B.Tech-3rd (EE)

Network Theory

Full Marks : 50

Time : 2.30 hours

Answer **all** questions.

The figures in the right-hand margin indicate marks.

Symbols carry usual meaning.

1. Answer *all* questions : 2×5

(*a*) Derive the expression of coefficient of coupling.

(*b*) Find the value of C in the circuit shown in Figure 1 to get resonance.

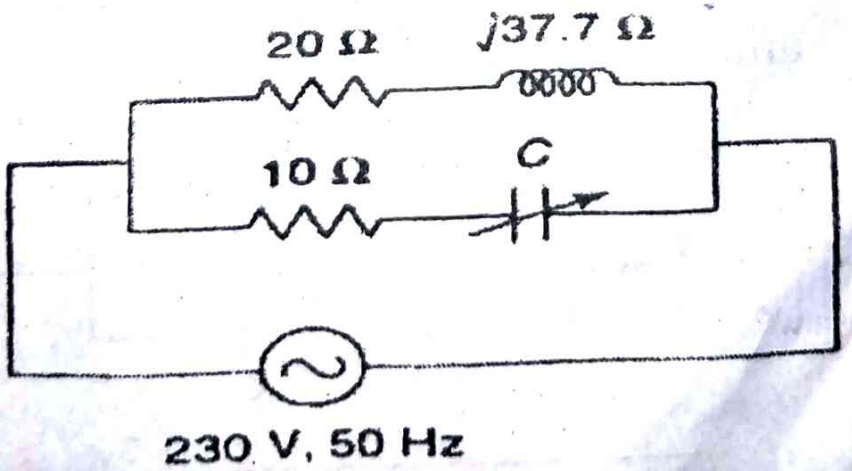

Figure 1

(Turn Over)

(*c*) What are the conditions of symmetry and reciprocity in a transmission two-port network ?

(*d*) What are the necessary conditions of stability of a network function ? Check whether the system with characteristics polynomial $P(s) = s^4 + 3s^3 + 2s^2 + 5s + 1$ is stable or not ?

(*e*) What are the different types of filters ? Mention the frequency limits for their pass band and attenuation band.

2. (*a*) Find the value of R_1 such that the following circuit given in Figure 2 is resonant. Here, $R_2 = 10\ \Omega$, $\omega L = j6\ \Omega$ and $\omega C = -j4\ \Omega$. 4

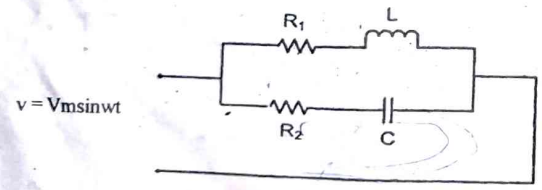

Figure 2

(*Continued*)

(*b*) (*i*) Derive the Transient Response of series RL-circuit with D.C excitation.

(*ii*) In the circuit shown in Figure 3, determine the complete solution for the current when switch is closed at $t = 0$, applied voltage is $V(t) = 20\cos\left(100t + \frac{\pi}{4}\right)$, resistance R = 10 Ω and capacitance C = 2 μF. 4

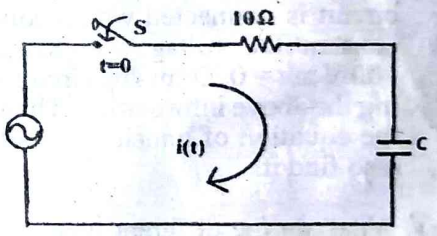

Figure 3

Or

(*a*) Find the current I_x resistor shown in Figure 4 using Thevenin's equivalent network. 4

(*Turn Over*)

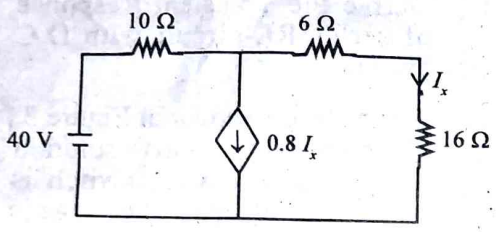

Figure 4

(*b*) A circuit consists of a resistance with 25 Ω, an inductance with 50 mH and a capacitance with 20 μF in Series. The circuit is connected with a source of constant DC voltage with magnitude 100 V at $t = 0$. Draw the circuit showing the above information. Then write the equation of transient current and also find it. 4

