Code: AE59 Subject: CIRCUIT THEORY & DESIGN

AMIETE – ET

Time: 3 Hours **DECEMBER 2012** Max. Marks: 100

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **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. Which of them is a non linear device?

(A) Capacitor **(B)** Inductor
(C) Transistor **(D)** All of these

b. At time t=0, if the switching of source is done, then an initially relaxed capacitor behaves as a

(A) Short circuit **(B)** Open circuit
(C) Voltage source **(D)** Current source

c. If a function f(t) is shifted by 'T', then is correctly represented as

(A) f(t–T)U(t) **(B)** f(t)U(t–T)
(C) f(t–T)U(t–T) **(D)** f(t–T)(t–T)

d. Laplace transform of function e^{-2t} sin 2t is

(A) $2/(s^2+2s+8)$ **(B)** $4/(s^2+2s+8)$
(C) $2/(s^2+4)$ **(D)** $4/(s^2+4)$

e. Nortons theorem is valid for

(A) Linear loads only **(B)** bilateral loads only
(C) Nonlinear loads only **(D)** all types of load

f. A lattice with Z_a=2s and Z_b=2/s is terminated in a load R_L=2. Then input impedance is

(A) An inductor of value 2 H **(B)** A capacitor of value ½ F
(C) A resistor of value 2 ohms **(D)** A resistor of value ½ ohms

g. Use CG:GC transformation to obtain the element values of an LP filter given the values for the HP filter as C=2F and R= 2.5Ω. R' and C' in LP filter have respectively values

(A) $\frac{1}{2.5}\Omega$, 1/2 F **(B)** $2\Omega, \frac{1}{2.5}$ F

(C) 2Ω, 2.5F **(D)** $\frac{1}{2}\Omega, \frac{1}{2.5}$ F

h. Given Z(s)=(s+2)/(s+1)(s+3). The number of elements in a canonical realization is

(A) 2 **(B)** 3
(C) 4 **(D)** 5

i. In a series RLC circuit, the maximum voltage across the capacitor occurs at a frequency

(A) Equal to resonant frequency **(B)** Greater than resonant frequency
(C) Smaller than resonant frequency **(D)** Both **(A)** and **(B)**

j. The h parameter of two port network can be obtained by setting

(A) $I_1 = 0$ or $V_2 = 0$ **(B)** $I_1 = 1A$ or $V_2 = 0$
(C) $I_1 = 0$ or $V_2 = 1V$ **(D)** All of these

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

Q.2 a. For the circuit shown in Fig.1, determine the equivalent voltage source and equivalent current source across the terminal 'a' and 'b' **(8)**

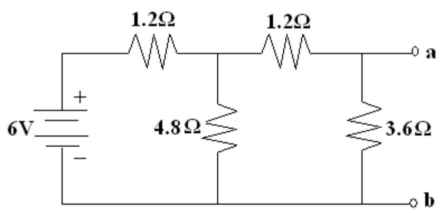

Fig. 1

b. Express the node voltage V in Fig. 2 as a function of time if R=½Ω. Given that the initial voltage across the capacitor (C) is +10V and there is no initial current through the inductor (L). **(8)**

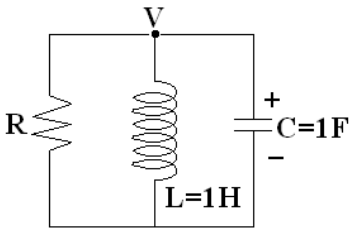

Fig. 2

Q.3 a. Fig.3 shows a two loop network. Assuming that prior to closing of switch K (at t=0) there was no voltage across the capacitor nor any current through the inductor. Find $\frac{di_1}{dt}(t=0^+)$, $\frac{di_2}{dt}(t=0^+)$, $\frac{d^2i_1}{dt^2}(t=0^+)$ and $\frac{d^2i_2}{dt^2}(t=0^+)$ **(8)**

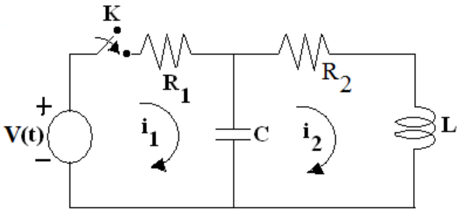

Fig. 3

b. In the given network, the switch K is opened at t=0. At $t=0^+$, solve the values of V, $\frac{dV}{dt}$ and $\frac{d^2V}{dt^2}$, if I=10A, R=1000 Ω and C=1 μF (Fig. 4) **(8)**

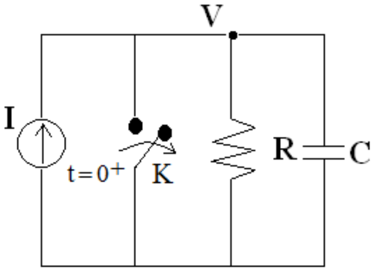

Fig. 4

Q.4 a. At t=0, a switch is closed, connecting a voltage source $V=V_m \sin\omega t$ to a series RL circuit. Find the expression for current by using method of Laplace transform. **(8)**

b. For the circuit as shown in Fig. 5 obtain the value of transfer function H(s) and impulse response h(t) if the output is taken as voltage across the capacitor. **(8)**

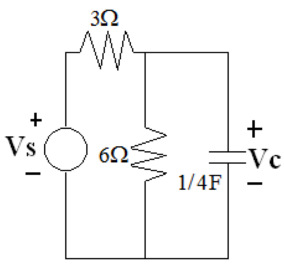

Fig. 5

Q.5 a. State and explain Norton's theorem. Obtain the Thevenin's equivalent of circuit shown in Fig.6. **(8)**

b. State and prove Superposition theorem. **(8)**

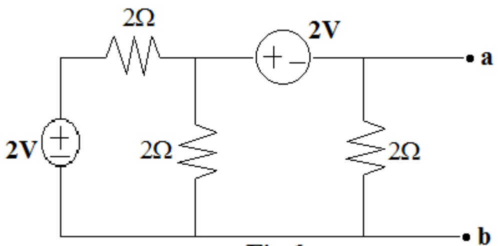

Fig.6

Q.6 a. Define Y and h parameters of a two-port. Hence obtain the relations between them. **(8)**

b. For the circuit as shown in Fig.7, find the Z-parameters. **(8)**

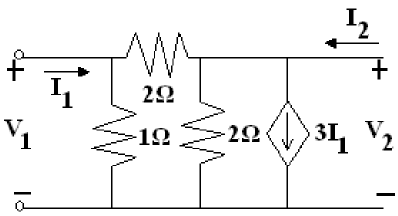

Fig.7

Q.7 a. Write the properties of positive real functions. **(8)**

b. For the given polynomial $P(S)=S^6+3S^5+4S^4+6S^3+13S^2+27S+18$, determine the number of zeros lying in the right half of S-plane, left half of S-plane and on the imaginary axis of S-plane. **(8)**

Q.8 a. Given $F(S)=\frac{6(S+2)(S+4)}{S(S+3)}$, find the continued function expression and hence synthesise the network for the case when F(S) is an impedance Z(S). **(8)**

b. Given Real $[Z_d(j\omega)] = \frac{18\omega^2+48}{\omega^4+17\omega^2+16}$. Obtain $Z_d(S)$. Show that $Z_d(S)$ is RC impedance and realize it in Cauer form. **(8)**

Q.9 a. Design a low pass T and π section filter having a design R_o=600 ohm and cut-off frequency=2000 Hz. **(8)**

b. Synthesize the function given below with a 1 ohm termination $Z_{21}(s)=\frac{2}{s^3+3s^2+4s+2}$. **(8)**