

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.TECH(OLD)/CSE,IT,ECE,EE,EEE,ICE,BME**

**PWE/SEM-3/EE-301/2011-12**

**2011**

**CIRCUIT THEORY AND NETWORKS**

Time Allotted : 3 Hours

Full Marks : 70

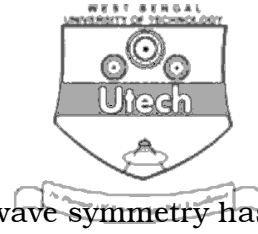
*The figures in the margin indicate full marks.*

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

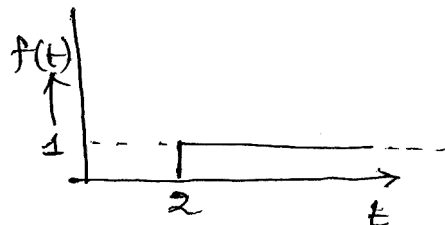
**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :  $10 \times 1 = 10$ 
  - i) When a number of two-port networks are connected in cascade, the individual
    - a) open circuit impedance parameters are added
    - b) short circuit admittance parameters are added
    - c) transmission parameters are multiplied
    - d) hybrid parameters are multiplied.
  - ii) A ramp function is given by
    - a)  $f(t) = t^2$
    - b)  $f(t) = t^{\frac{1}{2}}$
    - c)  $f(t) = t$
    - d)  $f(t) = t^n$
  - iii)  $\sqrt{L/C}$  has the unit of
    - a) sec
    - b) Hz
    - c) ampere
    - d) ohm.

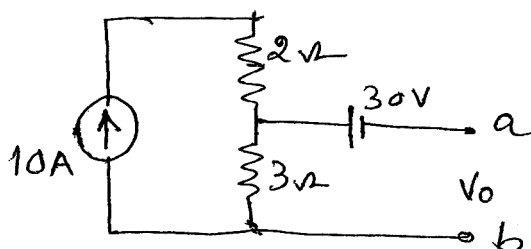


- iv) A periodic waveform possessing half-wave symmetry has no
- a) odd harmonics                      b) even harmonics
- c) cosine terms                      d) sine terms.
- v) Unit step function is first derivative of
- a) ramp function                      b) impulse function
- c) gate function                      d) parabolic function.
- vi) The number of links of a graph having ' $n$ ' nodes and ' $b$ ' elements is
- a)  $b - n + 1$                       b)  $n - b + 1$
- c)  $b + n - 1$                       d)  $b + n$ .
- vii) The function  $f(t)$  in fig. below is
- a)  $u(t)$                       b)  $u(t - 2)$
- c)  $u(2 - t)$                       d)  $u(2t)$ .

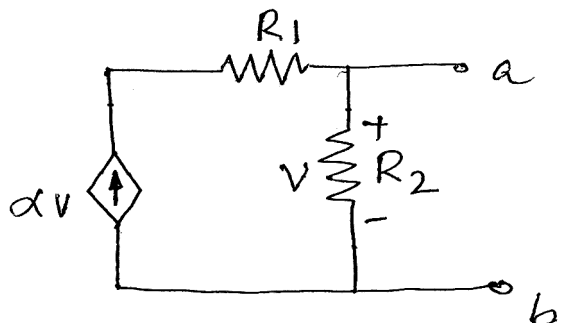




- viii) Voltage  $V_0$  between terminals  $a - b$  in the circuit of fig. below is



- a) 60 V                      b) 0 V  
c) 50 V                      d) 30 V.
- ix) The impedance measured between terminals  $a - b$  in the network of fig. below is



- a)  $\frac{R_2}{1-\alpha R_2}$                       b)  $\frac{R_1 R_2}{R_1 + R_2}$   
c)  $\frac{R_1 R_2 \alpha}{R_2 + R_1 \alpha}$                       d)  $R_2$ .
- x) Maximum power transfer occurs when
- a) Source Impedance is equal to Load Impedance  
b) Source Impedance is less than Load Impedance  
c) Load Impedance is equal to complex conjugate of Source Impedance  
d) Load Impedance is less than Source Impedance.



