Ref. No.: Ex/ES/EE/T101B/2019

B.E. Power Engineering First Year First Semester Examination 2019

Basic Electrical Engineering

Full Marks: 100 **Time: 3 Hours**

Answer any five

1. a) Find out the R.M.S and average value of the current wave form as shown in Figure 1. Also find the form factor.

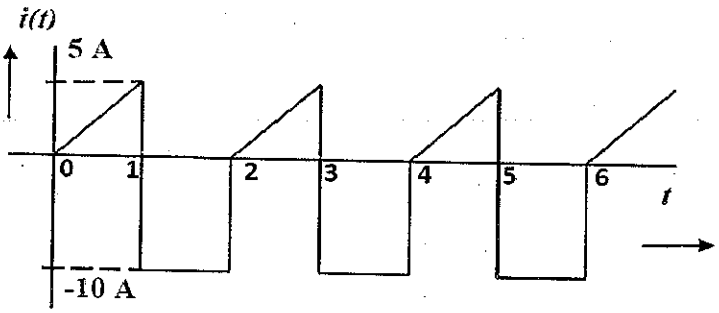

Figure 1

b) Write the properties of series and parallel resonant circuits.

c) Two impedances $Z_1 = (47.92 - j76.73)$ ohm and $Z_2 = (10 - j5)$ ohm are connected in parallel across a 200 volt, 50 Hz supply. Find the current flowing through each impedance and total current. What is the phase difference angle of each branch current with respect to the applied voltage?

7 + 6 + 7

2. a) Prove that the current flowing through the load resistance of a sample T network with two voltage sources at left and right hand side is same considering Superposition theorem and Thevenin theorem.

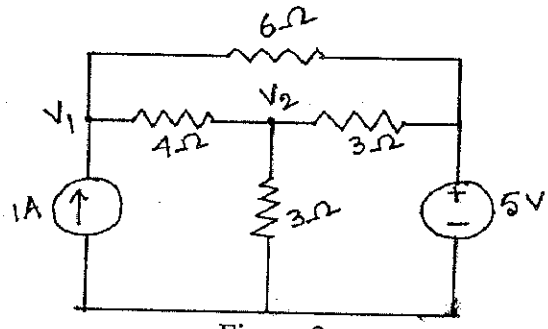

Figure 2

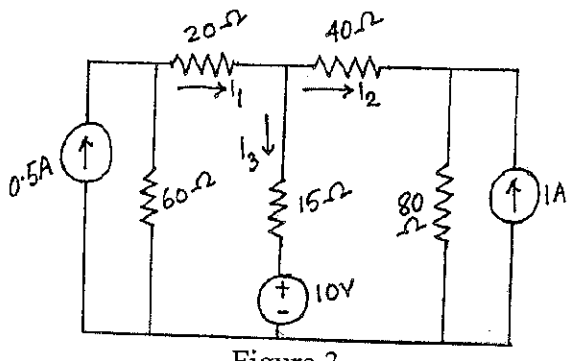

Figure 3

b) Determine the value of V_1 and V_2 using nodal analysis for the circuit as shown in Figure 2. Also find the currents flowing through 6 ohm and 4 ohm resistances.
c) Find the magnitude of currents I_1, I_2 and I_3 using mesh analysis for the circuit as shown in Figure 3.

6 + 7 + 7

3. a) A balanced star-connected load of (8 + j6) ohm per phase is connected to a balanced 3 phase 400 volt supply. Find the line current, power factor, total power and total volt-ampere.
b) A 3 phase, 3 wire, 240 volt, balanced RBY system supplies a delta connected load in which $Z_{RY} = 26\angle 95^0$ ohm, $Z_{YB} = 17\angle 32^0$ ohm and $Z_{BR} = 22\angle 0^0$ ohm. Find the line currents and total power.
c) Prove that the sum of two wattmeter readings gives the total active power consumption in the three phase load. Also find out the expression of power factor from the two wattmeter readings.

6 + 6 + 8

4. a) In a three-phase four wire system the currents in the lines a, b and c under abnormal conditions of loading were as follows:

$$I_a = 100\angle 30^0 A,\ I_b = 50\angle 300^0 A \text{ and } I_c = 30\angle 180^0 A$$

Calculate the zero, positive and negative phase sequence currents in line 'a' and the return current in the neutral conductor.
b) Prove that no zero sequence currents can flow in the lines connected to a delta connected system.
c) Define Fortescue's theorem and discuss about balanced and unbalanced system considering symmetrical components.

8 + 5 + 7

5. Write short notes (**any five**)
   (i) Relationship between speed, frequency and number of pole of synchronous generator
   (ii) Salient pole and cylindrical rotor alternator
   (iii) Different types of D.C generator
   (iv) Split ring operation in D.C generator
   (v) How does the rotor of three phase induction motor rotate?
   (vi) Development of rotating magnetic field in three phase induction motor
   (vii) Working principle of single phase transformer on load
   (viii) E.M.F expression of single phase transformer

(5 × 4)

6. a) Draw the complex waveform considering fundamental and second harmonic of sinusoidal nature.

b) Deduce the R. M. S value of complex wave. Determine the overall power factor of complex wave.

c) A voltage $e = 250Sin(\omega t) + 50Sin(3\omega t + {}^{\pi}/_{3}) + 2Sin(\omega t + {}^{5\pi}/_{6})$ is applied to a series circuit of resistance 20 ohm and inductance 0.05 H. Derive (i) an expression for the current (ii) the R.M.S value of the current and for the voltage (iii) the total power supplied and (iv) the power factor. Take ω = 314 rad/sec.

3 + 10 + 7

7. a) State the Gauss Law.

b) Derive the expression of capacitance for spherical and cylindrical capacitor.

c) Write the first and second laws of electrostatics. Briefly discuss about electric flux.

5 + 10 + 5

8. a) Discuss about the different parts of magnetic hysteresis loop considering magnetic field strength H on the X axis and magnetic field intensity on the Y axis.

b) A ring has a diameter of 22 cm and a cross-sectional area of 12 cm^2. The ring is made up of semicircular sections of cast iron and cast steel, with each joint having a reluctance equal to an air-gap of 0.2 mm. Find the ampere-turns required to produce a flux of 8×10^{-4} wb. The relative permeabilities of cast steel and cast iron are 800 and 166 respectively. Neglect fringing and leakage effects.

c) A horse-shoe magnet is formed out of a bar of wrought iron 46 cm long, having a cross-section of 6.56 cm^2. Exciting coils of 500 turns are placed on each limb and connected in series. Find the exciting current necessary for the magnet to lift a load of 70 kg assuming that the load has negligible reluctance and makes close contact with the magnet. Relative permeability of iron = 700.

8 + 6 + 6