Government Engineering College,

Electrical Engineering Department
Semester: 4
Subject: Electrical Machine-1 (3140913)

Assignment-1 (CO-1) **Weightage – 10 Marks**

Magnetic circuit and principle of electromechanical energy conversion

1. Define the following terms -

(a) MMF (b) flux (c) Reluctance (d) Inductance (e) Permeability (f) flux density

2. Explain the visualization of magnetic field produced by a bar magnet and a current carrying coil through (1) air (2) a combination of iron and air.

3. Explain Amperes law's and Biot savart law's.

4. Explain the principles of energy conversion. Draw and explain the general block diagram representation of an electromechanical energy conversion device.

5. What are the losses that occur during electromechanical energy conversion?

6. Show that the field energy in a linear magnetic system is given by

$$W_F = (1/2)Li^2 = (1/2)\psi i$$

7. Explain the B-H curve for magnetic material like iron, air and steel.

8. Explain the flux-linkage vs. current characteristic of magnetic circuits.

9. For a singly excited magnetic system, derive the expression for mechanical for mechanical workdone.

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Assignment-2 (CO-2 & CO-3) **Weightage – 20 Marks**

Part-1 D.C. Generator

Q.1 Answer the following questions:

1. Explain the working principle of D.C. Generator.
2. What are the main parts of a D.C. Machine? State the function of each part and the materials use for each part with necessary diagrams.
3. What is armature winding? Define the following terms related to armature winding.
   (a) Conductor (b) overhang (c) coil (d) coil span (e) turn
4. Distinguish between self-excited and separately excited D.C. Generator. How is self- excited D.C. generator classified? Give their circuit diagrams.
5. Classify the D.C. machine based on (a) Excitation and (b) Connections. Derive the expression of e.m.f. developed in a DC generator.
6. Explain the process of building up of Voltage in a D.C. shunt generator and give the conditions to be satisfied for Voltage build up.
7. What is meant by critical field resistance? What is its significance? How this could be determined?
8. State and explain the various losses which takes place in a d.c.machine.
9. What is armature reaction? Describe the effects of armature reaction on the operation of dc machines? How the armature reaction is minimized?

10. Define and discuss commutation. Explain the methods to improve it.

11. Draw and explain the internal and external characteristics of D.C. series generator.

12. Draw and explain the internal and external characteristics of D.C. shunt generator.

Q.2 Solve the following examples:-

1. A 4 – pole dc shunt generator with lap – connected armature supplies a load of 100 A at 220 V. The armature resistance is 0.2 ohm and the shunt field resistance is 100 ohm. Find (a) armature current and (b) generated e.m.f. Assume brush contact drop of 1V per brush.

2. A short shunt compound wound dc generator supplies a load current of 50 A at 220 V. The generator has the following winding resistances :
   Armature winding resistance = 0.5 ohm Series field resistance = 0.2 ohm Shunt field resistance = 100 ohm.
   Calculate the generated e.m.f. Assume brush drop is 1 V per brush.

3. When driven at 600 r.p.m .with a flux per pole of 0.03 Wb, a dc generator has an e.m.f. of 240 V. If the speed is increased to 650 r.p.m and at the same time the flux per pole is reduced to 0.028 Wb, what is then the induced e.m.f?

4. A 4 – pole, long – shunt lap wound generator supplies 25 kW at a terminal voltage of 500 V. The armature resistance is 0.03 ohm, series field resistance is 0.04 ohm and shunt field resistance is 200 ohm. The brush drop may be taken as 1 V. Determine the e.m.f. generated.
   Also calculate the number of conductors if the speed is 1200 r.p.m. and flux

per pole is 0.02 Wb. Neglect armature reaction.

5. A short – shunt compound d.c generator supplies a current 50A at a voltage of 220V. If the resistance of the shunt field is 100 ohm , of the series field 0.03 ohm , of the armature 0.1 ohm , the total brush drop is 2V and the iron and friction losses amount to 700w , find

a. generated e.m.f
b. the copper losses
c. the output power of prime mover and
d. the generator efficiency

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Assignment-3 (CO-2 & CO-3) **Weightage – 20 Marks**

Part -1 Single Phase Transformer

1. What is transformer? How does it transfer electrical energy from one circuit to another? Show that the voltage induced in a transformer per turn is the same, whether it is primary or secondary.
2. Describe the construction of core type and shell type of single phase transformer.
3. Explain the working of transformer under "ON load" condition with vector diagram for resistive, inductive load and capacitive.
4. Explain the equivalent circuit of a single phase transformer referred to primary side and secondary side.
5. Explain open and short circuit tests for single phase transformer. While making short circuit test, low voltage winding is always short circuited. Why?
6. Define voltage regulation of a transformer and reduce the expression for voltage regulation.
7. What is the need of parallel operation of transformers? Discuss the conditions to be satisfied before connecting two single phase transformers in parallel.
8. What is an auto-transformer? State its merits over the two-winding transformer. What are the applications of auto-transformer?
9. Explain the Sumpner's or back-to-back test for transformers with necessary circuit diagram.
10. Solve the example :

1. An ideal 25 KVA transformer has 500 turns on the primary winding and 40 turns on the secondary winding. The primary is connected 3000 V, 50 Hz supply. Calculate (i) Primary and secondary current on full load (ii) Secondary e.m.f. and (iii) Maximum core flux.
2. A 230/460 V transformer has a primary resistance of 0.15 ohm and leakage reactance of 0.4 ohm and the corresponding values for the secondary are 0.5 and 1.5 ohm respectively.

   Find the secondary terminal voltage when supplying (i) 10 A at 0.8 p.1 lagging and (ii) 10 A at 0.8 p.f. leading.
3. A 10 KVA, 2000/400 V, single phase transformer has R1 = 5 ohm, X1 = 12 ohm, R2 = 0.2 ohm and X2 = 0.48 ohm.

   Determine the equivalent impedance of the transformer referred to (i) Primary and (ii) Secondary side.
4. The following readings obtained from open and short circuit tests on 10 KVA, 400/100V, 50Hz single phase transformer are :

   O.C. test : 100V, 4A, 80W on L.V. side

   S.C. test : 10V, 20A, 120W on H.V. side

   Compute-

   (i) equivalent circuit parameters referred to primary

   (ii) efficiency and voltage regulation at 0.8 power factor lagging and

   (iii) efficiency at half full load and 0.8 lagging power factor load.

5. Obtain the equivalent circuit of a 200/400V, 50HZ, 1-phase transformer from the following test data :
   O.C. test : 200V, 0.7A, 70W (on L.V. side)
   S.C. test : 15V, 10A, 85W (on H.V. side)
   Also calculate the % regulation when delivering 5 kW at 0.8 p.f. lagging.