DECEMBER 2009

AMIETE – ET (OLD SCHEME)

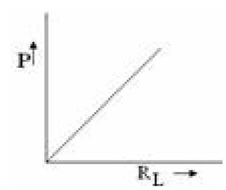
Code: AE08 **Subject: CIRCUIT THEORY & DESIGN**
Time: 3 Hours **Max. Marks: 100**

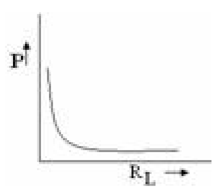
NOTE: There are 9 Questions in all.

- **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: (2x10)

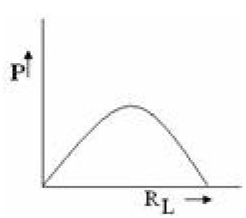
a.

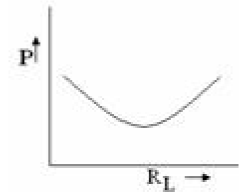




A voltage source with an internal resistance R_s, supplies power to a load R_L. The power P delivered to the load varies with R_L as

(A) **(B)**





(C) **(D)**

b. A series circuit has an impedance $Z = 5 - j12$, its susceptance is

(A) 5/13 **(B)** 5/169

(C) 12/13 **(D)** 12/169

c. If A is the incidence matrix of N_1 and B be the loop matrix of network N_2, the condition for the two networks to be duals of each other is that

(A) rank of [A] > rank of [B] **(B)** rank of [A] < rank of [B]

(C) rank of [A] = rank of [B] **(D)** None of these

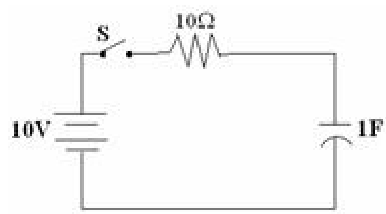


Fig.1

d. In the initially relaxed circuit shown in Fig.1, the switch S is closed at t=0. The value of current at t=0+ will be

(A) zero
(B) -1A
(C) +1A
(D) 100A

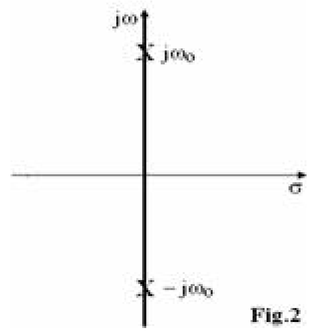
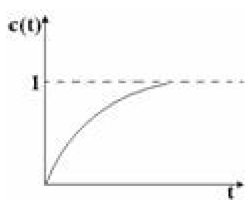
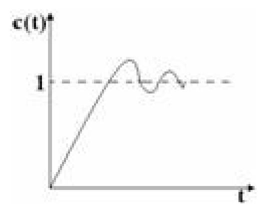


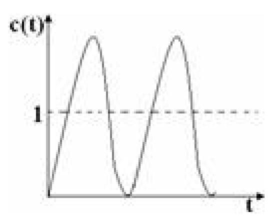
Fig.2

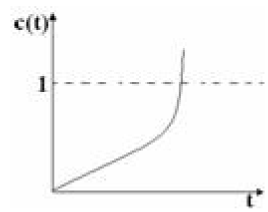
e. The closed-loop pole location of
 a network is shown in Fig.2.
 The nature of the unit step response
 would be





(A) **(B)**





(C) **(D)**

f. In a given circuit the input voltage and current are given by

$v = 10\sin(\omega t + 30^\circ)$

$i = 10\sin(\omega t - 30^\circ)$

The power consumed in the circuit is

(A) 100 watts **(B)** 50 watts

(C) 25 watts **(D)** 12.5 watts

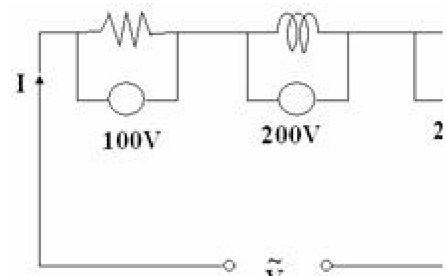


Fig.3

g. The voltmeter readings across different circuit elements are as shown in the Fig.3. The reactive component of the current I in the circuit is

