ROLL NO. ___________________

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

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **DECEMBER 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. A resistor with $R\Omega$ in a network is replaced in its dual network as

(A) resistor of same value **(B)** resistor with $\frac{1}{R}\Omega$

(C) conductance of $\frac{1}{R}$ **(D)** none of these

b. In a second order network if $\varsigma = 1$ *or* $\theta = 1/2$, the roots of the solution are

(A) real and distinct **(B)** imaginary
(C) real and equal **(D)** complex conjugate

c. The initial and final values of $F(s) = \dfrac{s+9}{s^2+7s+3}$ are respectively

(A) 1 and 0 **(B)** 1 and 9/3
(C) 9/3 and 0 **(D)** ∞ and 0

d. In $s = \sigma + j\omega$ the term σ is known as

(A) real frequency **(B)** complex frequency
(C) neper frequency **(D)** none of these

e. If $N(s) = \dfrac{s^2(s+3)}{(s+1)(s^2+4s+5)}$ the poles of $N(s)$ lies on

(A) right half of the s-plane **(B)** imaginary axis
(C) left half of the s-plane **(D)** on either side of the s-plane

f. In both Foster and Cauer form realization, the number of elements is

(A) one greater than the number of internal critical frequencies of the immittance Function.
(B) equal to the number of internal critical frequencies of the immittance Function.
(C) one less than the number of internal critical frequencies of the immittance Function.
(D) None of these

g. The immittance function $F(s) = \frac{(s+2)(s+4)}{(s+1)(s+5)}$ represents

(A) LC driving point admittance **(B)** RC diving point admittance
(C) RC driving point impedance **(D)** LC driving point impedance

h. The pole zero diagram for a function F(s) is shown in Fig.1, then the function F(S) is

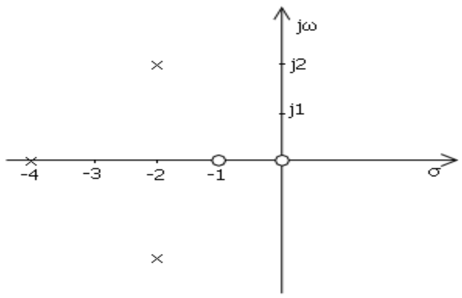

Fig.1

(A) $\frac{(s+4)(s^2+4s+8)}{s(s+1)}$ **(B)** $\frac{s(s+1)}{(s+4)(s^2+4s+8)}$

(C) $\frac{s(s+1)}{(s+4)(s^2+2)}$ **(D)** $\frac{(s+4)(s^2+2s)}{s(s+1)}$

i. Which of the following is necessary condition for the transfer function
(A) The degree of N(s) should be less than degree of D(s)
(B) All the coefficients in the polynomials N(s) and D(s) must be real
(C) Real part of the poles must be negative or zero.
(D) All of these

j. If the system function has a zero at $z = -\sigma + \omega_i$ *and* $\sigma < \omega_i$, then at $\omega = \omega_i$
(A) magnitude response will be peaked and phase response will decrease rapidly.
(B) magnitude response will be peaked and phase response will increase rapidly.
(C) magnitude response will dip and phase response will decrease rapidly.
(D) magnitude response will dip and phase response will increase rapidly.

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

Q.2 a. Explain the following terms
(i) Graph of a network
(ii) tree of a graph. **(5)**

b. Using source transformation technique find the equivalent voltage source between the points A and B for the network as shown in Fig.2 **(4)**

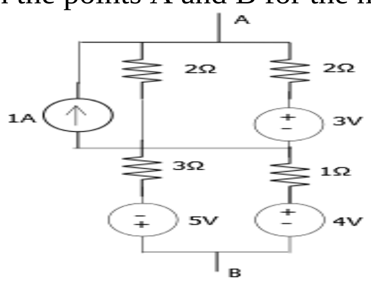

Fig.2

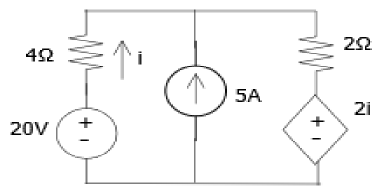

Fig.3

c. Determine the current 'i' using mesh analysis for the network as shown in Fig.3 **(7)**

