Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH (OLD)/CSE/IT/ECE/EE/ICE/BME/
PWE/EEE/SEM-3/EE-301/2012-13

2012

CIRCUIT THEORY AND NETWORKS

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words

as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1.   Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

   i)   If the voltage across a given capacitor is increased, the amount of stored charge

   a)   increases   b)   decreases

   c)   remains constant   d)   is exactly doubled.

   ii) When the frequency of applied voltage in a series RL circuit is increased what happens to the inductive reactance ?

   a)   Decreases   b)   Remains the same

   c)   Increases   d)   Becomes zero.

   iii) Mesh analysis is based on

   a)   Kirchhoff's current law

   b)   Kirchhoff's voltage law

   c)   both (a) and (b)

   d)   none of these.

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iv) Three equal resistances of 3 Ω are connected in star. What is the resistance in one of the arms in an equivalent delta circuit ?

a)   10 Ω   b)   3 Ω

c)   9 Ω   d)   27 Ω.

v) Superposition theorem is valid only for

a)   linear circuits   b)   non-linear circuits

c)   both (a) and (b)   d)   none of these.

vi) Maximum power transfer occurs at a

a)   100% efficiency   b)   50% efficiency

c)   25% efficiency   d)   75% efficiency.

vii) Which of the following theorems is a manifestation of the law of Conservation of Energy ?

a)   Tellegen's theorem   b)   Thevenin's theorem

c)   Norton's theorem   d)   Reciprocity theorem.

viii) The number of branches in a tree is .... the numbers of branches in a graph.

a)   less than

b)   more than

c)   equal to.

ix) An RLC series circuit has $R = 1$ Ω, $L = 1H$ and $C = 1F$. Damping ratio of the circuit will be

a)   more than unity   b)   unity

c)   0·5   d)   0.

x) A ramp function

a)   has Fourier transform but not Laplace transform

b)   has Laplace transform but not Fourier transform

c)   have both Laplace transform and Fourier transform

d)   none of these.

xi) The condition of reciprocity of a two-port network having different parameters are

      I. $h_{12} = -h_{21}$

      II. $Z_{12} = Z_{21}$

      III. $A = D$.

Choose the correct combination(s) :

a) I & II   b) I & III

c) II & III   d) I, II & III.

xii) An ideal filter should have

a) zero attenuation in the pass band

b) infinite attenuation in the pass band

c) zero attenuation in the attenuation bond.

xiii) The Laplace transform of the signal described in the following figure is

a) e^{-as}/s b) e^{-bs}/s^2

c) $(e^{-as} + e^{-bs})/s$ d) $(e^{-as} - e^{-bs})/s$.

xiv) A 1μF capacitor is connected across a 4V battery. The steady state current will be

a) 4×10^{-6} A   b) $10^6/4$ A

c) zero   d) 4 A.

xv) A periodic function $f(t)$ of time period T repeats itself after $T/2$. The Fourier series of $f(t)$ will possess only

a) sine terms   b) cosine terms

c) even harmonics   d) odd harmonics.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. For the network shown in the figure, calculate the current in the branch *AB* using superposition theorem.
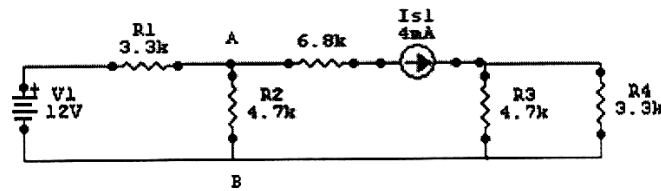
3. Find the inverse Laplace Transform of the function

$$F(s) = \frac{(s+2)^2}{(s+1)(s^2 + 4)}$$

4. What is an active filter ? Give the advantages and disadvantages of an active filter over a passive filter.

5. Define incidence matrix. The reduced incidence matrix of an oriented graph is $[A] = \begin{bmatrix} 0 & -1 & 1 & 1 & 0 \\ 0 & 0 & -1 & -1 & -1 \\ -1 & 0 & 0 & 0 & 1 \end{bmatrix}$. Draw the graph.

