THIRD SEMESTER EXAMINATION -2005

NETWORK THEORY

Full Marks - 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and ***four*** *other questions from the rest.*

The figures in the right-hand margin indicate marks for the questions.

1. Answer the following : 2×10

   (i) Two ac sources feed common variable resistive load as shown in Figure 1. Under maximum power transfer condition, power absorbed by load resistance R_L is

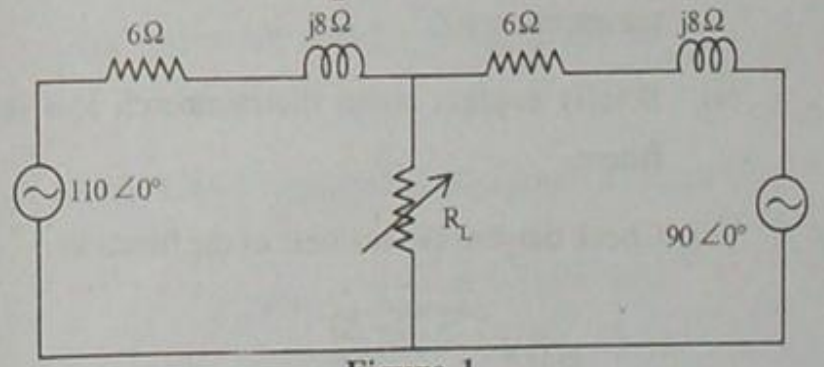

Figure 1

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(ii) A two port network is defined by the relation $I_1 = 2V_1 + V_2$, $I_2 = 2V_1 + 3V_2$. Find the value of Z_{12}.

(iii) What is the time constant of the circuit shown in Figure 2 ?

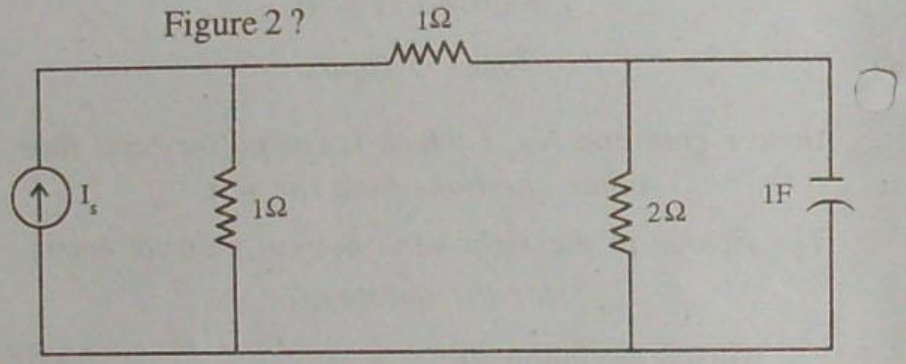

Figure 2

(iv) The driving point impedance is $Z(s) = s + 2/s + 3$. The system is initially at rest. For a voltage signal of unit step, find the current i(t) through the impedance Z.

(v) Briefly explain about the mismatch loss in filters.

(vi) Check the positive realness of the function :

$$y(s) = \frac{s^2 + 2s + 20}{s + 10}$$

(vii) A T-section low pass filter has series inductance 80 mH and shunt capacitance 0.022 μF. Determine the cut-off frequency and nominal design impedance (R_o). Also design an equivalent π-section.

(viii) What is the rms value of the periodic function e (t) shown in the Figure 3.

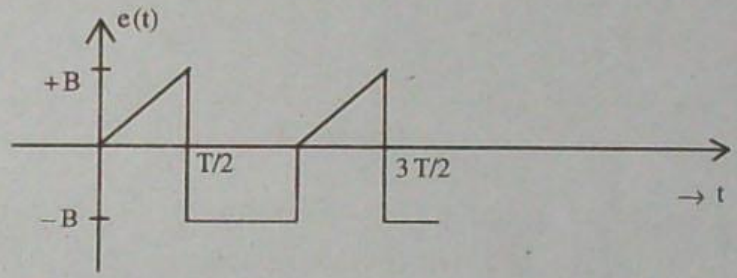

Figure 3

(ix) Mention the properties of RC driving point impedance.

(x) Check whether Z(s) represents a reactance

$$Z(s) = \frac{s^9 + 4s^7 + 3s^5 + 2s^3 + 2s}{s^8 + s^6 + s^4 + s^2 + 1}.$$

2. (a) Determine the ABCD parameters of the network shown in Figure 4. Also prove that it is a reciprocal network. 4

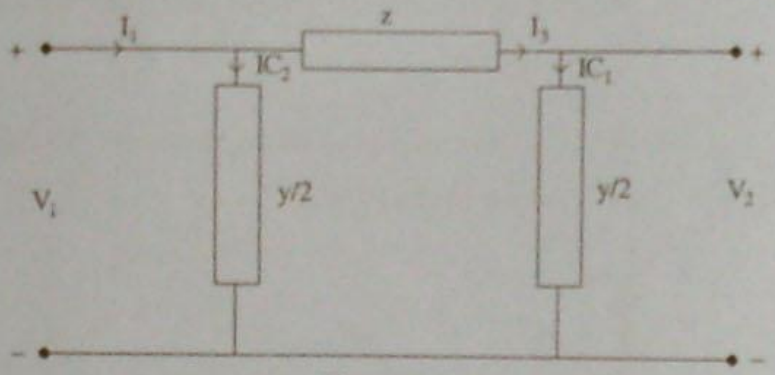

Figure 4

(b) In the circuit shown in Figure 5, steady state is reached with switch at position "a". At t = 0, switching is changed to position "b". Obtain the current in the circuit at $t = 0^+$. 3

