



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : EE-301

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.

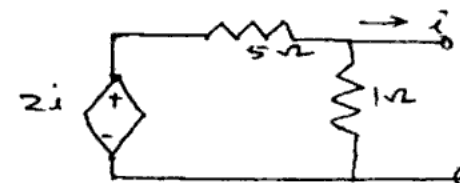
Graph sheet will be supplied by the institution.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following : 10 × 1 = 10
 - i) In a four branch parallel circuit, 10 mA of current flows in each branch. If one of the branch opens, the current in each of the other branches
 - a) increases b) decreases
 - c) remains unaffected d) ceases to flow.
 - ii) The tie-set schedule gives the relation between
 - a) branch currents & link currents
 - b) branch voltages & link currents
 - c) branch currents & link voltages
 - d) branch currents & branch voltages.

- iii) Norton's current in the circuit shown in fig is



- a) $\frac{2i}{5}$ b) infinite
 - c) zero d) 5.
- iv) Two coils connected in series have an equivalent inductance of 3 H when connected in aiding. If the self inductance of the first coil is 1 H, what is the self inductance of the second coil ? (Assume $M = 0.5$ H)
- a) 1 H b) 2 H
 - c) 3 H d) 5 H.
- v) When a series RL circuit is connected to a voltage source V at $t = 0$, the current passing through the inductor L of $t = 0^+$ is
- a) $\frac{V}{R}$ b) infinity
 - c) zero d) $\frac{V}{L}$.
- vi) A periodic function $x(t)$ is said to have half wave symmetry, if $x(t)$ is
- a) $-x\left(t + \frac{T}{2}\right)$ b) $x\left(t + \frac{T}{2}\right)$
 - c) $x\left(t - \frac{T}{2}\right)$ d) $-x\left(t - \frac{T}{2}\right)$.

vii) The inverse transform of $2 \log \left(\frac{s+2}{s} \right)$ is

- a) $\frac{2 - e^{-2t}}{t}$ b) $\frac{e^{-2t}}{t}$
c) $\frac{2}{t}$ d) $\frac{2 + e^{-2t}}{t}$

viii) An inductor in the S-domain consists of

- a) current source in series with an inductor
b) voltage source in parallel with an inductor
c) voltage source of LI_0 in series with an inductor
d) current source I_0/s in series with an inductor.

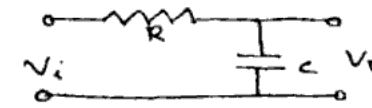
ix) Two-port networks are connected in cascade. The combination is to be represented as a single two-port network. The parameters of the network are obtained by adding the individual

- a) Z parameter matrix
b) $A'B'C'D'$ matrix
c) h parameter matrix
d) ABCD parameter matrix.

x) An ideal filter should have

- a) zero attenuation in the pass band
b) infinite attenuation in the pass band
c) zero attenuation in the attenuation band
d) infinite attenuation in the attenuation band.

xi) The cut-off frequency of the circuit shown below is



- a) RC b) $\frac{1}{RC}$
c) R^2C^2 d) $\frac{1}{R^2C^2}$

xii) The Fourier transform can be used to represent

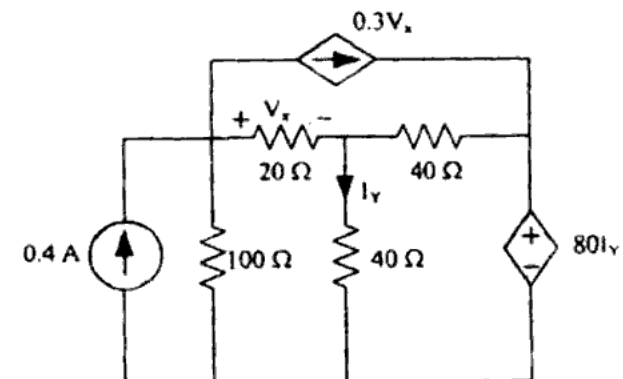
- a) any signal
b) all periodic signals
c) all non-periodic signals
d) all periodic signals that obey Dirichlet's condition.

GROUP - B

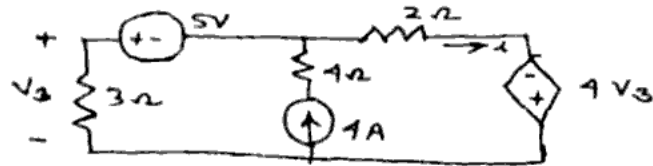
(Short Answer Type Questions)

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

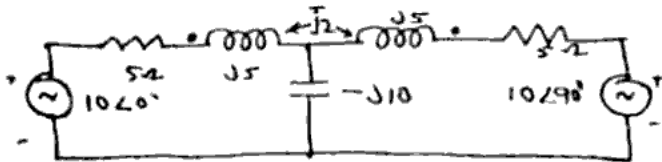
2. Find the value of V_x in the following circuit :



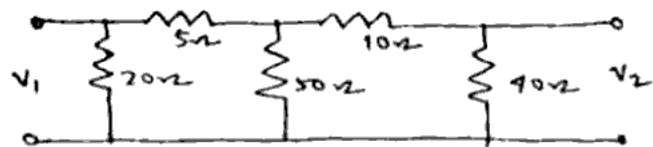
3. Determine the current through the 2Ω resistor as shown in fig. by using superposition theorem.



