ROLL NO. ___________________

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

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **JUNE 2017** **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. If there are 'b' branches and 'n' nodes the number of equations will be:

(A) n-1 **(B)** b
(C) b-n-1 **(D)** b-n+1

b. Kirchhoff's laws are applicable to circuits with:

(A) Distributed parameters **(B)** Lumped parameters
(C) Passive elements **(D)** Non-linear resistances

c. The electrical energy required to raise the temperature of a given amount of water is 200kwh. If the heat losses are 20%., total energy required is:

(A) 250 kwh **(B)** 240 kwh
(C) 160 kwh **(D)** None of these

d. An independent voltage source in series with an impedance $Z_s = R_s + jX_s$ delivers a maximum average power to a load impedance Z_L when

(A) $Z_L = R_s + jX_s$ **(B)** $Z_L = R_s$
(C) $Z_L = jX_s$ **(D)** $Z_L = R_s - jX_s$

e. The first and the last critical frequencies (singularities) of a driving point impedance function of a passive network having two kinds of elements, are a pole and a zero respectively. The above property will be satisfied by

(A) RL network only **(B)** RC network only
(C) LC network only **(D)** RC as well as RL networks

f. Consider the following statements S1 and S2
S1: At the resonant frequency the impedance of a series *RLC* circuit is zero.
S2: In a parallel *GLC* circuit, increasing the conductance *G* results in increase in its *Q* factor.
Which one of the following is correct?

(A) S1 is FALSE and S2 is TRUE **(B)** Both S1 and S2 are TRUE
(C) S1 is TRUE and S2 is FALSE **(D)** Both S1 and S2 are FALSE

g. The period of the signal x(t) = 8 sin (0.8πt + π /4) is

(A) 0.4πs **(B)** 0.8πs
(C) 1.25s **(D)** 2.5s

h. The initial current through the inductor is zero, while the initial capacitor voltage is 100V. The switch is closed at t=0. The current i through the circuit is:

(A) $5\cos(5\times10^3t)$A **(B)** $5\sin(10^4t)$A
(C) $10\cos(5\times10^3t)$A **(D)** 10sin(104t)A

i. If we double the voltage in a simple dc circuit and cut the resistance to half, then the current will

(A) Become four times **(B)** Become twice
(C) Stay the same as it was before **(D)** Become half as great

j. The average power delivered to an impedance (4 - j3)Ω by a current 5cos(100πt + 100π)A is

(A) 44.2W **(B)** 50W
(C) 62.5W **(D)** 125W

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

Q.2 a. Find V_a, V_b, and V_c in the network of Fig.2 (a) using nodal analysis. **(10)**

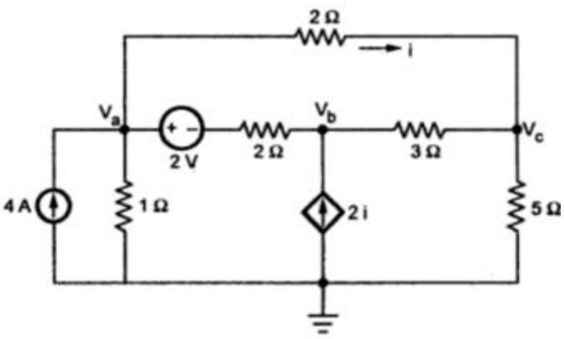

Fig.2 (a)

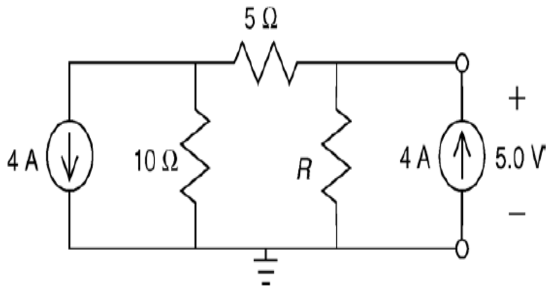

Fig.2 (b)

b. Consider the circuit shown in Fig.2 (b). Find the value of the resistance, R using source transformation technique. **(6)**

Q.3 a. Find the current i(t) for the network in Fig.3. When the voltage source is e(t)=$2e^{-0.5t}u(t)$ and $vc(0-) = 0$ **(9)**

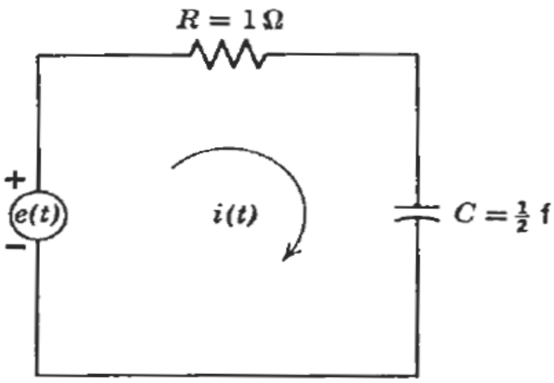

Fig.3

b. Find particular solutions for the differential equation $\frac{d^2i}{dt^2}+3\frac{di}{dt}+2i=0$ subject to the initial conditions: $i(0+)= 1, \frac{di(0+)}{dt} = 0$ **(7)**

Q.4 a. State and prove the following properties of Laplace Transform **(2+3+3)**
i) Modulation, ii) Multiplication by t^n, iii) Derivative

b. Given that $\mathbf{F}(s) = \frac{12(s+1)(s+3)}{s(s+2)(s+4)(s+5)}$, find the inverse Laplace transform using partial fraction expansion method **(8)**

Q.5a. In the circuit shown in the figure Fig.5 (a), find the value V_{TH} and $R_{TH,}$ **(3+3)**

