**JUNE 2009**

## AMIETE – ET (OLD SCHEME)

**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.**

**Q.1 Choose the correct or the best alternative in the following: (2 × 10)**

a.

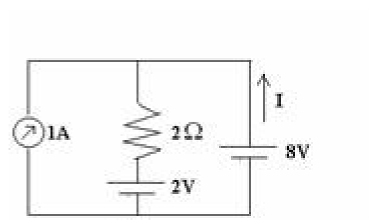


Fig.1

In the circuit shown, I is given by

**(A)** –2A.
**(B)** 2A.
**(C)** 3A.
**(D)** 4A.

b. A series RLC circuit has R=10,000 ohms, L=10mH, C=1μF. The resonant frequency $\omega_o$(rad/sec) is given by

**(A)** $10^4$. **(B)** $10^2$.
**(C)** $10^5$. **(D)** $10^3$.

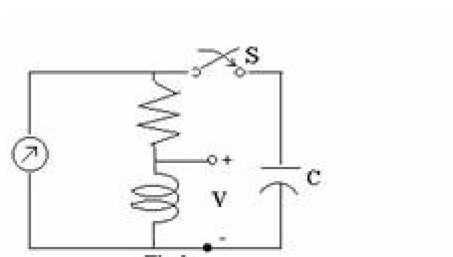


Fig.2

c. In the circuit shown, steady state is reached with S-open. S is closed at t=0 At t= $0_+$, the voltage across 'L' is given by

**(A)** 0.
**(B)** 6.
**(C)** –6.
**(D)** 2.

d. An instantaneous voltage of $V = 200 \sin 100t$ is applied across an element and the instantaneous power is observed to be $p = 2000 \sin 200t$. Then the element is a

**(A)** Resistor. **(B)** Inductor.
**(C)** Capacitor. **(D)** None of the above.

e. A system function $Z(s) = \frac{V(s)}{I(s)} = \frac{1}{s+3}$. The system is at rest for t<0. i(t)=unit step, is given at t = 0 then v(t) for t > 0 is given by

**(A)** $e^{-3t}$. **(B)** $1 - e^{-3t}$.
**(C)** $1 - 3e^{-3t}$. **(D)** $\frac{1}{3} - \frac{1}{3}e^{-3t}$.

f. The current i(t), through a 10Ω resistor in series with an inductance, is given by $i(t) = 3 + 4\sin(100t + 45^\circ) + 4\sin(300t + 60^\circ)$ Amperes. The RMS value of the current in the circuit is

**(A)** $\sqrt{41}$A. **(B)** $\sqrt{35}$A.
**(C)** 5A. **(D)** 11A.

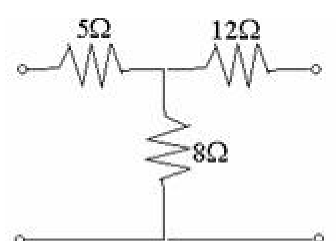

**Fig.3**

g. Determine the z-parameters of the network shown in Fig.3

**(A)** 5, 8, 12, 0
**(B)** 13, 8, 8, 20
**(C)** 8, 20, 13, 12
**(D)** 5, 8, 8, 12

h. The condition AD–BC=1 for a two port network implies that the network is a

**(A)** reciprocal network. **(B)** lumped element network.
**(C)** lossless network. **(D)** unilateral element network.

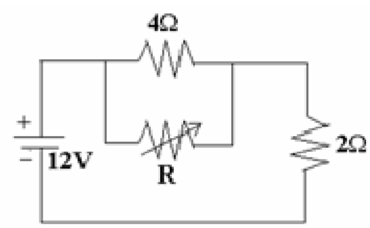

Fig.4

i. The value of the resistance 'R' in Fig.4 shown is adjusted such that the power dissipated in the 2Ω resistor is maximum. Under this condition

**(A)** The value of R is zero ohm.
**(B)** The value of R is 4 ohms.
**(C)** The power dissipated in the 2 ohms resistor is18W.
**(D)** The value of R is 2 ohms.

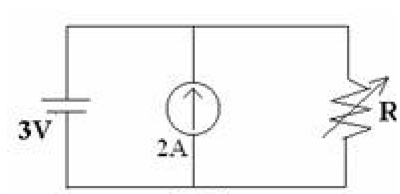

Fig.5

j. The value of R in the Fig.5 is adjusted so that Power developed by the voltage source is zero Watt. The value of R is

**(A)** 0Ω.
**(B)** 1.5Ω.
**(C)** 6Ω.
**(D)** 0.667Ω.

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

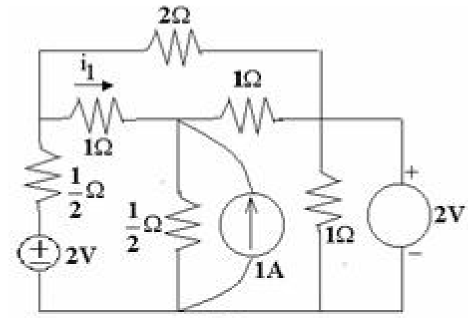

Fig.6

**Q.2** a. For the network shown in Fig.6, determine the numerical value of the branch current $i_1$. All the sources in the network are time invariant.

**(8)**

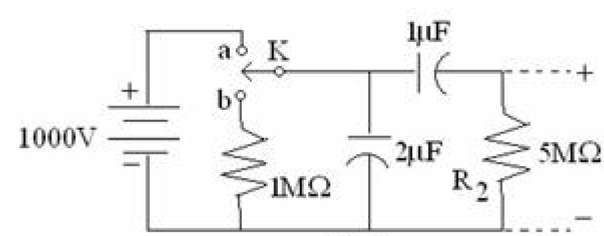

Fig.7

b. With switch K in a position a, the network shown in Fig.7 attains equilibrium. At time t=0, the switch is moved to position b. Find the voltage across $R_2$ as a function of time.

