Bengal Engineering and Science University, Shibpur

B.E. Part I 2nd Semester (CE,ME,ASE, Met.E, Min.E.) Final Examination 2013

Basic Electrical Engineering (EE-1201)

i. Answer any ***SIX*** questions taking ***THREE*** from each half

ii. Two marks are reserved for neatness in each half

Time: 3 hrs Full Marks: 70

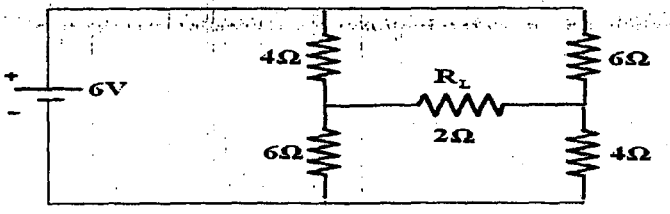
First Half

1. (a) Discuss the principle of operation of a single phase transformer. Derive an expression for the emf induced in a transformer winding. State the assumptions.

   (b) A 200 kVA single phase transformer has 1000 turns in the primary and 600 turns in the secondary. The primary winding is supplied from a 440 V, 50 Hz source. Find the (i) secondary voltage at no load and (ii) primary and secondary currents at the full load. [6+5]

2. (a) State and explain Thevenin's theorem. What are the limitations of this theorem?

   (b) Find the current through the 2 Ω resistor using Thevenin's theorem. [4+2+5]



3. (a) What are the different types of dc generators according to the ways in which the fields are excited?
   (b) Derive the equation of torque for a dc motor.

(c) A 220 V d.c shunt motor takes 4 A at no-load and runs at 800 rpm. The armature resistance is 0.6 Ω and field resistance is 110 Ω. For a motor input of 8.0 kW, determine the following:

(i) back emf under no load

(ii) back emf under full load

(iii) speed of the motor under full load (Neglect brush contact voltage drop and armature reaction) [3+3+5]

4. (a) Define mmf, flux, reluctance and permeability.

(b) Compare different quantities in a magnetic circuit with analogous quantities in an electrical circuit.

(c) A cast-steel electromagnet has an air-gap of length 2 mm and an iron path of length 30 cm. Find the number of Ampere Turns (AT) necessary to produce a flux density of 0.8 Wb/m^2 in the iron path. Neglect leakage and fringing. Given H = 730 AT/m at B = 0.8 Wb/m^2 for cast steel. [2+4+5]

5. Write short notes on any two:

(a) Principle of operation of the permanent magnet moving-coil (PMMC) instrument.

(b) Impedance transformation of a single phase transformer.

(c) Delta-star and star-delta transformation.

(d) Maximum Power Transfer theorem. [5.5+5.5]

Second Half

6. (a) Find the r.m.s. value of the periodic waveform shown in Fig. 1 below:

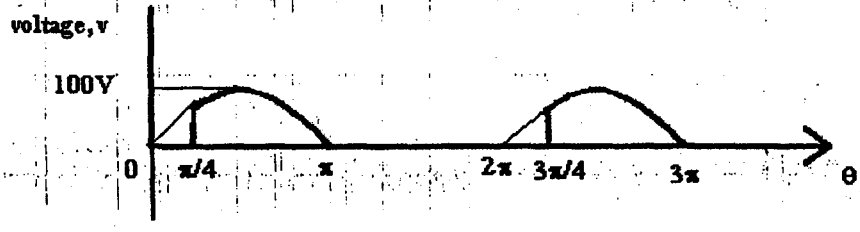


Fig. 1

(b) Find the r.m.s. value of the resultant current in a wire that carries a direct current of 20 A and a sinusoidal alternating current with peak value 20 A.

(c) Show from fundamental concepts how the current lags the voltage in an R-L circuit and leads the voltage in an R-C circuit. [4+3+4=11]

7. (a) What is a 'phasor'? "Current and impedance are both complex quantities yet only the current is represented by a phasor". Explain in brief.

(b) A choke coil of resistance 8 Ω and inductance 0.15 H is connected in series with a capacitor of capacitance 125 μF across a 230 V, 50-Hz supply. Calculate a) the inductive reactance, b) capacitive reactance, c) impedance, d) current, e) voltage across the both the coil and capacitor, f) the phase difference between the current and the supply voltage g) active and reactive power. [3+8=11]

8. (a) What do you mean by "resonance" in a series R-L-C circuit? Obtain the frequency of the supply at which resonance can occur. What is the expression of the current in this case?

(b) Three impedances Z_1, Z_2 and Z_3 are connected in ***parallel*** across a 40 V, 50 Hz a.c. source. $Z_1 = 10 + j0\ \Omega$, $Z_2 = 20 + j20\ \Omega$ and $Z_3 = 30 - j40\ \Omega$. Find i) the conductance and susceptance of the individual branches, ii) the resultant conductance and susceptance and iii) the in-phase and quadrature components of the resultant current? [5+6=11]

9. (a) Show that for a balanced three phase supply feeding power to a balanced three phase load, the instantaneous power delivered to the load is always equal to the average power delivered to the load.

(b) A star connected load is excited by a balanced three phase supply of line to line voltage 220 V, 50 Hz. Find (i) phase current, (ii) line current, (iii) phase voltage, (iv) power input (v)apparent power input and (vi) reactive power consumed by the three phase load if per phase load consists of resistance 6 ohms and inductive reactance 8 ohms. [4+ 1+1+2+1+1+1=11]

10. (a) Explain in brief the principle of operation of a 3-phase induction motor.

(b) Define 'slip' for an induction motor. What is the value of slip at starting?

(c) A 4-pole, 50 Hz 3-phase induction motor runs at 1400 rpm under full load. Determine its (i) full load slip and (ii) the frequency of the rotor induced emf.

[4+3+4=11]