2013

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 Question)

1. Choose the correct alternatives for any *ten* of the following: 10 x 1 = 10

i) Unit step function is first derivative of

a) Ramp function b) Impulse function

c) Gate function d) Parabolic function.

ii) A practical current source is usually represented by

a) a resistance in series with an ideal current source

b) a resistance in parallel with an ideal current source

c) a resistance in parallel with an ideal voltage source

d) none of these.

iii) A two-part network is defined by the relations $I_1 = 2V_1 + V_2$ and $I_2 = 2V_1 + 3V_2$, then Z_{12} is

a) -2 ohm b) -1 ohm

c) $-\frac{1}{2}$ ohm d) $-\frac{1}{4}$ ohm.

iv) The Z matrix of a 2-port network is given by $\begin{bmatrix} 0.9 & 0.2 \\ 0.2 & 0.6 \end{bmatrix}$. 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

v) The Fourier series of the function $f(x) = \sin^2 x$ is

a) $\sin x + \sin 2x$ b) $1 - \cos 2x$

c) $\sin 2x + \cos 2x$ d) $0.5\text{-}0.5\cos 2x$.

vi) A rectangular pulse of duration t and magnitude I has the Laplace transform

a) I/s b) $(I/s)e^{-sT}$

c) $(I/s)e^{sT}$ d) $(I/s)(1 - e^{-sT})$

vii) The Laplace transform of a delayed unit impulse function $\delta(t-2)$ is

a) 1 b) 0

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

viii) The convolution of $f(t)$ and $g(t)$ is

a) $\int_0^t f(t)g(t-\tau)d\tau$ b) $\int_0^t f(\tau)g(t-\tau)d\tau$

c) $\int_0^t f(t-\tau)g(t)dt$ d) $\int_0^t f(t)g(t-\tau)dt$.

ix) When applying the superposition theorem to any circuit

a) the voltage source is shorted, the current source is opened

b) the voltage is opened, the current source is shorted

c) both are opened

d) both are shorted.

x) A high-pass filter circuit is basically

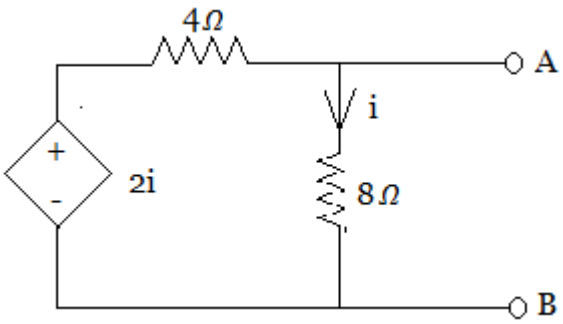
a) a differentiating circuit with low time constant

b) a differentiating circuit with large time constant

c) an integrating circuit with low time constant

d) an integrating circuit with large time constant

xi) The Thevenin's equivalent with respect to the terminals A and B would be only a resistance R th equal to



a) 2.66 Ω b) 3.2 Ω

c) 8 Ω d) 12 Ω

GROUP – B

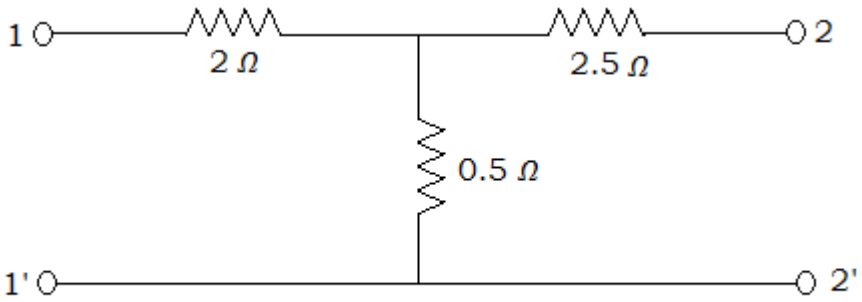
(Short Answer Type Questions)

Answer any *three* of the following. 3 x 5 = 15

2. State and prove maximum power transfer theorem for a.c. nerwork.

3. What is time constant of an R-L series circuit and what does is signify? Explain it graphically. 2+3

4. Find the equivalent π-network for the T-network as shown in the figure.



5. Prove that Laplace transform of a periodic function with period T_0 is equal to $\frac{1}{1-e^{-T_0 s}}$ times the Laplace transform of the first cycle.

6. Draw the oriented graph of a network with the fundamental cut set matrix given below:

$$Q = \begin{array}{c} \text{Twigs} \quad\quad\quad \text{Links} \\ \left(\begin{array}{cccc:ccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 1 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 \end{array}\right) \end{array}$$

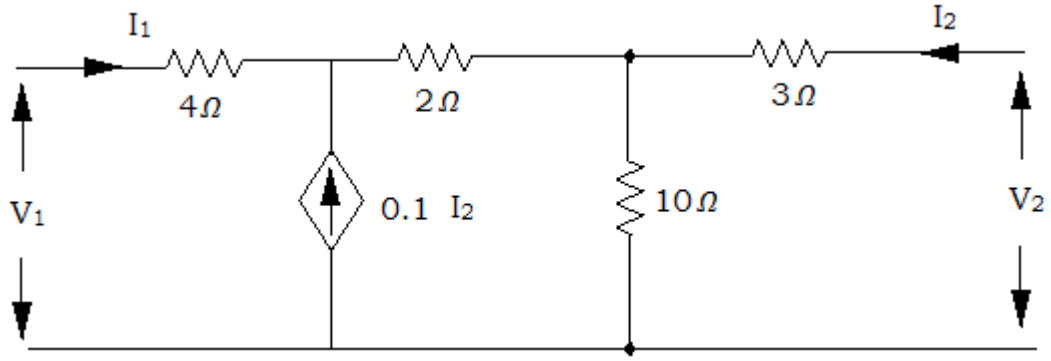
GROUP – C

(Long Answer Type Questions)

