ROLL NO. ___________________

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

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **June 2018** **Max. Marks: 100**

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

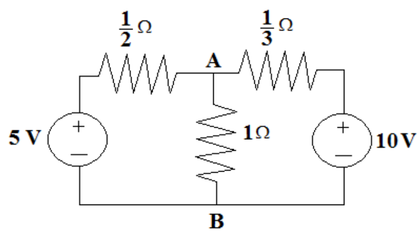
NOTE: There are 9 Questions in all.

- **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)

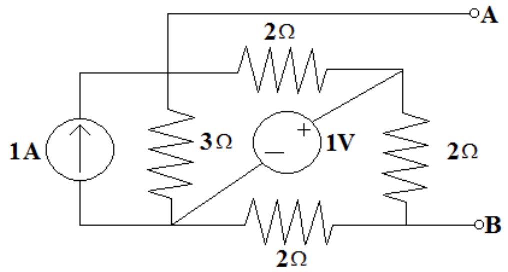
a. KCL is a consequence of law of conservation of
(A) Energy **(B)** Charge
(C) Flux **(D)** All of these

b. The potential of point A in the given network is
(A) 6 V
(B) 7 V
(C) 8 V
(D) None of these

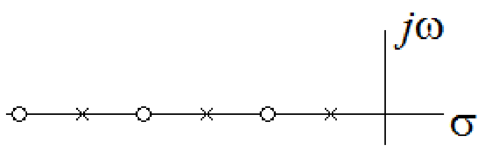


c. The impulse response of the first order system described by the differential equation $\frac{dy}{dt} + 4y = u(t)$
(A) $4\delta(t)$ **(B)** $e^{-2t}u(t)$
(C) e^{-4t} **(D)** None of these

d. The Thevenin impedance across the terminal AB of the given network is
(A) $\frac{10}{3}$
(B) $\frac{20}{9}$
(C) $\frac{13}{4}$
(D) $\frac{11}{5}$



e. The pole zero configuration of an impedance function is given in the figure. The network is
(A) RL realizable
(B) RC realizable
(C) LC realizable
(D) RLC realizable



f. The ABCD parameter of an ideal transformer with n:1 ratio are given as

(A) $\begin{bmatrix} n & 0 \\ 0 & -\frac{1}{n} \end{bmatrix}$ **(B)** $\begin{bmatrix} 0 & n \\ \frac{1}{n} & 0 \end{bmatrix}$

(C) $\begin{bmatrix} n & 0 \\ 0 & \frac{1}{n} \end{bmatrix}$ **(D)** $\begin{bmatrix} 0 & n \\ -\frac{1}{n} & 0 \end{bmatrix}$

g. The transfer function $T(s) = \dfrac{s^2}{s^2 + as + b}$ belongs to an active

(A) Lowpass filter **(B)** High pass filter

(C) Band pass filter **(D)** Band reject filter

h. A Hurwitz polynomial has

(A) Zeros only in the left half of the s-plane

(B) Poles only in the left half of the s-plane

(C) Zeros anywhere in the s-plane

(D) Poles on $j\omega$ -axis only

i. The design of electric wave filter is based on its characteristic impedance which at all frequencies is a

