RAMA UNIVERSITY

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FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-1

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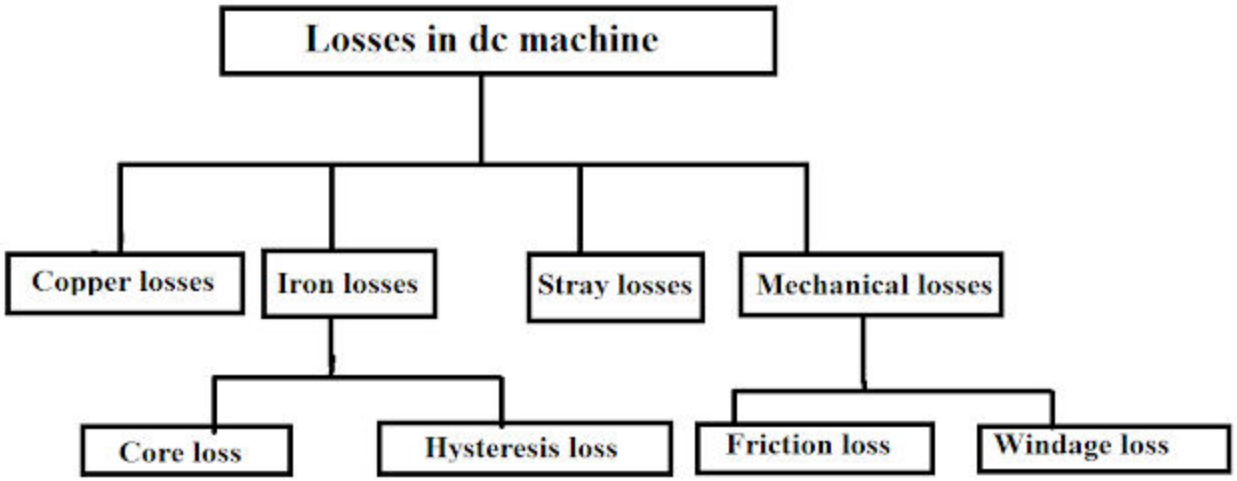
Faults in dc machines

DC motor fault zone analysis is a vital plan of any DC motor maintenance program. Several troubles may arise in a DC motor. A few of them are discussed below:

1. Failure to start
2. Sparking at brushes
3. Vibrations and pounding noises
4. Overheating of DC Motor

Losses in a DC machine



1. Copper losses:

These losses occure in these parts of dc machine which carry electric current.copper losses occur due to the current flowing in various windings of the machine. These losses are directly proportional to the square of current flowing in the winding and the ohmic resistance of the winding (I^2 R losses).

The variouse copper losses occurring in the windings are:

A. Armature copper loss
B. Shunt field copper loss
C. Series field copper loss
D. Copper loss in interpole winding

Shunt field copper loss is constant for shunt and compound wound dc machine. All other copper losses are called variable losses because these are directly proportional to the square of armature current which varies with the load. The armature copper loss is about 30% to 40%of total full load losses and field copper losses are about 20 to 30% of full load losses.

2. Magnetic losses:

These losses are also called iron or core losses . These losses occer in armature core and teeth where the flux is changing . Iron losses consists of

(A) hysteresis losses

(B) eddy current losses

A . Hysteresis losses:

This loss is due to the reversal of magnetism of the armature core.

$$Hysteresis\ loss\ P_h = \eta B_{max}^{1.6} fV\ \ watts$$

Bmax : maximum value of flux density in the core.

V: volume of the armature core

F : frequency of magnetic reversals

η: hysteresis coefficient

These losses occure in armature core and teeth of the dc machine.

Hysteresis loss can be reduced by using core material of silicon steel which has low hysteresis coefficient .

B .Eddy current loss:

When the armature core rotates in magnetic field of pole, it also cuts the magnetic flux. Hence an emf is induced in the body of the core according to the laws of electromagnetic induction. This emf sets up current in the body of the armature core and is khown is eddy current. The power loss due to the flow of this current is khown as eddy current loss.

The eddy current loss is given by

Eddy Current loss $\mathbf{P_e = K_e B^2_{max} f^2 t^2 V}$ **Watts**

Where, k_e = constant

B_{max} = Maximum flux density in wb/m^2

T = Thickness of lamination in m

V = Volume of core in m^3

Note: Constant ($\mathbf{K_e}$) depend upon the resistance of core and system of unit used.

To minimize eddy current losses the armature core is made of thin laminated stampings. The thickness of lamination used for armature core is 0.35 to 0.5 mm.

3. Mechanical losses:

Due to friction of bearings, air friction or windage losses occur in dc machines. These are khown as mechanical losses.

Mechanical losses consists of

(A) bearing and brush friction loss

(B) windage loss or air friction of rotating armature.

These losses are about 10% to 20% of total full-load losses.

4. Stray load losses:

There are certain types of losses which can not be easily determined. They appear when the machine is loaded. This indeterminable losses are called stray load losses and are due to the following reasons:

1. Distortion of flux because of armature reaction.
2. Due to eddy current in conductors there is an additional I^2R loss.
3. Short circuit current in the armature coils undergoing commutation.

Stray load losses may be assumed 0.5 to 1% of the power output for machines.