**(8)**

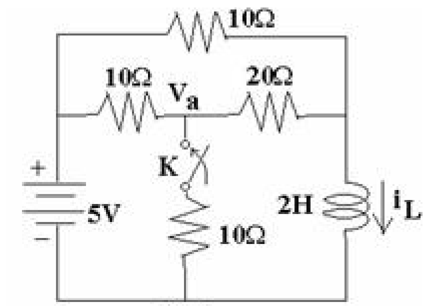


Fig.8

**Q.3** a. In the network shown in the Fig.8, a steady state is reached with the switch K open. At t=0, the switch is closed.
For the element values given, determine the value of $V_{a(0-)}$ and $V_{a(0+)}$.
**(8)**

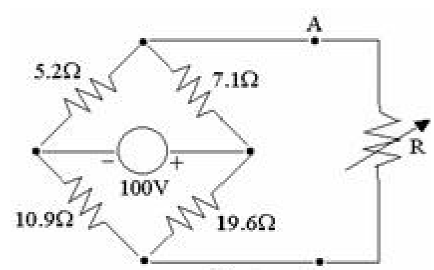


Fig. 9

b. Use the Thevenin equivalent of the network shown in Fig.9 to find the value of R which will receive maximum power. Find also this power. **(8)**

**Q.4** a. Given the ABCD parameters of two port network determine its 'Z' parameter. **(8)**

b. Find the y-parameters of the circuit shown in Fig.10. **(8)**

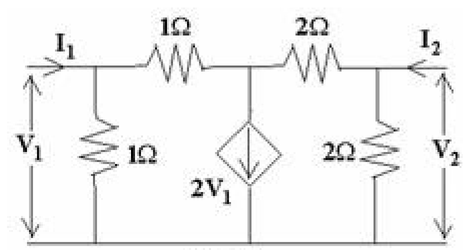

Fig.10

**Q.5** a. State the Hurwitz criteria for stability. Determine whether the given polynomial $H(s) = s_4 + 7s^3 + 4s^2 + 18s + 6$ is Hurwitz or not? **(8)**

b. Explain the following:
(i) phasor (ii) Resonance
(iii) Q (iv) Damping coefficient **(8)**

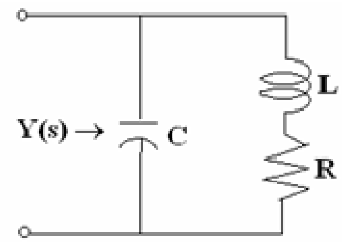

Fig.11

**Q.6** a. For the shunt peaking circuit shown in Fig.11 that the admittance Y(s) is of the form $Y(s) = \frac{K(s-s_1)(s-s_2)}{(s-s_3)}$ express $s_1$, $s_2$ and $s_3$ in terms of R, L and C.

(8)

**(8)**

**(8)**

b. Determine the amplitude and phase for F(J1) from the pole-zero plot in s-plane for the network function $F(s) = \frac{s^2+2s+5}{(s+2)(s+1)}$ **(8)**

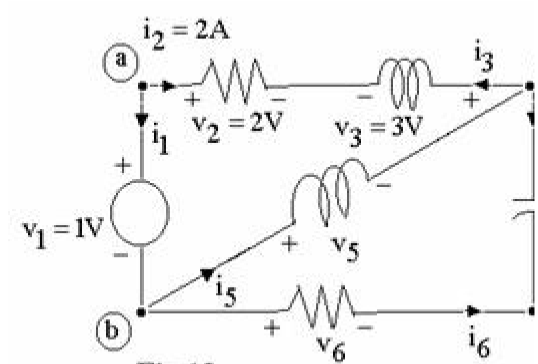


**Fig.12**

**Q.7** a. Check whether the function $Z(s) = \dfrac{2s^2 + 2s + 1}{s^3 + s^2 + s + 2}$ is a positive real function. **(8)**

b. Using Kirchhoff's laws to the network shown in Fig.12, determine the values of $v_6$ and $i_5$. Verify that the network satisfies Tellegen's theorem.

**Q.8** a. Find the networks for the following function in I Foster and I Caver form $Y(s) = \dfrac{(s+1)(s+3)}{(s+2)(s+4)}$. **(8)**

b. Synthesize the voltage ratio $\dfrac{V_2}{V_1} = \dfrac{s^2 + 1}{s^2 + 2s + 1}$ as a constant resistance bridged-T network terminated in a 1Ω resistor. **(8)**

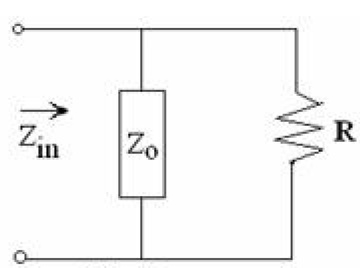


**Fig.13**

**Q.9** a. The input impedance for the network shown in Fig.13 is $Z_{in} = \dfrac{2s^2 + 2}{s^3 + 2s^3 + 2s + 2}$.

If $Z_o$ is an LC network:

(i) find the expression for $Z_o$.

(ii) synthesize $Z_o$ in a Foster series form. **(8)**

b. Synthesize the 3rd order low pass Butterworth filter terminated in a 1Ω load resistance. **(8)**