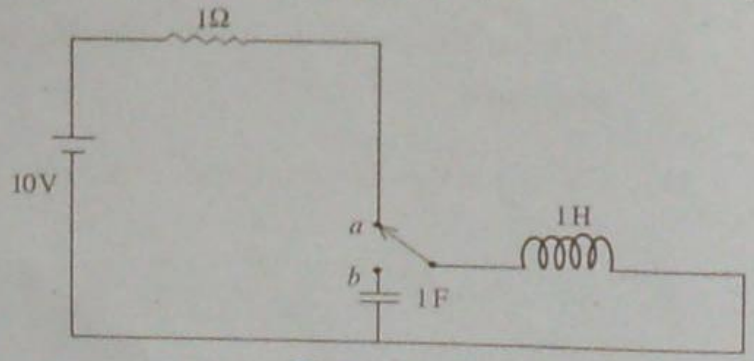

Figure 5

(c) Find the admittance of the circuit in Figure 6 at resonance. 3

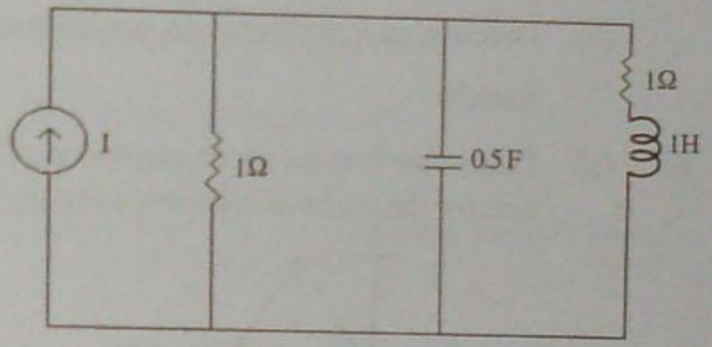

Figure 6

3. (a) Discuss on double-tuned coupled coils and derive the expression for optimum values of secondary current, output voltage, amplification factor at resonance. 8

(b) Define image impedance. 2

4. (a) Discuss the restrictions on location of poles and zeros in driving point functions. 5

(b) What are the limitations on pole and zero location in transfer function ? 5

5. (a) Design a prototype bandpass filter sections (T and π) having cut-off frequencies 3 kHz and 6 kHz and nominal characteristics impedance of

600 Ω. Also find the resonant frequency of the shunt arm and series arm. 7

(b) Discuss the problems in optimizing power transfer. 3

6. (a) Determine Fourier series expansion of the function for the waveform shown n Figure 7. 5

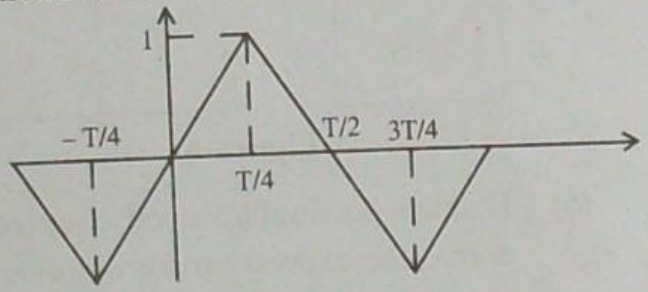

Figure 7

(b) Determine exponential form of Fourier series for the waveform shown in Figure 8. 5

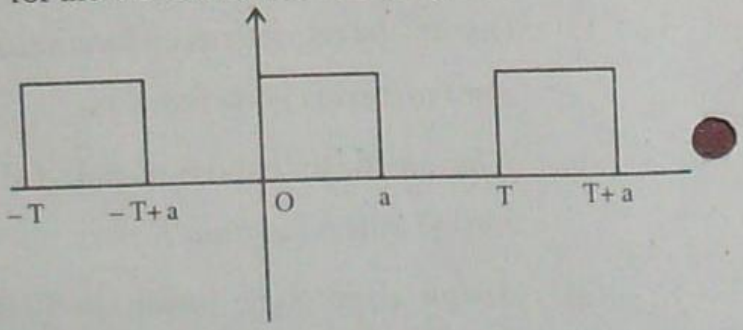

Figure 8

7. (a) Voltage applied to a load is V = 100 sin377t and current in load is

I = 4.2 sin (377t + 20) + 2.3 sin (754t – 70)

Determine the average power. 3

(b) Synthesise the impedance

$$z(s)=\frac{s(s^2+3)(s^2+5)}{(s^2+2)(s^2+4)}$$ Using cauer-II form.

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8. An impedance function at the input of a network is represented by

$$z(s)=\frac{s^2+5s+4}{s^2+2s}.$$

Express it in both foster forms. 10