(A) 10A **(B)**5A

(C) zero **(D)** 2A

h. For the two port network shown in Fig.4, select the correct statement

Fig.4

(A) It does not have z-parameter **(B)** It has z-parameters

(C) It does not have y-parameters **(D)** It does not have ABCD parameters

i. A network whose impedance function is $\frac{4(s^2+1)(s^2+9)}{s(s^2+4)}$ is synthesized. It consists of 'n' LC tank circuits in series with an inductance and/or a capacitance. The value of 'n' is

(A) zero **(B)** 1

(C) 2 **(D)** 3

j. The driving-point impedance of an RC network is given by $Z(s) = \frac{2s^2 + 7s + 3}{s^2 + 3s + 1}$. Its canonical realization will have

(A) 6 elements **(B)** 5 elements
(C) 4 elements **(D)** 3 elements

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

Q.2 a. State and explain the terminal relationships for ideal R, L and C in reference to network analysis. **(6)**

b. Define positive real function and write its properties. **(10)**

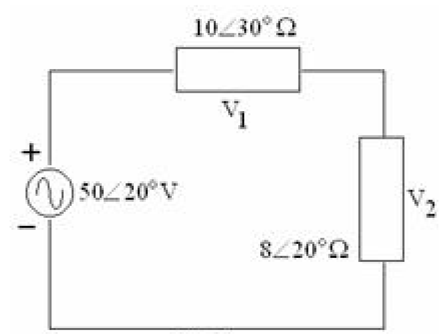


Fig.5

Q.3 a. Explain the concepts of duality in reference to electrical networks. Explain the graphical procedure of constructing the dual of a network. **(8)**

b. Find the voltages across the impedances in circuit shown in Fig.5. Transform the voltage source and $10\angle 30°\Omega$ impedance to a Norton's equivalent current source and again find the voltages. Compare results. **(8)**

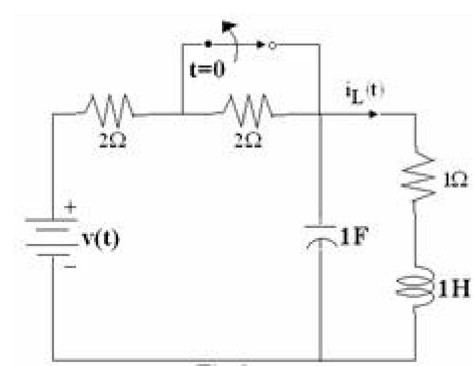


Fig.6

Q.4 a. State and illustrate with the help of an example the final value theorem in reference to electric networks. **(6)**

b. In the network shown in Fig.6, the switch is initially closed for a long time. The switch is opened at t=0. Find differential equation relating $i_L(t)$ and its derivatives with $v(t)$ and also evaluate the initial conditions required to solve for $i_L(t)$. **(10)**

Q.5 a. State super-position theorem in reference to electrical networks and also give its limitations. **(7)**

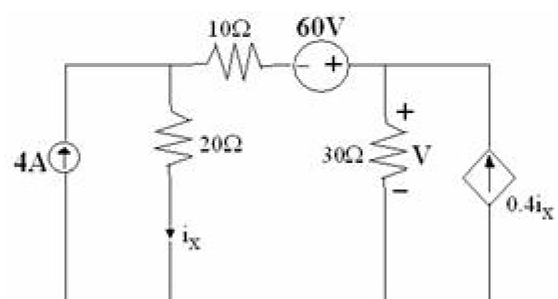


Fig.7

b. Use super-position theorem to find voltage V in the network shown in Fig.7. **(9)**

