the circuit using graph theory.
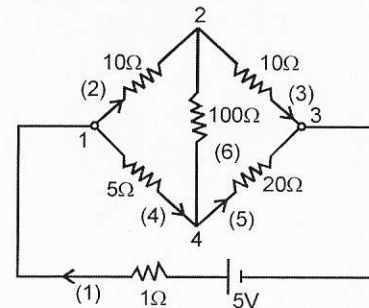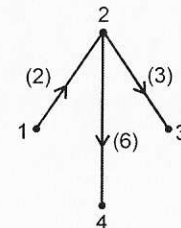

Fig. 6b

3+(1+4+4) = 12

7. (a) Define Z parameters. Derive the relationship between Z parameters and Y parameters.

(b) Prove that a two-port network is reciprocal if AD−BC=1

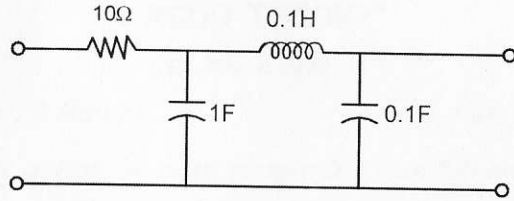(c) Determine ABCD parameters for the network shown in (Fig.7c).

Fig. 7c

$3+3+6 = 12$

GROUP - E

8. (a) Draw and explain the gain vs. frequency characteristics of band pass and band reject filters.

(b) Find $\dfrac{V_0(s)}{V_i(s)}$ for the circuits shown in (Fig.8b). Determine cut off frequency and type of the filter.
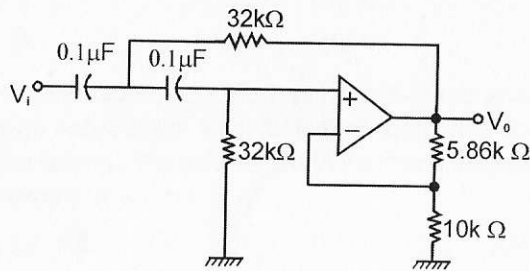

Fig. 8b

$4+(6+1+1) = 12$

9. (a) Explain '.OP', '.TF','.AC' and '.PLOT' statements in SPICE.

(b) A series R-L-C circuit with L=1H and C=1F is excited with a 10V, DC source. Write a SPICE program to plot the voltage across inductor (V_L) and voltage across capacitor (V_c) up to 10 seconds for R = 1Ω,2Ω and 10Ω respectively.

$6+6 = 12$