ROLL NO. ___________________

Code: AE59 Subject: CIRCUIT THEORY & DESIGN

AMIETE – ET (NEW SCHEME)

Time: 3 Hours **DECEMBER 2011** **Max. Marks: 100**

NOTE: There are 9 Questions in all.

- **Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.**
- **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 network N′ is dual of a network N if

(A) Both network have same mesh equation
(B) Both network have same node equations
(C) Mesh equation of one are the node equation of other
(D) All of them are correct

b. At time t=0, if the switching of source is done, then an initially relaxed inductor behave as a

(A) Short circuit **(B)** Open circuit
(C) Voltage source **(D)** Current source

c. If roots of characteristic equation lie on $j\omega$ axis, then system gives

(A) Sinusoidal response **(B)** Unstable response
(C) Asymptotically stable response **(D)** None

d. Laplace inverse of $4s/(s^2+4)$

(A) 2sin2t **(B)** 4sin2t
(C) 2cos2t **(D)** 4cos2t

e. Any n^{th} order differential equation requires minimum

(A) n initial conditions to solve
(B) n+1 initial conditions to solve
(C) n–1 initial conditions to solve
(D) None

f. The reciprocity relation for h parameters is

(A) $h_{12} = 0$ (B) $h_{21} = 0$
(C) $h_{12} + h_{21} = 0$ (D) $h_{12} - h_{21} = 0$

g. The step response of a second order Butterworth function exhibit an overshoot. As the order n increases, the overshoot ________

(A) decreases (B) increases
(C) becomes zero (D) is not affected

h. F(s)=(s+1)/(s+2) is

(A) RC impedance only (B) RL admittance only
(C) RC admittance and RL impedance (D) RC impedance and RL admittance

i. The Z and Y parameter matrices are inverse of each other. Hence Det Z is given by

(A) Z_{11}/Y_{11} (B) Z_{22}/Y_{11}
(C) Z_{22}/Y_{22} (D) $Z_{22}Y_{11}$

j. Consider $F(s) = \frac{s+3}{s^2 + 2s + 1}$. In regard to F(s) being positive real function (PR).

(A) F(s) is PR as denominator polynomial has its roots in the left half of the s-plane.
(B) F(s) is PR as both numeretor and denominator polynopmials are Hurwitz
(C) F(s) is not PR as the poles and zeros do not alternate on the negative real axis
(D) F(s) is not PR as the ensignant E(ω) is negative for some values of ω

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

Q.2 a. Express voltage at node, V as a function of time if capacitor is initially charged at 10 volt and there is no initial current in the inductor (Fig.1) **(10)**

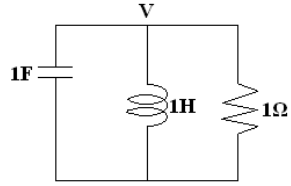

Fig. 1

b. Find the value of voltage and power dissipation in 5 Ω resistors (Fig.2). **(6)**

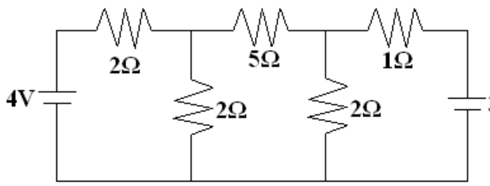

Fig. 2

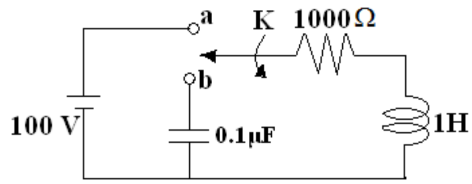

Fig. 3

Q.3 a. For the circuit shown in Fig.3. Find i(t), $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at t=0^+ if switching of K from a to b is done at t=0 **(8)**

b. In the accompanying network, (Fig.4) the switch K is closed at t=0 with zero capacitor voltage and zero inductor current. Solve for
(i) $V_1(0^+)$ and $V_2(0^+)$ (ii) V_1 and V_2 at t= ∝
(iii) $\frac{dv_1}{dt}(0^+)$ and $\frac{dv_2}{dt}(0^+)$ **(8)**

