1)

Slip:- Slip in belt drives is the relative motion between the belt and pully due to lack of frictional grip between them

Creep: Creep in belt drives is the relative motion between the belt & pulley due to elongation & contraction of belt as it moves from tight to slack side

Velocity ratio: It is the ratio of velocities of the driven and the follower / driven

$$= \frac{N_1}{N_2}$$

Gear drives over Belt drives

Advantages

- Requires less space Compared to belt drives
- Requires less maintenance, but maintenance cost can be higher
- low friction loss compared to belt drive
- higher transmission,
- more efficiency
- greater life capacity

Disadvantages

- maintenance cost can be higher
- Noisier in operation
- Requires regular lubrication
- Complicated equipment design
- Vibration produces more

2) Difference b/w belt drives & gear drives

Sr.No	Belt drives	Gear drives
1	Requires more space compared to gear drives	Requires less space compared to Belt drives
2	High frictional loss therefore lower transmission.	low frictional loss therefore higher transmission
3)	less efficiency	more efficiency
4)	Requires high inspection and maintinance	Requires less maintenance
5)	low life expectancy	high/long life expectancy
6)	Easy, flixible equipment design as tolerance are not important	Complicated equipment design tolerance are very much important
7)	Isolation from shock and vibration b/w driving & driven system	No isolation from shock & vibration b/w driver & driven systm
8)	Requires relatively less or no lubrication	Requires regular lubrication
9)	Very quiet in opeation	noisy in opeation

3) Discuss V-Belt drive over flat belt drive

merits

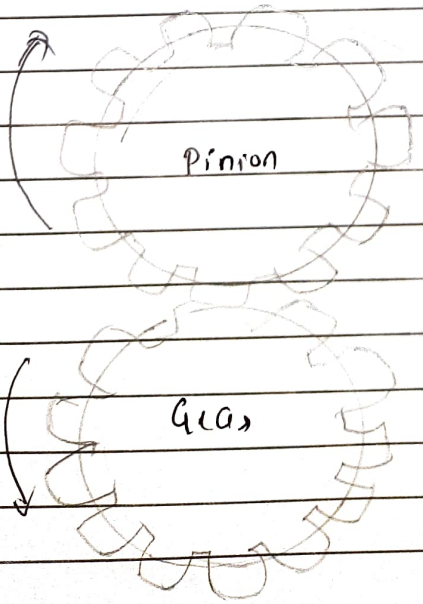
- more power can be transmitted without slip
- short centred distance
- velocity ratio is low & hence efficiency will high
- This type drives can be used for vatical & inclined drive
- no joint trouble therfore opeation is smooth

Demerits

- Cost is very high
- Construction is Complicated
- it cannot be used for long centre distance power transmitted
- constant speed cannot be used applications

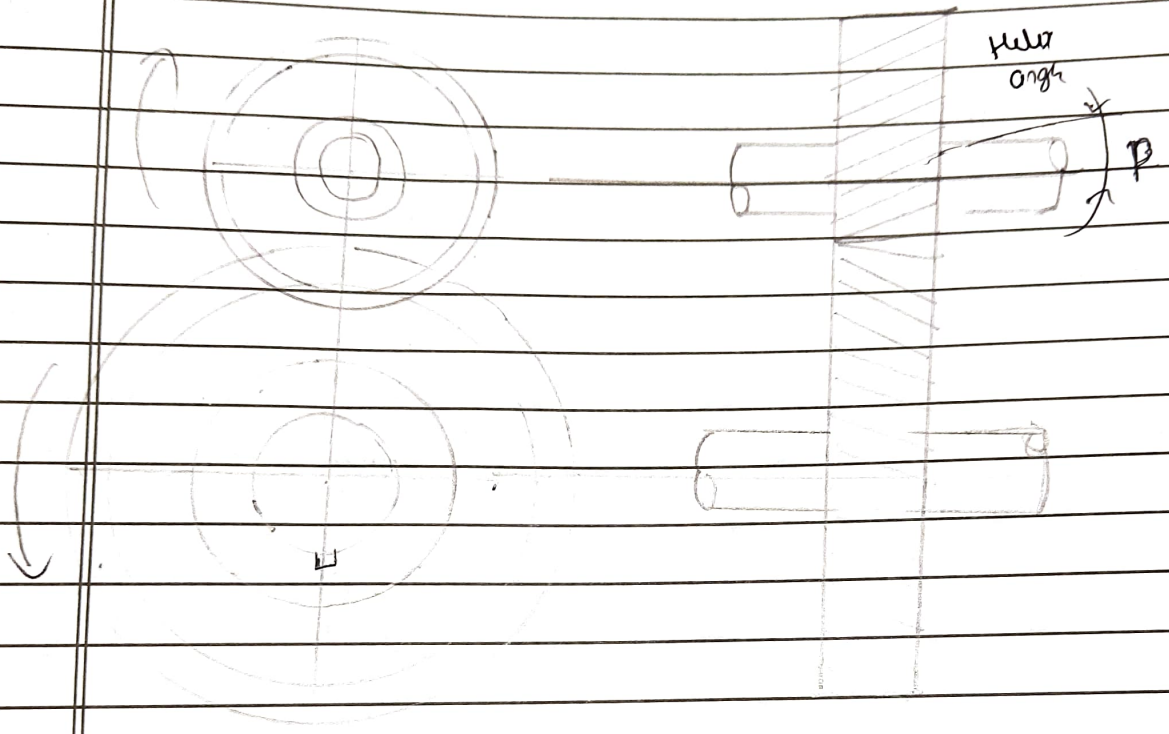
4) with neat skitch explain the various types of Gear Drive

