ROLL NO. ___________________

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

AMIETE – ET

Time: 3 Hours **JUNE 2013** **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 100Ω resistance is connected across a 10V battery. The energy consumed in 5 secs is

(A) 3 Joules **(B)** 4 Joules
(C) 5 Joules **(D)** 6 Joules

b. The current I_{ab} in the circuit shown in Fig.1 is

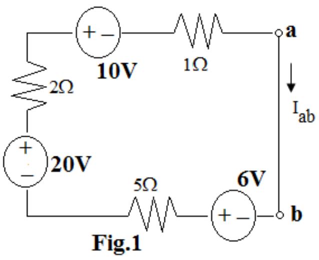

Fig.1

(A) 1A **(B)** 2A
(C) 3A **(D)** 4A

c. The correct statement is ________

(A) $V_L = L\frac{di}{dt}$ and $i_c = C\frac{dv}{dt}$ **(B)** $i_L = L\frac{dv}{dt}$ and $V_c = C\frac{di}{dt}$
(C) $V_L = L\frac{di}{dt}$ and $i_L = C\frac{dv}{dt}$ **(D)** $V_c = L\frac{dv}{dt}$ and $i_c = C\frac{di}{dt}$

d. Laplace transform of $f(t) = e^{at}\,u(t)$ is

(A) $\frac{1}{s^2}$ **(B)** $\frac{1}{s+a}$
(C) $\frac{1}{s-a}$ **(D)** $\frac{1}{(s+a)^2}$

e. The Quality factor of a purely resistive circuit is

(A) 0 **(B)** 1
(C) 1.5 **(D)** infinite

f. The impedance of one port network $Z(s) = \frac{15(s^3+2s^2+3s+2)}{s^4+6s^3+8s^2}$ indicates

(A) Double pole at origin **(B)** Double zeros at origin
(C) Single pole at origin **(D)** Single zero at origin

g. The current i(t) corresponding to transform current $I(s) = \frac{1}{s(s+1)}$ is

(A) $i(t) = (1 - e^{-t})u(t)$ **(B)** $i(t) = (1 + e^{-t})u(t)$
(C) $i(t) = e^{t}u(t)$ **(D)** $i(t) = e^{-t}u(t)$

h. The Thevenin resistance as seen at *ab* of the circuit in Fig.2 is

(A) 5Ω **(B)** 8Ω
(C) 10Ω **(D)** 12Ω

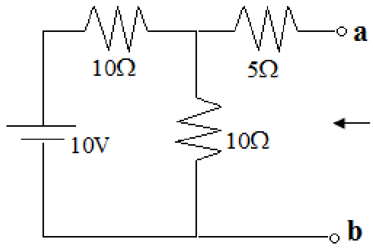

Fig.2

i. The duty cycle of a square wave is
(A) 40% **(B)** 50%
(C) 60% **(D)** All of these

j. The minimum phase function has zeros of transmission on
(A) $j\omega$ axis only **(B)** $j\omega$ axis or in left half of s-plane
(C) $j\omega$ axis or right half of s-plane **(D)** in left half of s-plane only

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

Q.2 a. A battery has an internal resistance of 0.5Ω and open circuit voltage of 12V. What is power lost in the battery and terminal voltage on full load if a resistance of 3Ω is connected across the terminals of the battery? **(4)**

b. In the Fig.3, find the current in the resistances using node analysis. **(6)**

c. Find v_o using Kirchhoff's laws in the circuit as shown in Fig.4. Given that $r_1 = 1000\Omega$, $r_2 = 500\Omega$, $r_3 = 50\Omega$, $r_4 = 5\Omega$, $\alpha = 0.5, \beta = 2$ and $v_s = 10V$. **(6)**

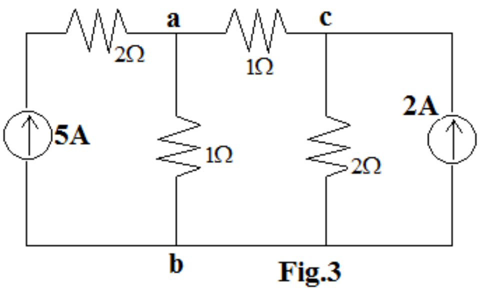

Fig.3

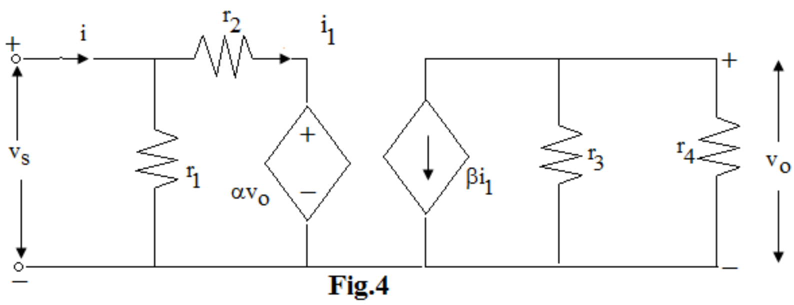

Fig.4

Q.3 a. For the circuit given in Fig.5, switch K is closed at t = 0. Find the i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at $t = 0^+$. **(6)**

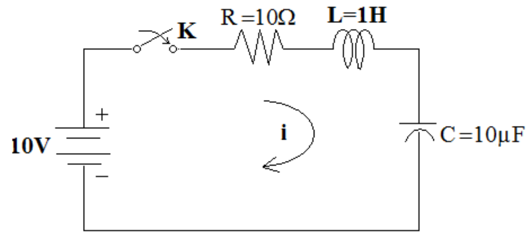

Fig.5

b. Find the general solution of the equation $2\frac{di}{dt} + i(t) = 2i(t)$ with initial condition at t = 0, i = 5A. **(4)**

c. A voltage of v= 200 Sin (314t-30°) is applied to a 50mH, 15Ω coil; calculate the current and the power factor for the arrangement. **(6)**

