ENGINEERING (DIPLOMA)

Branch: Electrical

Subject Code: 3340903

Subject Name : Utilization of Electrical Energy

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Chapter – 3
Electric Drives & Elevators

- Concept of drives
- Features of electric drives
- Selection of drives
- Motor operation
- Different methods of motor control
- Ac v/s dc drives

What is Drives ???

- **System employed for motion control are known as DRIVES**
  - **Prime mover**
  - **Energy transmitting device**
  - **Equipment (Mechanical Load)**

- **Prime movers**
  - **Diesel/Petrol engine**
  - **Gas/steam turbine**
  - **Electric motors**

What is Electric Drives ???

- Drives employing electric motors as prime mover are known as **ELECTRIC DRIVES**
- The energy transmitting shaft and the control equipment by which the motor characteristics are adjusted and their operating conditions are varied with respect to load for particular requirements is called **ELECTRIC DRIVE.**
- The Drive together with load constitute the **drive system.**

Advantages of Electric Drives

- Variable speed control
- Dynamic characteristics can be shaped to match particular load requirements
- Wider power, speed & torque range
- Electric motors have
  - Higher efficiency
  - Low no load losses
  - Less maintenance
  - Long life

Advantages of Electric Drives

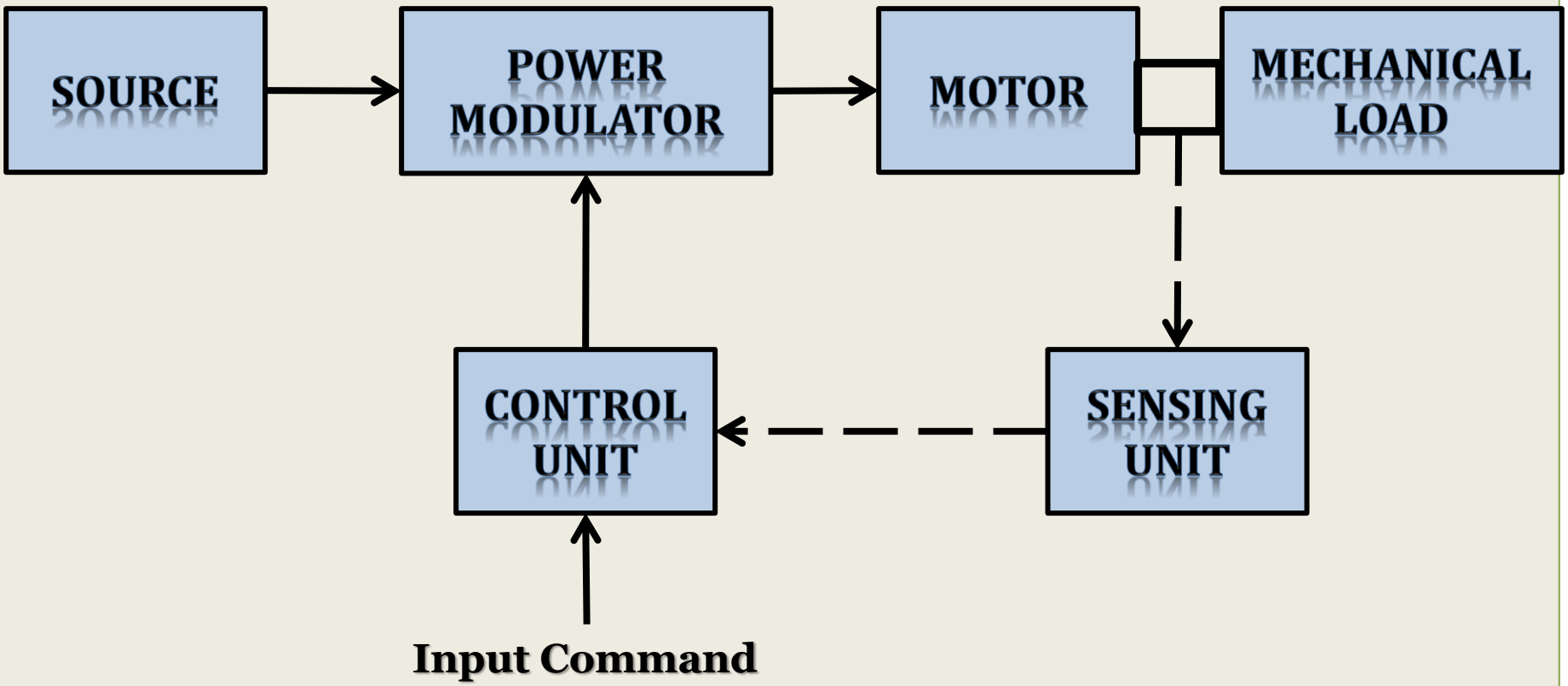
- Higher overload capacity
- Reduction of transients
- Better dynamic performance
- Compact in size
- Suitable for any environmental conditions
- Clean, pollution free & silent operation
- No warm up time required