- xi) The network of fig. (A) may be represented by an equivalent current source as shown in Fig. (B), where the value of 'I' is

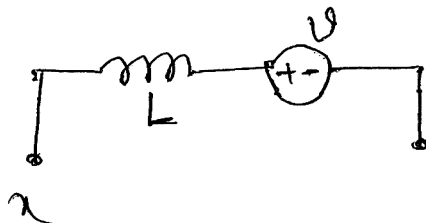


fig. (A)

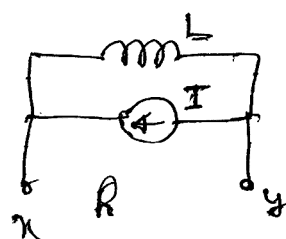


fig. (B)

- a)  $\frac{1}{L} \int v dt$                       b)  $\frac{1}{L} \frac{dv}{dt}$   
 c)  $\frac{v}{L}$                                   d)  $L \frac{dv}{dt}$
- xii) The transient current in a loss-free LC circuit when excited from a constant voltage dc source is
- a) an overdamped sine wave  
 b) an underdamped sine wave  
 c) an undamped sine wave  
 d) a critically damped sine wave.

### GROUP – B

#### ( Short Answer Type Questions )

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

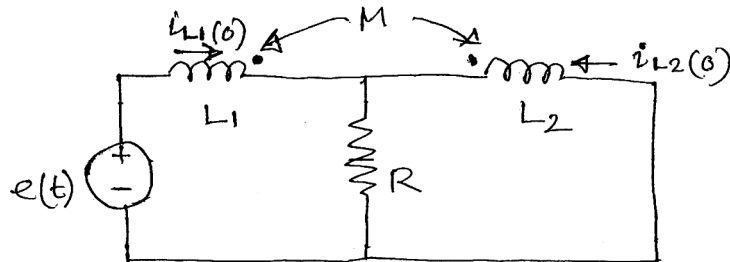
2. Draw the oriented graph of the network whose reduced nodal incidence matrix is given below :

$$A = \begin{bmatrix} 1 & 0 & 0 & -1 & 0 & 0 & -1 \\ -1 & 1 & 0 & 0 & 1 & -1 & 0 \\ 0 & -1 & 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

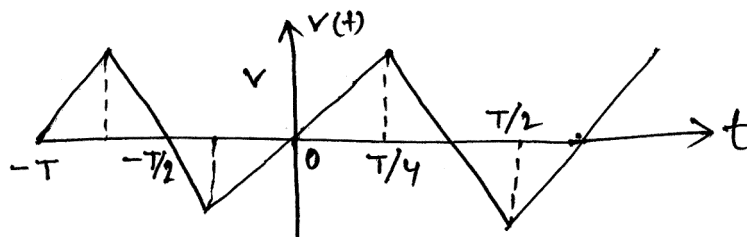
Also, choose a Tree of the graph.



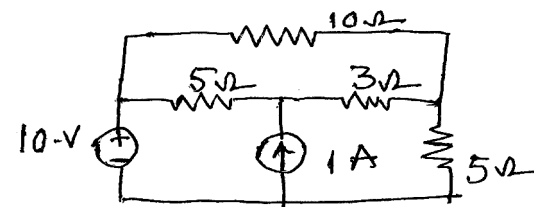
3. Draw the transformed equivalent of the network of fig. below:



4. For a reciprocal and symmetrical two-port network, the open circuit impedance parameters are  $Z_{11} = 5\Omega$  and  $Z_{12} = 0.1\Omega$ . Determine the hybrid parameters of the network.
5. Find the Fourier series expression of the triangular wave shown below.