(A) Pure resistance

(B) Pure reactance

(C) Pure resistance in the pass band and pure reactance in the stop band

(D) Pure reactance in the pass band and pure resistance in the stop band

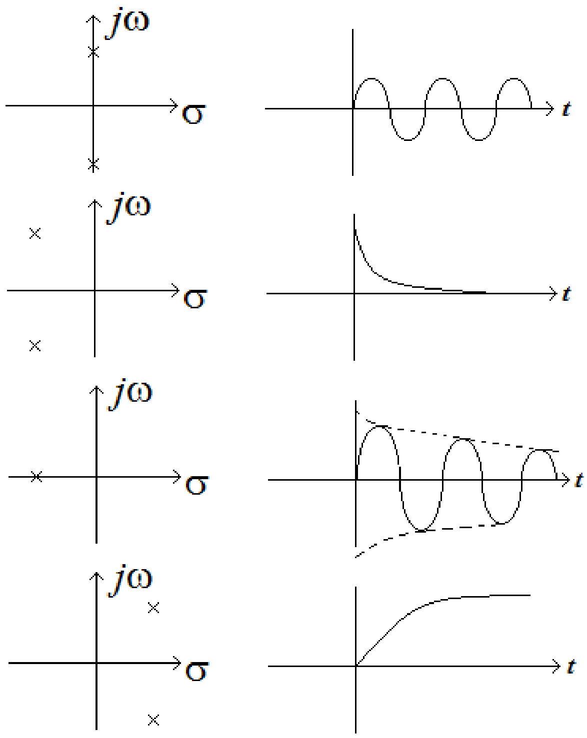
j. Which of the following pairs of poles and responses is correctly matched

(A)

(B)

(C)

(D)



Poles Response

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

Q.2 a. Fig.1 shows four windings on a magnetic flux conducting core. Using different shaped dots, establish polarity markings for the windings. **(3)**

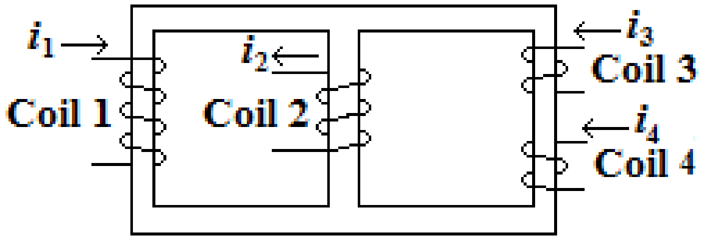


Fig. 1

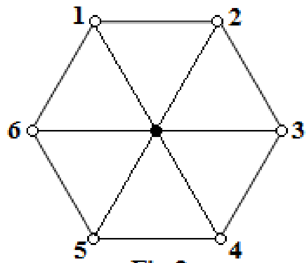


Fig.2

b. Draw different possible trees for the graph shown in Fig 2. Show branches with solid lines and chords with dotted lines. **(5)**

c. Write the node basis equations in generalized form using node-to-datum voltages as variables for the network shown in Fig 3. **(8)**

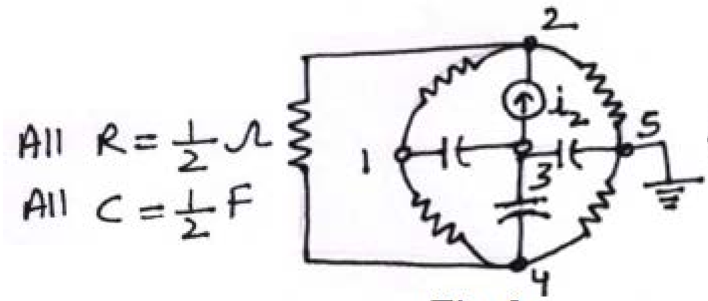


Fig. 3

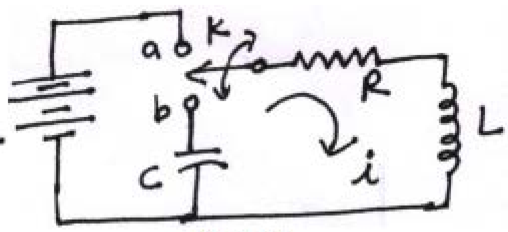


Fig. 4

Q.3a. In the network shown in Fig 4, *K* is changed from position *a* to *b* at $t = 0$. Solve for i, $\frac{di}{dt}$ and $\frac{d^2 i}{dt^2}$ at $t = 0^+$ if $R = 1000\ \Omega$, $L = 1\text{H}$, $C = 0.1\ \mu F$ and $V = 100$ volts. **(5)**

b. For the circuit shown in Fig. 5, the capacitor voltage is $v_c = 20\sqrt{2}\sin 0.5t$ V. Find (i) instantaneous energies stored in the capacitor and inductor (ii) **Q** of the circuit, resonant frequency if the resistor and the inductor are interchanged. **(11)**

