DECEMBER 2007

Code: AE08
Subject: CIRCUIT THEORY & DESIGN
Time: 3 Hours
Max. Marks: 100

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

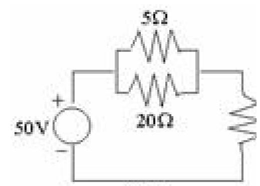


Fig.1

Q.1 Choose the correct or best alternative in the following: (2x10)

a. Power in 5Ω resistor is 20W. The resistance R is

(A) 10Ω.
(B) 20Ω.
(C) 16Ω.
(D) 8Ω.

b.

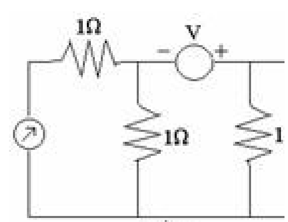


Fig.2

The Thevenin's equivalent circuit to the left of AB in Fig.2 has R_{eq} given by

(A) $\frac{1}{3}\Omega$ **(B)** $\frac{1}{2}\Omega$

(C) $1\,\Omega$ **(D)** $\frac{3}{2}\Omega$

c. The energy stored in a capacitor is

(B) $\frac{1}{2}ci^2$ **(B)** $\frac{1}{2}\frac{1}{c}i^2$

(C) $\frac{1}{2}\frac{v^2}{c}$ **(D)** $\frac{1}{2}cv^2$

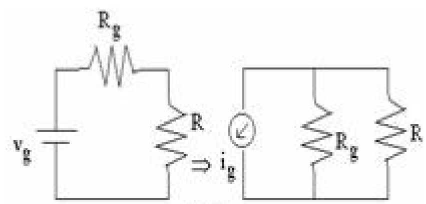


Fig.3

d. The Fig.3 shown are equivalent of each other then

(A) $i_g = -\frac{v_g}{R_g}$ **(B)** $i_g = \frac{v_g}{R_g}$

(C) $i_g = v_g R_g$ **(D)** $i_g = \frac{R_g}{v_g}$

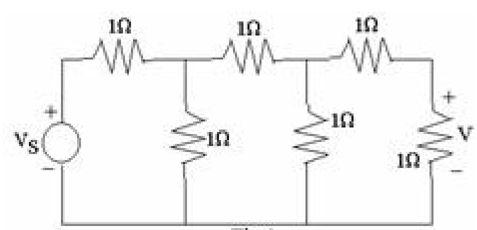
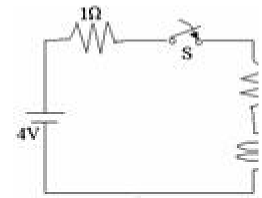


Fig.4

e. For the circuit shown in Fig.4, the voltage across the last resistor is V. All resistors are of 1Ω.
The V_S is given by

(A) 13V. **(B)** 8V.

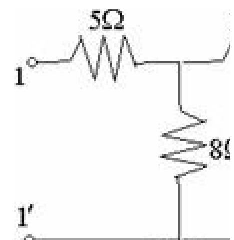
(C) 4V. **(D)** 1V.



f. In the circuit shown in Fig.5, the switch s is closed at t = 0 then the steady state value of the current is

(A) 1 Amp. **(B)** 2 Amp.

(C) 3 Amp. **(D)** $\frac{4}{3}$ Amp.



g. The z parameters of the network shown in Fig.6 is

(A) $\begin{bmatrix} 5 & 8 \\ 8 & 20 \end{bmatrix}$ **(B)** $\begin{bmatrix} 13 & 8 \\ 8 & 20 \end{bmatrix}$

(C) $\begin{bmatrix} 8 & 20 \\ 13 & 12 \end{bmatrix}$ **(D)** $\begin{bmatrix} 5 & 8 \\ 8 & 12 \end{bmatrix}$

h. For the pure reactive network the following condition to be satisfied

(A) $M_1(J\omega)M_2(J\omega) + N_2(J\omega)N_1(J\omega) = 0$

(B) $M_1(J\omega)N_1(J\omega) - N_2(J\omega)M_2(J\omega) = 0$

(C) $M_1(J\omega)M_2(J\omega) - N_1(J\omega)N_2(J\omega) = 0$

(D) $M_1(J\omega)N_2(J\omega) - N_1(J\omega)M_2(J\omega) = 0$

Where $M_1(J\omega)$ & $M_2(J\omega)$ even part of the numerator and denominator and N_1 N_2 are odd parts of the numerator & denominator of the network function.

