ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER – 2008

CIRCUIT THEORY AND NETWORKS

SEMESTER – 3 (EIE)

Time : 3 Hours]   [*Full Marks : 70*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Energy stored in an inductance and in a capacitance over a complete cycle, when excited by a purely sinusoidal *ac* source is

    a)   zero and maximum respectively

    b)   zero and zero respectively

    c)   half of that due to a *dc* source of equal magnitude

    d)   maximum and maximum respectively.

ii) Inverse Laplace transform of $1/(s + a)$ is

    a)   sin (at)   b)   cos (at)

    c) e^{at} d)   none of these.

iii) The condition for underdamped response of an *R-L-C* circuit is

    a) $\dfrac{R^2}{4L^2} = \dfrac{1}{LC}$ b) $\dfrac{R^2}{4L^2} > \dfrac{1}{LC}$

    c) $\dfrac{R^2}{4L^2} < \dfrac{1}{LC}$ d) $\dfrac{R^2}{4L^2} \leq \dfrac{1}{LC}$.

iv) Condition for symmetry in two-port network is

    a) $Z_{12} = Z_{21}$ b) $Z_{11} = Z_{22}$

    c) $| Z | = 1$ d)   none of these.

v)   When a source is delivering maximum power to a load, the efficiency

    a)   is always 50%   b)   depends on the circuit parameters

    c)   is infinity   d)   is 100%.

vi) A series *R-L-C* circuit under resonance condition is called

    a)   an oscillator circuit   b)   a rejecter circuit

    c)   an acceptor circuit   d)   none of these.

vii) A network has seven nodes and five independent loops. The number of branches in the network is

    a)   13   b)   17

    c)   15   d)   11.

viii) At $t = 0^+$ with zero initial condition which of the following will act as open circuit ?

    a)   Resistance   b)   Inductance

    c)   Capacitance   d)   None of these.

ix) A step voltage is applied to an *RLC* series circuit having $R = 2\Omega$, $L = 1H$ and $C = 1F$. The transient current response of the circuit will be

    a)   overdamped   b)   critically damped

    c)   underdamped   d)   all of these.

x)   Thevenin's theoprem is not applicable for circuits with

    a)   passive load   b)   active load

    c)   bilateral load   d)   none of these.

xi)   A ramp function

    a)   has Laplace transform but not Fourier transform

    b)   has Fourier transform but not Laplace transform

    c)   have both Laplace and Fourier transform.

    d)   none of these.

xii)   In a series R-L-C circuit, the maximum voltage across the inductor occurs at a frequency

    a)   equal to ω_o b)   less than ω_o

    c)   greater than ω'_o d)   none of these.

GROUP – B
(Short Answer Type Questions)
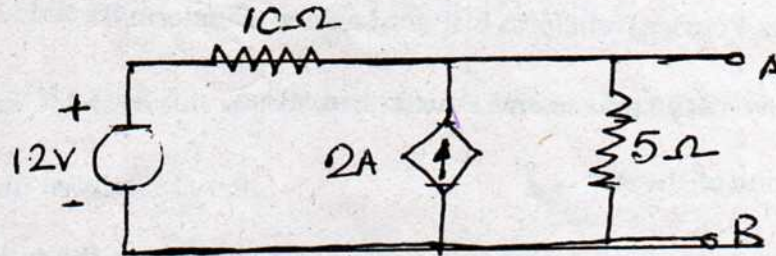
Answer any *three* of the following. $3 \times 5 = 15$

2.   A source with internal impedance $R_S + jX_S$ delivers power to a variable load impedance $R_L + j0$. Show that the condition for maximum power in the load is $R_L^2 = R_S^2 + X_S^2$.

3.   Two wattmeters with their current coils in the lines A and B respectively of three phase 50 Hz, 120 V system read 1500 watt and 500 watt respectively. Find the impedance of the balanced delta load.

4.   Find the inverse Laplace transform of the following function :

$$F(S) = \frac{20(S+2)}{S(S^2 + 6S + 25)}$$

5.   Convert a voltage source V with internal resistance R to a corresponding current source. Can a voltage source V with zero internal resistance be converted to a corresponding current source ?

