ROLL NO. ________________

Code: AE59/AE110 **Subject: CIRCUIT THEORY & DESIGN**

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **JUNE 2015** **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 the following is not a passive element?

(A) Resistance **(B)** Capacitance
(C) Inductance **(D)** Transistor

b. If any network has 'b' branches & 'n' nodes then minimum number of equations required to solve this network are

(A) b – n **(B)** b – n – 1
(C) b – n + 1 **(D)** 2(b – n)

c. Laplace transform of $e^{-at}\cos\omega t$ is

(A) $\frac{s+a}{(s+a)^2+\omega^2}$ **(B)** $\frac{s}{s^2+\omega^2}$

(C) $\frac{s-a}{(s-a)^2+\omega^2}$ **(D)** $\frac{\omega^2}{(s+a)^2+\omega^2}$

d. Final value of function $X(s)=\frac{7s+20}{s(s+5)}$

(A) 0 **(B)** ∞
(C) 4 **(D)** 7/5

e. What is Thevenin's voltage (V_{TH}) & Thevenin Resistance (R_{TH}) at 'ab' of the network shown in Fig.1?

(A) 6V, 4Ω
(B) 10V, 4Ω
(C) 14V, 4Ω
(D) 16V, 4Ω

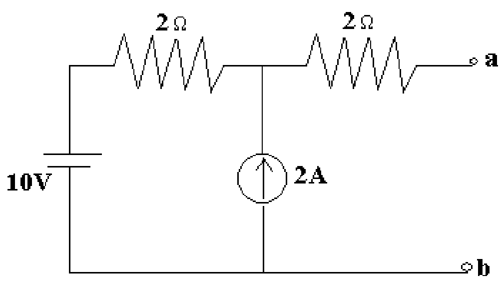

Fig.1

f. Z Parameters of network shown in Fig.2 are

(A) $Z = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ **(B)** $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

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

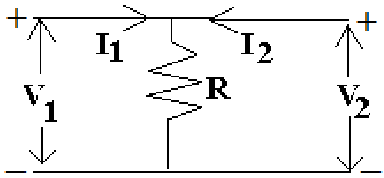

Fig.2

g. What is transfer function of network which has pole – zero plot as shown in Fig.3 is

(A) $(s + 1)(s + 2) / s(s^2 + 4)$
(B) $s(s^2 + 4) / (s + 1)(s + 2) / (s^2 + 4)$
(C) $s(s + 1)(s + 2) / (s^2 + 4)$
(D) $\dfrac{s(s+2)}{(s+1)(s^2+4)}$

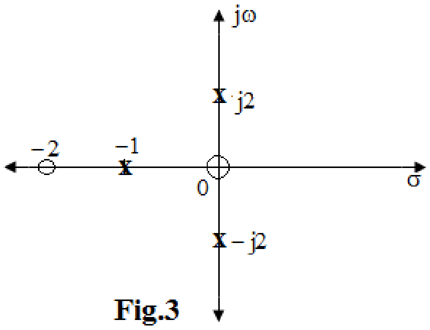

Fig.3

h. Which of the following statement is wrong regarding positive real function, $\dfrac{N(s)}{D(s)}$

(A) All coefficients in N(s) & D(s) must be real & positive
(B) D(s) must be Hurwitz Polynomial
(C) Residues may be negative
(D) $M_1M_2 - N_1N_2 \geq 0$ for all ω

i. Inverse Laplace transform of $\dfrac{1}{(s+1)(s+2)}$

(A) $\dfrac{1}{2}\left(e^{-t} - e^{-2t}\right)$ **(B)** $e^{-t} - e^{-2t}$

(C) $e^{-t} + e^{-2t}$ **(D)** $e^{-t} + 2e^{-2t}$

j. Which of the following is II order butterworth Polynomial?

