Total number of printed pages – 8

B. Tech

CPEE 5301

Fifth Semester Examination – 2007

ELECTRICAL MACHINES – I

Full Marks – 70

Time – 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (i) What are the two functions of a commutator in d.c. machine ?

   (ii) A single phase transformer when supplied from 220 V, 50 Hz has eddy current loss of 50 W. If the transformer is connected to a voltage of 300 V, 50 Hz, what will be the eddy current loss ?

(iii) In a dc machine what is the angle between the stator and rotor field ?

(iv) A transformer is feeding a lagging load. What will be the effect on the voltage regulation of the transformer if :

(a) An inductor is connected in parallel to the load,

(b) A capacitor is connected in parallel to the load ?

(v) In a given magnetic circuit, a current of 1 A flowing in the exciting winding produces a flux of 1 Wb. If the circuit reluctance is doubled, what should be the exciting current ?

(vi) What is the critical resistance of a dc generator ?

(vii) What is the primary reason for providing compensating winding in a dc generator?

(viii) What are the conditions to be fulfilled for parallel operation of two or more DC compound generators ?

(ix) When a generator losses its residual magnetism either due to lighting or short circuit, how can it be made to build up ?

(x) A dc motor is found to stop running after a short period of time. What do you think could be the reasons ?

2. (a) Derive the expression for the electromagnetic torque developed in a dc machine. 3

(b) A 2-pole lap-wound dc shunt motor with 360 conductors operates at a constant flux level of 50 mWb. The motor armature has a resistance of 0.12 Ω and is designed to operate at 240 V, taking a current of 60 A at full load.

(i) Determine the value of external resistance to be inserted in the armature circuit so that armature current does not exceed twice its full-load value at starting.

(ii) The external resistance is completely cut out when the motor reaches its final speed, with the armature current at the full-load value. Calculate the motor speed under this condition. 7

3. (a) Explain why the terminal voltage of a dc shunt generator falls as it is loaded. 3

(b) A 4-pole compound generator has armature, series-field and shunt-field resistances of 1 Ω, 0.5 Ω and 100 Ω respectively. The generator delivers 4 kW at a

terminal voltage of 200 V. Allowing 1 V per brush for contact drop, calculate for both short-shunt and long-shunt connections,

(i) generated emf and

(ii) the flux per pole if the armature has 200 lap-connected conductors and is driven at 750 rpm. 7

4. (a) Explain the principle of transformer action. 2

(b) Derive an expression for the emf induced in a transformer winding. Show that emf per turn in primary is equal to emf per turn in the secondary. 3

(c) A 6300/210 V, 50 Hz, single-phase transformer has per turn emf of about 9 volts and maximum flux density of 1.2 T. Find

the number of high voltage and low voltage turns and the net cross-sectional area of the core. 5

5. (a) Developed the exact circuit of a 1-phase transformer. From this derive the approximate and simplified equivalent circuits of the transformer. State the various assumptions made. Also draw the phasor diagram for the equivalent circuit developed. 5

(b) A 100 kVA, 1000/400 Volts, single-phase transformer, when excited at rated voltage on h.v. side, draws a no-load current of 3.0 A at 0.5 lagging power factor. If it is excited from low voltage side at rated voltage, determine the no load current, power factor and power input. 5

6. (a) Show that the armature reaction effect in an alternator, while supplying a leading pf load, has a magnetizing effect. 4

(b) Draw the combined space and time phasor diagram for a cylindrical rotor alternator with armature current lagging the excitation emf. Discuss the various parameters involved in it. Explain how the diagram can be applied to a synchronous motor ? 6

7. (a) What is voltage regulation of an alternator? Explain how the Potier triangle can be drawn with the help of OCC and any two points on the zpfc ? 4

(b) The following test results are obtained on a 6.6 kV alternator.

OC Voltage (kV) :	3.1	4.9	6.6	7.5	8.3
Field current (A) :	16	25	37.5	50	70

A field current of 20 A is found necessary to circulate full-load current on short-circuit of the armature. Calculate by ampere-turn method the full-load regulation at 0.8 power factor lagging. Neglect resistance and leakage reactance. 6

8. Write short notes on : 5×2

(i) Armature reaction in dc machines

(ii) Elimination of harmonics in generated emf of an alternator.