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# 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.

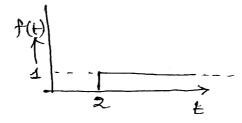
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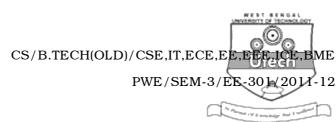
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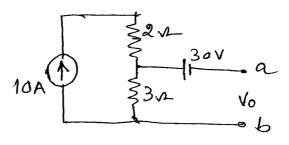
- iv) A periodic waveform possessing half-wave symmetry has no
  - a) odd harmonics
- b) even harmonics
- c) cosine terms
- d) sine terms.
- v) Unit step function is first derivative of
  - a) ramp function
- b) impulse function
- c) gate function
- d) parabolic function.
- vi) The number of links of 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* (2*t*).





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



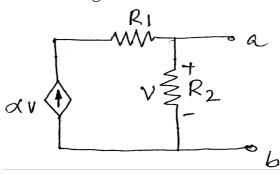
a) 60 V

b) 0 V

c) 50 V

d) 30 V.

ix) The impedance measured between terminals a - b in the network of fig. below is

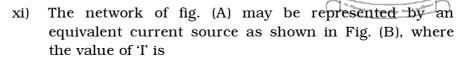


a)  $\frac{R_2}{1-\alpha R_2}$ 

- 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.

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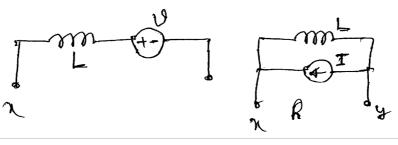


fig. (A) fig. (B)

a) 
$$\frac{1}{L} \int v dt$$

b) 
$$\frac{1}{L}\frac{\mathrm{d}v}{\mathrm{d}t}$$

c) 
$$\frac{v}{I}$$

d) 
$$L\frac{\mathrm{d}v}{\mathrm{d}t}$$
.

- 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 cirtically damped sine wave.

### **GROUP - B**

#### (Short Answer Type Questions)

Answer any three of the following.

$$3 \times 5 = 15$$

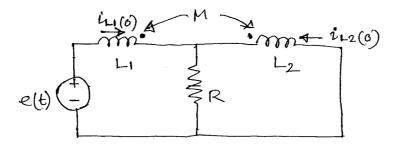
2. Draw the oriented graph of the network whose reduced nodal incidence matrix is given below:

$$A = \left[ \begin{array}{cccccccc} 1 & 0 & 0 & -1 & 0 & 0 & -1 \\ -1 & 1 & 0 & 0 & 1 & -1 & 0 \\ 0 & -1 & 1 & 0 & 0 & 0 & 1 \end{array} \right]$$

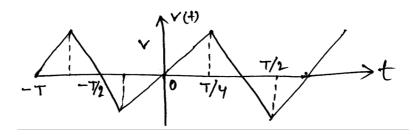
Also, choose a Tree of the graph.



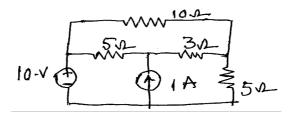
3. Draw the transformed equivalent of the network of fig. below:



- 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 :



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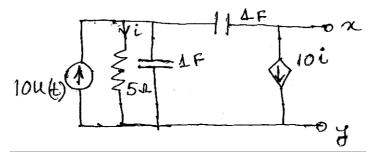


#### **GROUP - C**

#### (Long Answer Type Questions)

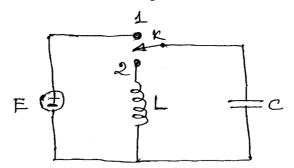
Answer any *three* of the following.  $3 \times 15 = 45$ 

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



5 + 10

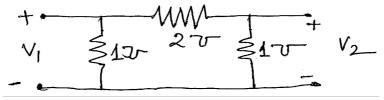
8. a) In the circuit shown in fig. below the switch k is at position 1 for a long time before being thrown over to contact 2 at t = 0. Obtain an expression for the potential difference across the capacitor for  $t \ge 0$ .



b) A sinusoidal source of *e.m.f*  $e(t) = E_{\rm m} \sin (\omega t + \phi)$  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.
  - b) For the network-graph shown in fig. (C) below, form the basic cut-set incidence matrix.
  - c) Write the nodal equations for the network of fig. (D) below:

