Reg. No. :

Question Paper Code : 11358

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Second Semester

Electrical and Electronics Engineering

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

(Common to Electronics and Instrumentation Engineering and Instrumentation and Control Engineering)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Find the equivalent conductance G_{eq} of the circuit shown below.

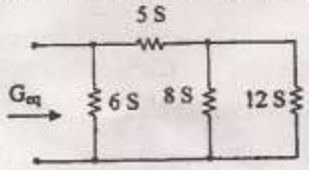
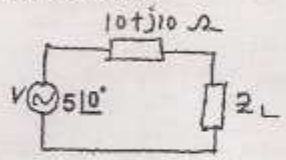


Fig . 1

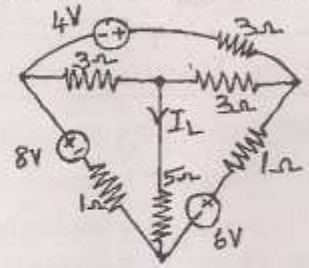
2. Define 'Mesh analysis' of a circuit.
3. Give a delta circuit having resistors, write the required expressions to transform the circuit to a star circuit.
4. In the circuit shown below, find the value of the load impedance Z_L for maximum power transfer to the load.



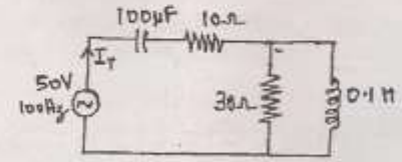
5. A series resonant circuit has a bandwidth of 20 kHz and a quality factor of 40. The resistor value is 10 kΩ. Find the value of L of this circuit.
6. Define mutual inductance.
7. Determine the Laplace transform for the unit step function $u(t)$.
8. Write down the condition for critically damped response of a series RLC circuit excited by a sinusoidal AC source.
9. Three inductive coils each having resistance of 16 Ω and reactance of j12 Ω are connected in star across a 400 V, 3 ϕ, 50 Hz supply. Calculate phase voltage.
10. A three phase motor can be regarded as a balanced Y load. A three phase motor draws 5.6 kW when the line voltage is 220 V and the line current is 18.2 A. Determine the power factor of the motor.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Determine the current I_L in the circuit shown in figure below. (8)

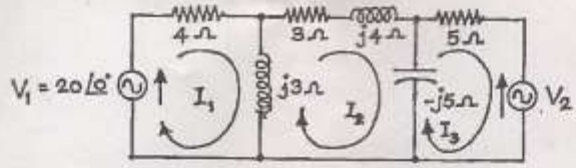


(ii) For the circuit shown in figure below, determine the total current I_T, phase angle and power factor. (8)

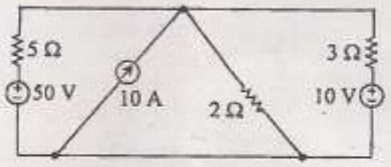


Or

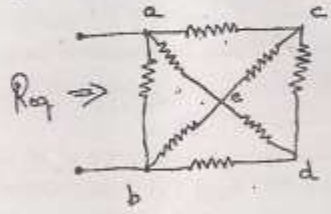
(b) For the circuit shown in figure below, determine the value of V_2 such that the current through (3+j4) Ω impedance is zero. (16)



12. (a) (i) Using source transformation, replace the current source in the circuit shown below by a voltage source and find the current delivered by the 50 V voltage source. (8)

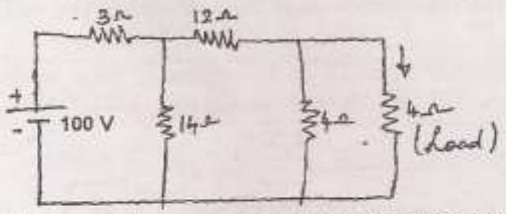


(ii) Calculate the equivalent resistance R_{ab} when all the resistance values are equal to 1 Ω for the circuit shown below. (8)

