B.Tech.

Fourth Semester Examination, 2014-15

Electromechanical Energy Conversion-I

Time: 3 Hours Total Marks: 100

Note: Attempt all questions. Assume missing data, if any.

1. Attempt any two parts of the following: 10x2=20

(a) Develop the torque equation for a rotational multiple excited magnetic field system.

(b) A shunt generator delivers 50 kW at 250 V and 400 rpm. The armature resistance is 0.02 Ω and field resistance is 50 Ω. Calculate the speed of the machine when running as a shunt motor and taking 50 kW input at 250 V.

(c) Draw the characteristics of d.c. shunt, d.c. series and d.c. compound motors and from the nature of the curves explain the applications of each motor.

2. Attempt any two parts of the following: 10x2=20

(a) Estimate the number or turns needed on each commutating pole of a 6-pole generator delivering 200 kW at 200 V; given that the number of armature conductors is 540 and the winding is lap connected, interpole air gap

(b) A 220 V d.c. series motor takes 20 A while running at constant speed. Its armature and field resistances are 0.3 Ω and 0.2 Ω respectively. Calculate the value of resistance to be connected in series with the armature to reduce the speed by 40%. Assume that the torque varies with the cube of the speed and flux is proportional to the current.

(c) What are the drawbacks of a three point starter? How four-point starter differs with the three-point starter? Discuss the working of Four-Point starter with neat sketch.

3. Attempt any two parts of the following: 10x2=20

(a) The Hopkinson test on two shunt machines gave the following results for full load: Line voltage 250 V; line current excluding field currents 50 A; motor armature current 380 A; field currents 5 A and 4.2A. Calculate the efficiency of each machine. Armature resistance of each machine is 0.02 Ω.

(b) A transformer has a reactive drop of 6% and a resistive drop of 2.5%. Determine the lagging power factor at which the voltage regulation is maximum and the value of this regulation.

(c) A 20 kVA, single phase 50 Hz, 2200/200 V transformer gave the following test results:

OC Test: 2200 V applied to primary, power taken 220 W

SC Test: Power required to circulate full load current in short circuited secondary 240 W.

Calculate the efficiency at full-load and half-full load at p.f. 0.8 lagging.

4. Attempt any two parts of the following: **10x2=20**

(a) The primary and secondary voltages of an auto-transformer are 230 V and 75 V respectively. Calculate the currents in different parts of the winding when the load current is 200 A. Also calculate the saving in the use of copper.

(b) (i) Discuss the Scott connection of transformers for 3-phase to 2-phase conversion with the help of neat circuit arrangement.

(ii) Draw and explain the transformer winding connections of

(i) Yy0 (ii) Yy6 (iii) Dy1 (iv) Dy11

(c) Write short notes on the following:

(i) Open-delta connection.

(ii) All-day efficiency

(iii) Parallel operation of transformers

5. Attempt any two parts of the following: **10x2=20**

(a) For a certain relay, the magnetisation curves for open and closed positions of the armature are linear. If the armature of the relay moves from open to close position at constant current (i.e. very slowly), show that the electrical energy input is shared equally between field energy and the mechanical work done

(b) What are the advantages of analysing energy conversion devices by field energy concept?

Draw and explain the general block diagram representation of an electromechanical energy conversion devices.

(c) Derive the emf equation of a transformer. Discuss the phasor diagram of a 1-phase transformer at (i) No Load (ii) Full Load