ROLL NO. _____

Code: AE59 **Subject: CIRCUIT THEORY & DESIGN**

AMIETE – ET

Time: 3 Hours **DECEMBER 2014** **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. In order to apply superposition theorem, it is necessary that the network be only

(A) Linear and reciprocal **(B)** Time-invariant and reciprocal
(C) Linear and time-invariant **(D)** Linear

b. An L-C impedance or admittance function:

(A) has simple poles and zeros in the left half of the s-plane
(B) has no zero or pole at the origin or infinity
(C) is an odd rational function
(D) has all poles on the negative real axis of the s-plane

c. The Laplace-transformed equivalent of a 5/8 F capacitor is

(A) $\frac{5}{8s}$ **(B)** $\frac{5s}{8}$
(C) $\frac{8s}{5}$ **(D)** $\frac{8}{5s}$

d. Quality factor of purely resistive circuit is

(A) 0 **(B)** 1
(C) 1.5 **(D)** ∞

e. A 2 – port network using Z parameter representation is said to be reciprocal if

(A) $Z_{11} = Z_{22}$ **(B)** $Z_{12} = Z_{21}$
(C) $Z_{12} = -Z_{21}$ **(D)** $\Delta Z = 1$

f. Given $F(s) = \frac{5s+3}{s(s+1)}$ then $f(\infty) =$

(A) 1 **(B)** 2
(C) 0 **(D)** 3

g. Z – parameter of network shown in **Fig.1** is :

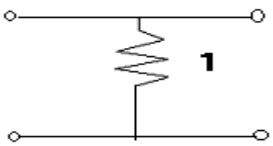

Fig.1

(A) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ **(B)** $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} -1 & -1 \\ -1 & -1 \end{bmatrix}$ **(D)** Does not exist

h. A network function can be completely specified by:

(A) Real parts of zeros **(B)** Poles and zeros
(C) Real parts of poles **(D)** Poles, zeros and a scale factor

i. In the circuit shown in **Fig.2**, the switch s is closed at t = 0 then the steady state value of the current is

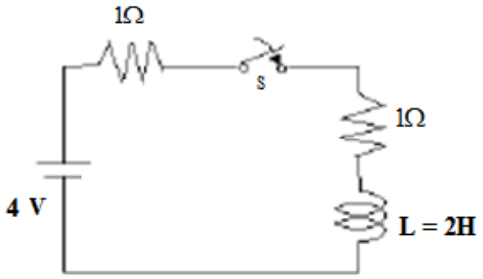

Fig.2

(A) 1 Amp **(B)** 2 Amp
(C) 3 Amp **(D)** 4/3 Amp

j. The following property relates to LC impedance or admittance functions:

(A) The poles and zeros are simple and lie on the imaginary axis
(B) There must be either a zero or a pole at origin and infinity
(C) The highest (or lowest) powers of numerator or denominator differ by unity
(D) All of the above

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

Q.2 a. Calculate the voltage V_{AB} across terminals A and B in the network, shown in **Fig 3.** **(8)**

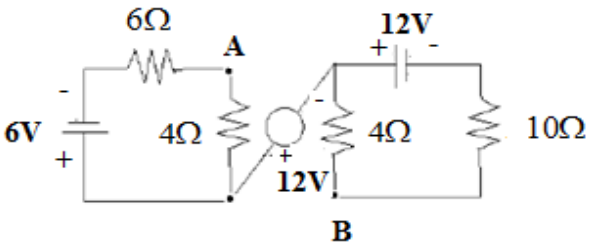

Fig.3

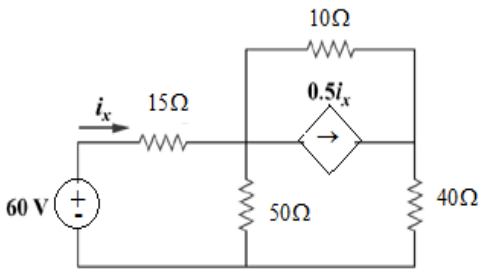

Fig.4

b. Using source transformation, calculate the current i_x flowing in the circuit shown in **Fig 4**. **(8)**

Q.3 a. After steady-state current is established in the R-L circuit shown in **Fig.5** with switch S in position 'a', the switch is moved to position 'b' at t = 0. Find $i_L(0+)$ and i(t) for t > 0.What will be the value of i(t) when t = 4 seconds? **(8)**

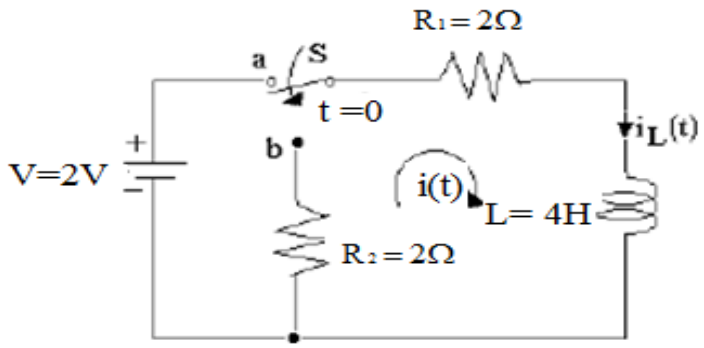

Fig.5

b. Determine the amplitude and phase for F(j2) from the pole-zero plot in s-plane for the network function $F(s) = \dfrac{4s}{(s^2 + 2s + 2)}$ **(8)**

