**BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR**
**B.E.(EE) 3rd Semester Final Examination 2012**

**Subject: Network Theory**

**Paper / Code No:** EE – 301
**Time:** 3 HRS.

**Branch:** Electrical Engineering
**Full Marks:** 70

*i) Answer any SIX questions taking THREE from each half.*
*ii) TWO marks are reserved for neatness in each half*

## FIRST HALF

1. (a) State and prove the Compensation Theorem for AC networks.
   (b) In the circuit of Fig.1 find the current through the 5Ω resistor using principle of superposition.

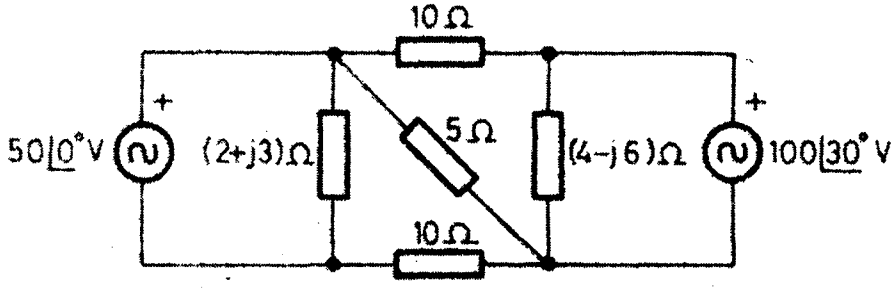


Fig.1

[5+6]

2. (a) State and verify the Tellegen's Theorem in a d.c. network.
   (b) Find Norton's Equivalent Network to the left of the terminals X and Y in Fig.1

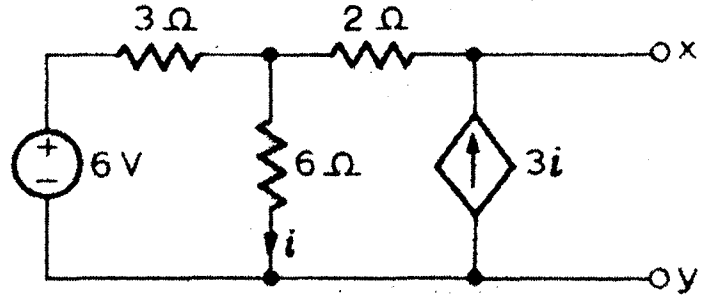


Fig.2

[5+6]

3. (a) State and prove the Maximum Power Transfer Theorem for AC networks.

   (b) In the circuit of Fig.3 find the current through $Z_L$ using Millman's Theorem.

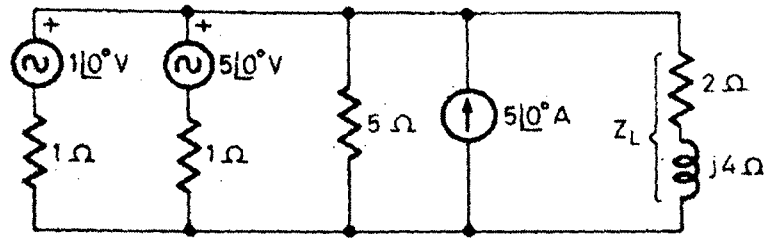


**Fig. 3**

[5+6]

4. (a) State and prove the Initial and Final Value Theorems in Laplace Transform.

   (b) In the circuit of Fig.4, the switch K was initially at *x* before t=0 and the circuit reached steady state. At t=0 the switch is shifted to y. Find the voltage across the terminals a and b for t>0. Assume zero initial condition for $L_2$.

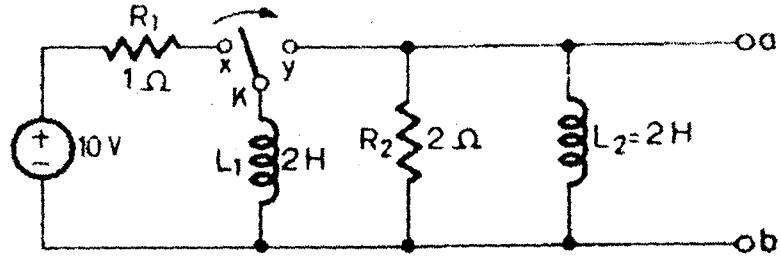


Fig.4

[5+6]

5. (a) Derive the Exponential form of the Fourier series from Trigonometric form of the series.

   (b) Find the Trigonometric Fourier series of the waveform shown in Fig.5

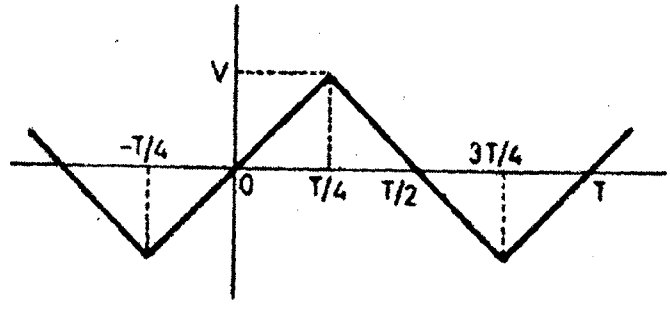


Fig. 5

[5+6]

## SECOND HALF

6. a) Discuss the properties of a driving point function and a transfer function?

   b) Verify whether the following functions satisfy the conditions of a valid driving point function or a valid transfer functions or both.

