*Name* : .....

*Roll No.* : .....

*Invigilator's Signature* : .....

**CS/B.Tech(ECE,EE,EEE,IC,BME,PWE,CSE,IT)/SEM-3/EE-301/2009-10**

# 2009

# CIRCUIT THEORY & 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) Laplace transform analysis gives

      a) time domain response only

      b) frequency domain response only

      c) both (a) & (b)

      d) real response only.

   ii) If a function is shifted by '$T$', then it is correctly represented as

      a) $f(t-T)\,u(t)$

      b) $f(t-T)\,u(t-T)$

      c) $f(t)\,u(t-T)$

      d) $(t-T)f(t-T)$.

iii) The equivalent resistance between $x$ & $y$ of the figure shown below is

Dia.

a) 30Ω b) 50Ω
c) 60Ω d) 10Ω.

iv) If $f(t)$ is an even function, then its Fourier transform $F(jw)$ is given by

a) $2\int_0^{\infty} f(t)\cos wt\, dt$

b) $\int_0^{\infty} f(t)\cos wt\, dt$

c) $2\int_0^{\infty} f(t)\sin wt\, dt$

d) $\int_0^{\infty} f(t)\sin wt\, dt$.

v) The Thevenin's equivalent resistance of the given circuit with respect to the terminals $A$ & $B$ is equal to

Dia.

a) 2·66Ω b) 3·2Ω
c) 8Ω d) 12Ω.

vi) The value of the unity impulse function $\delta(t)$ at $t = 0$ is

a) 0 b) •

c) 1 d) indeterminate.

vii) The number of links for a graph having '$n$' nodes & '$b$' branches are

a) $b - n + 1$ b) $n - b + 1$

c) $b + n - 1$ d) $b + n$.

viii) The $h$ parameters $h_{11}$ & $h_{12}$ are obtained by

a) shorting output terminals

b) opening input terminals

c) shorting input terminals

d) opening output terminals.

ix) The convolution of $f(t) * g(t)$ is

a) $\int_0^{\bullet} f(t)\, g(t-\tau)\, d\tau$

b) $\int_0^{t} f(\tau)\, g(t-\tau)\, d\tau$

c) $\int_0^{t} f(t-\tau)\, g(t)\, dt$

d) $\int_0^{t} f(t)\, g(t-\tau)\, dt$ .

x) A ramp voltage $V(t)$ = 100 V is applied to an RC series circuit with $R$ = 5 kΩ & $C$ = 4 μF. The maximum output voltage across capacitor is

a) 0·2 volt b) 2·0 volt

c) 10·0 volt d) 50·0 volt.

xi) The voltage across the dependent source of the circuit shown is

Dia.

a) $8 \angle 0^\circ$ b) $4 \angle 0^\circ$

c) $4 \angle 90^\circ$ d) $8 \angle -90^\circ$.

xii) Relative to a given fixed tree of a network

a) link currents form an independent set

b) branch currents form an independent set

c) branch voltages form an independent set

d) both (a) & (c).

## GROUP – B

### ( Short Answer Type Questions )

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

2. In the circuit shown, determine the current $i(t)$ when the switch is changed from position 1 to 2. The switch is moved from position 1 to 2 at time $t$ = 0.

Dia.

3. For the circuit shown is the figure, find the current in the 2Ω resistor by using Thevenin's theorem.

Dia.

4. Draw the graph corresponding to the given incidence matrix :

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

5. Determine the cut off frequency for the high pass filter shown below.

dia.

6. Find the *Z*-parameters of the network given below :

Dia.

## GROUP – C

### ( Long Answer Type Questions )

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

7. a) Explain with example, odd symmetry & even symmetry of periodic waveforms.

   b) Determine the Fourier series for the saw tooth waveform shown below

Dia.

   c) Applying Fourier transforms determine the output voltage across the capacitor if the excitation is a current source of $i(t) = e^{-t}\ u(t)$.

Dia.

8. a) The hybrid parameters of a two-port network shown in figure are $h_{11}$ = 1 kΩ, $h_{12}$ = 0·003, $h_{21}$ = 100, $h_{22}$ = 50 μ℧ . Find $V_2$ & $Z$ parameters of the network.

Dia.

   b) What are *ABCD* parameters ? Prove that AD – BC = 1.

10 + 5

9. a) For the circuit shown, determine the load current $I_2$ using Norton's theorem.

Dia.

b) Convert the active network shown in figure to a single voltage source in series with impedance.

Dia.

7 + 8

10. a) Draw the circuit diagram of a first order high pass filter and find out the expression of the cut-off frequency. 5

b) Draw and explain the characteristics of ideal band-pass & band-stop filter. 5

c) The circuit shown in figure is a second order low-pass filter. Analyze the circuit and find out the cut-off frequency. 5

Dia.

11. a) Find the Laplace transform of the periodic waveform shown in figure.

Dia.

b) Define convolution theorem.

c) Find $h^{-1}\{F_1(s)\ F_2(s)\}$ by using the convolution of the following functions :

$$F_1(s) = \frac{1}{s+1} \ \& \ F_2(s) = \frac{1}{s+2} \ .$$ 8 + 2 + 5