4. Determine the voltage across the capacitor in the circuit shown :



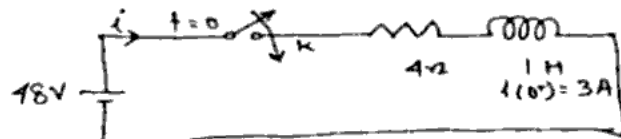
5. Find Y parameters of the network shown :



6. Obtain the incidence matrix A from the following reduced incidence matrix A_1 & draw its graph :

$$[A_1] = \begin{bmatrix} -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 1 & 0 \\ 0 & 0 & -1 & 0 & 0 & -1 & 1 \end{bmatrix}$$

7. For the R-L circuit shown in figure find the expression for the current $i(t)$ using Laplace transformation method.



GROUP - C

(Long Answer Type Questions)

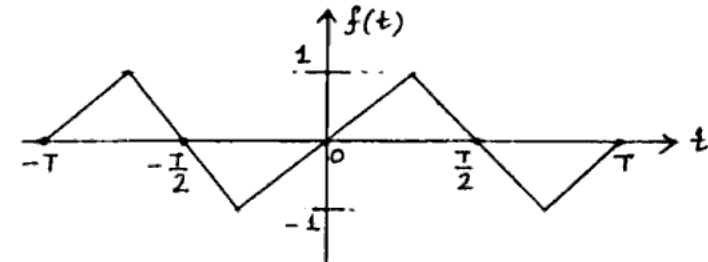
Answer any *three* of the following. $3 \times 15 = 45$

8. a) Determine the Fourier transform and sketch the amplitude and phase response of the exponential voltage function

$$f(t) = Ee^{-t/a}; \quad t \geq 0$$

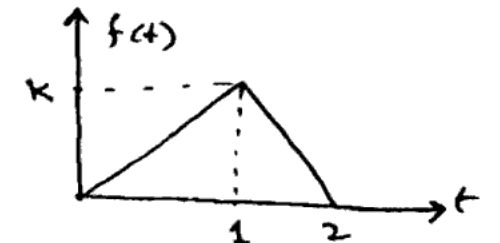
$$= 0 \quad t < 0$$

- b) Determine the Fourier series expansion of the triangular waveform shown in fig. :

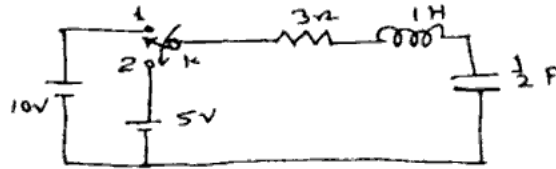


6 + 9

9. a) Find the Laplace transform for the waveform shown in fig. :

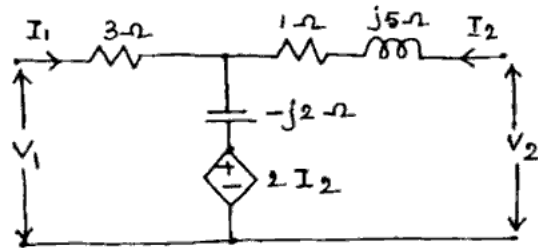


- b) For the circuit shown in fig, switch K is moved from position 1 to position 2 at $t = 0$. Find the expression of current $i(t)$ assuming the initial condition of inductor current = 2A & the initial condition for capacitor voltage = 2V.



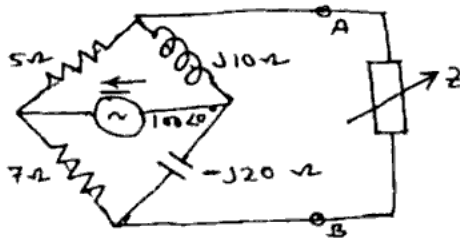
7 + 8

10. a) Derive the condition for reciprocity & symmetry for h parameter.
b) Calculate the Z parameter for the network shown in Fig. Also check for reciprocity and symmetry.

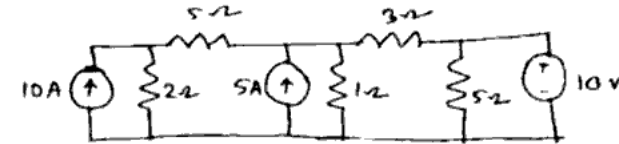


7 + 8

11. a) For the circuit shown in fig., find the value of Z that will receive maximum power. Also determine this power :

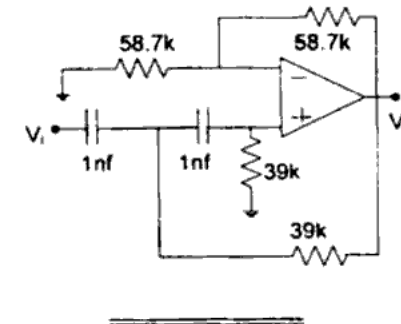


- b) Find the current in the 3Ω resistor for the circuit shown below.



10 + 5

12. a) Design a first-order low-pass filter with a cut-off frequency of 2 kHz and pass-band gain of 3.
b) For the second-order high-pass filter shown below, find an expression for its cut-off frequency and compute its value.



5 + 10