JUNE 2010

AMIETE – ET (OLD SCHEME)

Code: AE08 **Subject: CIRCUIT THEORY & DESIGN**
Time: 3 Hours **Max. Marks: 100**

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.**
- **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. The current through 2 Ω register in the Fig.1 is:

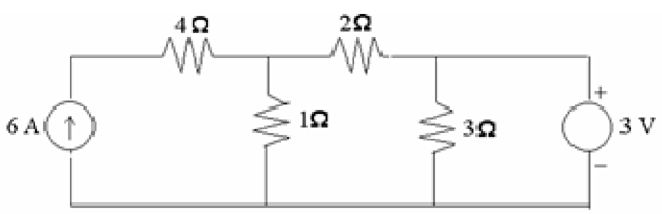

Fig.1

(A) 3 **(B)** 2
(C) 1 **(D)** 0

b. Time constant of a capacitance circuit may be defined as the time during which voltage

(A) rises to 63.2% of its final steady value
(B) rises to 38.6% of its final steady value
(C) falls to 38.6% of its final steady value
(D) 50% of its final steady state value.

c. A capacitor used in 240 volt AC line should have a peak voltage rating of

(A) 240 volts **(B)** 340 volts
(C) 120 volts **(D)** 720 volts

d. If four resistors each of 4 kΩ are connected in parallel, the net resistance is

(A) 1 kΩ (B) 16 kΩ
(C) 2 kΩ (D) 8 kΩ

e. In the circuit $V_S = 10 \cos \omega t$, power drawn by the 2 ohm resistor in 4 watt. The power factor is

(A) 0.3 (B) 0.4
(C) 0.6 (D) 0.8

f. Kirchoff's voltage law cannot be used

(A) with parallel circuit
(B) to find current in a circuit
(C) to find voltage across a resistor in a series circuit
(D) for non-linear circuits

g. In RLC circuit, the current at resonance is

(A) maximum in parallel resonance and minimum in series resonance. (B) maximum in series resonance and minimum in parallel resonance.
(C) maximum in both series and parallel resonance.
(D) minimum in both series and parallel resonance.

h. The current in the 12 Ω resistor in the following circuit (Fig.2) is given by

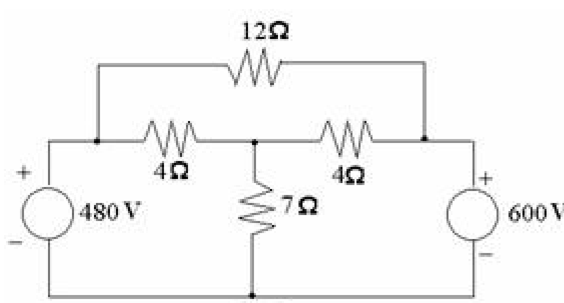

Fig.2

(A) 10 amp from left to right **(B)** 10 amp from right to left
(C) 5 amp from left to right **(D)** 5 amp from right to left

i. If the load connected to the source is inductive, for a maximum transfer of power from source to load, the source impedance should be

(A) Inductive **(B)** capacitive
(C) Resistive **(D)** combination of L and C

j. Kirchoff's current law is valid for

(A) DC circuits only **(B)** AC circuits only
(C) Both DC and AC circuits **(D)** Sinusoidal sources only