3. (*a*) What are the different types of two-port networks ? Define their dependent and independent parameters. Write the expression of equivalent parameters in case of two series networks. 4

(*b*) How a two-port network is different from one-port network ? The given *ABCD* parameters of the two-port network are, $A = 2$, $B = 0.9$, $C = 1.2$, $D = 0.5$. Find its equivalent *Y*-parameters. 4

Or

(*a*) Find the *h*-parameters for the circuit shown in Figure 5. 4

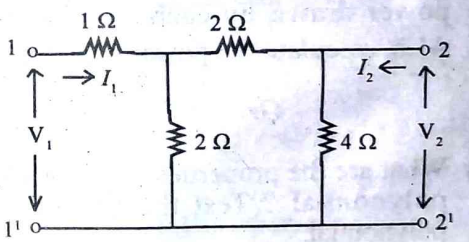

Figure 5

(*b*) Derive the expression for Image impedances in terms of ABCD parameters. 4

4. (*a*) Two coupled coils have $K = 0.6$, $N_1 = 450$ turns, $N_2 = 750$ turns and mutual flux being 0.9 Weber. If primary current is 10 A, then find the primary and secondary coil inductances. 4

(*b*) Three impedances Z_A, Z_B and Z_C are connected in star. They are supplied from a source with 3-ϕ, 50 Hz and 100 V. Calculate the line current, power drawn by each impedance. Also, calculate the power factor. 4

Or

(*a*) What are the properties of a Hurwitz polynomial ? Test the following polynomial.

$$P(s) = s^4 + 11s^3 + 39s^2 + 51s + 20$$ 4

(*b*) Explain two-wattmeter method for power and power factor calculation of a balanced three-phase load. 4

5. (*a*) What do you mean by positive real function ? What are its properties ? 4

(*b*) Driving point impedance of a network is given by $Z(s) = \frac{s^3 + 3s}{s^2 + 1}$. Realize the network. 4

Or

(*a*) Discuss Foster's canonical form for LC network synthesis. 4

(*b*) The driving point impedance is given by

$$Z(s) = \frac{s(s^2 + 2)(s^2 + 4)}{(s^2 + 1)(s^2 + 3)}$$

Obtain the first form of Cauer's network. 4

6. (*a*) For the graph shown in Figure 6 find incidence and cut set matrices. 4

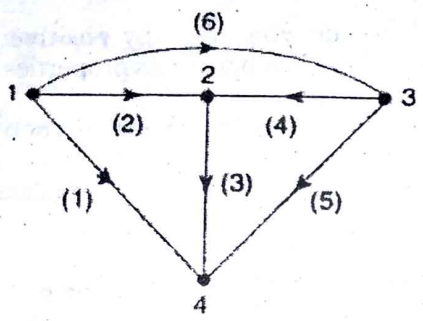

Figure 6

(*b*) Define the following with appropriate diagrams.
(*i*) Branch (*ii*) Loop (*iii*) Node (*iv*) Tree and (*v*) Co-tree. 4

Or

(*a*) For the circuit shown in Figure 7, draw the oriented graph and write the (*i*) incidence matrix, (*ii*) tie-set matrix, and (*iii*) f-cut-set matrix. 4

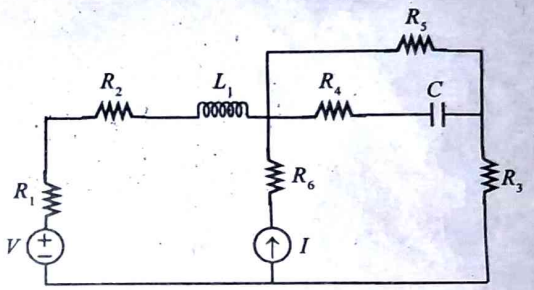

Figure 7

(*b*) Draw the oriented graph for the following reduced incidence matrix. Write its (*i*) incidence matrix and (*ii*) tie-set matrix. 4

$$A = \begin{bmatrix} 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & -1 \\ -1 & 0 & 0 & 0 & 1 \end{bmatrix}$$