Disadvantages of Electric Drives

- Continuous power supply requirements
- Low power to weight ratio

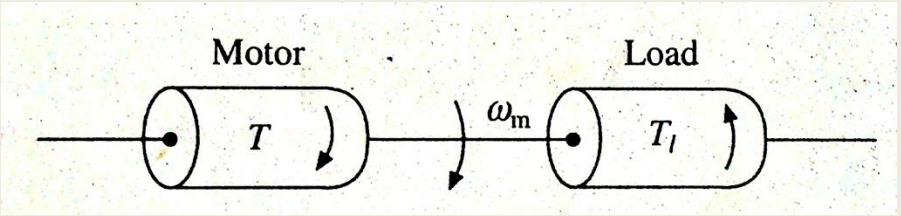
Electric Drives

- **Block diagram of electric drive system**



Dynamics of Electric Drives

- **Fundamental torque equation**



$$T - T_l = \frac{d}{dt}(J\omega_m) = J\frac{d\omega_m}{dt} + \omega_m \frac{dJ}{dt}$$

$$T = T_l + J\frac{d\omega_m}{dt}$$

T = Instantaneous value of developed motor torque $N-m$

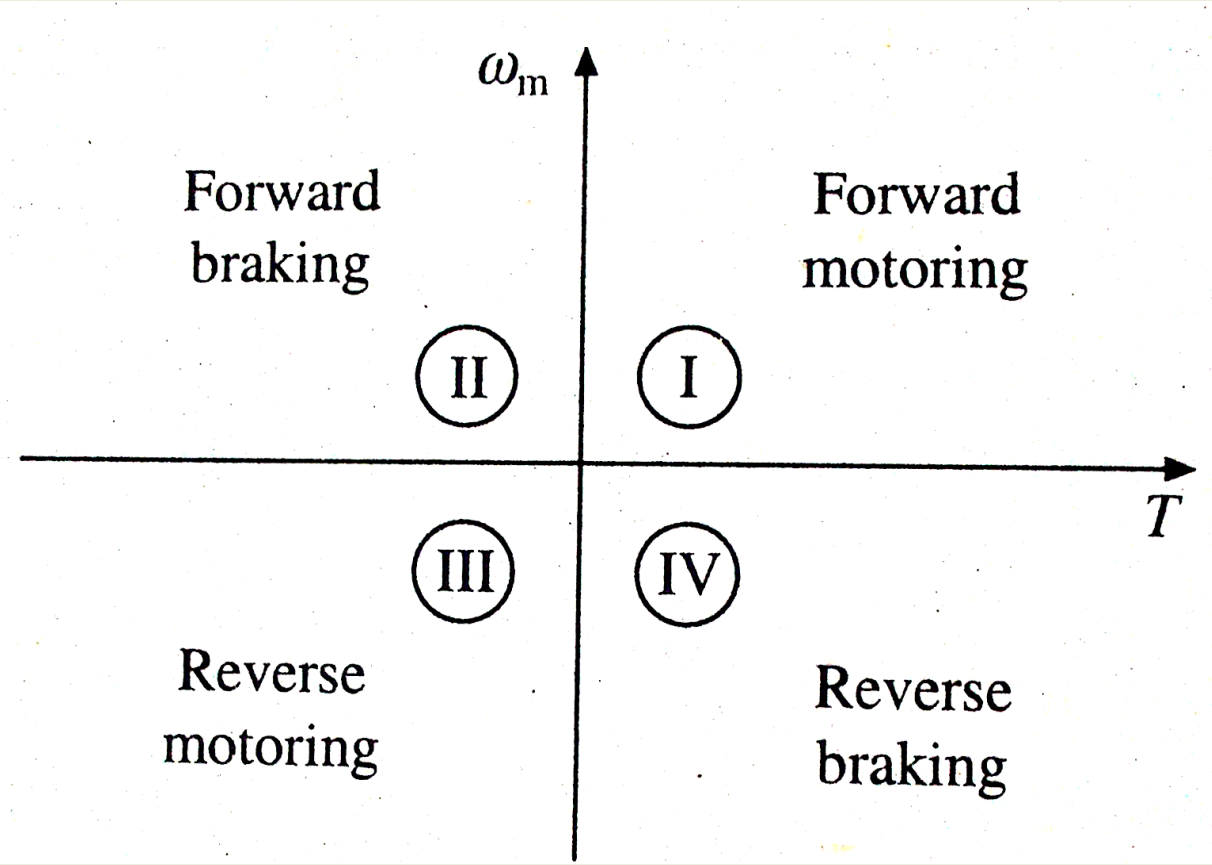
J = Polar moment of inertia $kg-m^2$

ω_m = Instantaneous angular velocity of motor shaft rad/sec

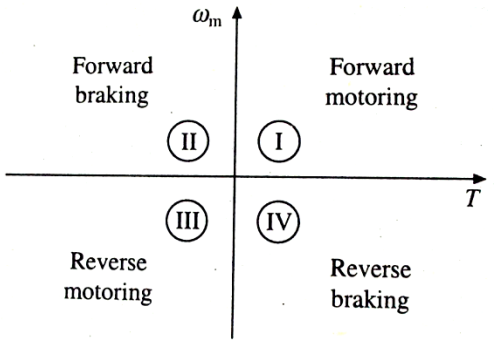
T_l = Instantaneous value of load (resistance) torque $N-m$