Q.4 a. Using Laplace transform technique, find i_2 at $t = 0^+$ when switch k is closed at t = 0 in Fig.6. **(8)**

b. A unit impulse voltage is applied to a series RC circuit at t =0 with $R = 5\Omega$ and C = 2F. Find i(t) using Laplace transform, assuming the initial charge stored in the capacitor is zero. **(8)**

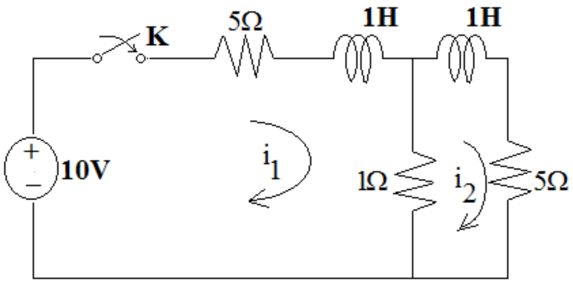

Fig.6

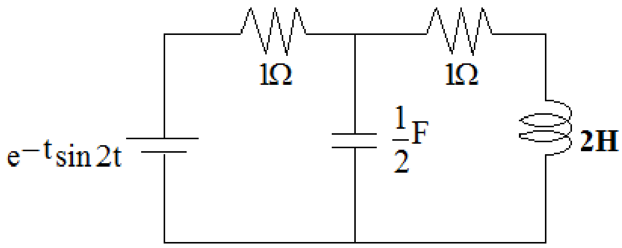

Fig.7

Q.5 a. Determine Z(s) and I(s) for the network shown in Fig.7 using transform network. **(8)**

b. Consider the network shown in Fig.8. Calculate $i_1(t)$ using Thevenin's theorem. **(8)**

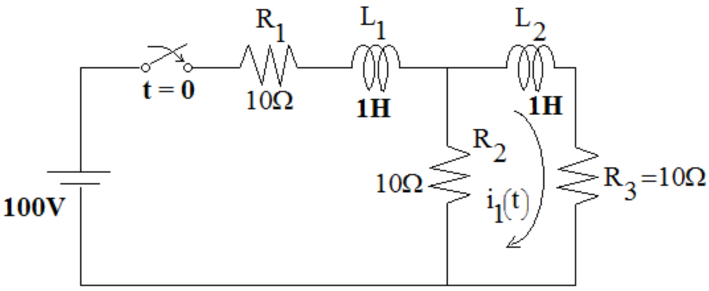

Fig.8

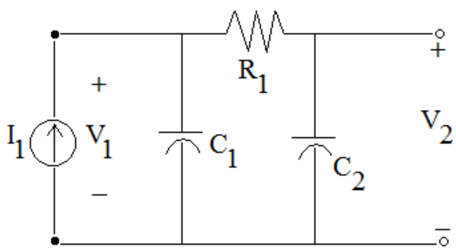

Fig.9

Q.6 a. Compute the current gain $\alpha_{12}(s)$ and driving point impedance $Z_{12}(s)$ for the network shown in Fig.9 with $C_1 = 1F$, $R_1 = 1\Omega$ and $C_2 = 2F$. **(8)**

b. A network function is given by $H(s) = \frac{2s}{(s+2)(s^2+2s+2)}$. Obtain pole-zero diagram. **(4)**

c. Check the positive realness of the function $F(s) = \frac{s^2+10s+4}{s+2}$. **(4)**

Q.7 a. Determine the Z-parameter of the network shown in Fig.10. **(6)**

b. The Z-parameter of a circuit are given by $\begin{bmatrix} 4 & 1 \\ 3 & 3 \end{bmatrix}$. Obtain the transmission line ABCD parameters. **(4)**

c. Establish the relation between Impedance parameters (Z) and hybrid parameters (h). **(6)**

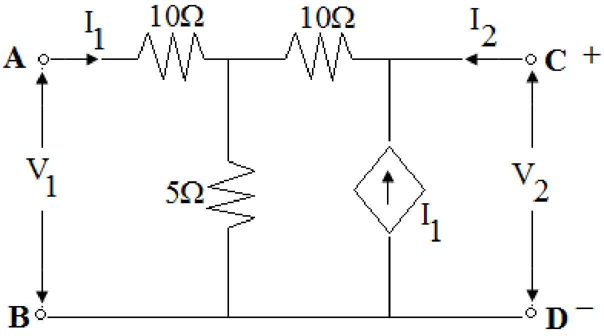

Fig.10

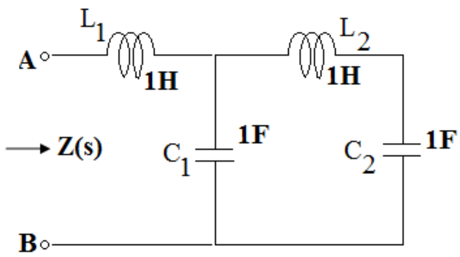

Fig.11

Q.8 a. Obtain the driving point impedance of the given network across A-B shown in Fig.11 using Transform network. **(8)**

b. The driving point impedance of an LC network is $Z(s) = \frac{10(s^2+4)(s^2+16)}{s(s^2+9)}$. Obtain Foster form of network. **(8)**

Q.9 a. What are the error criteria in any approximation problem in network theory? Derive amplitude approximation for maximally flat low pass filter approximation. **(8)**

b. 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 1Ω resistor. **(8)**