(A) $s^2 + 1.414s + 1$ **(B)** $s^2 + s + 1$
(C) $s^2 + 1.618s + 1$ **(D)** $s^2 + 0.636s + 1$

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

Q.2 a. Calculate current 'I' in circuit shown in Fig.4 using Loop analysis. **(8)**

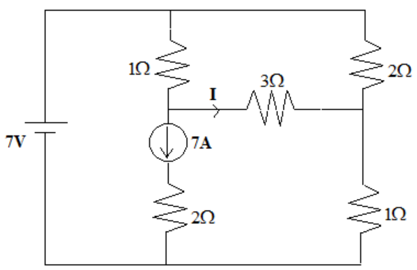

Fig.4

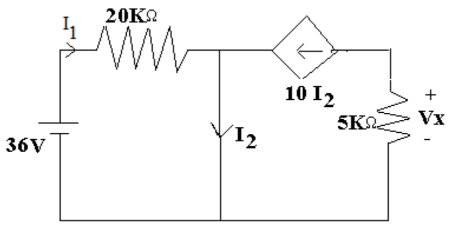

Fig.5

b. Calculate I_1, I_2 and V_x in the circuit shown in Fig.5. **(8)**

Q.3 a. For the circuit as shown in Fig.6 switch S is changed from position 'a' to 'b' at t = 0. Find values of i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at t = 0. **(8)**

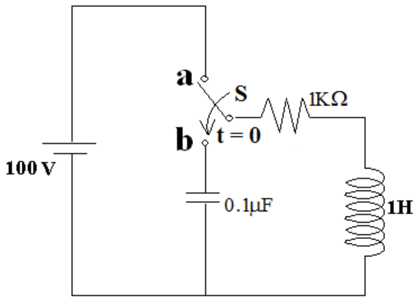

Fig.6

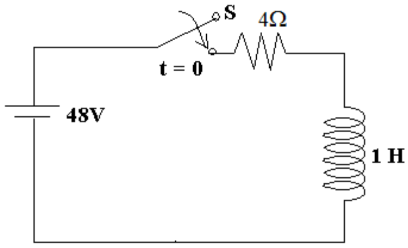

Fig.7

b. In a series R-C circuit, the value of R = 10Ω & C = 25 nF, A sinusoidal voltage of 50 MHz is applied and the maximum voltage across the capacitor is 2.5V, find the maximum voltage across the series combination. **(4)**

c. Find the solution of the equation $\frac{dx}{dt} + 2x = 10$ with initial value x(0) = 2. **(4)**

Q.4 a. Consider R-L series circuit as shown in Fig.7 here i(0) = 3A. using Laplace transform find current i(t) at $t \geq 0$. **(8)**

b. Find the current i(t) for the network using Laplace Transform shown in Fig.8. **(8)**

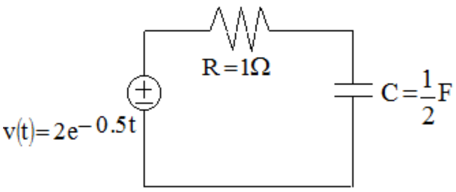

Fig.8

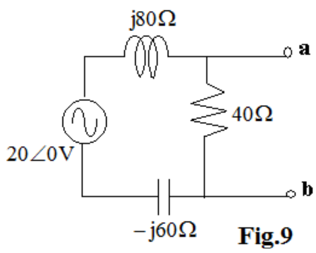

Fig.9

Q.5 a. Find Norton's equivalent along a, b terminals for the network shown in Fig.9 **(8)**

b. Find Z(s) for the network shown in Fig.10 **(8)**

Q.6 a. For the circuit shown in Fig.11 obtain voltage transfer function. **(4)**

b. Draw Pole- Zero Plot for $Z(s) = \frac{s+1}{s^2 + 2s + 2}$ **(4)**

c. Test the positive realness of $F(s) = \frac{2s^2 + 2s + 1}{s^3 + 2s^2 + s + 2}$ **(8)**

