B.E. ELECTRONICS AND TELECOMMUNICATION ENGINEERING

FIRST YEAR SECOND SEMESTER 2017

Subject: CIRCUIT THEORY   Time: 3 Hours   Full Marks: 100

All parts of the same question must be answered at one place only
Use separate answer scripts for each PART.

PART – I
Answer any FIVE.

1. Derive the fundamental tie-set matrix of the following circuit in Fig. 1 and hence obtain the branch voltages.
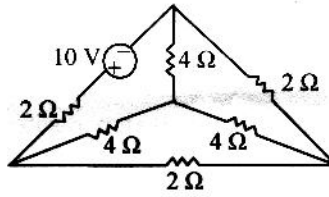

Fig. 1

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2. Determine the values of the components L and R of Fig. 2 so that the amplitude of the direct component of $v_o(t) \geq 90$ V and the ripple $\leq 4\%$ for the fundamental frequency of 60 Hz.
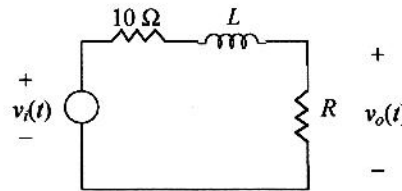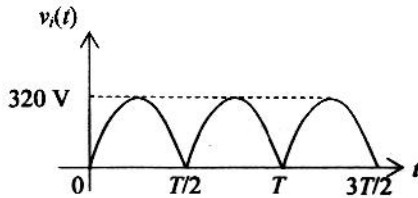

Fig. 2

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3. Find the Fourier series expansion of current $i(t)$ of the circuit in Fig. 3 under steady state. Also, express the power dissipated in the circuit as a sum of harmonic powers.
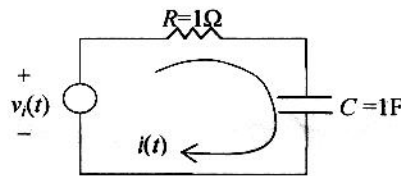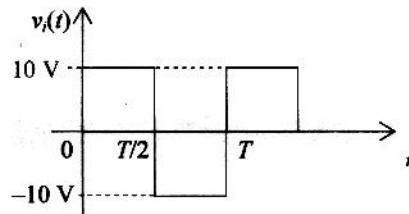

Fig. 3

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4. What would be the energy dissipated in the 1-Ω resistor in Fig. 4, 'a' being a real positive constant.

$v(t) = \exp(-a|t|)$ | Low Pass Filter with Cut-off Frequency $\omega_c = a$ | 1Ω
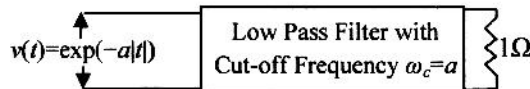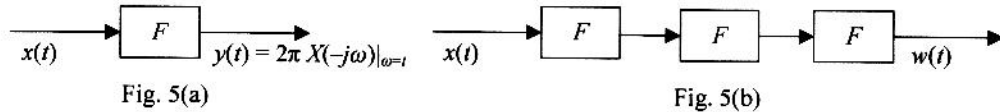
Fig. 4

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[Turn over

5. Based on the behavior of the system F described by Fig. 5(a), determine the output of the system given in Fig. 5(b). Here $X(-j\omega)$ is the Fourier transform of the signal $x(t)$.

Fig. 5(a)   Fig. 5(b)

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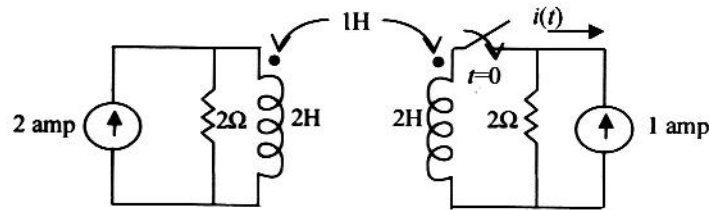6. Determine $i(t)$ of the circuit in Fig. 6 for $t > 0$.

