Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (EE-N)/EEE(N)/PWE(N)/ICE(N)/SEM-3/EE-301/2011-12

2011
ELECTRIC CIRCUIT THEORY

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)

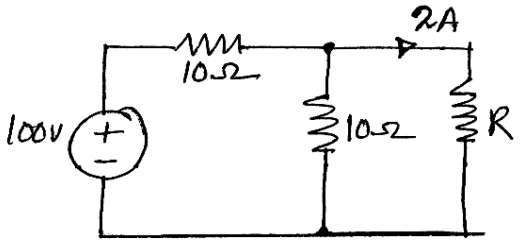
1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) The internal impedance of an ideal current source is

a) zero b) infinite

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

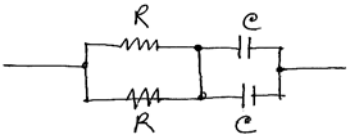
ii) In the figure given below, the value of the resistance R in ohm is



a) 10 b) 20

c) 30 d) 40.

iii) Time constant of the network shown below is



a) CR b) 2 CR

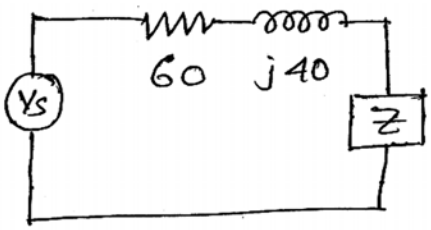
c) CR/4 d) CR/2.

iv) For a series RC circuit, when subjected to a unit step input voltage, the voltage across the capacitor will be

a) $1 - e^{-t/RC}$ b) $e^{-t/RC}$

c) $e^{t/RC}$ d) 1.

v) In the figure given below, value of load Z which maximizes the power delivered to it is



a) $60 + j40$ b) $60 - j40$

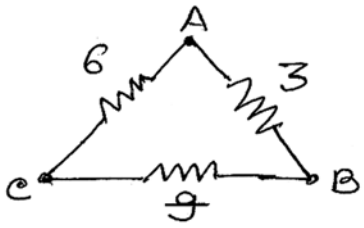
c) 60 d) none of these.

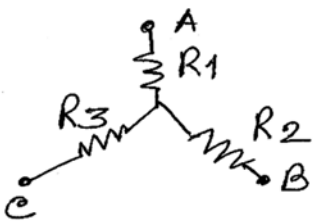
vi) If the unit step response of a network is $(1 - e^{-\alpha t})$, the unit impulse response will be

a) $\alpha . e^{-\alpha t}$ b) $1/(\alpha . e^{-\alpha t})$

c) $1/(\alpha . e^{-t\,\alpha})$ d) $(1 - \alpha).\ e^{t}.\ (-\alpha t)$.

vii) The resistances R_1, R_2 and R_3 are respectively





a) 1, 3/2 & 3 b) 3, 3/2 & 6

c) 9, 3 & 1 d) 2, 1 & 9.

viii) The Z–matrix of a 2-port network is given by $\begin{bmatrix} 0{\cdot}9 & 0{\cdot}2 \\ 0{\cdot}2 & 0{\cdot}6 \end{bmatrix}$

The element Y_{22} of the corresponding Y-matrix of the same network is given by

a) 1·2 b) 0·4

c) – 0·4 d) 1·8.

ix) The transfer function of an electric low pass RC network is

a) RCS/(1 + RCS) b) 1/(1 + RCS)

c) RC/(1 + RCS) d) S/(1 + RCS).

x) How many branches can be connected to a node ?

a) 1 b) 2

c) 3 d) any number.

xi) When a number of 2-port network is connected in cascade, the individual

a) Z_{oc} matrices are added

b) Y_{sc} matrices are added

c) chain matrices are multiplied

d) H matrices are multiplied.

xii) The tie-set matrix gives the relation between

a) branch currents and link currents

b) branch voltages and link currents

c) branch currents and link voltages

d) none of these.

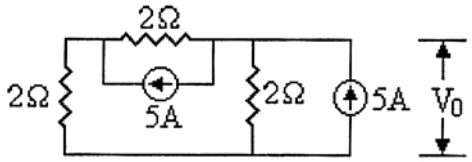
GROUP – B

(Short Answer Type Questions)

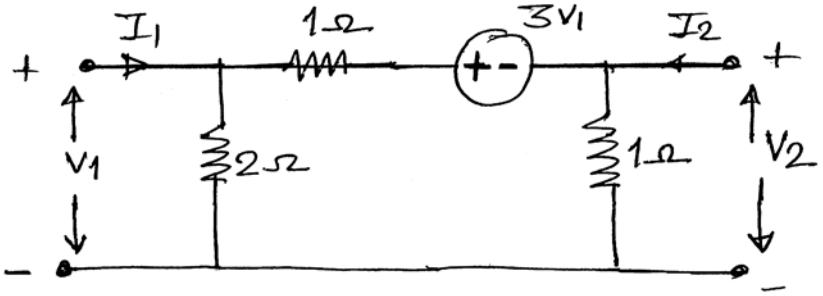
Answer any *three* of the following.

$3 \times 5 = 15$

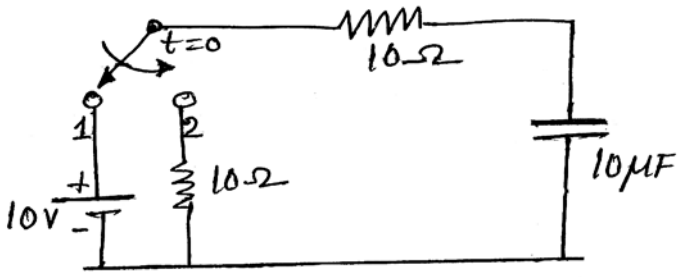
2. Convert the current sources into voltage sources (equivalent) and find the voltage v_o.