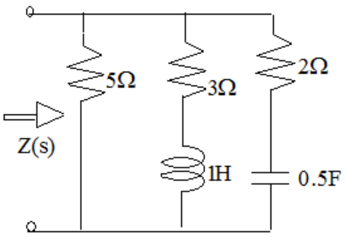

Fig.10

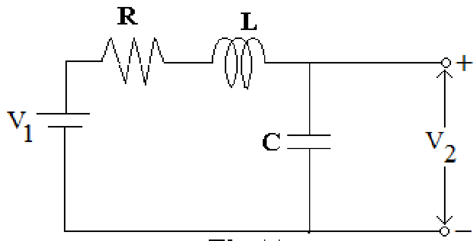

Fig.11

Q.7 a. Obtain h –parameter for the circuit shown in Fig.12 **(4)**

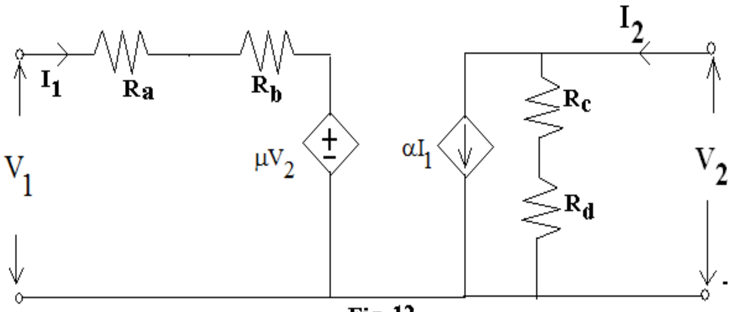

Fig. 12

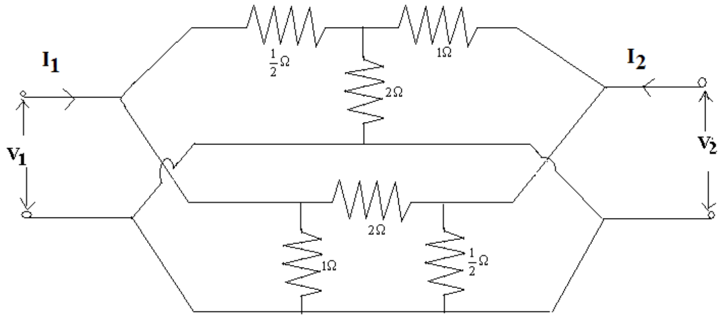

Fig. 13

b. The Y Parameter of the network are Y = $\begin{bmatrix} 2 & 4 \\ 3 & 1 \end{bmatrix}$. Obtain h Parameters. **(4)**

c. The network shown in Fig.13 consists of a resistive T and a resistive π network connected in parallel. Determine Y parameter for overall network. **(8)**

Q.8 An Impedance function has the pole & zero pattern shown in the Fig.14. If $Z(-2) = -\frac{136}{16}$ obtain Foster – I & Cauer – I forms of this impedance function. (here 0 shows zeros and X shows poles). **(16)**

Q.9 a. Show that the $\frac{V_2}{V_g}$ for Double terminated lattice shown in Fig. 15 is

$$\frac{V_2}{V_g} = \frac{\frac{1}{2}(Z_b - R)}{Z_b + R}$$ **(8)**

b. Draw optimum filter for the transfer impedance.

$$Z_{21}(s) = \frac{0.577}{s^3 + 1.37s^2 + 1.359s + 0.577}$$ **(8)**

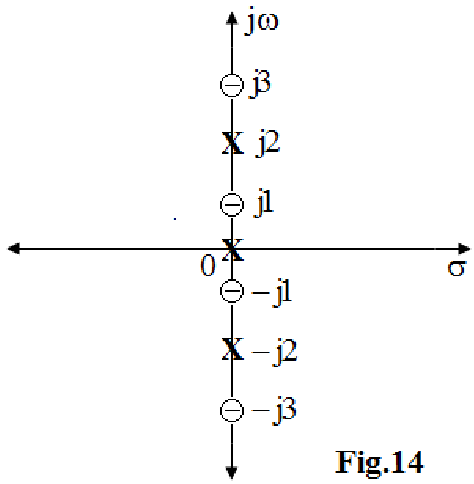

Fig.14

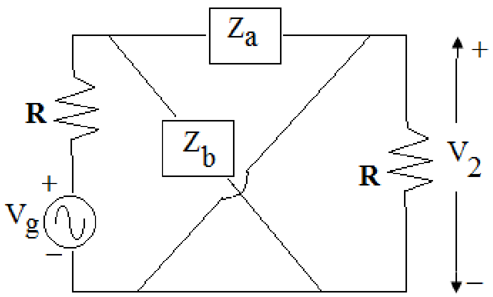

Fig.15