Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (EIE-N)/SEM-3/EE(EI)-301/2011-12

2011
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) A circuit has 5 branches, 4 nodes and no separate parts. The number of independent mesh equations is

a) 1 b) 2

c) 3 d) 5.

ii) A notch filter is basically a

a) low-pass filter b) high-pass filter

c) band-pass filter d) band-reject filter.

iii) A capacitor C at time $t = 0+$ with zero initial charge acts as a

a) short circuit b) open circuit

c) current source d) voltage source.

iv) It is given that $z_1 = (2 + j\,3)$ and $z_2 = (6 + j\,3)$ ohm. Then $|z_1 + z_2|$ is

a) 10 Ω b) 14 Ω

c) 11 Ω d) none of these.

v) The Laplace transform of a delayed unit impulse function δ (T – 2) is

a) 1 b) 0

c) e^{-2s} d) s.

vi) If $f(t)$ and its first derivative are Laplace transformable, then final value theorem is

a) $\underset{t\to\infty}{Lt}\ f(t) = \underset{s\to 0}{Lt}\ f(s)$ b) $\underset{t\to\infty}{Lt}\ f(t) = \underset{s\to\infty}{Lt}\ f(s)$

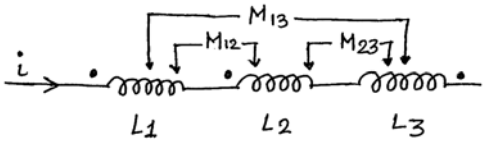
c) $\underset{s\to 0}{Lt}\ f(t) = \underset{s\to\infty}{Lt}\ sf(s)$ d) none of these.

vii) A periodic waveform possessing half-wave symmetry has no

a) odd harmonics b) even harmonics

c) cosine terms d) sine terms.

viii) Find the total inductance of the three series connected coupled coils :



L_1 = 1H, L_2 = 2H, L_3 = 5H

M_{12} = 0·5H, M_{13} = 1H

M_{23} = 1H

a) 5 H b) 8 H

c) 13 H d) none of these.

ix) The inverse Laplace transform of $s/(s^2 + a^2)$ is

a) e^{-at} b) e^{at}

c) cos at d) sin at.

x) An RC series circuit has a time constant given by

a) R/C b) C/R

c) $1/(RC)$ d) RC.

xi) For maximum power to be transferred between the load and the source the condition is

a) $R_S > R_L$ b) $R_S = R_L$

c) $R_S < R_L$ d) none of these.

xii) An ideal filter should have

a) zero attenuation in the pass band

b) zero attenuation in the stop band

c) infinite attenuation in the pass band

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

$3 \times 5 = 15$

2. Find the solution of the following differential equation, using Laplace transformation :

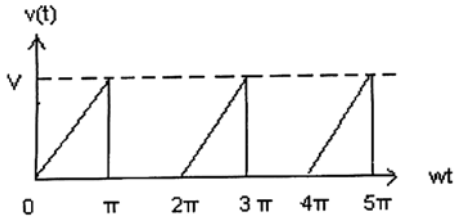
$$x'' + 3x' + 2x = 0 ;$$

where $x'' = d^2 x(t) / dt^2$, $x' = d\,x(t)/dt$ and

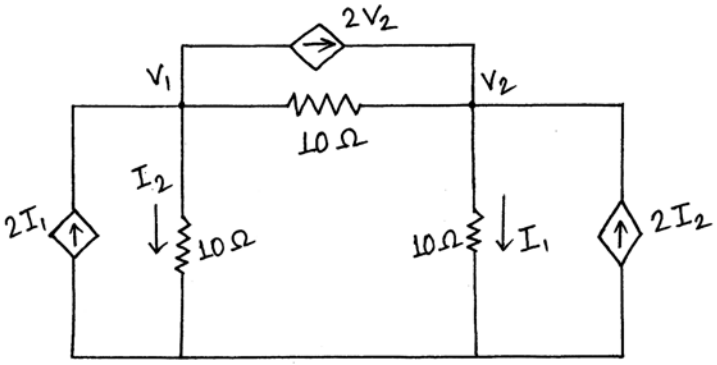
$x'(0) = 4$, $x(0) = 0$

3. State and explain superposition theorem with a suitable example.

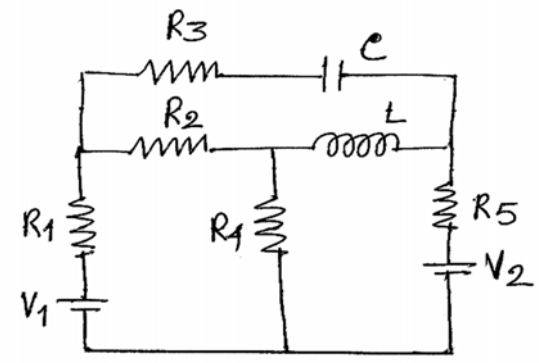
4. Find the trigonometric Fourier series for the waveform shown in the following figure and sketch the spectra :