1) spur gears



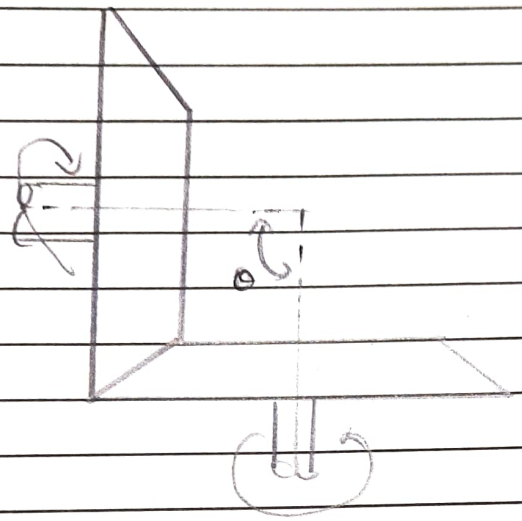
- This is the simplist form of gears for transmitting power between two parallel shaft. The teth are straight & paralled to the axis
- Supur gear - impose only radial loads on bearings
- Because of instanious line contact during muhing, drive will noisy
- Spur gear is widely used in machine tools, automobile gearbox

ii) Helical Gear



- Helical gears are used to transmit power b/w parallel shaft
- In this gear, the teeth are inclined to the axis of the shaft at an angle known as Helix angle (15° to 45°)
- Helical gear are preferred to spur gears as their operation is quiet due to the progressive engagement of teeth
- the disadvantage of helical gear is it produce an axial thrust. hence double helical gears are used

iii) Bevel gear



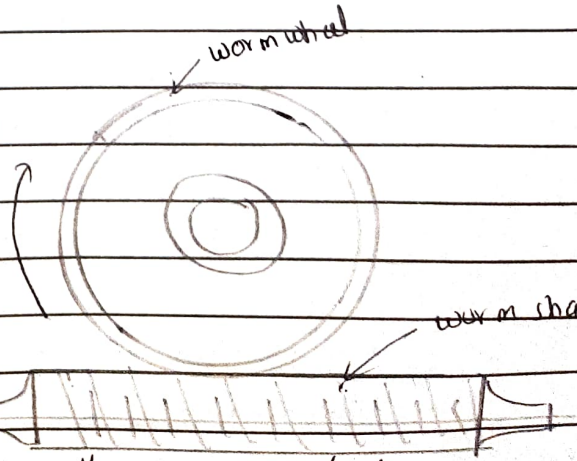
- Bevel gears are most commonly used for transmitting power b/w intersecting shaft
- The pitch surface of bevel gear are rolling cones. The tooth section becomes gradually smaller as the apex of the cone is approached
- They impose thurst as well as radial loads on the bearing supporting the shaft
- When two equal bevel gear have their axis at right angles, they are called miter bevel gear

iv) Worm gear

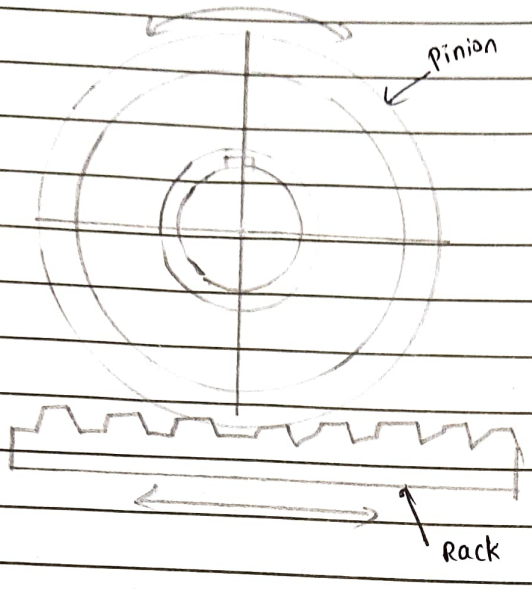
- worm gear are used to transmit power b/w two non-intersecting shaft
- it Consist of a worm shaft with helical grooves which mesh with gear called.

v) worm wheel

- worm gear drives are used for high-speed reduction are high
- The worm gear drive may be made self-locking. It does not allow the reversal in the direction of the drive worm gear.



vi Rack & pinion



- When a rotatory motion is to be converted into a linear motion, rack & pinion arrangement is used
- Theoretically, the rack is straight gear of infinite diameter
- Elliptical gears are used when there is a need for varying speeds of the driven gear in each revolution
- In each revolution of the driven shaft, there are four different speeds, two maximum & two minimum
- Two commonly used profiles of gear teeth are the Involute profile & the cycloidal profile

5) In a belt drives, the ratio of tension 2 & the slack side tension is 500N if the speed & diameter of the driven pulley are 200rpm & 120cm respectively find power transmitted.