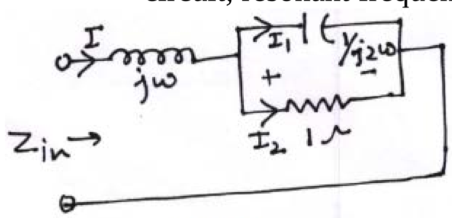


Fig. 5

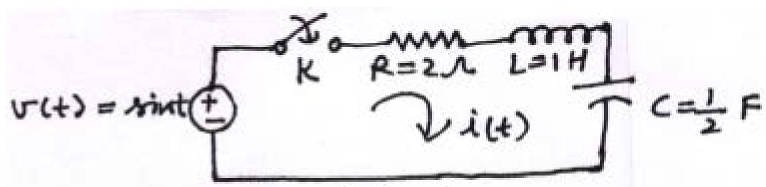


Fig. 6

Q.4 a. In the series RLC circuit shown in Fig. 6, the applied voltage is $v(t) = \sin t$ for $t > 0$. For the element values specified, find $i(t)$ if the switch *K* is closed at $t = 0$ **(13)**

b. The waveform shown in Fig. 7 occurs only once. Write an equation for $v(t)$ in terms of steps and related functions as needed. **(3)**

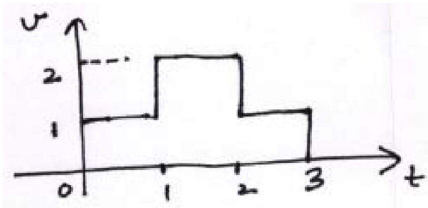


Fig. 7

Q.5 a. In the network shown in Fig. 8(a), $v_1 = V_0 e^{-2t} \cos t\, u(t)$ and for the network shown in Fig. 8(b), $i_1 = I_0 e^{-t} \sin 3t\, u(t)$. The impedance of the passive network N is found to be $Z(s) = \frac{(s+2)(s+3)}{(s+1)(s+4)}$

(i) with N connected to the voltage source as in Fig. 8(a), what will be the complex frequencies in the current $i_1(t)$?

(ii) with N connected to the current source as in Fig. 8(b), what will be the complex frequencies in the voltage $v_1(t)$? **(6)**

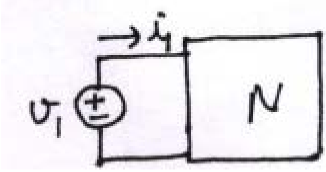


Fig. 8(a)

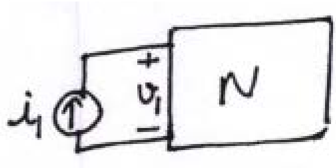


Fig. 8(b)

b. For the network shown in Fig. 9, determine Thevenin's circuit in s-domain at the load terminal having load R in series with L. **(10)**

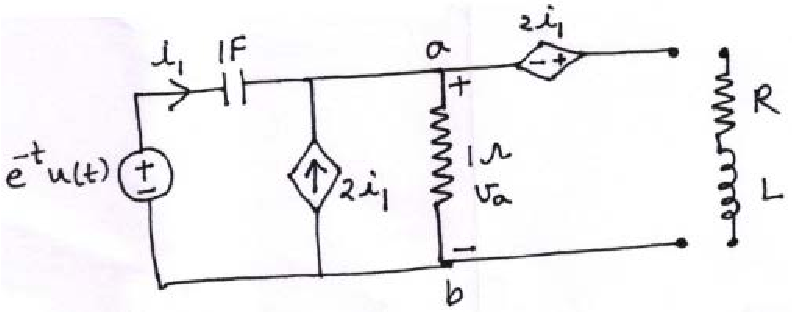


Fig. 9

Q.6 a. For the resistive two port network shown in Fig. 10, determine the numerical value for (i) G_{12} (ii) Z_{12} (iii) Y_{12} and (iv) α_{12} **(8)**

