B.Tech. Degree III Semester Examination in Marine Engineering December 2017

MRE 1302 ELECTRICAL TECHNOLOGY

(2013 Scheme)

Time: 3 Hours   Maximum Marks: 100

(5 × 20 = 100)

I.   (a)   Derive the expression for the induced EMF in a transformer in terms of frequency, the maximum value of flux in the core and the number of turns of the winding.   (8)

     (b)   Explain the function of the active and reactive components of the no-load current of a static transformer.   (6)

     (c)   The voltage per turn of a single phase transformer is 1.1 V. When the primary winding is connected to a 220 V, 50 Hz AC supply, the secondary voltage is found to be 550 V. Find:

         (i)   Primary and secondary number of turns.

         (ii)   Core area if the maximum flux density is 1.1 T.   (6)

OR

II.   (a)   Explain the significance of the various losses in a transformer. Give the condition for maximum efficiency of a transformer.   (8)

     (b)   Obtain the approximate equivalent circuit referred to primary, of the given 200/2000 V, 30 kVA, 50 Hz single-phase transformer having the following test results: (12)

         OC Test : 200 V, 6.2 A, 360 W (on LV side)

         SC Test : 75 V, 18 A, 600 W (on HV side)

III.   (a)   What do you mean by Armature Reaction in DC machines? Enumerate and explain the methods to overcome the adverse effects of armature reaction.   (10)

     (b)   A 4-pole, long shunt, lap wound DC generator supplies 25 kW at a terminal voltage of 500 V. The armature resistance is 0.03 Ω, series field resistance is 0.04 Ω and shunt field resistance is 200 Ω. The brush drop may be taken as 1.0 V per brush. Determine the EMF generated. Also calculate the number of conductors of the generator if the speed is 1200 rpm and the flux per pole is 0.02 wb. Neglect armature reaction.   (10)

OR

IV.   (a)   What is the working principle of a DC motor? Give its Torque equation.   (7)

     (b)   What is back emf or counter voltage in DC motors? Explain.   (5)

     (c)   A 220 V DC shunt motor draws a no-load armature current of 2.5 A when running at 1400 rpm. Determine its speed when taking an armature current of 60 A, if armature reaction weakens the flux by 3%.   (8)

V.   (a)   Show that a rotating magnetic field can be produced by the use of 3-phase currents of equal magnitude. Hence explain how a 3-phase induction motor works.   (12)

     (b)   A 3-phase, 6-pole, 50 Hz induction motor has a slip of 1% at no-load and 3% at full-load. Find (i) scynchronous speed (ii) No-load speed (iii) Full-load speed (iv) frequency of rotor current at standstill and a full load.   (8)

OR

VI. (a) Draw and explain the torque-slip characteristic of a three-phase induction motor. (6)

 (b) The following test data was obtained for a 3.73 kW, 200 V, 50 Hz, 4-pole, three-phase, starconnected induction motor. (14)

No-load Test : 200 V, 5 A, 350 W.

Blocked-Rotor Test : 100 V, 26 A, 1700 W.

Rotor copper loss at standstill is half the total copper loss.

Draw the Circle diagram and find from the circle diagram:

    (i) Full-load values of line-current, power-factor, slip and efficiency

    (ii) Maximum torque in terms of full-load torque.

VII. (a) Derive an expression for the voltage induced in an alternator. Discuss the role of different factors which appear in the expression. (10)

 (b) A 3-phase, 12-pole, star connected alternator has 180 slots with 10 conductors per slot and the conductors of each phase are connected in series. The coil-span is 144° (electrical). Determine the phase and line values of the induced EMF if the machine runs at 600 rpm and the flux per pole is 0.06 webers, distributed sinusoidally over the pole. (10)

OR

VIII. (a) Is the synchronous motor self-starting? If not, why? What are the different methods adopted for starting synchronous motors. (10)

 (b) A 3-phase, star-connected, 1000 kVA, 11000 V alternator has rated current of 52.5 A. The AC resistance of the winding per phase is 0.45 Ω. The test results are given below: (10)

OC Test : Field current = 12.5 A, Voltage between lines = 422 V.

SC Test : Field current = 12.5 A, Line current = 52.5 A.

Determine the full-load voltage regulation of the alternator at (i) 0.8 pf lagging and (ii) 0.8 pf leading.

IX. (a) Define electric power supply system. Describe a typical AC power supply scheme with lay-out. (10)

 (b) Compare AC and DC transmission systems. (10)

OR

X. (a) Explain radial, ring-main and inter-connected distribution schemes. (10)

 (b) What is a fuse? What are the materials used for fuses? Briefly explain low-voltage fuses and high voltage fuses. (10)

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