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

Q.2 a. Explain Duality and find dual of the given network (Fig.3). **(3+3)**

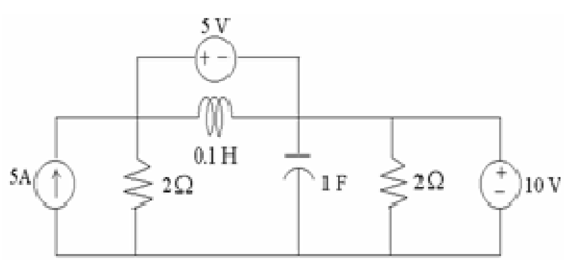

Fig.3

b. Determine I_x and I_y in the Fig. 4, using Kirchoff's law. **(5)**

c. For the circuit Fig. 5, find V_{BG} using Nodal analysis. **(5)**

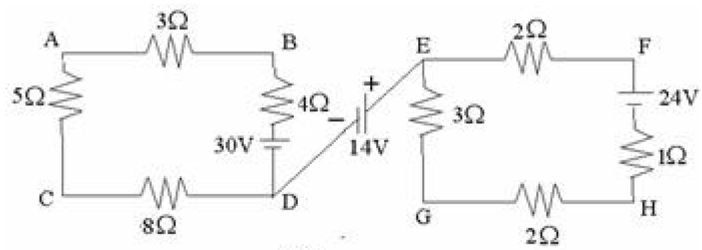

Fig.5

Q.3 a. What do you mean by Initial conditions? **(4+4)**

Switch 'S' in the circuit shown in Fig. 6 below is closed at t=0. Determine the initial

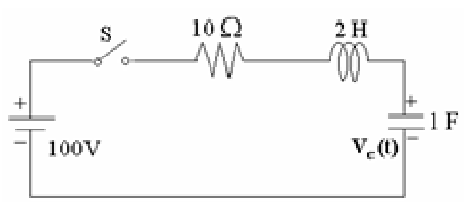

Fig.6

value of i, di/dt and d^2i/dt^2

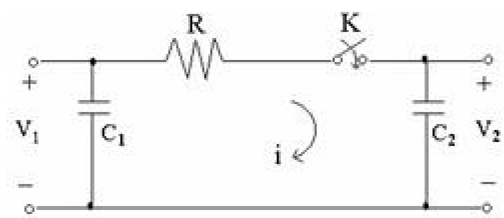

Fig.7

b. In the network shown in Fig.7, initial voltage on C_1 is V_1 and on C_2 is V_2, such that V_1 (0)=V_1 and V_2 (0)=V_2. The switch 'K' is closed at t=0. Obtain i(t) and V_2(t) for all time. Given Data: $R = 1 ohm$, $C_1 = 1$ F, $C_2 = 0.5$ F, $V_1 = 2V$ and $V_2 = 1V$. **(8)**

Q.4 a. Define poles and zeros of a network function. Find the transfer function of the network shown in the Fig. 8. Also sketch pole zero configuration. **(2+6)**

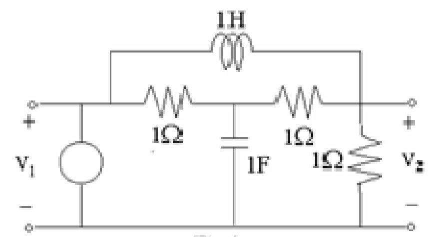

Fig.8

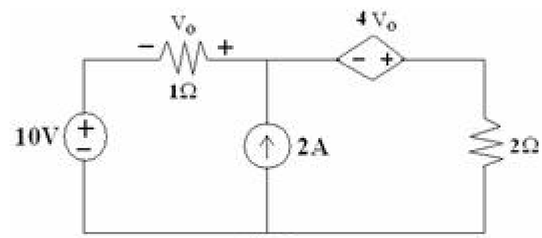

Fig.9

b State Thevenin's theorem. Find the power loss in the 2 Ω resistor shown in Fig. 9 using Thevenin's theorem. **(2+6)**

Q.5 a. Find Z parameters of the network shown in the Fig.10. **(8)**

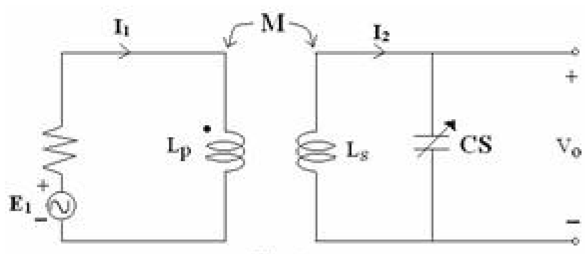

Fig.11

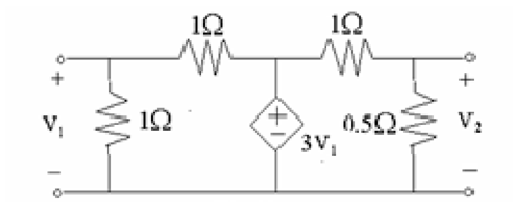

Fig.10

b. Derive the expressions for O/P voltage, O/P current and amplification factor of single tuned circuit shown in Fig. 11 at resonance. **(8)**