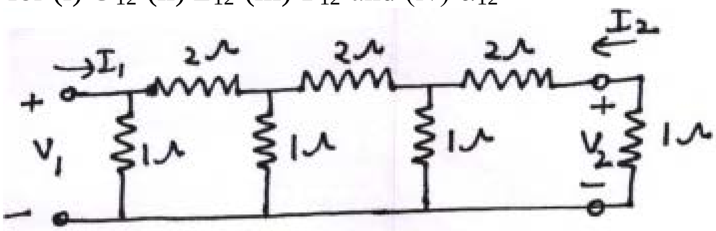


Fig. 10

b. Given $R_1 = R_2 = 1\ \Omega$, C_1=1F and C_2=2F in the network shown in Fig. 11. For what values of k, will the network be stable? **(8)**

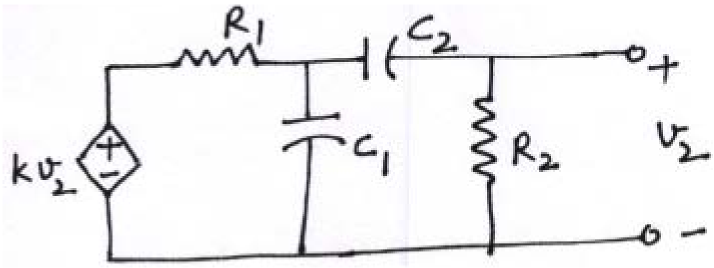


Fig. 11

Q.7 a. The network shown in Fig. 12 contains both dependent current source and dependent voltage source. For the element values given, determine the y and z parameters. **(8)**

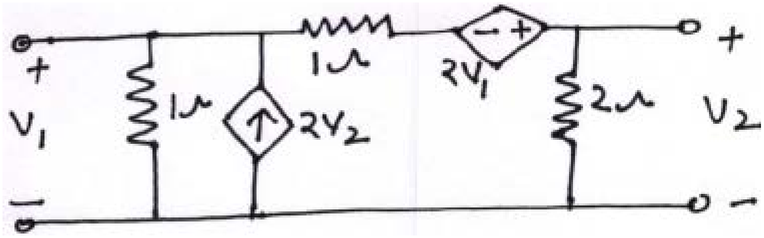


Fig. 12

b. Determine y - parameters for the resistive network shown in Fig. 13. **(8)**

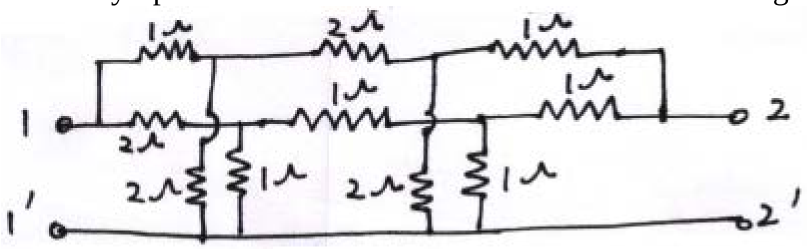


Fig.13

Q.8 Obtain Foster and Cauer forms (both I and II in each case) realization of

$$F(s) = \frac{2(s+1)(s+3)}{s(s+2)}.$$ **(16)**

Q.9 a. Synthesize the voltage ratio $\frac{V_2}{V_1} = \frac{s^2+1}{s^2+2s+1}$ as a constant resistance bridged T network terminated in a l Ω resistor. **(6)**

b. What do you understand by maximally flat low pass filter approximations? **(10)**