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Question Paper Code : 10314

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Second Semester

EE 2151/131201/EE 25/10133 EE 205/080280005/EE 1151 – CIRCUIT THEORY

(Common to EEE, E & I and I & C branches)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. How are the following affected by change of frequency?

   (a) Resistance

   (b) Inductive reactance.

2. Define 'Nodal analysis' of a circuit.

3. Find the equivalent current source for a voltage source of 100 V with series resistance of 2 Ω.

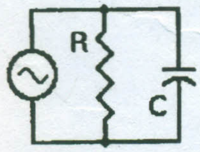
4. State Reciprocity theorem.

5. Define resonant network.

6. State 'Dot rule' for coupled circuits.

7. Sketch the transient current $i(t)$ vs t graph for a series RL circuit.

8. Consider two cases of RC parallel circuit shown below,



   first case when DC voltage is applied and second case when AC voltage is applied. Compare how the capacitor gets charged in the two cases.

9. A 3-phase 440 V supply is given to a balanced star connected load of impedance $(6 - j8)\Omega$ in each branch. Find the magnitude of the line current.

10. Define power factor of a circuit.

PART B — (5 × 16 = 80 marks)

11. (a) (i) In the circuit shown in figure Q.11(a) (i), V_R and V_L were measured and found to be 10 V each.

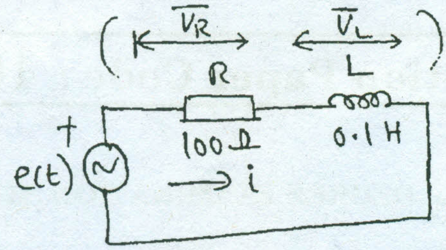


Fig. Q.11(a) (i)

Assuming $i(t)$ as the reference waveform, find

(1) the frequency f and current $i(t)$ (6)

(2) Z_T, the total impedance and $e(t)$. (4)

(ii) What is the voltage across A and B in the circuit shown in figure Q.11(a) (ii)? (6)

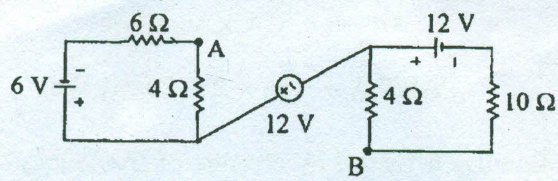


Fig. Q.11(a) (ii)

Or

(b) Find the current in 4 Ω resistor in the circuit shown in Figure below Q.11 (b), using mesh analysis technique. (16)

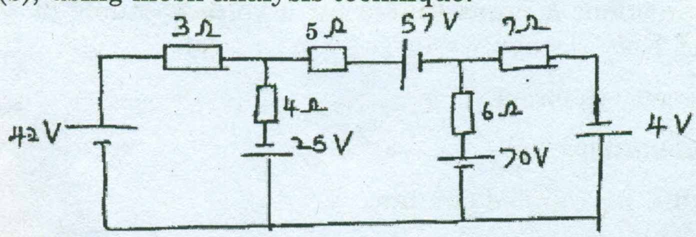


Fig. Q.11 (b)

12. (a) Convert the network shown below Fig. Q.12 (a), into a π-connected equivalent circuit. (16)

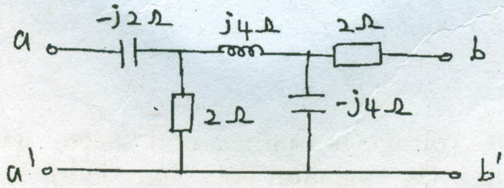


Fig. Q.12 (a)

Or

(b) (i) Calculate the current through the 2 Ω resistor in the circuit shown below Fig. Q.12(b) (i), using superposition theorem. (8)

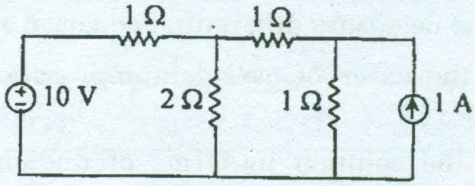


Fig. Q. 12(b) (i)

