Ex/ET/T/121/2018

**BACHELOR OF ELECTRONICS & TELE-COMMUNICATION ENGINEERING EXAMINATION, 2018**

( 1st Year, 2nd Semester )

**CIRCUIT THEORY**

Time : Three hours Full Marks : 100

( 50 marks for each Group )

Use a separate Answer-Script for each group

***Answer all the parts of a question in the same place***
***All questions carry equal marks***
***Answer any three from Group-A and any two from Group-B***

***Group-A***

1. A voltage wave having the form shown in Fig. 1 is applied across a 4Ω resistance. Find the expression for the current i(t) using Fourier series. Also draw the amplitude and phase spectra.

(8+2)

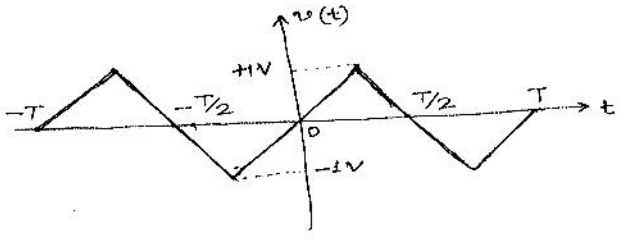


Fig. 1

2. a) Calculate the Fourier transform of g(t) = exp(-α t), where α is a constant and it is either positive or negative.
   b) In the circuit of Fig. 2, i(t) = 10 exp(-t) u(t) A, where u(t) is a unit step function. Calculate the voltage v(t) using Fourier transform method.

(3+7)

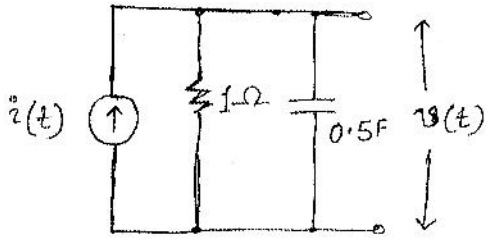


Fig. 2

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3. The waveform of input voltage, $v_1(t)$ is shown in Fig. 3 and it is applied to the initially un-energised RC circuit shown in Fig. 4. Determine the output voltage $v_2(t)$ for $t \geq 0$ using Laplace transform method. Also sketch $v_2(t)$ approximately.

(8+2)

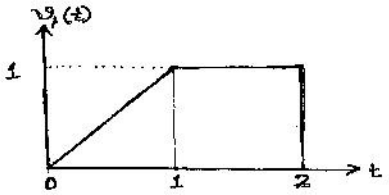


Fig. 3

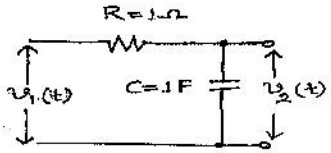


Fig. 4

4. The circuit shown in Fig. 5 is initially in the steady state with the switch S open. At t=0, the switch S is closed. Obtain the current through the inductor for t>0 using Laplace transform method. (10)

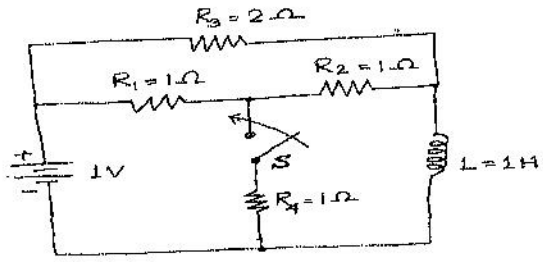


Fig. 5

## Group-B

5. a) A sinusoidal voltage with variable frequency is applied to a series RLC circuit. Derive the expression for resonant frequency and frequency at which the voltage across the inductance L will be the maximum.

   b) Calculate the value of R in the circuit shown in Fig. 6 to yield resonance.

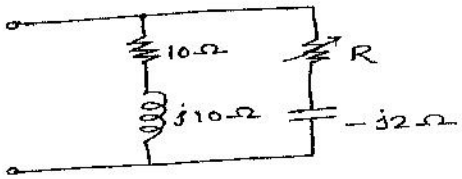


Fig. 6

(2+5+3)

6. a) For a circuit given in Fig. 7 with $R_1 = 6.4\Omega$, $R_2 = 2.4\Omega$, $X_{L1} = 4.8\Omega$ and $X_{L2} = 8\Omega$, find
   i) Total conductance and susceptance of the circuit.
   ii) Total admittance

iii) Branch currents
iv) Power factor angle of the circuit.

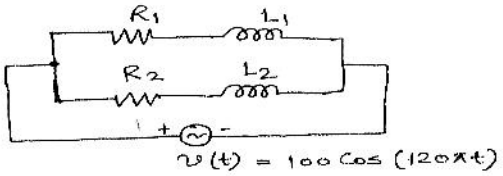


Fig. 7

b) Find voltage v in the circuit shown in Fig. 8.

