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UNIVERSITY

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FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-ii

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COMPONENTS OF LOAD TORQUES:

The load torque T_l can be further divided into the following components

(i) Friction Torque (T_F)

Friction will be present at the motor shaft and also in various parts of the load. T_F is the equivalent value of various friction torques referred to the motor shaft.

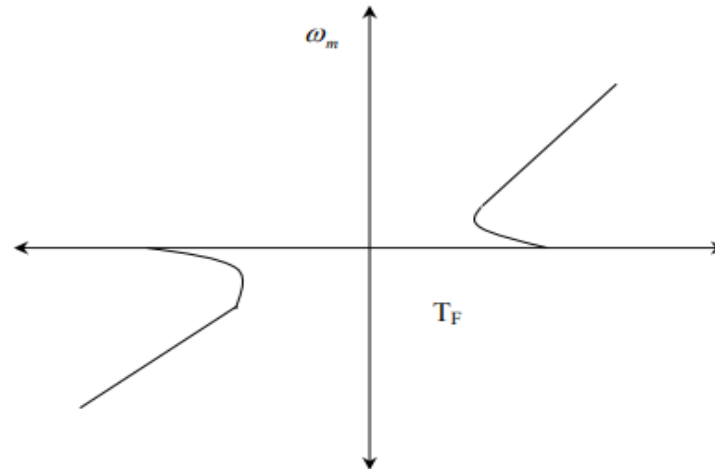
(ii) Windage Torque (T_W)

When the motor runs, wind generates a torque opposing the motion. This is known as windage torque.

(iii) Torque required to do useful mechanical work.

Nature of this torque depends upon the particular application. It may be constant and independent of speed. It may be some function of speed, it may be time invariant or time variant. Its nature may also change with the load's mode of operation.

Its value at stand still is much higher than its value slightly above zero speed. Friction at zero speed is called stiction or static friction. In order to start the drive, the motor should at least exceed stiction.



Value of friction torque with speed is shown in figure

Friction torque can also be resolved into three components

Component T_v varies linearly with speed is called VISCOUS friction and is given by

$$T_v = B \omega_m$$

Where B is viscous friction co-efficient.

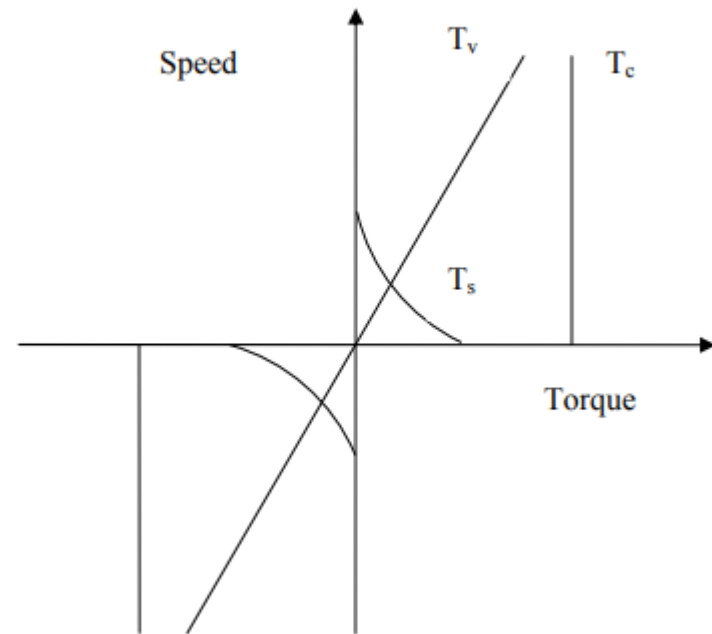
Another component T_c , which is independent of speed, is known as COULOMB friction.

