ROLL NO. _____

Code: AE08 **Subject: CIRCUIT THEORY & DESIGN**

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **OCTOBER 2012** **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 characteristic equation represents a non-linear resistance?

(A) v+10 i=0 **(B)** i+3v=10
(C) $v = i^2$ **(D)** All of these

b. If there are b branches and n nodes, the number of KCL equations required will be

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

c. A 500 watt 220 V bulb is supplied with 110V. The power consumption by the bulb will be _____

(A) 250 W **(B)** 125 W
(C) slightly more than 125 W **(D)** Slightly less than 125 W

d. The Thevenin's impedance between A and B in the circuit shown below in Fig.1 is

(A) 3.0Ω
(B) 3.75Ω
(C) 3.25Ω
(D) 20Ω

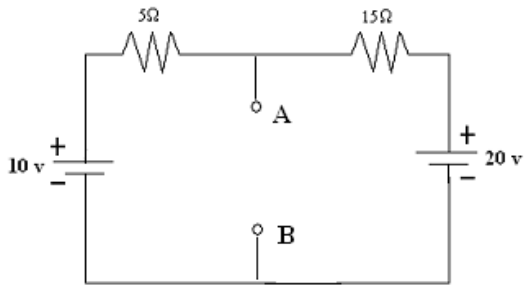

Fig.1

e. What is the efficiency of a network working under maximum power transfer condition?

(A) 100% **(B)** 50%
(C) 0.0% **(D)** 70.7%

f. In an RLC series circuit, the impedance at resonance is

(A) minimum **(B)** maximum
(C) zero **(D)** infinity

g. The open-circuit impedance parameter Z_{11} for the T-network shown below in Fig.2 is

(A) $Z_a + Z_b$
(B) $Z_a + Z_b + Z_c$
(C) $Z_b + Z_c$
(D) $Z_a + Z_c$

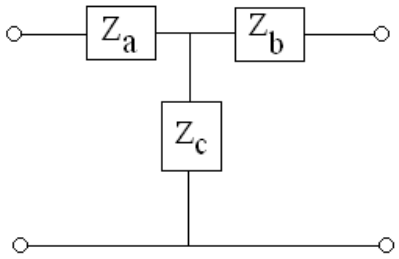

Fig.2

h. $F(S)= \dfrac{(S+1)(S+3)}{S(S+2)}$ represents an

(A) R C impedance
(B) R C admittance
(C) R C impedance and an R L admittance
(D) R L admittance.

i. The transfer function

$$T(S) = \frac{S^2}{S^2 + aS + b}$$

Belongs to an active

(A) Low pass filter **(B)** High pass filter
(C) Band pass filter **(D)** Band-reject filter

j. The coupling between two magnetically coupled coils is said to be ideal if the coefficient of coupling is

(A) Zero **(B)** 0.5
(C) 1 **(D)** 2

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

Q.2 a. Explain what do you understand by the duality in reference electrical networks. **(8)**

b. Fig.3 shows a network containing one capacitor and several resistors. The capacitor is charged to voltage V_0. Find the expression for the current $i_1(t)$ through the resistance R_1. **(8)**

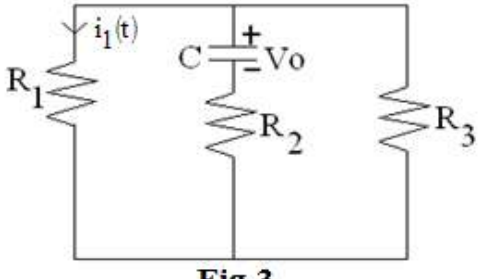

Fig.3

Q.3 a. State the superposition theorem in reference to electrical network. Can this theorem be applied directly to calculate the power in an element of the network? Explain. **(8)**

b. In the network shown below in Fig.4 determine the value of impedance Z_L for maximum power and calculate the maximum power **(8)**