Q.3 a. In a network shown in Fig.4, $v_1(t) = e^{-t} \quad for \quad t \geq 0$ and is zero for all t<0. If the capacitor is initially uncharged, determine the value of $\frac{d^2 v_2}{dt^2} \;\; at \;\; t = 0^+$ **(10)**

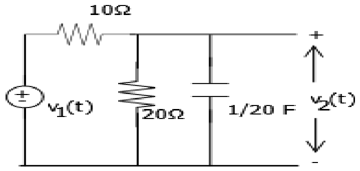

Fig.4

b. A series RL circuit is driven by a sinusoidal voltage source $V \sin \omega t$. Find the expression for current by solving differential equation. **(6)**

Q.4 a. Obtain the Laplace transform of the function $e^{-at} \sin \omega t$ from the definition of Laplace transform. **(4)**

b. Using partial fraction expansion find the inverse Laplace transform of

$$F(s) = \frac{s}{(s+1)^2 (s+3)}$$ **(6)**

c. For the waveform shown in Fig.5, find the Laplace transform of the signal. **(6)**

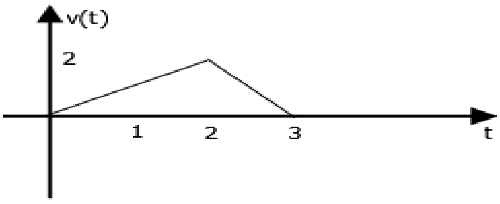

Fig.5

Q.5 a. For the LC network shown in Fig.6, find the transform impedance Z(s). **(7)**

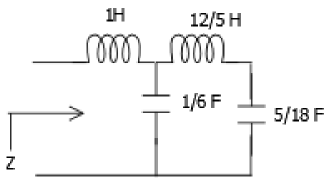

Fig.6

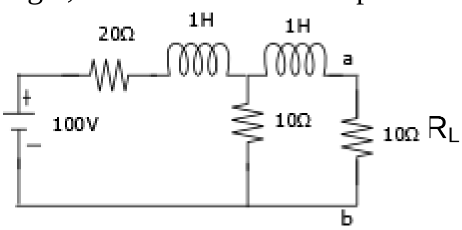

Fig.7

b. In the network shown in Fig.7, find the voltage across R_L=10Ω using Thevinin's theorem. **(9)**

Q.6 a. Explain the voltage and admittance transfer functions for a two port network. **(4)**

b. Determine the voltage transfer function and driving point impedance of the network shown in Fig.8 **(5)**

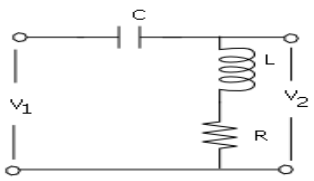

Fig.8

c. Find the range of k in $F(s)$ so that $F(s) = 2s^4 + s^3 + ks^2 + s + 2$ is Hurwitz. **(7)**

Q.7 a. Express the h-parameters in terms of Z-parameters. **(7)**

b. For the network shown in Fig.9, find the transmission parameters. **(9)**

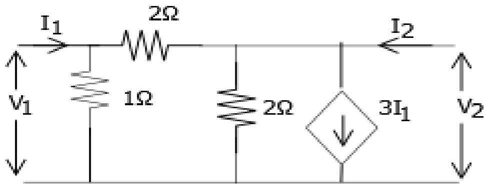

Fig.9

Q.8 a. Represent the admittance function $Y(s) = \frac{4(s+1)(s+3)}{s(s+2)}$ in Foster form and hence synthesize the Network. **(10)**

b. Indicate the following functions are either RC, RL or LC impedance functions with appropriate reasons. **(6)**

(i) $Z(s) = \frac{s^3 + 2s}{s^4 + 4s^2 + 3}$ (ii) $Z(s) = \frac{s^2 + 4s + 3}{s^2 + 6s + 8}$

Q.9 a. Obtain the zeros of transmission for the network shown in Fig.10 **(8)**

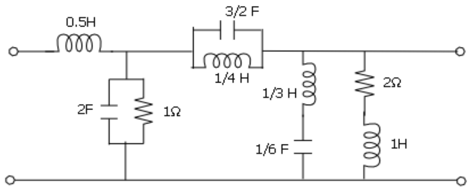

Fig.10

b. Synthesize the network function $Z_{21}(s) = \frac{2}{s^3 + 2s^2 + 4s + 2}$ into an LC network terminated with 1Ω. **(8)**