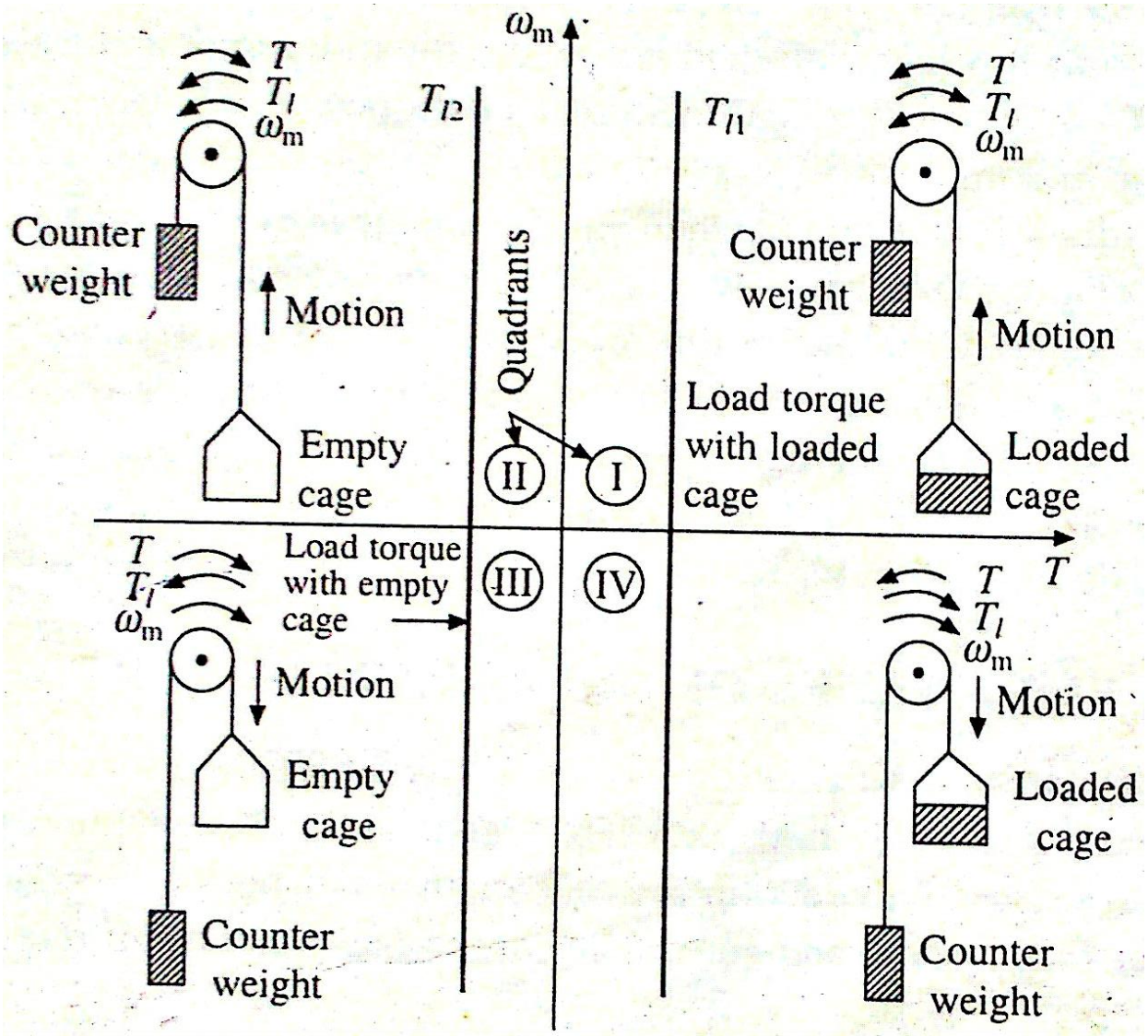
Dynamics of Electric Drives

- **Four quadrants**



- **Four quadrant operation**





Selection of Prime Mover for Electric Drives

- Type of Supply (AC/DC)
- Electrical Characteristics
  - Starting Torque
  - Speed Control
  - Braking
  - Overload Capacity
  - Parallel Running
- Mechanical Features
  - Robust Construction
  - Small Size
  - Less Weight
  - Enclosure
  - Low Noise
- Cost

Selection Between AC & DC Drives

- Availability of Supply
- Ease of Control
- Power Rating
- Nature of Load
- Environmental Condition
- Size & Weight
- Cost
- Harmonic Content