Third component T_s accounts for additional torque present at stand still. Since T_s is present only at stand still it is not taken into account in the dynamic analysis. Windage torque, T_w which is proportional to speed squared is given by

$$T_w = C \omega_m^2 \quad C \text{ is a constant}$$

From the above discussions, for finite speed

$$T_l = T_L + B \omega_m + T_c + C \omega_m^2$$



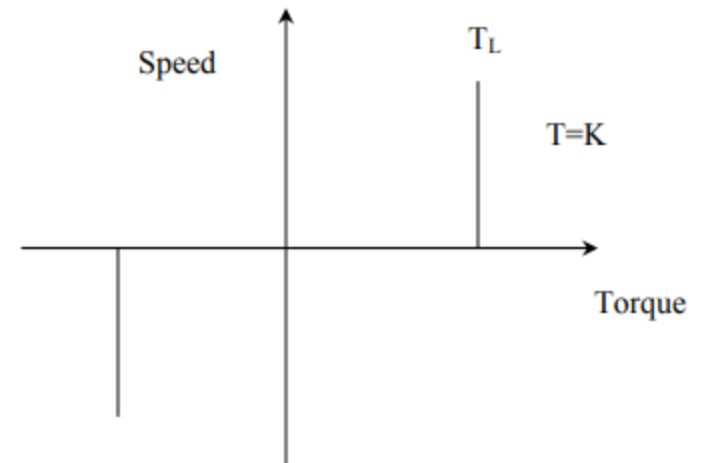
CHARACTERISTICS OF DIFFERENT TYPES OF LOADS

One of the essential requirements in the selection of a particular type of motor for driving a machine is the matching of speed-torque characteristics of the given drive unit and that of the motor. Therefore the knowledge of how the load torque varies with speed of the driven machine is necessary. Different types of loads exhibit different speed torque characteristics. However, most of the industrial loads can be classified into the following four categories.

1. Constant torque type load
2. Torque proportional to speed (Generator Type load)
3. Torque proportional to square of the speed (Fan type load)
4. Torque inversely proportional to speed (Constant power type load)

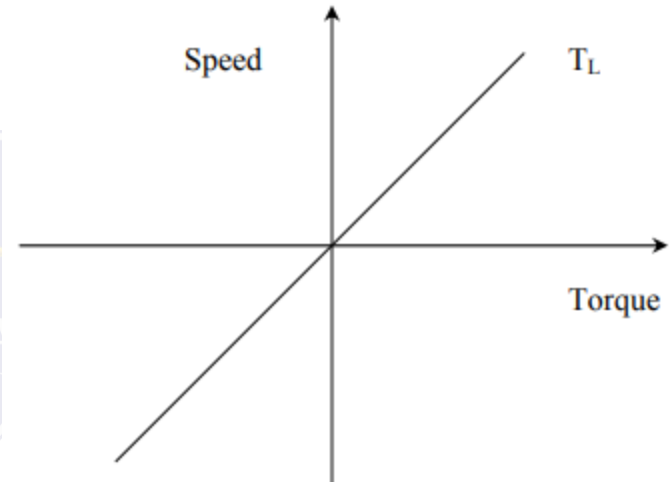
Constant Torque characteristics:

Most of the working machines that have mechanical nature of work like shaping, cutting, grinding or shearing, require constant torque irrespective of speed. Similarly cranes during the hoisting and conveyors handling constant weight of material per unit time also exhibit this type of characteristics.



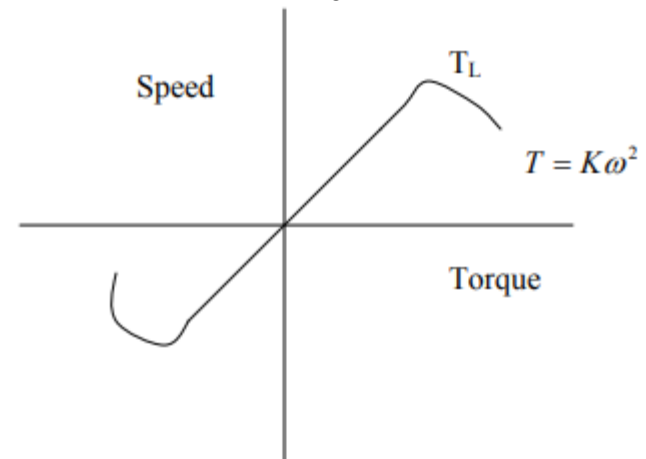
Torque Proportional to speed:

Separately excited dc generators connected to a constant resistance load, eddy current brakes have speed torque characteristics given by $T = k\omega$



Torque proportional to square of the speed:

Another type of load met in practice is the one in which load torque is proportional to the square of the speed. Eg Fans rotary pumps, compressors and ship propellers.



Torque Inversely proportional to speed:

Certain types of lathes, boring machines, milling machines, steel mill coiler and electric traction load exhibit hyperbolic speed-torque characteristics