i. The network has a network function $Z(s) = \frac{s(s+2)}{(s+3)(s+4)}$. It is

(A) not a positive real function. (B) RL network.
(C) RC network. (D) LC network.

j. The Q factor for an inductor L in series with a resistance R is given by

(A) $\frac{\omega L}{R}$ **(B)** $\frac{R}{\omega L}$

(C) ωLR **(D)** $\frac{1}{\omega LR}$

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. For the circuit shown in Fig.7. Determine the current i_1, i_2 and i_3 . **(8)**

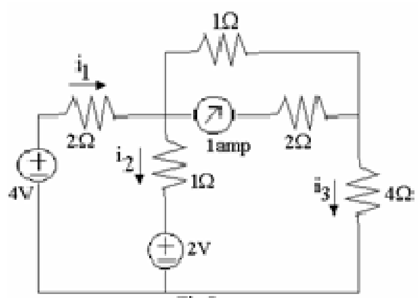


Fig.7

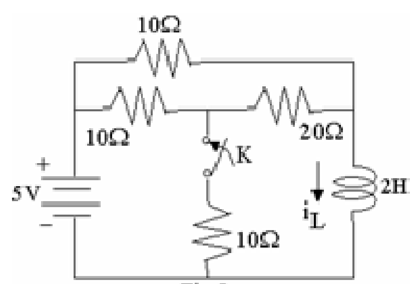


Fig. 8

b. In the network of the Fig.8, the switch K is open and network reaches a steady state. At t=0, switch K is closed. Find the current in the inductor for t>0. **(8)**

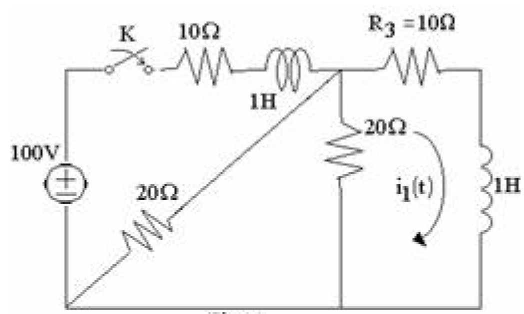


Fig.10

Q.3 a. The network shown in the accompanying Fig.9 is in the steady state with the switch K closed. At t = 0 the switch is opened. Determine the voltage across the switch v_k and $\frac{dv_k}{dt}$ at $t = 0_+$. **(6)**

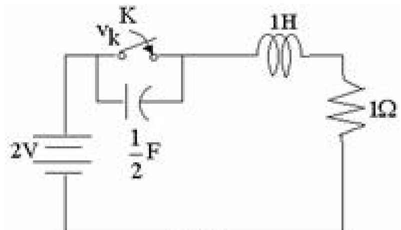


Fig.9

b. Define Thevenin's theorem. **(4)**

c. It is required to find the current $i_1(t)$ in the resistor R_3, by using Thevenin's theorem: The network shown in Fig.10 is in zero state until t = 0 when the switch is closed. **(6)**

Q.4 a. For the given network in Fig.11, determine the value of R_L that will cause the power in R_L to have a maximum value. What will be the value of power under this condition. **(8)**

