Code No: 113BZ

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, December-2014
ELECTRICAL MACHINES – I
(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

Part – A **(25 Marks)**

1.a) State the advantages of analyzing energy-conversion devices by field-energy concept. [2M]
b) Explain the principle of energy conversion. [3M]
c) What are the two functions of a commutator in D.C. machines? [2M]
d) Explain the following terms with reference to armature windings of D.C. machines: (i) Pole pitch (ii) Back pitch (iii) Front pitch. [3M]
e) Define critical field resistance and critical speed of a d.c generator. [2M]
f) Draw the external characteristics of a D.C. series generator. [3M]
g) State the applications of d.c shunt motor. [2M]
h) A 240 V series motor takes a 40 A and gives its rated output at 1500 rpm. Its resistance is 0.3Ω. Find what resistance must be added to obtain rated torque. (i) at starting (ii) at 1000 rpm. [3M]
i) Enumerate the various losses in a d.c machine. [2M]
j) Derive the condition for maximum efficiency of a D.C. motor. [3M]

Part – B **(50 Marks)**

2.a) Find an expression for the magnetic force developed in a singly excited translational magnetic system.
b) Two magnetic surfaces separated by distance g have a flux density of 1.5 T in between them. This value is usually the saturation level for ferromagnetic materials. Find the force between these two surfaces for area A = 2 m^2.

OR

3.a) Define field energy and co-energy. Give the significance of co-energy in the derivation of torque or force in an electromechanical energy conversion device.
b) Self and mutual inductances in henries of two coupled coils are $L_1 = 3+\frac{1}{2x}$, $L_2 = 2+\frac{1}{2x}$, $M_{12} = M_{21} = \frac{1}{2x}$, over a certain displacement x in meters. The coil resistances are negligible. For constant currents of I_1 = 10 A and I_2 = -5A.
c) Compute the mechanical work done in increasing x from 0.5 to1m.

4.a) Explain the methods of improving commutation in d.c generators with the help of neat sketches.

b) A 250 kW, 400 V, 4 pole d.c generator has 720 lap wound conductors. It is given a brush lead of 3 angular degrees (mech.) from the geometric neutral. Calculate the cross and demagnetizing ampere turns per pole. Neglect the shunt field current.

OR

5.a) What is armature reaction? What are the effects of armature reaction? How the armature reaction is minimized?

b) A single turn coil has an inductance of 0.02mH in the commutating zone. Find the value of compensating field required for obtaining straight line commutation for an armature current of 120A for 4-pole lap wound d.c machine.

6.a) Explain the desirable conditions and parallel operation of d.c compound generators with a neat circuit diagram.

b) Two d.c shunt generators are rated 230 kW and 150kW, 400 V. Their full load drops are 3% and 6% respectively. They are excited to no load voltages of 410 V and 420 V respectively. How will they share load of 1000A and the corresponding bus voltage?

OR

7.a) How O.C.C. characteristic of d.c. seperately excited generator is drawn?

b) The open circuit characteristics of a d.c shunt generator at rated speed is

I_f (A)	1	2.5	5	7	9	12	15	18
V_{OC} (V)	22	231	400	479	539	605	642	671

The field and armature resistances are 46Ω and 0.12Ω respectively. Determine the terminal voltage when the armature current is 360A in two cases:
i) Armature reaction is negligible
ii) 1A field current is needed to counteract the effect of armature reaction.

8.a) Derive an expression for the electromagnetic torque produced by d.c motor.

b) A 10 kW, 250 V d.c shunt motor takes a no-load armature current of 6A at rated voltage and runs at 1250 r.p.m. The armature circuit resistance is 0.3Ω and the field resistance is 50Ω. At rated load and rated voltage, the motor takes a current of 20A and the armature reaction weakens the field flux by 2%. Calculate the full load speed and the corresponding electromagnetic torque of the motor.

OR

9.a) Explain different speed control methods of d.c. motor. Mention their advantages and disadvantages.

b) A d.c series motor is driving a fan load where the load torque is proportional to the cube of speed. The resistance of the armature and field in series is 0.1 Ω and the motor takes 10 A and runs at 1000 r.p.m when operating from a 200 V supply. Calculate the value of resistance to be inserted in series with the armature to reduce the operating speed to 800 r.p.m.

10.a) Explain the procedure of conducting a suitable test to separate stray losses in a d.c motor.

b) A 200V, 14.92KW D.C. shunt motor when tested by Swinburne's method gave the following results:
Running light: Armature current was 6.5A and field current was 2.2A
With armature locked: The current was 70A when a potential difference of 3V was applied to the brushes.
Estimate the efficiency of the motor when working under full load conditions.

OR

11.a) Discuss the effect of speed and size on the efficiency of d.c machines.

b) Two identical d.c machines when tested by Hopkinson's method gave the following test results:
Field currents are 5A and 4.2A. Line voltage is 230V. Line current excluding both the field currents is 40A. Motor armature current is 350A. The armature resistance of each machine is 0.02Ω. Calculate the efficiency of both machines.

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