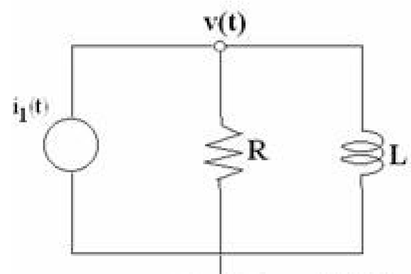


Fig.8

Q.6 a. The network shown in Fig.8 has a sinusoidal excitation $i_1(t) = I_1 \sin(\omega t + \phi)$. Determine the response node-to-datum voltage v(t) in the steady state. **(8)**

b. The networks shown in Fig.9 (i) & Fig.9 (ii) have the identical graphs. Verify Tellegen's theorem for these networks. **(8)**

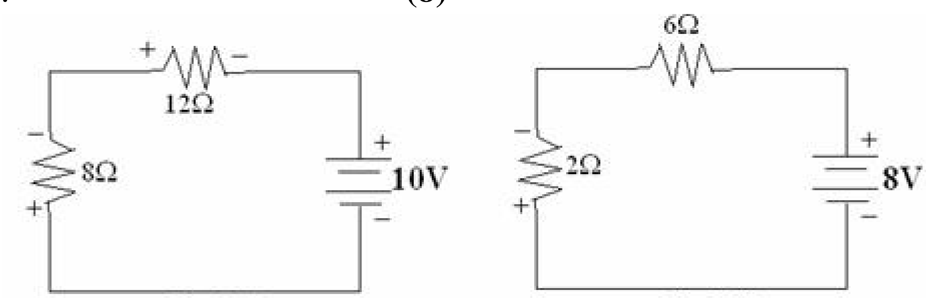


Fig.9 (i) Fig.9 (ii)

Q.7 a. Write the properties of
(i) L-C immittance functions.
(ii) R-C impedance functions.
(iii) R-L impedance functions. **(8)**

b. (i) A coil having a 2 Ω resistance is connected in series with a $50\mu F$ capacitor. The circuit resonates at 100 Hz. What is the inductance of the coil?
(ii) If the circuit is connected across a 100 V, 100 Hz ac source, find the power dissipated in the coil.
(iii) Calculate the voltages across the capacitor and the coil. **(8)**

Q.8 a. Show that when two 2-port networks N_1 and N_2 are connected in parallel, the equivalent Y-parameters of the combined network is the sum of Y-parameters of each individual 2-port network. **(7)**

b. Determine the h-parameters of the network shown in Fig.10. **(9)**

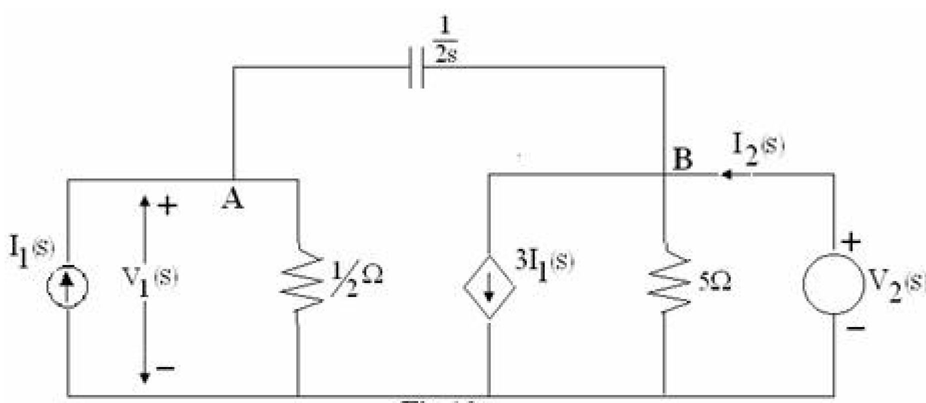


Fig.10

Q.9 Write notes on any **<u>TWO</u>** of the following:

(i) Properties of transfer function.
(ii) Chebyshev approximation.
(iii) Magnitude and frequency scaling. **(16)**