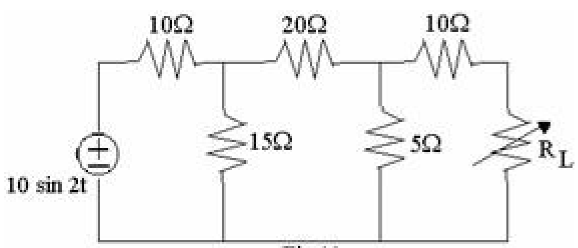


Fig.11

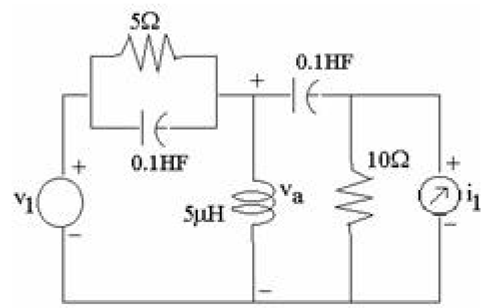


Fig.12

b. In the network shown in Fig.12 $v_1 = 10 \sin 10^6 t$ and $i_1 = 10 \cos 10^6 t$ and the network is operating in the steady state – For the element values as given, determine the node to datum voltage $v_a(t)$. **(8)**

Q.5 a. Determine the amplitude and phase for F(J4) from the pole zero plot in s-plane for the network function $F(s)=\frac{s^2+4}{(s+2)(s^2+9)}$. **(8)**

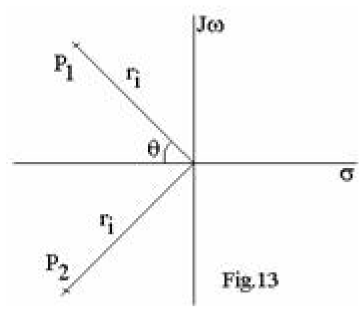


Fig.13

b. A network function consists of two poles at $P_{1,2}=r_i e^{\pm J(\pi-\theta)}=-\sigma_i \pm J\omega_i$ as given in the Fig.13. Show that the square of the amplitude response $M^2(\omega)$ is maximum at $\omega_m^2=r_i^2|\cos 2\theta|$. **(8)**

Q.6 a. Following short circuit currents and voltages are obtained experimentally for a two port network

(i) with output short circuited $I_1=5mA \quad I_2=-0.3mA \quad V_1=25V$

(ii) with input short circuited $I_1=-5mA \quad I_2=10mA \quad V_2=30V$

Determine Y-parameters. **(8)**

b. The network of the Fig.14 contains a current controlled current source. For the network find the z-parameters. **(8)**

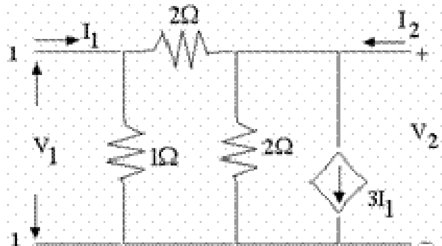


Fig.14

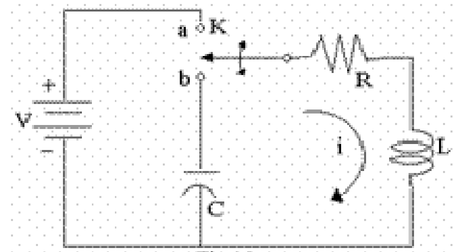


Fig.15

Q.7 a. In the network of Fig.15, K is changed from position a to b at t = 0. Solve for i, di/dt, and d^2i/dt^2 at t = 0 + if R = 1000Ω, L=1H, C=0.1 μF, and V = 100 V. **(8)**

b. Given $z(s)=\dfrac{s^2+Xs}{s^2+5s+4}$ what are the restrictions on 'X'. For z(s) to be a positive real function and find 'X' for $\mathrm{Re}[z(J\omega)]$ to have second order zero at $\omega=0$. **(8)**

Q.8 a. List out the properties of LC immittance function and then realize the network having the driving point impedance function $z(s)=\dfrac{2s^5+12s^3+16s}{s^4+4s^2+3}$ by continued fraction method. **(8)**

b. For the network function $Y(s)=\dfrac{2(s+1)(s+3)}{(s+2)(s+4)}$ synthesize in one Foster and one Cauer form. **(8)**

Q.9 a. The voltage ratio transfer function of a constant-resistance bridged-T network is given by $\dfrac{v_2}{v_1}=\dfrac{s^2+1}{s^2+2s+1}$ synthesize the network that terminated in a 1Ω resistor. **(8)**

b. Find the poles of system functions for low-pass filter with n =3 and n = 4 Butterworth characteristics. (Do not use the tables) **(8)**