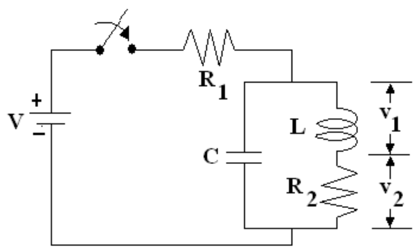

Fig. 4

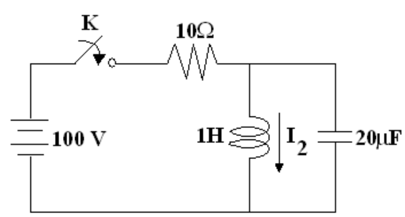

Fig. 5

Q.4 a. Determine **L**bf(t/a) in terms of **L**f(t), given that a and b are constants. Also find $\mathbf{L}^{-1}$F(s/c) in terms of $\mathbf{L}^{-1}$F(s), where c is the constant. **(8)**

b. In the network shown in Fig.5, the switch K is closed and a steady state is reached in the network. At t=0, the switch is opened. Find an expression for the current in the inductor, $i_2(t)$ and $I_2(s)$. **(8)**

Q.5 a. Calculate the current in the branch having impedance Z_3 using Thevenin's theorem (Fig.6). **(8)**

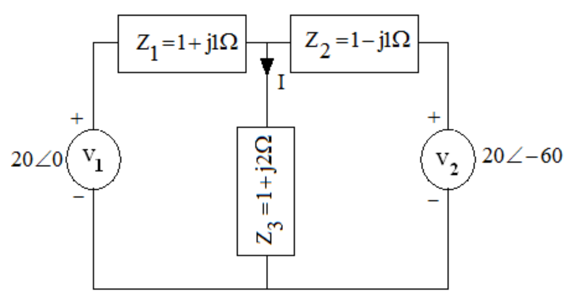

Fig. 6

b. Find the transform admittance of the circuit as shown in Fig.7. **(8)**

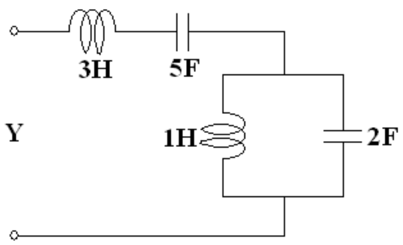

Fig. 7

Q.6 a. Given $h_{11} = \frac{s(s^2+2)}{s^2+1}$, $Z_{22} = \frac{s^2+1}{s}$ and $Z_{21} = 1/s$ of a passive reciprocal two port network. Obtain the Y parameter. **(6)**

b. Relate ABCD parameters to other parameters as indicated; A, C in terms of Z-parameters, B in terms of Y-parameters and D in terms of h-parameters. **(10)**

Q.7 a. For the polynomial $P(s)=s^6+2s^5+6s^4+10s^3+11s^2+12s+6$. Determine the number of roots in right half of S-plane and on imaginary axis of S-plane if any. **(8)**

b. The given network contains resistors and controlled sources. For this network compute $G_{12} = V_2/V_1$ (Fig. 8). **(8)**

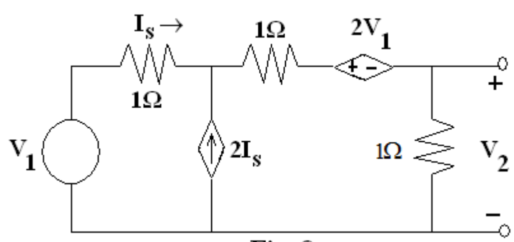

Fig. 8

Q.8 a. Design T and π section high pass filter, if design impedance=600 Ω and cut-off frequency=5 kHz. **(8)**

b. Given $F(s) = \frac{6s^2+36s+48}{s^2+3s}$. Find the continued fraction expansion and hence synthesise the network when F(s) is an admittance Y(s). **(8)**

Q.9 An LC two port terminated in a resistor of one ohm has the transfer impedance $Z_t(s) = \frac{3}{2s^4+2s^3+10s^2+9s+3}$. Realise the network and obtain $Z_d(s)$. **(16)**