   (i) $N_1(s) = \dfrac{s^2 - s + 2}{5s^2 + 2s + 1}$ (ii) $N_2(s) = \dfrac{4}{s^3 + 2s}$ (iii) $N_3(s) = \dfrac{4s^2 + s + 7}{s + 5}$

   c) Find the driving point impedance function for the network shown in Fig. Q-6(c). Show the poles and zeros of the network function on complex frequency plane.

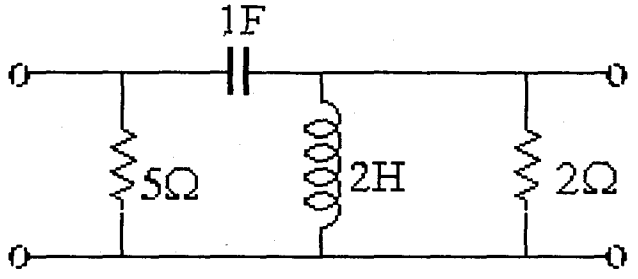


Fig. Q-6(c) [ 5 + 3 + 3 ]

7. a) What are the transmission parameters of a network? Where are they used?

   b) Find the conditions of reciprocity and symmetry of a two-port network in terms of its transmission parameters.

   c) Find the suitable parameters of the network shown in figure Q-7(c) considering it as a combination of two interconnected networks.

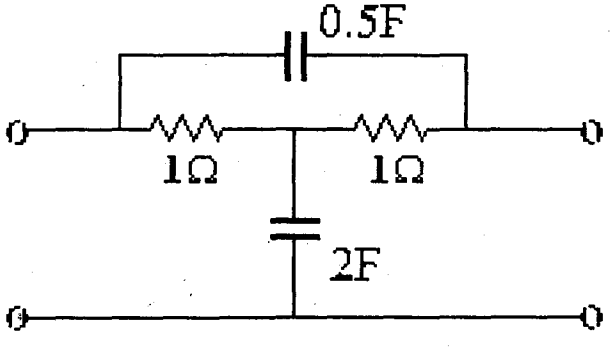


Fig. Q-7(c) [ 3 + 4 + 4 ]

8. Write the equilibrium equations of the mechanical system shown in Fig.8. Draw the electrical analogous network for the system using *T-i* / *f-i* analogy. [11]

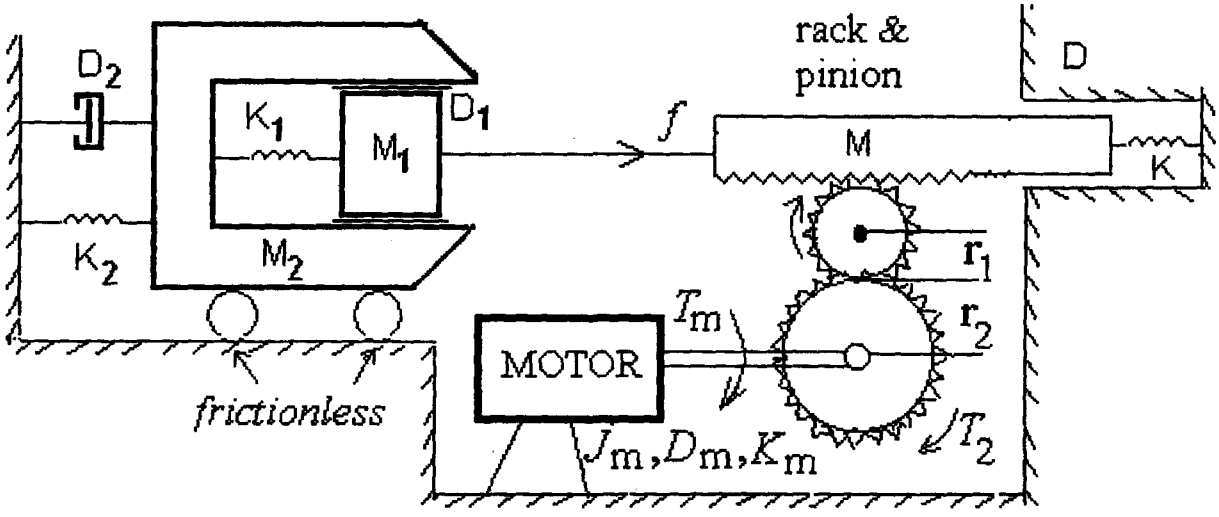


Fig. 8

9. a) Find the voltage transfer function of the network given in Fig. Q-9(a).

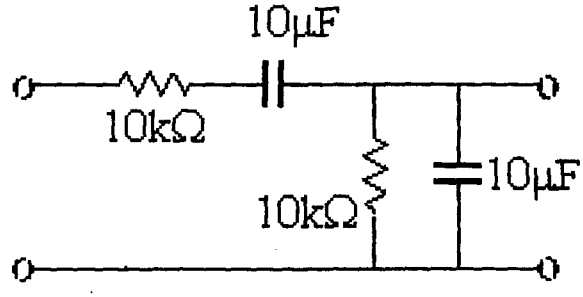


Fig. Q-9(a)

b) Show the critical frequencies of the above network function and draw the gain-frequency plot of the output voltage response on semi-log graph paper.

[ 3 + 8 ]

10. a) Explain the terms 'short-circuit impedance', 'open-circuit impedance' and 'image impedance' with respect to a two-port network. [3]

b) Write critical notes on any two: [ 4x2 =8]

i) Electrical analogous network of water heater (thermal) system.

ii) *h*-parameters in terms of *Z*-parameters.

iii) Energy stored in a mutually coupled inductor.