6. Find the *y*-parameters of the resistive network of the figure shown below.
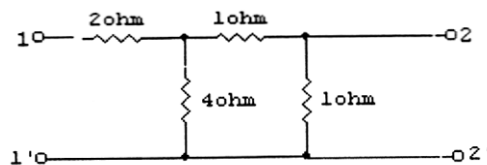
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Using source transformation and simplification, determine the voltage between the points *P* & *Q* shown in figure.
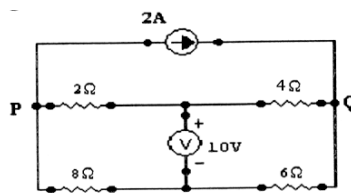
b) Find the voltage across the resistor R = 2 Ω in given figure.
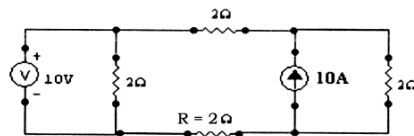
c) Find the current through the 5Ω resistor in given figure, using mesh analysis.
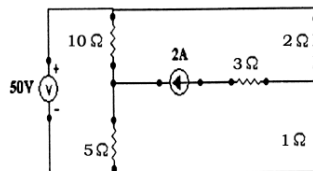
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8. a) The circuit shown in figures below is initially in the steady state with the switch *S* open. At *t* = 0, the switch *S* is closed. Obtain the current in the inductor for *t* > 0.
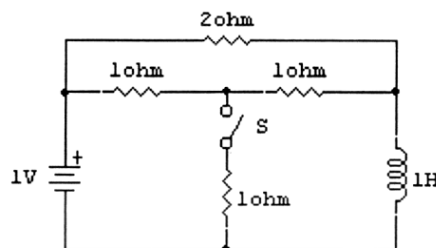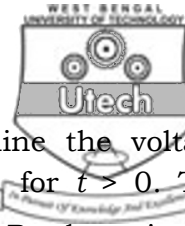
b) In the circuit of figure below, determine the voltage $V(t)$ and the circuit $i_R(t)$ and $i_L(t)$ for $t > 0$. The circulating current at $t = 0$ in the R_L loop is 1A clockwise.
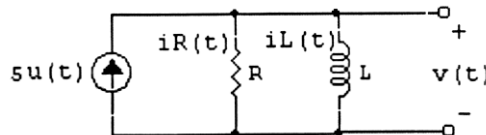

c) Show that the Laplace Transform of a periodic function $f(t)$ of period T is $F(s) = [1/(1 - e^{-sT})] F_1(s)$, where $F_1(s)$ is the Laplace Transform of $f(t)$ if it existed from $t = 0$ to $t = T$. Determine the Laplace Transform of the following waveforms $f(t)$ of figure shown below.
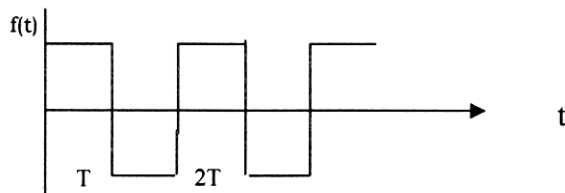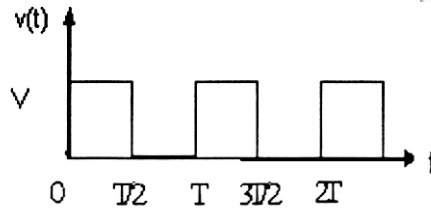

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9. a) Draw the circuit diagram of a first order low pass active filter and find out the expression of the cut-off frequency.

b) The circuit shown in figure below is a second order low pass filter. Analyze the circuit and find out the cut-off frequency.
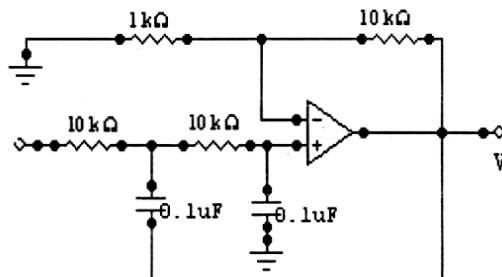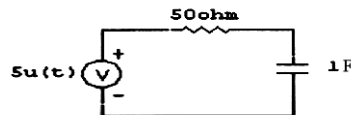
c) Find the Fourier series for the train of pulses shown in figure shown below.
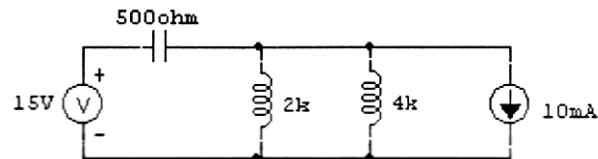

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10. a) Write the input file in SPICE to plot the capacitor voltage and capacitor current (initial voltage for the capacitor is 1 volt) in the circuit given in the figure.

b) Write SPICE input file for the circuit shown in the figure below.

c) Write advantages and disadvantages of *P*-Spice.

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