Q.4 a. Switch K in the circuit shown in **Fig.6** is opened at t = 0^+ Draw the Laplace transformed network for t > 0^+ and find the voltages V_1 (t) and V_2 (t), t > 0^+. **(8)**

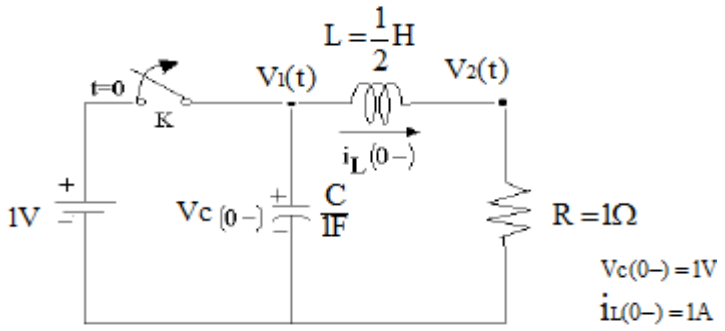

Fig.6

b. In the network shown in **Fig. 7**, the switch 'K' is moved from position 'a' to position 'b' at t=0, a steady state having previously been established at position 'a'. Solve the current i(t) using the Laplace transformation method (**8)**

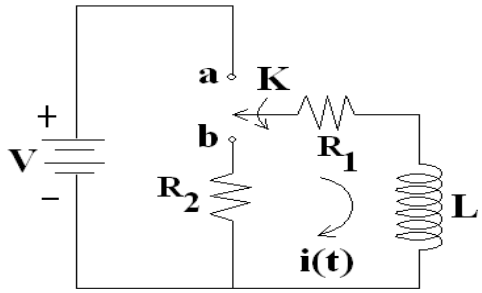

Fig.7

Q.5 a. Determine the equivalent Norton network at the terminals a and b of the circuit shown in **Fig.8** below. **(8)**

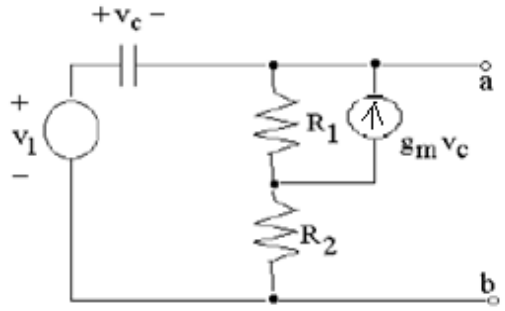

Fig.8

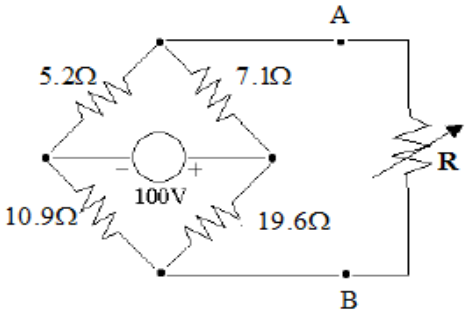

Fig.9

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.6 a. Test the following polynomial for the Hurwitz property. **(8)**

$P(s) = s^4 + s^3 + 2s^2 + 3s + 2$

b. Determine if the function F(s) = $\frac{s^3 + 5s^2 + 9s + 3}{s^3 + 4s^2 + 7s + 9}$ is Positive real function. **(8)**

Q.7 a. Following short circuit currents and voltages are obtained experimentally for a two port network. Determine Y parameters. **(8)**

(i) With output short circuited I_1=5mA, I_2 = - 0.3mA, V_1=25V

(ii) With input short circuited I_1 = - 5mA, I_2 = -10mA, V_2=30V

b. Derive the Relationship between Z and Y parameter. **(8)**

Q.8 a. Consider the system given by system function Z(s) = $\frac{2(s+1)(s+3)}{(s+2)(s+6)}$. Design a RC network. **(8)**

b. Design a one-port RL network to realize the driving point admittance function F(s) = $\frac{3(s+2)(s+4)}{s(s+3)}$ **(8)**

Q.9 a. Synthesise the network that has a transfer impedance $Z_{21}(s)$ = $\frac{2}{s^3 + 3s^2 + 4s + 2}$ and 1Ω termination at the output. **(8)**

b. Show that the filter described by the transfer function H(s)= $\frac{1}{(s^2 + 0.73536s + 1)(s^2 + 1.84776s + 1)}$ is a low pass filter. **(8)**