Selection Between AC & DC Drives

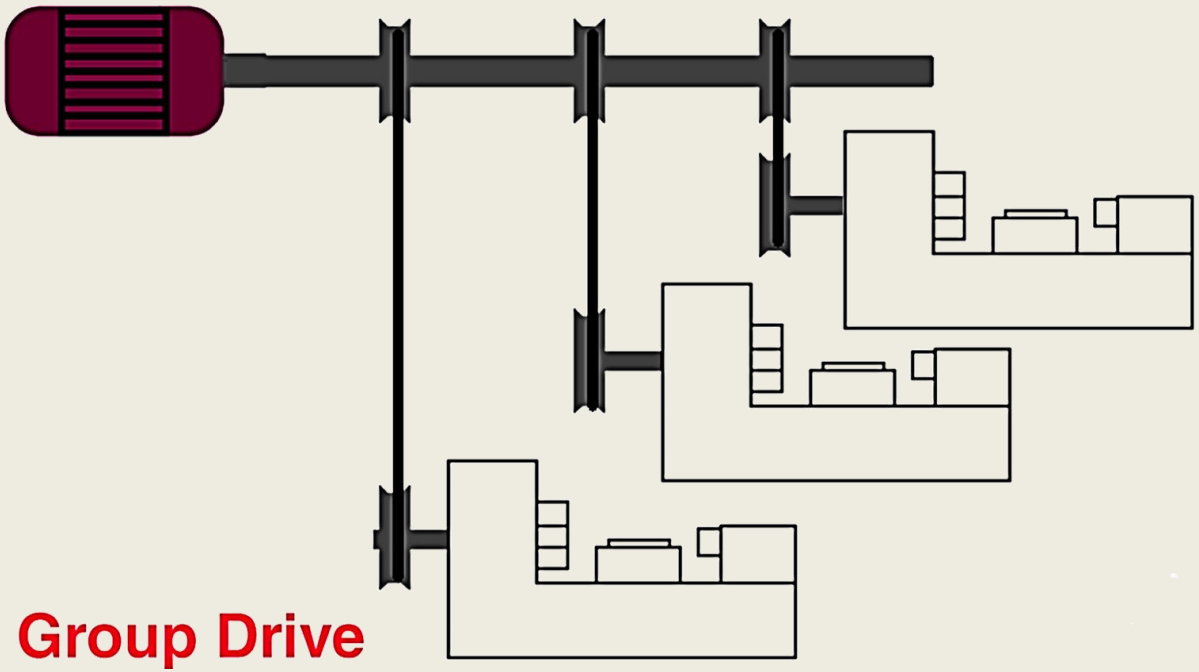
AC Drive	DC Drive
High Efficiency	Low Efficiency
Difficult Speed Control	Easy Speed Control
Low Starting Torque	High Starting Torque
Low Maintenance	High Maintenance
Low Cost	High Cost
Long Life	Medium Life
No sparking	Sparking

Type of Drives

- **Group drive**
- **Individual Drive**
- **Multimotor Drive**

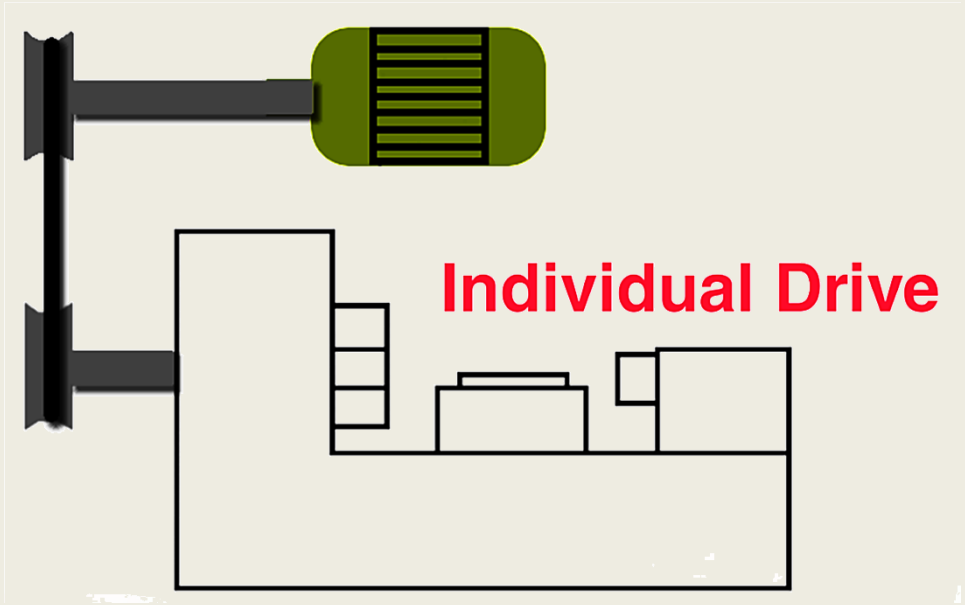
Group Drives

- If several group of machines are organized on one shaft and driven by one motor, the system is called a group drive.