Fig. 6

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7. Determine the transient and the steady state current $i(t)$ of the network in Fig. 7 with $i(0^-)=\rho$.
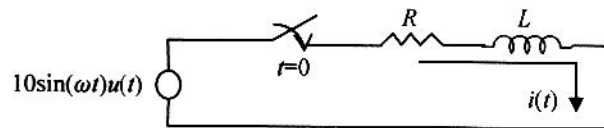

Fig. 7

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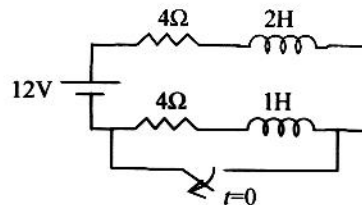8. Determine the voltages across the inductors of the circuit in Fig. 8 over time.

Fig. 8

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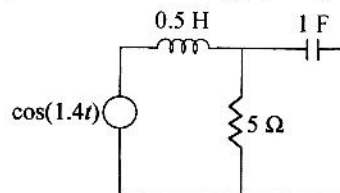9. Show that the circuit in Fig. 9 is resonant at supply frequency.

Fig.9

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10. The Q-factor of a series RLC circuit is 5 at its resonance frequency of 1 kHz. Assuming the power dissipation of 250 Watt across resistance when the current drawn is 1 amp, find the circuit parameters and the bandwidth of the circuit.

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Part-II
Answer any FIVE questions

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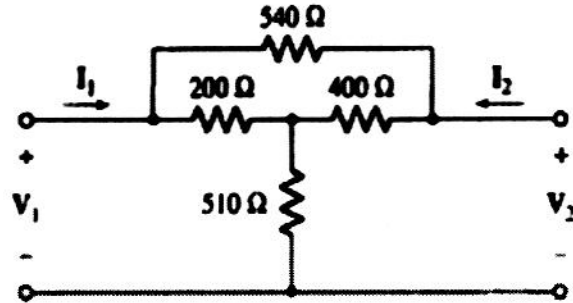

Figure 1

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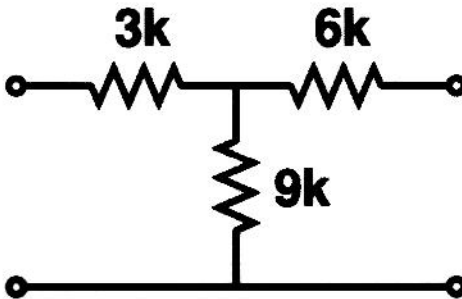

Figure 2

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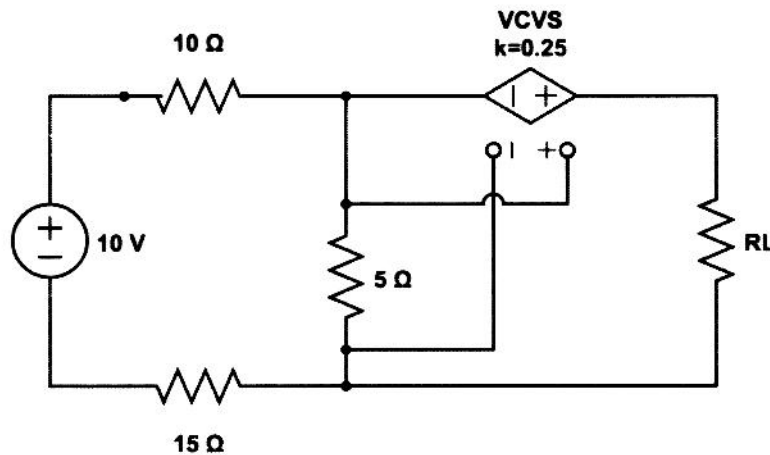