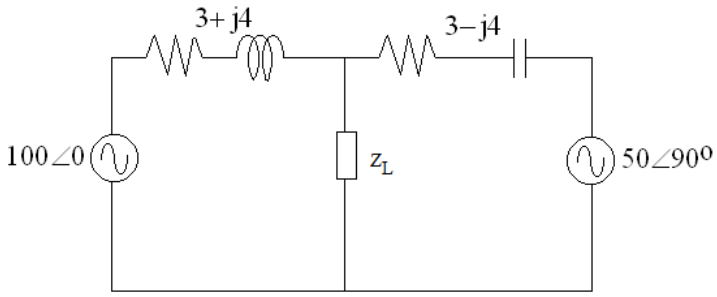

Fig.4

Q.4 a. Show that the sum of energy stored by the inductor and the capacitor connected in series at resonance at any instant is constant and is given by LI^2 **(8)**

b For the circuit shown below in Fig.5 **(8)**

$Z_1 = (5 - j3)\Omega$, $Z_2 = (4 + j2)\Omega$ and $Z_3 = (2 + j3)\Omega$

Find:

(i) The input impedance Z_{in}

(ii) The input current I

(iii) The current through Z_2

(iv) Is the series parallel circuits operating at its resonant frequency?

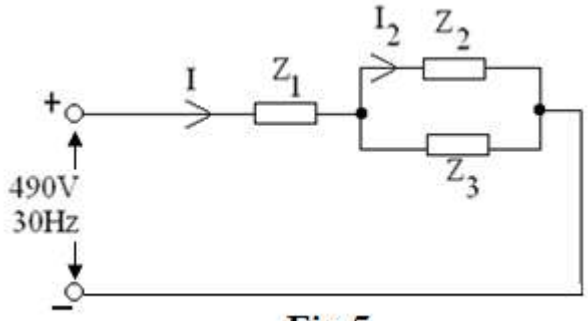

Fig.5

Q.5 a. Define hybrid-parameters for a two- port network. **(8)**

b. Obtain Y-parameters of the circuit given below in Fig.6. Draw its equivalent model and find whether the network is reciprocal or symmetrical? **(8)**

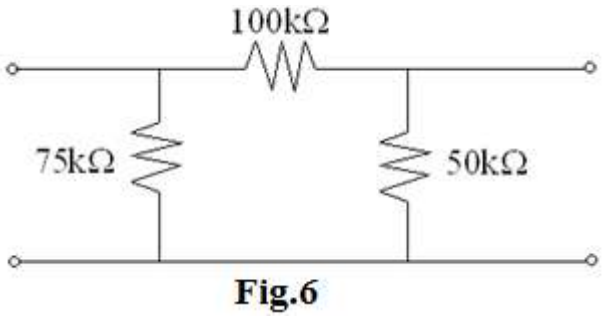

Fig.6

Q.6 a. State the properties of 'POSITIVE REAL FUNCTIONS'. **(8)**

b. Test whether the polynomial $P(S) = S^5 + 3S^3 + S$ is Hurwitzian or not. **(8)**

Q.7 a. Synthesize the function $Z(S) = \frac{S(S^2+10)}{(S^2+4)(S^2+16)}$ using first Foster form of realization. **(8)**

b. Synthesize the LC impedance function **(8)**

$Z(S) = \frac{(S^2+1)(S^2+3)}{S(S^2+2)}$ in II Cauar Form

Q.8 a. List the various properties of transfer functions of electrical networks. **(8)**

b. Determine the values of a, b and c for the given function $|F(j\omega)|$ to be a maximally flat magnitude function. **(8)**

$F(S) = \frac{S+a}{S^2+bS+c}$

Q.9 a. An ideal voltage source in series with an impedance is shown in the following Fig.7. Obtain its equivalent current source across AB **(4)**

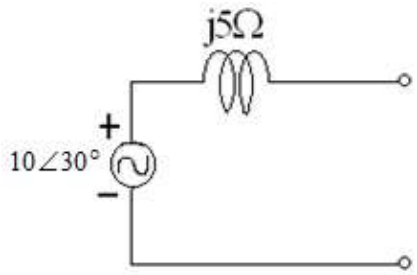

Fig.7

b. Calculate the following for half wave alternating current
(i) Average value
(ii) RMS value
(iii) Form factor. **(8)**

c. Describe the sine function using two oppositely rotating phasors. **(4)**