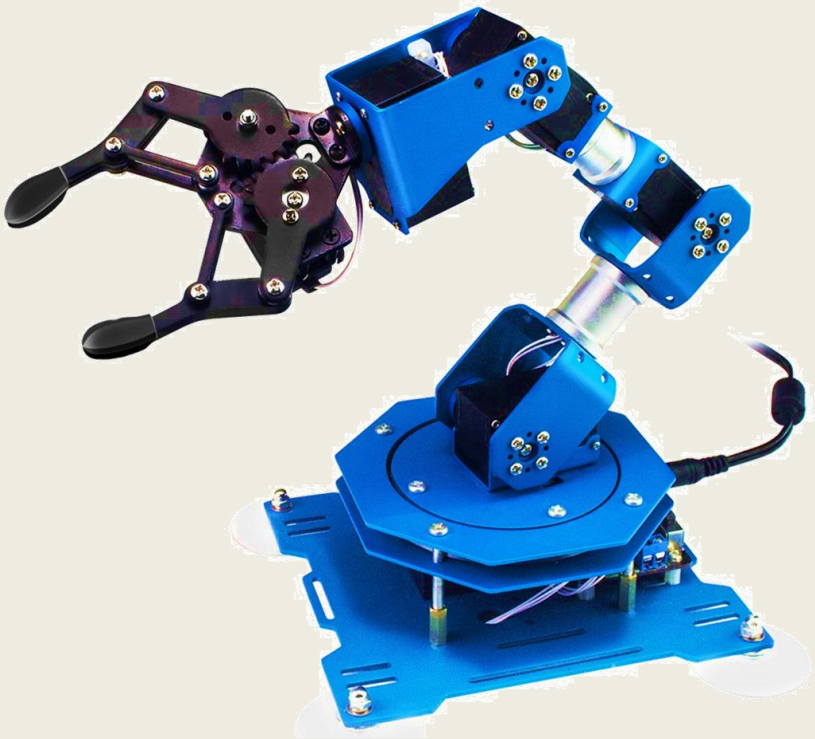
Individual Drives

- **If a single motor is used to drive a given mechanism and it does all the jobs connected with this load , the drive is called individual drive.**



Multi Motor Drive

- **Each operation of the mechanism is taken care of by a separate drive motor.**



Group Drive & Individual Drive

Group Drive

- Lower Power Rating Motor is Required
- Less space required
- Load on the motor is less than the rating, so poor efficiency & PF
- Main motor fails then whole process is stopped
- Automatic control is not possible
- Speed can not be changed
- Future expansion not possible

Individual Drive

- Required power rating motor is needed
- More space required
- As working on full load, good efficiency & PF
- In case of fault only one machine is affected
- Automatic control possible
- Speed can be changed
- Future expansion possible

Type of Load Torque

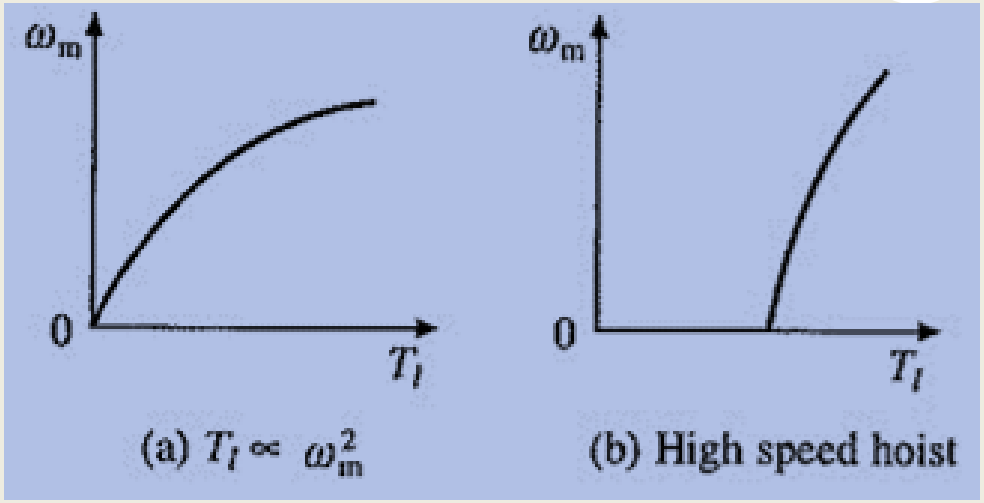
Active Load Torque

- Load torques which have the potential to drive the motor under equilibrium condition are called Active Load Torques.
- gravitational force, tension, compression and torsion, undergone by an elastic body