6. Find the Norton's equivalent circuit across the terminal AB of the circuit shown in figure below :

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Prove that $\mathcal{L}[f_1(t) * f_2(t)] = F_1(S) \cdot F_2(S)$.   6

   b) Determine the Laplace transform of $F(t) = \dfrac{2 - 2e^{-t}}{t}$.   6

   c) Prove final value theorem.   3

8. a) Two impedances $Z_1 = (10 + j15)\,\Omega$ and $Z_2 = (6 - j8)\,\Omega$ are connected in parallel. If the total current supplied is 15A, what is the power taken by each branch ? Find also the power factor of the whole circuit. Draw the phasor diagram.   4 + 3 + 3

   b) Show that the maximum voltage across C of a series RLC circuit occurs at an angular frequency $\omega = \omega_o \sqrt{1 - \dfrac{1}{(2Q^2)}}$, with usual nomenclature.   5

9. a) Establish the relations between Y and Z parameters of a two-port network.   8

   b) What are the transmission parameters ? Deduce the relation

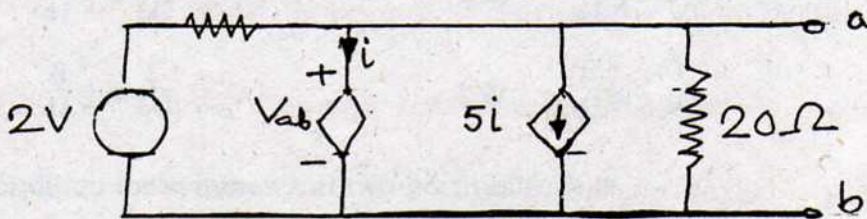 $AD - BC = 1$

   for a symmetrical two terminal network.   7

10. a) Two coils $L_1 = 400\ \mu H$ and $L_2 = 100\ \mu H$ are magnetically coupled. The coefficient of coupling between two coils is 0·1. Calculate effective inductance if two coils are connected in

   i)   series adding

   ii)   series opposing.   8

   b) A series resonating circuit has $R = L\ k\Omega$, half-power frequencies of 10 and 90 kHz respectively. Determine the bandwidth and resonant frequency. Also calculate the inductance and capacitance.   7

11. a) Determine the loop currents in Laplace domain for the network shown in figure below, assuming zero initial condition. Also find the loop currents in time domain.   8
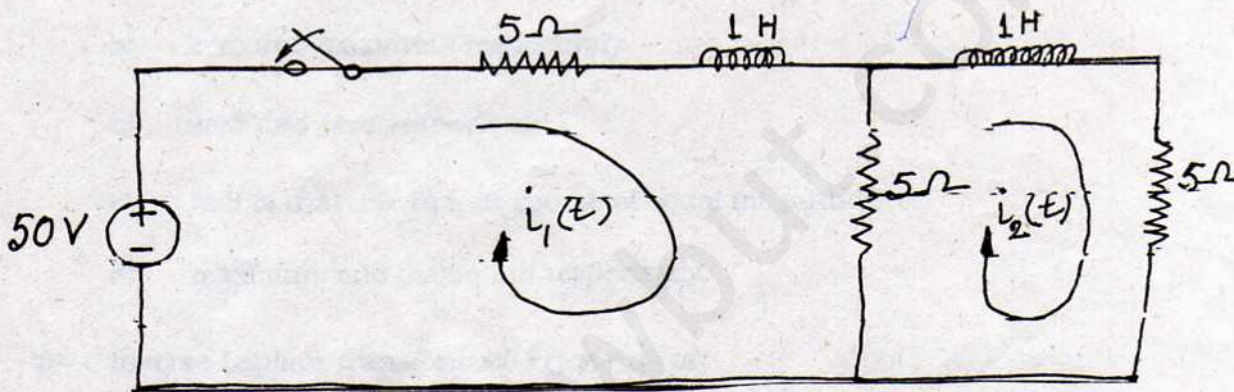
   b) Find the The venin's equivalent for the circuit shown in the figure below :   7

END