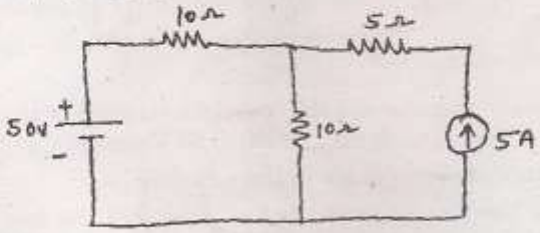


Or

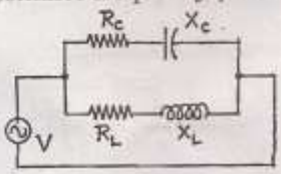
(b) (i) Verify Reciprocity theorem for the circuit shown below. (8)



(ii) Find the current through various branches of the circuit shown below, by employing superposition theorem. (8)



13. (a) (i) Derive the resonance frequency 'f_r' for the circuit shown below. (8)

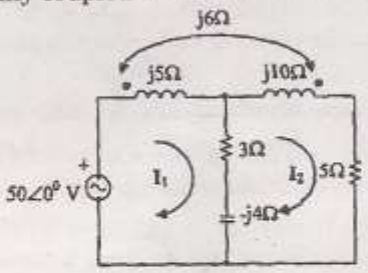


(ii) State the concept of band width of a series RLC circuit. (3)

(iii) A series RLC circuit consists of 50 Ω resistance, 0.2 H inductance and 10 μF capacitance with the applied voltage of 20 V. Determine the resonant frequency, the Q factor, the lower and upper frequency limits and the bandwidth of the circuit. (5)

Or

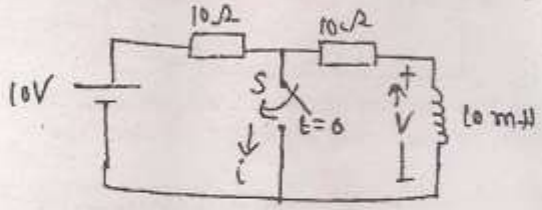
(b) (i) Obtain a conductively coupled equivalent circuit for the magnetically coupled circuit shown below. (8)



(ii) Two coupled coils have self inductavces of L_1 = 100 mH and L_2 = 400 mH. The coupling coefficient is 0.8. Find M. If N_1 is 1000 turns, what is the value of N_2? If a current i_1 = 2 sin (500t) A through the coil 1, find the flux ϕ_1 and the mutually induced voltage V_{2M}. (8)

14. (a) (i) Derive the transient response of a series R-L circuit with DC input. Sketch the variation of current and of the voltage across the inductor. (8)

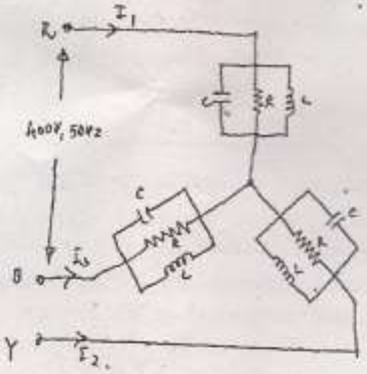
(ii) Solve for i and V as functions of time in the circuit shown below, when the switch is closed at time t = 0. (8)



Or

(b) Derive the expression for the complete solution of the current response of RC series circuit with an excitation of V $\cos(wt + \phi)$. Briefly explain the significance of phase angle in the solution. (16)

15. (a) (i) For the circuit shown below, calculate the line current, the power and the power factor. The value of R, L and C in each phase are 10Ω, 1 H and 100 μF respectively. (8)



(ii) A 3 phase, 3 wire 120 V RYB system feeds a Δ-connected load whose phase impedance is $30\angle 45^\circ\ \Omega$. Find the phase and line currents in this system and draw the phasor diagram. (8)

Or

(b) (i) A three-phase four-wire 120 V ABC system feeds an unbalanced Y-connected load with $Z_A = 5\angle 0^\circ\Omega$, $Z_B = 10\angle 30^\circ\Omega$ and $Z_C = 20\angle 60^\circ\Omega$. Obtain the four line currents. (8)

(ii) Three impedances Z_1 = (17.32 + j10), Z_2 = (20 + j34.64) and Z_3 = (0 – j10) ohms are delta connected to a 400 V, three phase system. Determine the phase currents, line currents and total power consumed by the load. (8)