(ii) Calculate the current through the 2 Ω resistor in the circuit shown below Fig. Q. 12(b) (ii), using Thevenin's theorem. (8)

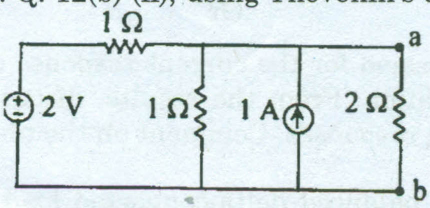


Fig. Q. 12(b) (ii)

13. (a) (i) The signal voltage in the circuit shown below Fig. Q. 13(a) (i) is $e(t) = 0.01\sin(2\pi \times 455 \times 10^3 t)V$.

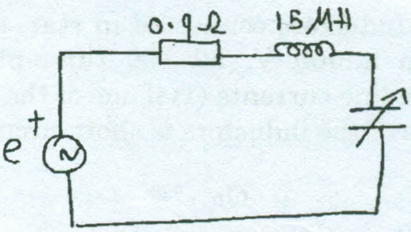


Fig. Q. 13(a) (i)

What should be the value of C in order that the circuit would resonate at this signal frequency? At this condition, find the values of I, V_C, Q, and bandwith of the circuit. (10)

(ii) $(R_L + j20)\Omega$ and $(20 - j10)\Omega$ are connected in parallel. Determine the value of R_L for resonance. (6)

Or

(b) (i) Derive the relationship between self inductance, mutual inductance and coefficient of coupling. (8)

(ii) Consider the single tuned circuit shown below Fig. Q. 13(b) (ii) and determine (1) the resonant frequency and (2) the output voltage at resonance. Assume $R_S >> \omega_r L_1$, and $K = 0.9$. (8)

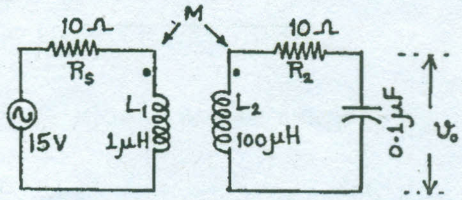


Fig. Q. 13(b) (ii)

14. (a) Derive the transient response of series R-L-C circuit, with DC input, using Laplace transform.

(i) Derive the necessary differential equation and solve. (4)

(ii) Discuss the cases of over-damping, critical-damping and under-damping. (6)

(iii) Express the solution in terms of undamped natural frequency, damped natural frequency and damping factor. (3)

(iv) Sketch the transient response curve for the three cases. (3)

Or

(b) Derive an expression for the current response of RLC series circuit with sinusoidal excitation. From the results, discuss the nature of transient and steady state responses. Comment on the phase angle involved. (16)

15. (a) (i) A 3-phase balanced delta-connected load of $(4+j8)\Omega$ is connected across a 400 V, 3-phase supply. Determine the phase currents and line currents. Assume the RYB phase sequence. Also calculate the power drawn by the load. (8)

(ii) Three equal inductors connected in star, take 5 kW at 0.7 pf when connected to a 400 V, 50 Hz, three-phase, three-wire supply. Calculate the line currents (1) if one of the inductors is disconnected and (2) if one of the inductors is short circuited. (8)

Or

(b) (i) If W_1 and W_2 are the readings of the two wattmeters which measures power in the three phase balanced system and if $\frac{W_1}{W_2}=a$, show that the power factor of the circuit of the circuit is given by $\cos\phi=\frac{a+1}{\sqrt[2]{a^2-a+1}}$. (8)

(ii) Obtain the readings of two wattmeters connected to a three-phase three-wire 120 V system feeding a balanced Δ-connected load with a load impedance of $12\angle 30^\circ\,\Omega$. Assume either phase sequence. Find the phase power and compare the total power to the sum of the wattmeter readings. (8)

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