B.E. / B.Tech. (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL/MAY 2014

ELECTRICAL AND ELECTRONICS ENGINEERING BRANCH

FOURTH SEMESTER

EE 8403 ELECTRICAL MACHINES – I

REGULATIONS 2013

Duration: 3 Hr | Answer All Questions | Max. Marks: 100

PART – A (10 x 2 = 20 Marks)

1. A coil of 300 turns wound on a ferro-magnetic material has an inductance of 10 mH. Calculate the flux produced by the current of 5 A.
2. Draw the BH curve of a permanent magnet depicting the design components in it?
3. In an electro-mechanical system what happens if the stored energy changes with the position of the rotor?
4. Show the picture of a coil experiencing rotational induced emf.
5. A 2 kW, 220 V, 12A, 4 pole lap connected d.c. generator is converted into a wave connected machine. What will be the new power rating of the machine?
6. Show the MMF diagram of the commutator winding of the dc machine.
7. Draw the starting current characteristics of a dc shunt motor if it is started using a three-point starter.
8. A 220 V, 5kW, 26A, 1460 RPM d.c separately excited motor is started using an external rheostat arrangement. What value of external resistance is to be added to develop 50% rated torque at starting?
9. Draw the phasor diagram of a practical transformer based on its actual equivalent circuit model.
10. Which three phase transformer is used for power distribution in sub-stations?

PART – B (5 x 16 = 80 Marks)

11 (a). The magnetic circuit shown in Figure 1 has a core of relative permeability μ_r = 2000. The depth of the core is 5 cm. The coil has 400 turns and carries a current of 1.5 A. (i) Find the flux in the core. (ii) Determine the inductance of the coil.

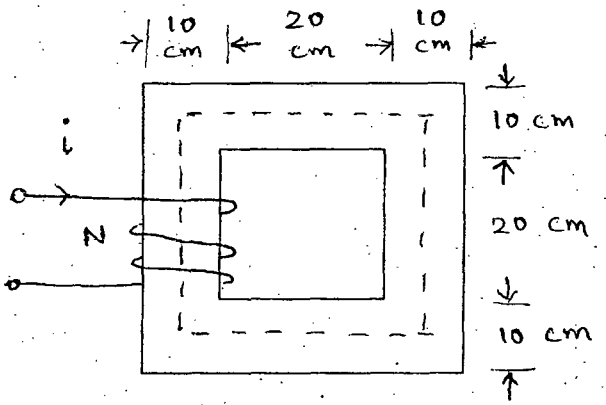

Figure 1. [8]

11 (b). A coil wound on a magnetic core is excited by (i) 100 V, 60 Hz and (ii) 110 V, 50 Hz power supply at different instants. Determine which source will result in higher amount of iron loss. For hysteresis loss, consider n = 2. [8]

12 (a) (i). Derive the expression for force in a singly excited system. [8]

(ii). In a translational motion actuator, the λ–i relationship is given by: $i = \lambda^{3/2} + 2.5\lambda(x-1)^2$, for $0 < x < 1$, where **i** is the current in the coil of the actuator. Determine the force on the moving part at x = 0.6m. [8]

(Or)

12 (b). From first principles show that the average torque developed by a reluctance motor is proportional to twice the rotor angle. [16]

13 (a). Show that how an electromagnetic system produces an unidirectional rotating magnetic field in its air gap. [16]

(Or)

13 (b). A four pole d.c. machine has a lap winding of 300 turns. The flux per pole is 0.025 Wb and the d.c. machine rotates at 1000 rpm. Determine the generated voltage, developed torque and the kW rating of the generator if the rated current through the turn is 25 A. [16]

14 (a). A 10 kW, 250 V self excited d.c. generator has the following magnetization characteristics at 1000 rpm.

I_f (A)	0	0.1	0.2	0.3	0.4	0.5	0.75	1.0	1.5	2.0
E_a (V)	10	40	80	120	150	170	200	220	245	263

The machine parameters are r_a = 0.2 Ω, and R_{fw} = 133 Ω. The generator delivers rated load when driven at 1000 rpm. The rotational loss is 500 W. Neglect armature reaction effect. Determine generated voltage, developed torque and efficiency. [16]

(Or)

14 (b) (i). Elaborate on commutation in a d.c. motor. [8]

14 (b) (ii). A 5 kW, 220V, d.c. shunt motor draws a line current of 6 A under no-load when excited with the 220 V power supply. The machine parameters are r_a = 1.0 Ω, and R_{fw} = 200Ω. Using appropriate test procedure, predetermine its efficiency at 50% full load. [8]

15 (a). A single phase, 25 kVA, 220/440 V, 60 Hz, transformer gave the following test results. Open circuit test (440 V side open): 220 V, 9.5 A, 650 W; Short circuit test (220 V side shorted): 37.5 V, 55 A, 950 W. Determine the (i) voltage regulation at full load and 0.8 power factor leading and draw the respective phasor diagram and (ii) Maximum efficiency and the load at which it occurs. [16]

(Or)

15 (b) (i). Show that when a two winding transformer is converted into an auto-transformer it will result in saving of copper for the same power rating. [8]

15 (b) (ii). Write short notes on harmonics in transformers. [8]