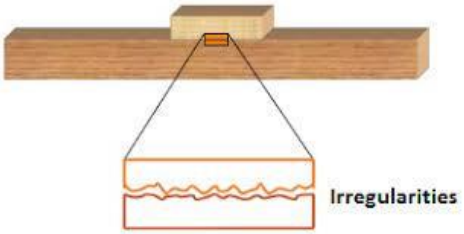
Chapter – 10: Friction

Friction

- Take a ball – role it on floor – stops after some time
- Stop peddling – cycle stops
- Force – stop moving objects
- Some force – acts on objects – change state of motion – moving to rest
- This force – **frictional force** or **friction**
- Contact force
- Ball moves on floor – both surfaces in contact – rub against each other – friction generated
- Friction – opposite direction of motion
- Friction opposes motion
- Objects – overcome friction – keep moving
- Friction – also exists – only contact – no motion
- Brick on floor – make it move – apply force (Muscular) – overcome friction between brick and floor
- More bricks – more friction – more pressure on surfaces

What causes friction?

- Irregularities of 2 surfaces in contact – lock into each other – create friction



- Characteristics –
  - Acts only when contact is there
  - Always opposes the motion
  - Increases when surfaces are pressed harder
  - Causes wear and tear (damage) of surfaces in contact

Types of friction

- Static friction
  - Between 2 surfaces in contact – no relative movement
  - Static friction – force applied at instant (exact time) – object starts to move
  - Heavy box on floor – push it – force applied by you to make it move – static friction
- Sliding friction
  - Between 2 surfaces in contact – in motion
  - Sliding friction – force required to keep the object moving
  - Already moving box – apply force to keep it moving – sliding friction
  - Always less than – static friction – easier to keep it moving than moving a stationary object
- Rolling friction
  - Between 2 surfaces in contact – 1 of them rolling over other
  - Lesser magnitude than sliding friction

    - Wheels in suitcase – offer less friction – make it easy to carry luggage
    - Type of friction – can be changed
    - Ball bearings – convert sliding friction to rolling friction – ensure smooth motion and prevent wear and tear
- Fluid friction
    - Opposes movement within fluids (liquids and gases)
    - Also known as drag
    - Air exerts force on moving objects
    - Cycle stops moving – not only by rolling friction – but also by fluid friction by air
    - Experienced by aeroplane
    - Boat stops when boatmen stops rowing – fluid friction by water
    - Depends on nature of fluid
    - Easier to stir water – harder to stir honey
    - Honey – more thicker or viscous – more friction
    - Depends on speed with respect to fluid
    - Higher speed – higher friction
    - Depends on shape of object
    - Objects shaped – streamlined – require less force to overcome friction

Factors affecting friction

- Magnitude of friction depends on –
    - Nature of surfaces in contact
    - Weight of body
    - Pushing a box on cemented floor – easy – it is smoother – pushing a box on grass – difficult – it is rough
    - Pushing a lighter box – easy – less weight – pushing a heavier box – harder – more weight
    - Force – body presses down the other
    - Take a brick – tie some weight on one end – hang the weight – with a pulley over the edge of table – leave it gently – brick moves some distance
    - Now add some more weight to the hanging weight – bricks move greater distance

Methods of reducing friction

- Friction – opposes motion
- Sometimes – cause wear and tear (damage)
- Methods to reduce friction –
    - Oiling –
        - Make the surfaces smoother – done by oiling (applying oil to surface) – **lubrication**
        - Movement improved – less fraction
    - Polishing –
        - Make the surfaces smoother – done by polishing surfaces in contact
    - Streamlining –
        - Object – flowing in water – receive friction from water
        - Object – floating in air – recieve friction from air

        - Reduce by **streamlining** – narrow in front and back, broad in centre – ships and aeroplane
        - All birds – streamline by nature
        - All fish – streamline by nature
    - Using anti-friction alloys –
        - Steel slides on steel – more friction – steel slides on bronze – less friction
        - Reduce friction by using alloys
    - Using air cushions –
        - Reduce friction by – thin cushion of compressed air – between solid surfaces in motion
        - Hovercraft – work on this concept

    - Using ball bearings –
        - Try to walk over marbles – you will slip
        - Circular marbles – reduce friction
        - Same concept – used in machines
        - Ball bearings – reduce friction – between moving surfaces
        - Made of ceramic or hard steel
        - Reduce friction by converting sliding friction to rolling friction

Methods of increasing friction

- Sometimes – necessary to oppose motion
- Methods to increase friction –
    - Treading of tyres –
        - Tyres – grooves (design) on the surface – increase friction
        - Tyres do not skid
        - Synthetic rubber – offer lots of friction

    - Sanding –
        - Sand – thrown on tracks with snow – increases friction – vehicles do not skid
    - Athletes and players – **spikes** on boots – run very fast – do not slip

- Cleaning floors – **hard brushes** – increase efficiency
- Sides of matchboxes – made **rough** – match rubbed – enough friction to light matchstick

Advantages and disadvantages of friction

- Advantages –
  - Helps in walking – friction between foot (sole) and ground – wet floor – you may slip
  - Helps in writing – friction between pen and paper – oily surface of paper – pen may slip
  - Friction produces heat – friction between matchstick and matchbox – matchstick catches fire
  - Wood – friction between wood and axe – wood cut easily
  - Helps in all the daily jobs – opening lid (cap)
- Disadvantages –
  - Parts of machine – wear and tear – continuous friction
  - Sole of shoes after some time – wear off – regular use
  - Friction produce heat – car parts, engines – heat up
  - Moving objects – overcome friction – waste energy