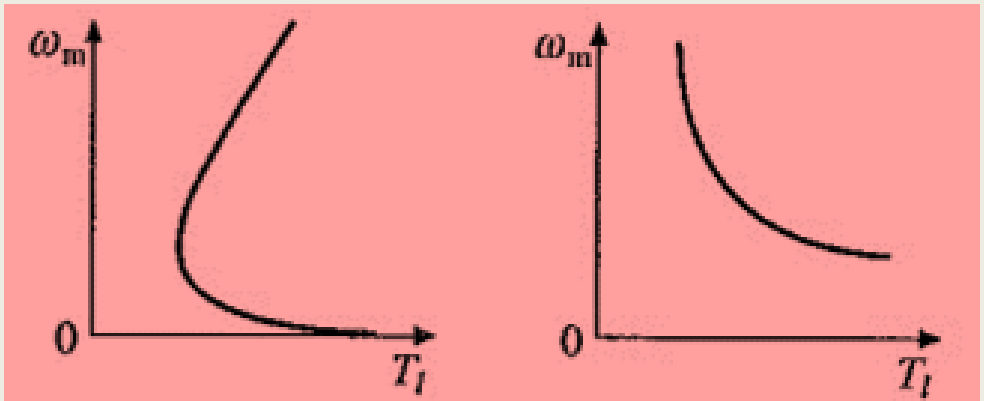
Passive Load Torque

- Load torques which always oppose the motion and change their sign on the reversal of motion are called Passive Load Torques.
- friction, windage, cutting etc.

Type of Load Torque



(a) $T_l \propto \omega_m^2$ (b) High speed hoist



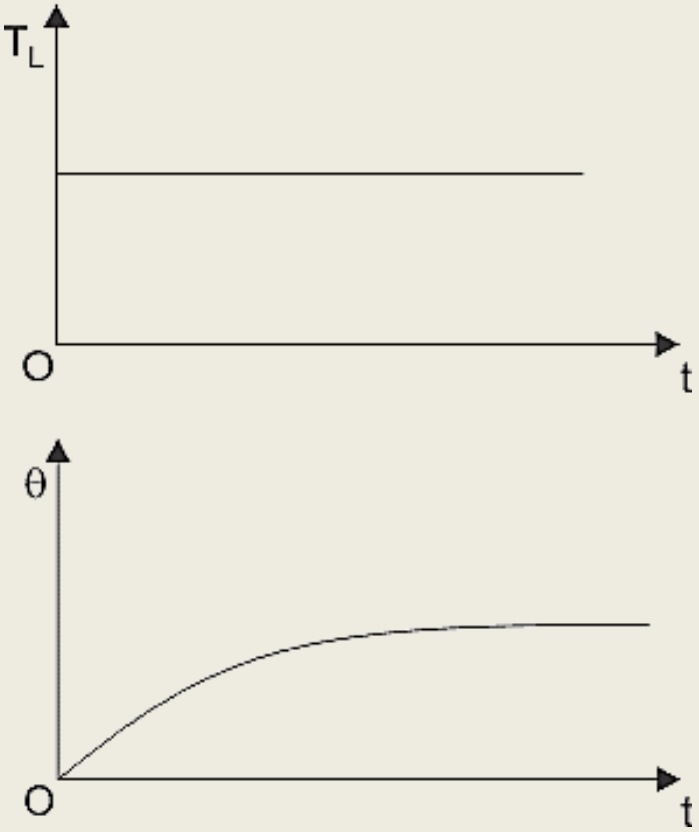
(c) Traction load (d) Constant power loads

Motor Duty Cycle

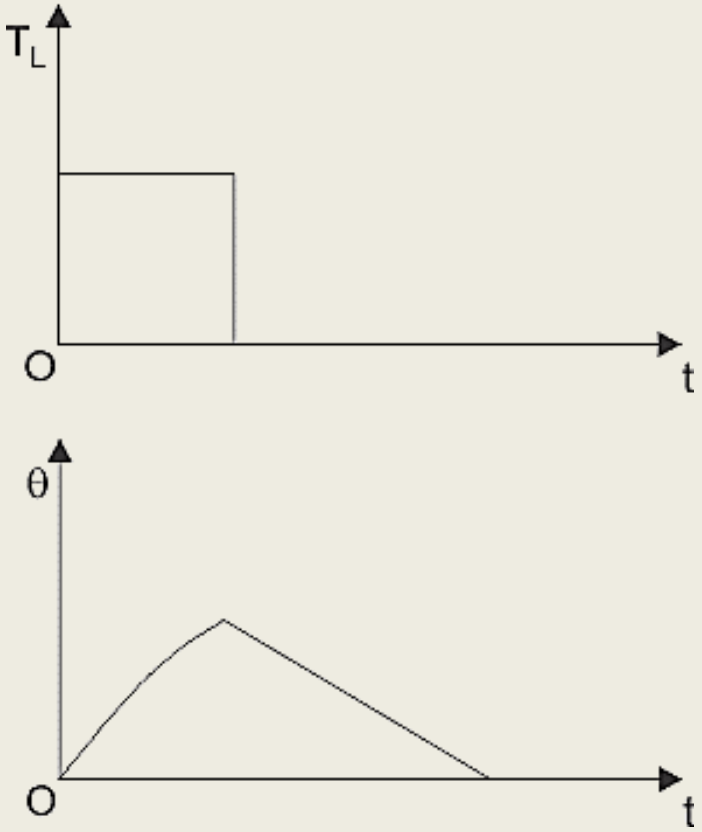
- Continuous duty
- Short time duty
- Intermittent periodic duty
- Intermittent periodic duty with starting
- Intermittent periodic duty with starting and braking
- Continuous duty with intermittent periodic loading
- Continuous duty with starting and braking
- Continuous duty with periodic speed