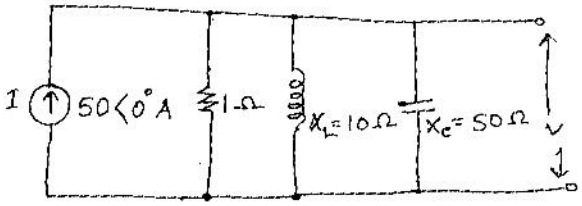


Fig. 8

(6+4)

7. a) What do you mean by fundamental cut-set of a graph?
b) For a resistive network shown in Fig. 9, draw the directed graph and tree of the network. Also develop the fundamental cut-set matrix and express the branch currents and branch voltages in terms of fundamental cut-set matrix.

(2+1+1+3+3)

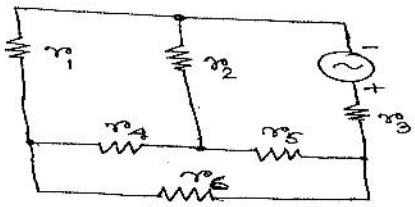


Fig. 9

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## Group - B

Answer **Question 1** and any **FOUR** questions from rest

1. What is mutual inductance? Describe the effect of mutual inductance in series and parallel combination of inductors. [Marks: 4+6=10]

2. Find the **h parameters** of the network shown in Figure 1. Comment on **reciprocal** and **symmetrical** property of the network. [Marks: 8+1+1]

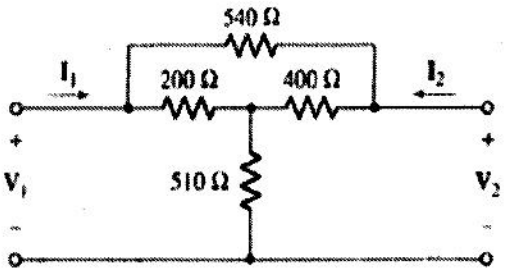


Figure 1

3. A) Determine the image impedance $Z_{i1}$ & $Z_{i2}$ of the T network shown below. [Marks: 5]

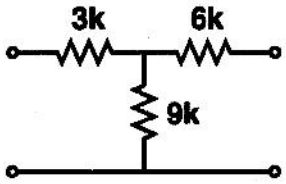


Figure 2

B) Find the Norton equivalence of the circuit shown in Figure 3. [Marks: 5]

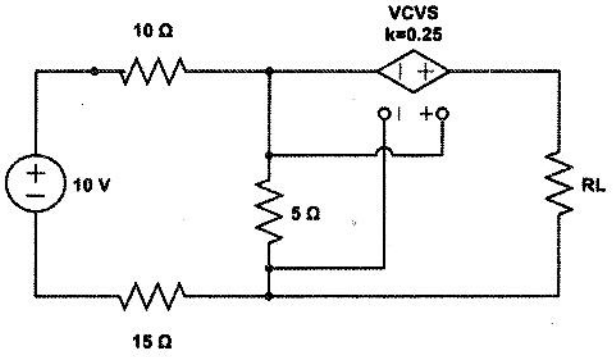


Figure 3

4. Find the **equivalent inductance** of the combination of inductors shown below. (Coupling Coefficient = 0.5) [Marks: 10]

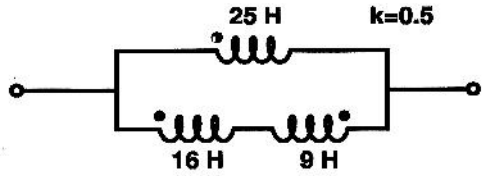


Figure 4

5. Determine the current $I_L$ flowing through the 5k resistive branch. [Marks: 10]

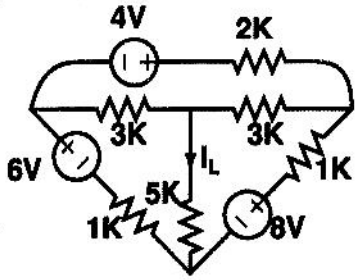


Figure 5

6. Determine the **ABCD matrix** of the network shown in Figure 6. Using those ABCD parameters find the Y **parameters** of the same network. [Marks: 5+5]

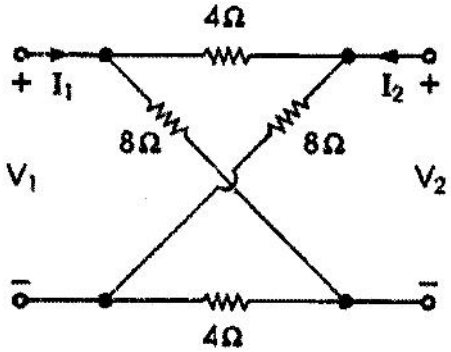


Figure 6

7. Obtain the loop current $\mathbf{I}_1$ and $\mathbf{I}_2$ of the network shown in Figure 7. *(Mutual inductance M=2H and the RMS value of the applied voltage source is 100V)* [Marks: 10]

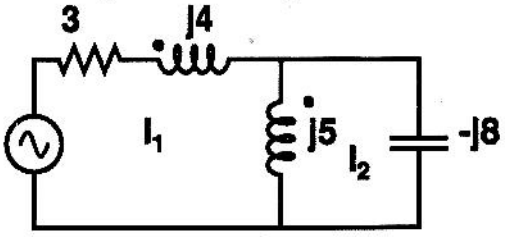


Figure 7