5. Find the voltages V_1 and V_2 at the node.



6. Draw a connected, planar graph for the circuit given below. Obtain the reduced incidence matrix for the graph. 3 + 2



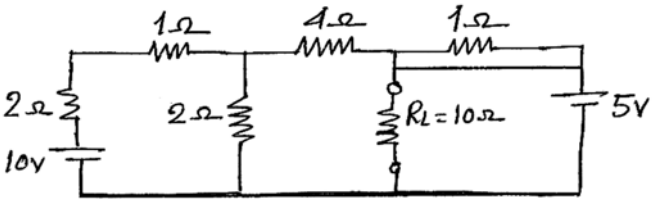
GROUP – C

(Long Answer Type Questions)

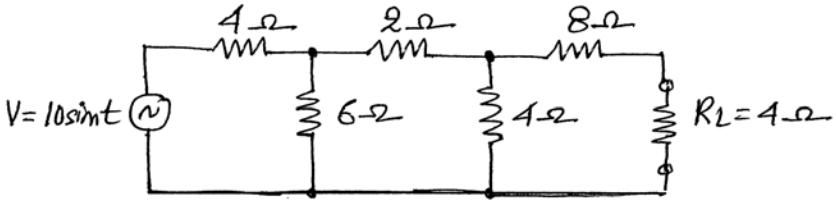
Answer any *three* of the following. 3 × 15 = 45

7. a) State Thevenin's theorem. 2

b) Use Thevenin's theorem to determine the load current in the circuit given below : 7



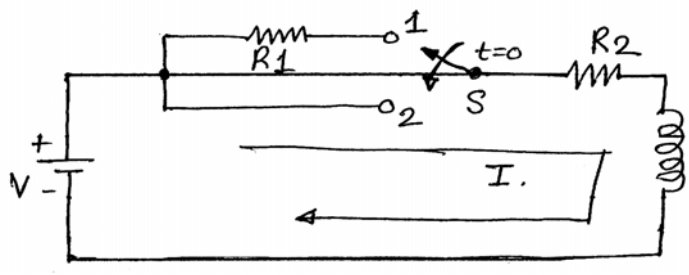
c) Find the maximum power delivered to the load in the circuit given below : 6



8. 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 and band-stop filters. 5

c) In the circuit shown below, the switch 'S' is thrown to position 1 for a long period of time. Find the complete expression for the current 'I' after throwing the switch 'S' to position 2 which removes R_1 from the circuit. 5



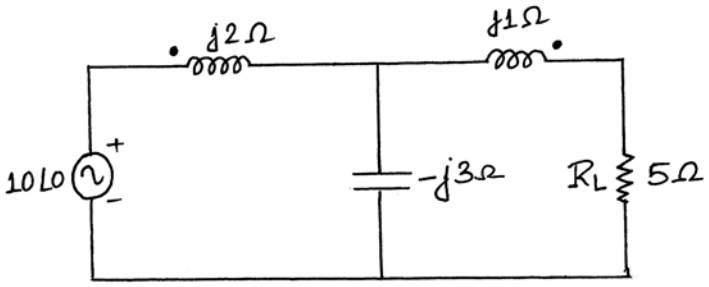
9. a) Consider two coupled coils with flux value as ϕ_{11} = 0·5 mWb, ϕ_{12} = 0·3 mWb. The number of turns in the first and second coils are 100 and 500 respectively. Find,

i) coefficient of coupling (K)

ii) inductances L_1 and L_2

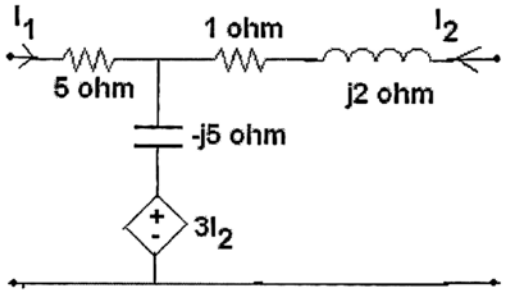
iii) mutual inductance (M) 1 + 2 + 1

b) Find the voltage drop across RL. (Coefficient of coupling, K = 0·5) 9



c) Give two examples each for linear and non-linear circuit elements. 2

10. a) Find the Z-parameters and ABCD parameters of the circuit given below : 8



b) Express *h*-parameters in terms of Y-parameters of a two-port network. 4

c) What is the cascade connection between two 2-port networks ? Explain with diagram. 3

11. a) Explain two-wattmeter method for three phase power measurement. 5

b) A balanced star-connected load with impedances of 20 $\angle$-30° ohms is supplied from 3 phase, 4 wire, 170/100 volt system, the voltages to neutral being V_{AN} = 100 $\angle$150°, V_{BN} = 100 $\angle$30°, V_{CN} = 100 $\angle$270° volts. Determine the currents in the line conductors and the current in the neutral. Draw the relevant circuit and phasor diagrams. 10