Motor Duty Cycle

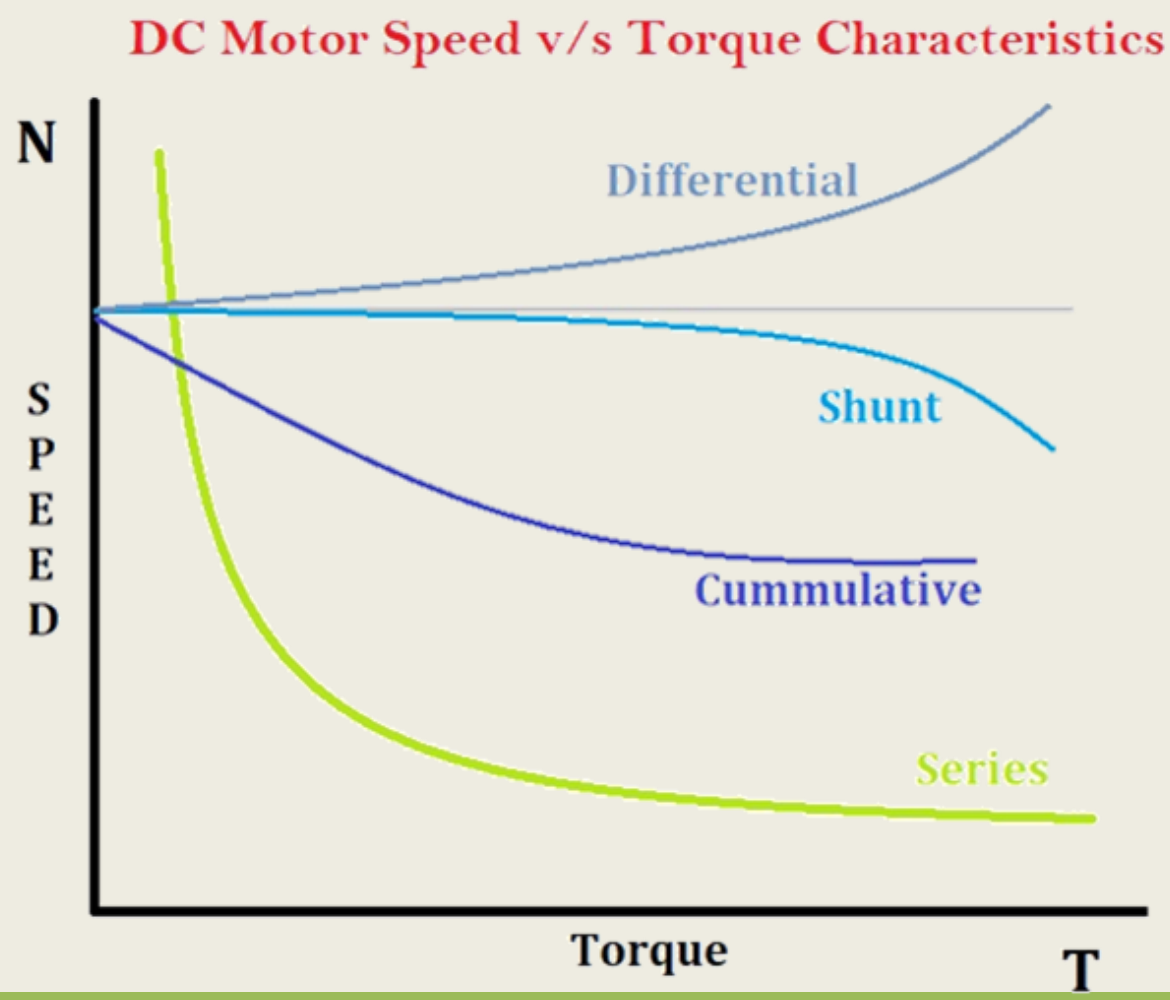
- **Continuous duty**



- **Short time duty**

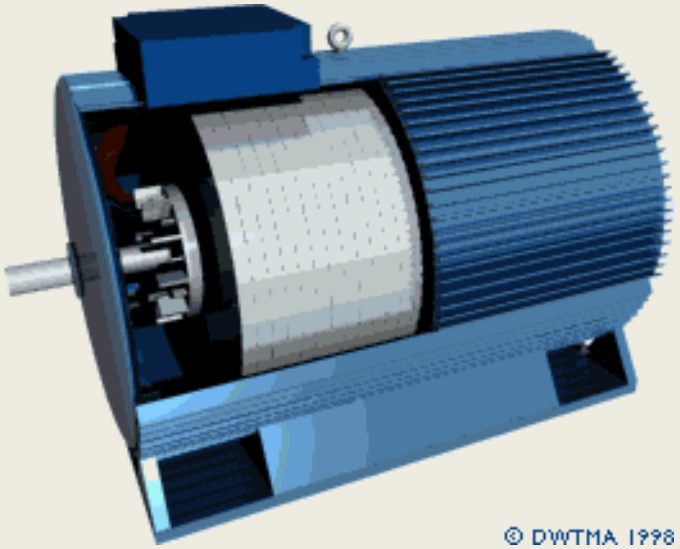


DC Motor Drives



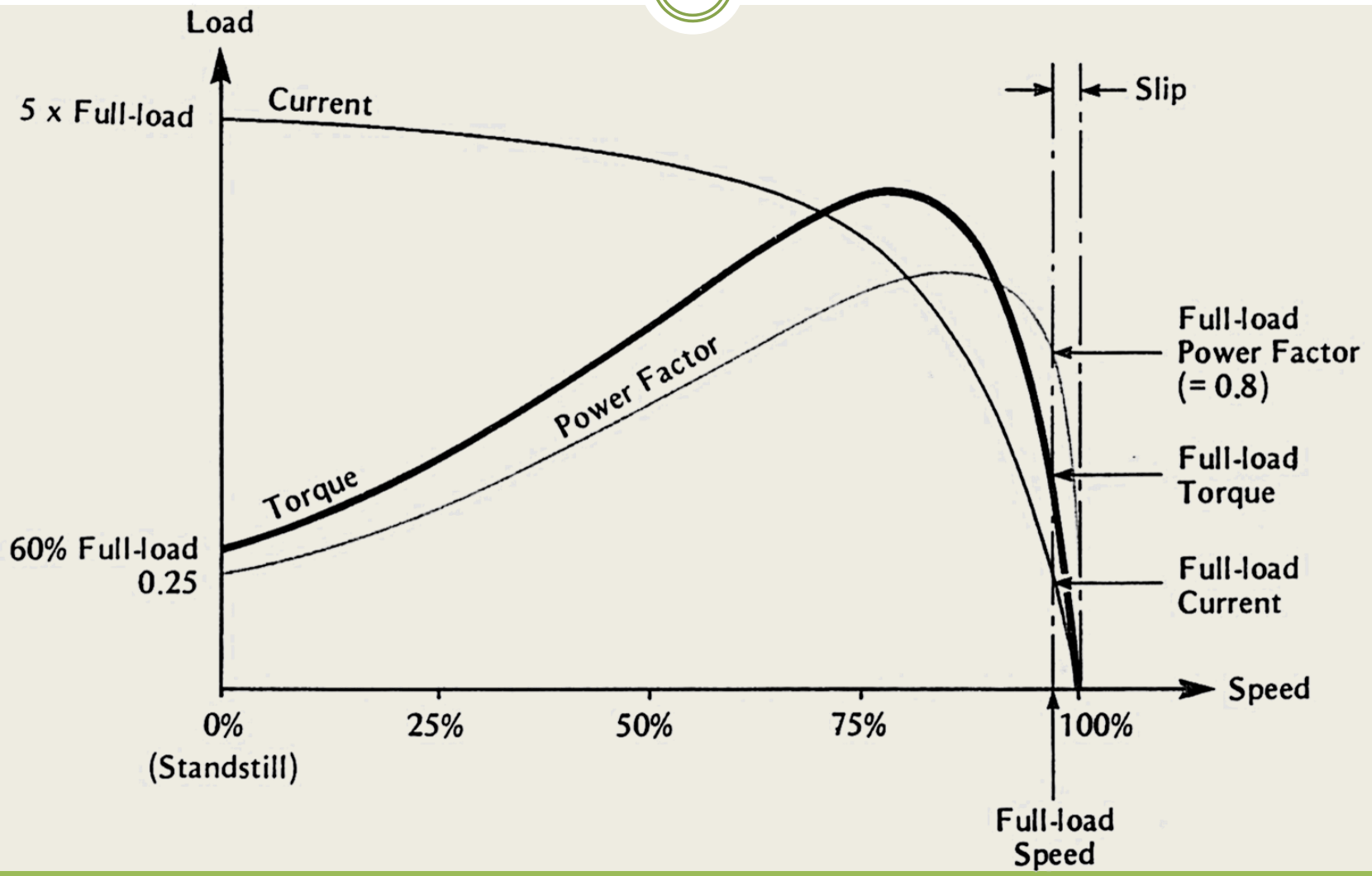
Induction Motor Drives

- **75% of total drives are made up of Induction Motor**



  - **Simple construction**
  - **Robust**
  - **High efficiency**
  - **Less maintenance**
  - **Low initial cost**
  - **Reliable operation**
  - **Suitable in explosive atmosphere**

Induction Motor Drives



Thank You

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