Q.6 a. Show that an average power consumed by inductor circuit is Zero. **(4)**

b. Find the resultant of three currents $(i_1, i_2 \text{ and } i_3)$ and express it in the form of

(6)

$$i = I_m \sin(wt + \Phi), \text{ where}$$
$$i_1 = 20\sin(314t + \pi/3)$$
$$i_2 = -10\sin(314t)$$
$$i_3 = 15\sin(314t - \pi/4)$$

c. Determine the form factor of the given waveform (Fig.12). **(6)**

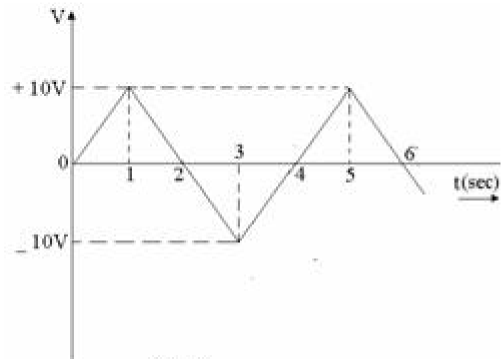

Fig.12

Q.7 a. Diagnose whether the following impedance function represents a RL or RC network and find its first Cauer Form Z(s)= [(s+4)(s+6) / (s+3)(s+5)] **(8)**

b. Test whether the polynomial $s^5 + s^3 + s$ is Hurwitz or not. **(4)**

c. Check the positive realness of the function $Y(s) = (s^2 + 2s + 20)/(s + 10)$ **(4)**

(iii)

Calculate the voltages across the capacitor and the coil. **(8)**

Q.8 a. Design a constant K-low pass filter having f_c=2 kHz and design impedance R_o=600 Ω . Obtain the value of attenuation at 4 kHz. **(8)**

b. Find the short-circuit admittance function y_{11} and y_{21} for the network in the Fig.13. **(8)**

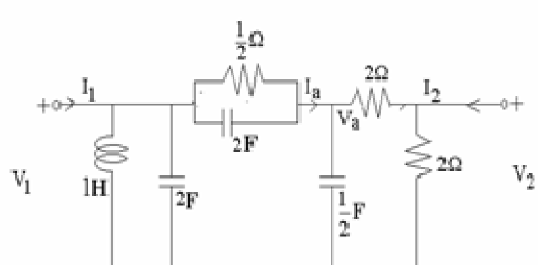

Fig.13

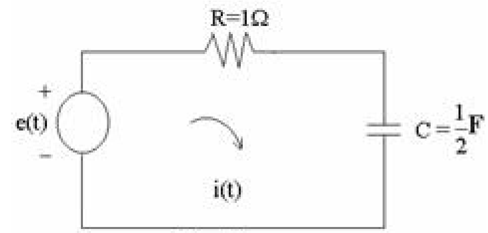

Fig.14

Q.9 a. Find the current i(t) for the network shown in Fig.14, when the voltage source is

$e(t) = 2e^{-0.5t}u(t)$ and $v_c = (0-) = 0$ **(8)**

b. Find the current through the capacitor of $(-j\ 5)\ \Omega$ reactance shown in Fig.15 below, using superposition theorem. **(8)**

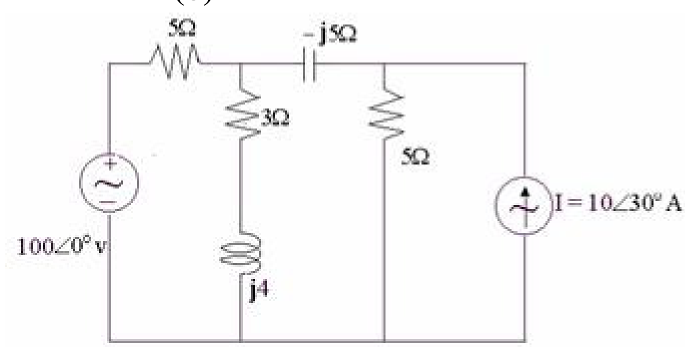

Fig.15