6. Obtain a single source equivalent of the network of fig. below using source transformation technique :



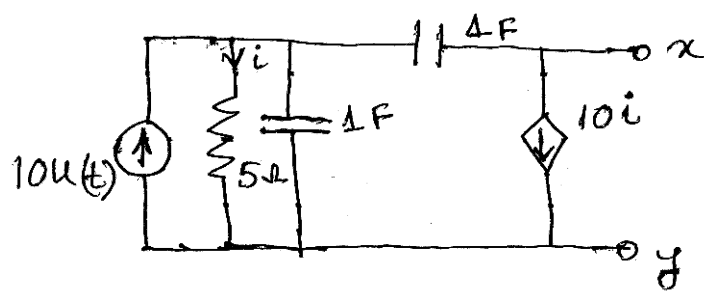


**GROUP – C**

**( Long Answer Type Questions )**

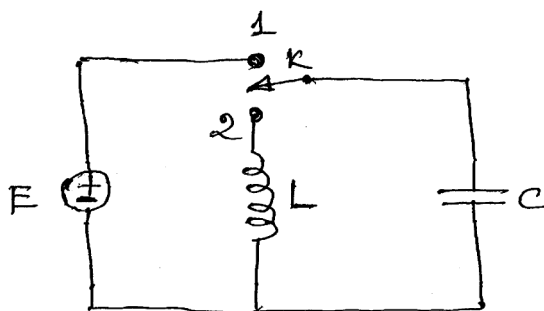
Answer any *three* of the following.  $3 \times 15 = 45$

7. a) State and explain Norton's theorem.  
b) Obtain Norton's equivalent of the network of fig. below :



5 + 10

8. a) In the circuit shown in fig. below the switch  $k$  is at position 1 for a long time before being thrown over to contact 2 at  $t = 0$ . Obtain an expression for the potential difference across the capacitor for  $t \geq 0$ .

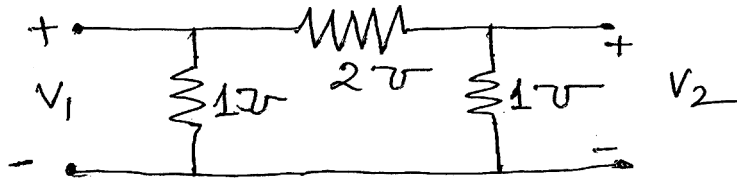


- b) A sinusoidal source of *e.m.f*  $e(t) = E_m \sin (\omega t + \phi)$  is applied to a series  $R - L$  circuit at  $t = 0$ . Obtain an expression for the transient current and show a plot for the current and voltage in the circuit.

8 + 7



9. a) Two identical sections of the two-port network shown in fig. below are connected in series at both the ports. Find the Y-parameters of the resultant two-port network.



- b) Derive conditions for (i) symmetry and (ii) reciprocity of two-port network described in terms of transmission parameters. (6 + 3) + 6
10. a) Design a low-pass filter having a cut-off frequency of 2 kHz and nominal characteristic impedance of  $5000\Omega$ .
- b) A 110V, 50Hz supply is impressed across a  $55\Omega$  resistor through a half-wave rectifier. Obtain Laplace transform of the current. 9 + 6
11. a) Define 'path', 'sub-graph' and 'co-tree' in connection with the network graph. 6
- b) For the network-graph shown in fig. (C) below, form the basic cut-set incidence matrix. 4
- c) Write the nodal equations for the network of fig. (D) below :

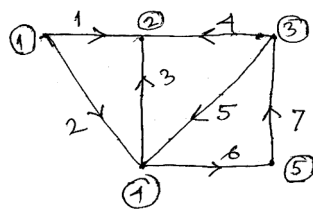


fig. (C)

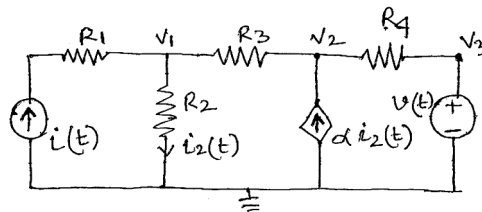


fig. (D)

6 + 4 + 5