Figure 3

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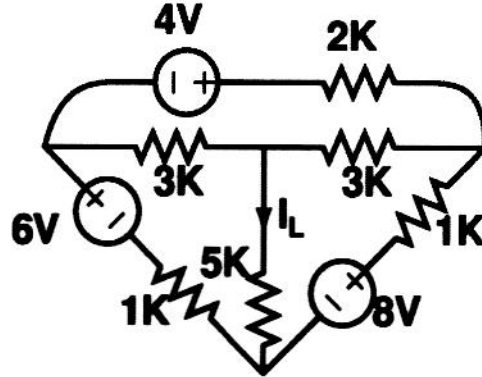

Figure 4

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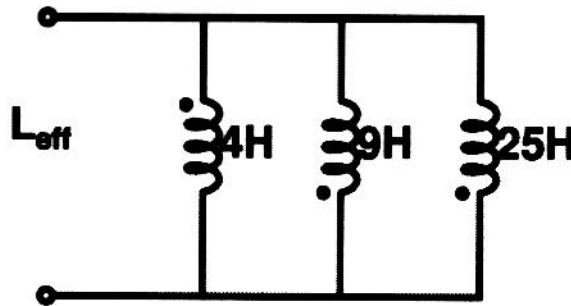

Figure 5

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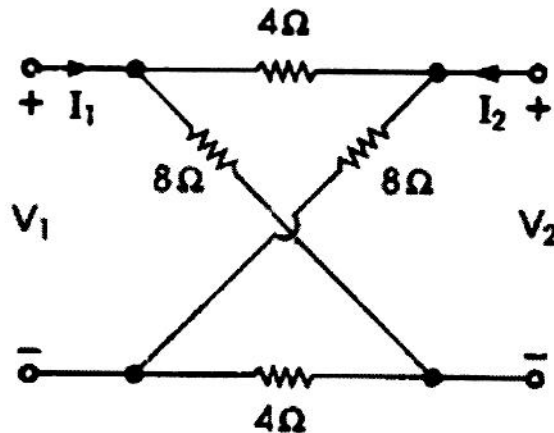

Figure 6

6. Obtain the loop current I_1 and 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]
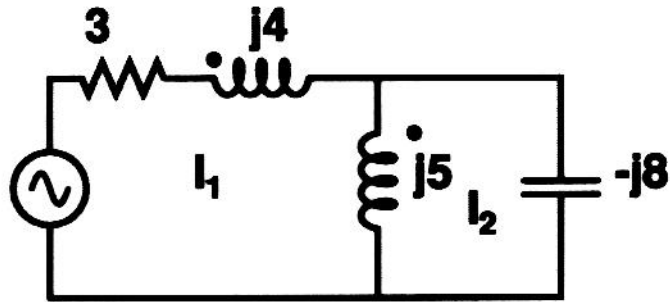

Figure 7

7. For the circuit shown in Figure 8, determine the value of V_2 such that (a) the current through $(3+j4)\Omega$ impedance is zero and (b) the current through 5Ω resistance is zero.   [Marks: 5+5]
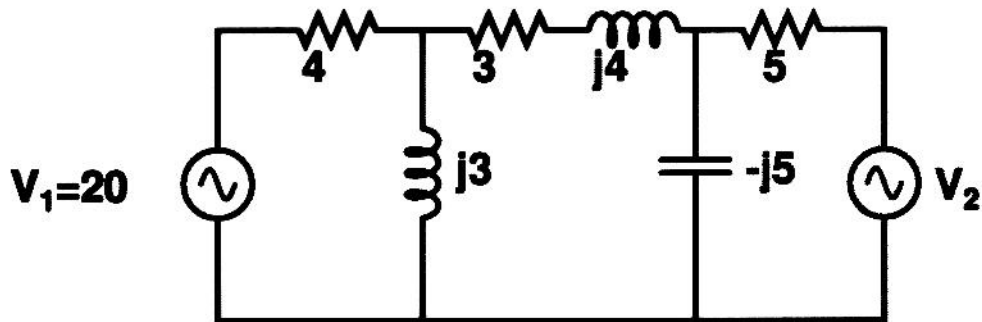

Figure 8