B. Tech Degree IV Semester Examination, May 2006

EE 405 ELECTRICAL MACHINES I

(1999 Admissions Onwards)

Time : 3 Hours Maximum Marks : 100

*(All questions carry **EQUAL** marks)*

I. (a) Explain the principle of working of a DC generator. Classify its type and write the general e.m.f equation of a generator.

(b) A 4-pole shunt generator with lap connected armature having field and armature resistance of 50 Ω and 0.1 Ω supplies sixty, 100V, 60W lamps. Calculate the armature copper loss, current in each armature conductor and the generated e.m.f. Allow a contact drop of 1V per brush.

OR

II. (a) What is meant by the term armature reaction? How does it affect the main field flux? Define GNP (Geometric Neutral Plane) and MNP (Magnetic Neutral Plane). Explain armature reaction in dc machines and show how cross magnetizing and demagnetizing m.m.fs are produced?

(b) The brushes of a certain lap connected 400KW, 6 pole generator are given a lead of 18^0 electrical. From the data given, calculate

(i) The demagnetizing ampere turns

(ii) The Cross magnetizing ampere turns

(iii) Series turns required to balance the demagnetizing component.

The full load current is 750A and total numbers of conductors are 900 and leakage coefficient is 1.4.

III. (a) Draw and explain the following characteristics of dc series and shunt wound generators.

(i) No load and load magnetization characteristics

(ii) External and internal characteristics.

(b) The OCC of a dc shunt generator driven at 600rpm is as follows.

I_f(A) :	0.5	1	2	3	4	5
E_0(V) :	75	225	330	390	400	425

Find - (i) The e.m.f to which the generator will excite when the circuit resistance is 100 Ω

(ii) The additional resistance required in the field circuit to reduce the emf to 350V.

(iii) The critical field resistance for 600rpm.

OR

IV. (a) Describe the advantage of using several small dc generators in parallel over the use of single large generator. Explain how 2 shunt generators work in parallel and how they share the load?

(b) Two shunt would generators running in parallel have each an armature resistance of 0.02 Ω and a field resistance of 50 Ω and the combined external load current is 5000A. The fields are excited so that the e.m.f induced I one machine is 600V and in the second machine is 610V. Calculate the bus-bar voltage and output of each machine.

(Turn Over)

V. (a) What are the three important characteristics of a dc motor and explain the characteristics of a shunt motor and series motor?

(b) The speed of a 50HP (37.3 KW) series motor working on 500V supply is 750rpm at full load and with 90% efficiency. If the load torque is made 350 Nm and 5 Ω resistance is connected in series with a machine calculate the speed at which the machine will run. Assume the magnetic circuit to be un-saturated and the armature and the field resistance to be 0.5 Ω.

OR

VI. (a) Explain the necessity of starter in a dc motor. With a neat sketch, explain the working of a 4-point starter. What are the advantages with 4-point starter over 3-point starter?

(b) Briefly explain the Hopkinson's test on a pair of shunt motors. In such a test on 250V machines, the line current was 50A and the motor current 400A not including the field currents of 6A and 5A . The armature resistance of each machine was 0.015 Ω. Calculate the efficiency of each machine.

VII. (a) Draw an equivalent circuit for a single –phase two winding transformer with referred to primary winding. Also show how an equivalent circuit is useful in the analysis of performance of a transformer.

(b) The following data referred to a single phase-transformer. Turns ratio is 19.5:1.R_1=25 Ω; X_1=100 Ω ;R_2=0.06 Ω ;X_2=0.25 Ω, No load current =12.5A leading the flux by 30^0. The secondary delivers 200A at a terminal voltage of 500V and a power factor of 0.8 lagging. Determine by the aid of phasor diagram, the primary applied voltage, the primary power factor and the efficiency.

OR

VIII. (a) What are the different losses in a transformer? Derive the condition for maximum efficiency of the transformer.

(b) The primary and secondary windings of a 40KVA, 6600/250V single-phase transformer have resistances of 10 Ω and 0.02 Ω respectively. The total leakage reactance is 35 Ω as referred to primary winding. Find Full load regulation at a power factor of 0.8 lagging.

IX. (a) Describe the back-to-back test for separation of losses in two identical transformers.

(b) Consider a 4KVA, 200/400V single phase transformer supplying full load current at 0.8 lagging power factor. The OC and SC test results are as follows.
OC Test : 200V, 0.8A, 70W (on LV side)
SC Test : 20V, 10A, 60W (on HV side)
Calculate the efficiency, secondary voltage and current in the primary at the above load. Calculate the load at unity power factor corresponding to maximum efficiency.

OR

X. (a) Give an account on :
(i) Open delta or V-V- connection
(ii) Scott connection or T-T connection.

(b) Two transformers A and B are connected in parallel to a load of (2+j5) Ω. The impedance in secondary are Z_A=(0.15+j0.5) Ω and $Z_B = (0.1 + j0.6)\Omega$. Their no load terminal voltages are $E_A = 207\angle 0^0 V$ and $E_B = 205\angle 0^0 V$. Find the power output and power factor of each transformer.

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