

**IPE-432**  
**MACHINE TOOLS SESSIONAL**

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# 1 Experiment 02: Study Milling Machine & Dividing Head (Rashik Sir)

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## Why this milling machine is called "universal milling machine"?

A milling machine who has these three characteristics are counted as universal milling machine -

- The axis motion -
  1. z axis or Longitudinal motion
  2. x axis or Cross motion
  3. y axis or Vertical motion
- Sqivel Plate (make an angle for incline feed)
- Dividing Head

## Why it is called knee & column type? what does it signify?

The milling machine has a knee and a column. Knee bears the weight and give support. whereas column transmit powers. That is analogous to human body, leg and spinal cord.

## How many guideways? and their classifications?

There are 3 guide ways. They are -

1. Dove Tail Guide way
2. Flat or Rectangular Guide way
3. Cylindrical guide way

### Dove Tail Guide Way

It looks like the tail of dove. that's why the name is given. 4 Dove tail in milling machine.

1. In between of overarm & arbor support
2. In between of table & saddle (longitudinal motion)
3. In between of saddle & knee (cross or x-directional motion)
4. In between of knee & column

### Flat & Rectangular Guideway

They are normally with the stoppers. 3 flat & Rectangular guideway in milling machine.

- Stopper with table
- Stopper with Saddle
- Stopper with column

## Cylindrical Guideway

Cylindrical guideway situated with arbor & arbor support.

## Milling Operations

There are 3 types of milling operations in milling machine:

1. Peripheral Milling: Known as conventional milling, cut materials from the periphery
2. Face milling: cut materials with the face.
3. End milling: cut materials with cutter's teeth.

## Cutting Strategies

1. Upmilling : Feed motion & cutter motion are opposite in direction
2. Downmilling : Feed motion & cutter motion in same direction

## Dividing Head

### Indexing

The main function of dividing head is to equally divide a circular or cylindrical object. There are 3 types of indexing.

1. Simple Indexing
2. Differential Indexing
3. Cutting Helical Gear

### Name of different parts

Some parts of dividing head are - **Index Plate, Index crank, Index Crank Handle, Index Pin, Change Gear & Inside parts** (such as - some spur gears, some bevel gears, 1 work gear & 1 worm wheel)

Required Index plate rotation

$$= \frac{\text{Gear ratio between index plate \& gear}}{\text{Number of gears to be cut}} = \frac{40}{T}$$

### Change Gear

When number of teeth doesn't match with the index plate, then to adjust it change gear helps. For example - we want to cut 67 teeth, but nearest available index plate number is 66. So, we will choose 66 and use change gear to adjust rest. Here, we need to use **Differential Indexing** mechanism.

## Helical Gear

Have to rotate workpiece also and have to sync with change gear, to cut gear inclined.

## Mathematical Relations

$$p_{h.g.} = \frac{Z_o}{Z} \times 1 \times 1 \times 1 \times \frac{a}{b} \times \frac{c}{d} \times P_{l.s.}$$
$$\frac{a}{b} \times \frac{c}{d} = \frac{P_{h.g.}}{Z_o P_{l.s.}}$$

here,  $Z_o$  = No. of Teeth of worm wheel = 40

$Z$  = No. of start of worm wheel = 1

$P_{h.g.}$  = Lead of helical gear

$P_{l.s.}$  = Lead of Lead screw

✓ worm wheel will rotate a single time, if worm gear rotates 40 times.

✓ For the above equation, right hand side is constant.

So, we have to control a,b,c & d to get helical shape.

✓ It's mandatory to keep error under 1%

## Set angle relation

set angle,  $\omega = 90^\circ$  - Helix angle ( $\alpha$ ) = Lead angle again,

$$\omega = \arctan \left( \frac{\pi D}{P_{h.g.}} \right)$$

✓ set angle means the angular rotation of swivel plate. helix angle means the inclination angle in helical gear.

✓  $D$  indicates the diameter of gear blank.

✓ if we know  $\omega$ , then we can find out helix angle and  $P_{h.g.}$  by the above equations.

✓ For helical gear, we need to rotate lead screw by change gear.

**IMPORTANT : There will be math related with this is QUIZ. \_\_\_\_\_**