3. For the network given below determine the X-parameters.

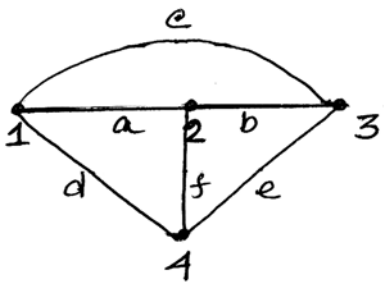


4. In the circuit given below, the switch is initially in position 1 until the steady state is reached. At t = 0, the switch is moved to position 2. Find $i(t)$, the loop current.

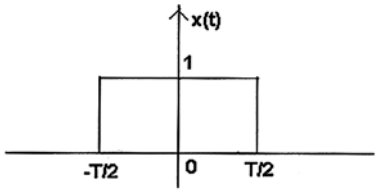


5. a) Define Incidence Matrix. 2

b) For the graph shown below find the complete incidence matrix. 3



6. Find the Fourier transform for the following gate function :

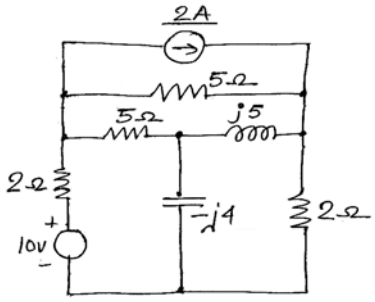


GROUP – C

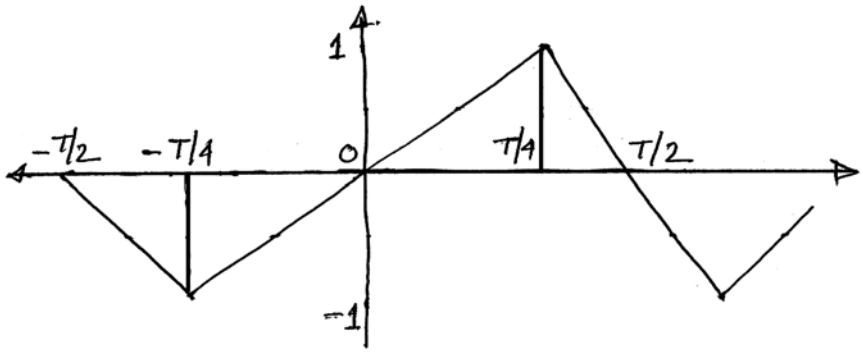
(Long Answer Type Questions)

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

7. a) Consider the network illustrated below, draw its graph, and determine :
   i) No. of links.
   ii) Rank of the graph
   iii) Total number of trees. 8



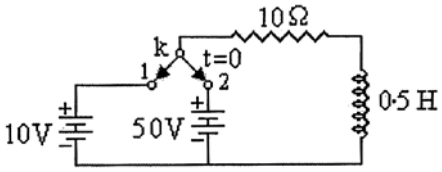
b) Determine the Fourier series expansion for the following waveform. 7



8. a) State the Final value theorem. 2

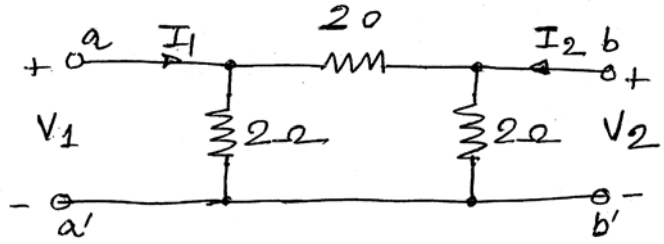
b) Find the expression for the current $i(t)$ for a series R – C circuit, if the circuit is initially relaxed. 3

c) In the circuit shown below, determine the current $i(t)$ when the switch is changed from position 1 to position 2 at $t = 0$. Find the steady state current using final value theorem. 10



9. a) Find the condition of reciprocity and symmetry for short circuit parameters of a 2-port network. 4 + 4

b) Find the transmission parameters for the circuit shown below : 7



10. a) Differentiate between the following : 4

i) Active filter and passive filter

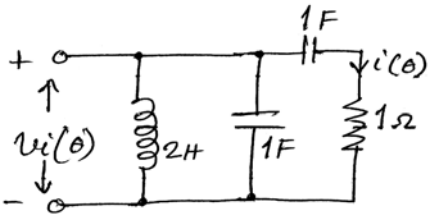
ii) High-pass filter and low-pass filter.

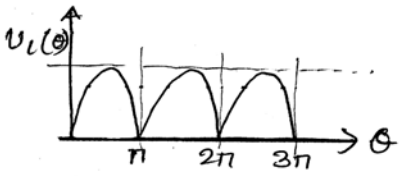
b) The response of a network to an impulse is

$h(t) = 0{\cdot}18\,(e^{-0{\cdot}3t} - e^{-2{\cdot}1t})$.

Find the response of the network to a step function using convolution theorem. 6

c) The input to the circuit shown below is a rectified sine wave as illustrated below. Determine expression of current in the 1Ω resistance. Assume W = 1 rad/sec. 5

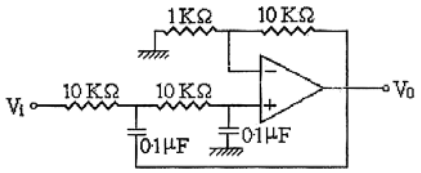




$V_i(\theta) = \sin\theta,\ 0 < \theta < \pi$

$= -\sin\theta,\ \pi < \theta < 2\pi$

11. a) The circuit given below shows a low-pass second order active filler. Analyze the circuit and find the cut-off frequency.



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b) For the second order high-pass filter shown below, find the cut-off frequency and the high frequency gain. 7