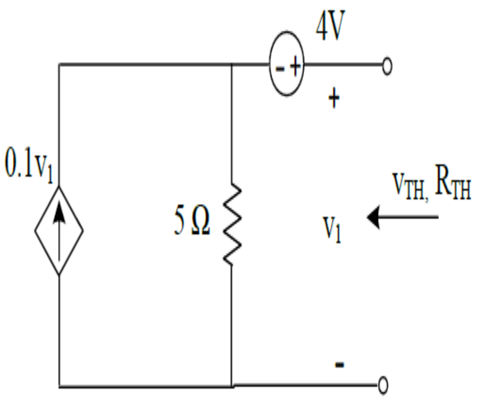

Fig.5 (a)

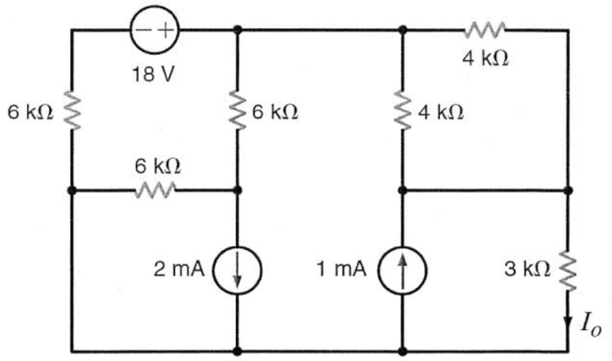

Fig.5(b)

b. State the superposition theorem and find I_0 in the network shown in Fig.5 (b). **(10)**

Q.6 a. Determine the ABCD parameters of the network shown in Fig.6 (a). **(6)**

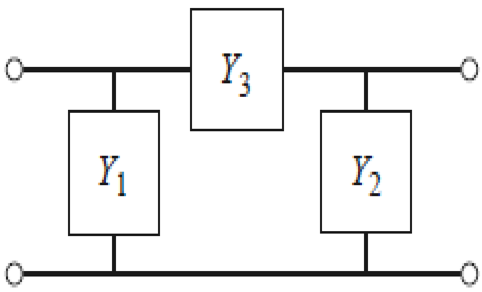

Fig.6 (a)

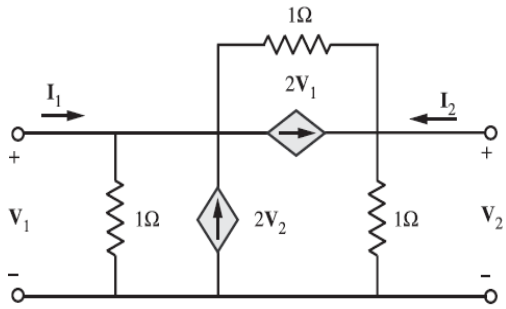

Fig.6 (b)

b. Determine **y** and **z** parameters of the network of Fig.6 (b) **(10)**

Q.7 a. Test whether the polynomial P(s) is Hurwitz polynomial or not. **(7)**
$P(s) = s^4+3s^3+5s^2+5s+2$

b. Find the transform impedance Z(s) of the given one port network shown in Fig.7 **(4)**

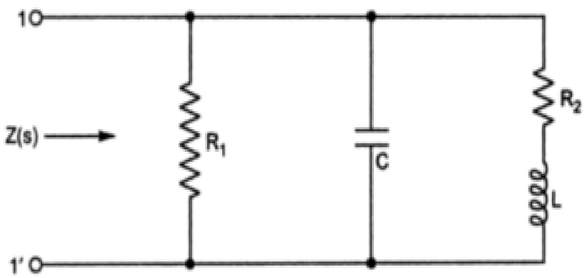

Fig.7

c. The transfer function of a system is given $G(s) = \frac{s+3}{s(s^2+2)}$, determine its response for unit step input. **(5)**

Q.8 a. Write the properties of LC-impedance functions and find whether Z(s) is LC function or not? $Z(s)= s^5+4s^2+5s/3s^4+6s^2$ **(8)**

b. Synthesize the following impedance function using II form of Cauer network. **(8)**

$$Z(s) = s\frac{(s^2+3)(s^2+5)}{(s^2+2)(s^2+4)}$$

Q.9 a. Synthesize the following function $Z_{21}(s)$ into the form shown in Fig.9 (a) **(9)**

$$Z_{21}(s) = \frac{2}{s^3+3s^2+4s+2}$$

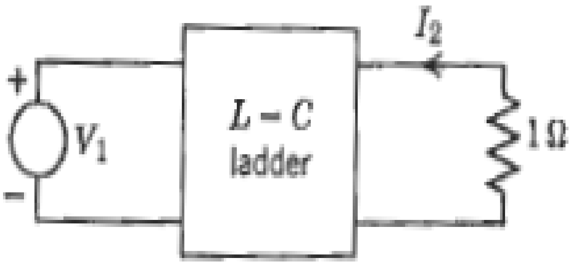

Fig.9 (a)

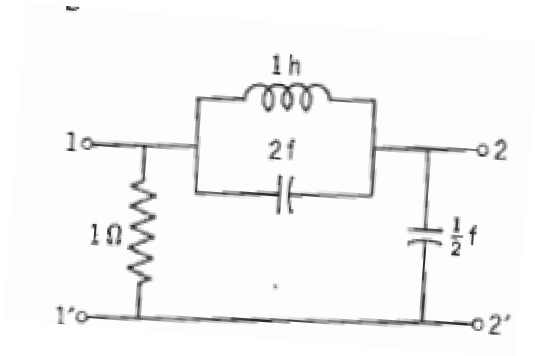

Fig. 9(b)

b. Show that the residue condition holds for the network shown in Fig.9 (b) **(7)**