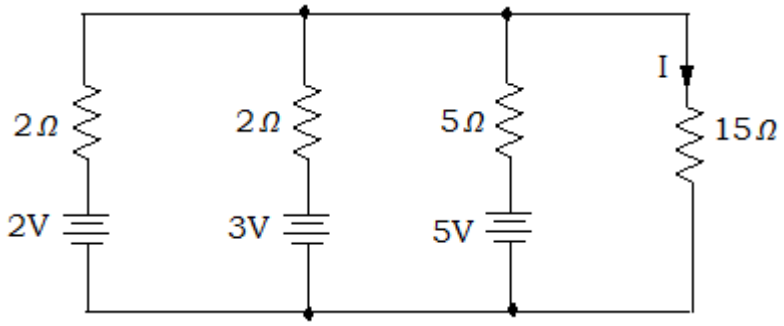
Answer any *three* of the following. 3 x 15 = 45

7. a) What are ABCD parameters? Prove that $\Delta T = (AD - BC) = 1$. 7

b) Find the z-parameter for the network shown in figure below. Hence find the h-parameter for the same network. 8

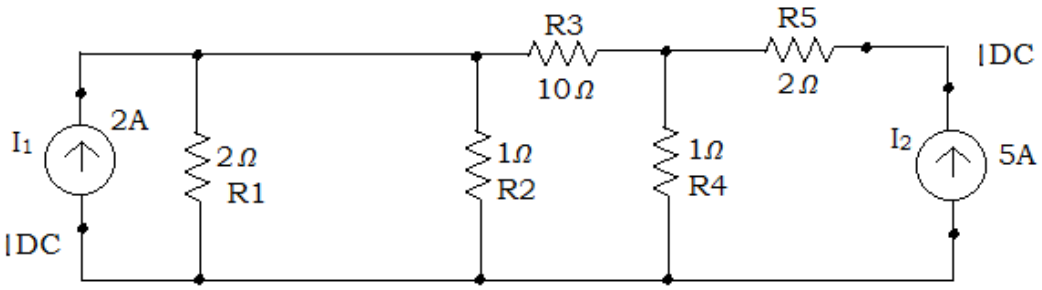


8. a) State and explain Millman's theorem. Calculate the load current I in the circuit in figure by Millman's theorem.



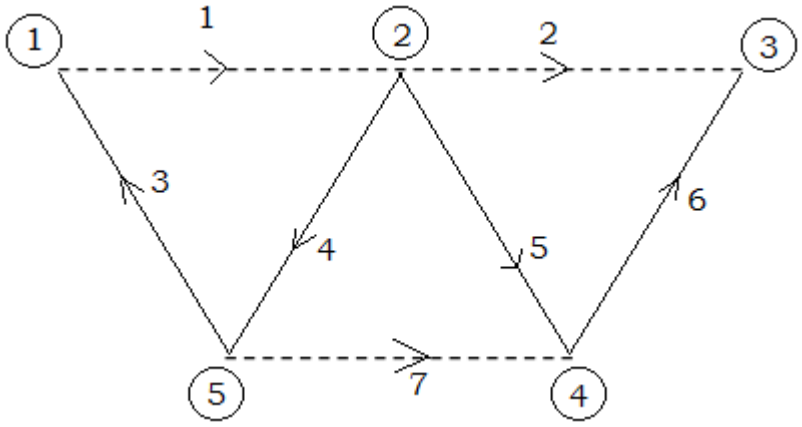
2+6

b) What is the power loss in the 10 ohm resistor? Use Thevenin's theorem in figure below: 7



9. a) What is tree? Discuss with a suitable example. 2

b) A graph is shown in figure below. Find the tie-set and cut-set matrices and obtain the KCL & KVL equations. [bold lines indicate twigs and dotted lines the links.] 6

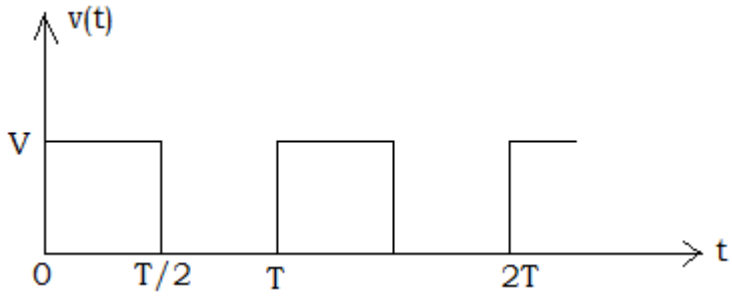


c) Explain odd symmetry and even symmetry of periodic waveform. 4

10. a) Define Fourier transform. How does Fourier transform differ from Laplace transform? 5

b) What is impulse function? Find its Laplace transform. 3

c) For the square wave shown in the figure, find the exponential Fourier series.



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11. a) What are the advantages of active filter over passive filter? 4

b) Design a high-pass active filter of cut-off frequency 1 kHz with a pass-band gain of 2. 5

c) Draw the circuit diagram of a first order low-pass filter and find out the expression of the cut-off frequency. 6

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