$\frac{T_1}{T_2} = 2$ $T_2 = 500N$ $d = 120cm$

$N = 200$ $d = 1.2m$

$T_1 = 2 \times 500$

$T_1 = 10000$

$P = (T_1 - T_2)V$

$V = \omega \times r$

$= \frac{2 \times \pi \times 200}{60} \times \frac{1.2}{2}$

$= 12.56 \text{ m/s}$

$P = (T_1 - T_2)v$

$= (1000 - 500)12.56$

$= 6279.9 \text{ W}$

$= 6.2 \text{ kW}$

power transmitted by drive is 6.2kW

in belt drive the angle of lap on driven pully 160° & of the Coefficient of frictional 0.3 & the maximum Tension is 10,000N find the initial Tension belt dry

Given data

$\theta = 160°$

$\theta = 160 \times \pi / 180 = 2.79 \text{ rad}$

$\mu = 0.3$

$T_1 = 10,000$

$\frac{T_1}{T_2} = e^{\mu\theta}$

$T_0 = \frac{T_1 + T_2}{2}$

$\frac{10000}{T_2} = e^{(0.3)(2.79)}$

$T_0 = \frac{10000 + 4330.88}{2}$

$T_2 = 4330.88$

$T_0 = 7.165 \text{ KN}$

7) Discuss the various of gear drives & this application

i) according to the relative position of shaft axis:
parallel axis: spur gear, helical gear
Intersecting axis: Bevel gears Non-parallel
non intersecting: worm gear

ii) according to position of the teeth on the gear surface

i) Spur gear
⇒ This is simplest form of gears for transmitting power b/w two parallel shafts
⇒ spur G impose only radial loads on bearings
application
machine tools
automobile, gearboxes, etc
gear

ii) Helical Gears
⇒ Helical gears are used to transmit power b/w parallel shaft
⇒ in this gear the teeth are inclined to the axis of the shaft angle
Know as Helix angle (15° to 45°)
application
Herringbone gear

iii) Bevel gears
- They impose thrust as well as radial loads on the bearing supporting the shaft
- Bevel G are most commonly used for transmitting power b/w intersecting shaft
- when two equal Bevel G have their axes at right angles they are miter bevel

iv) worm gear & worm wheel

- worm gears are used to transmit b/w two non-parallel, non-intersecting shafts
- worm drive consist of a worm shaft with helical groove which meshes with a gear called worm wheel

v) Rack & pinion

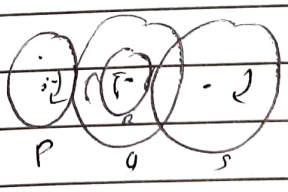
- When rotary motion is to be converted into a linear motion, rack & pinion arrangement is used
- Theoretically the rack is a straight gear of infinite diameter

3) A compound gear train is formed by 4 gears P, Q, R & S. Gear P meshes with Q & R meshes with S. Q & R compound pair connected to driving shaft & S is connected to driven shaft. P is connected to the driven shaft. If power is transmitted

P = 30 teeth
Q = 60 "
R = 40 "
S = 80 "

if S rotates 60 rpm. Calculate the speed P

Represent the gear arrangement symbolically



Given data

$Z_P = 30 \quad Z_R = 40$

$Z_Q = 60 \quad Z_S = 80$

$N_S = 60$ rpm

$N_P = ?$

$$\text{Train value} = \frac{N_{\text{first driven}}}{N_{\text{last follower}}} = \frac{\text{product of follower teeth}}{\text{product of driver teeth}}$$

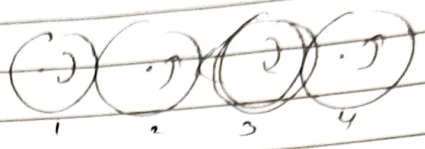
$$\frac{N_P}{N_S} = \frac{Z_Q \times Z_S}{Z_P \times Z_R}$$

$$\frac{x}{60} = \frac{60 \times 80}{30 \times 40}$$

$N_P = 240$ rpm

The speed of P = 240 rpm

a) a simple gear train consist of 4 gear wheel having 30, 40, 50, 60 nop. determine speed & direction of last gear if 1st gear make 600 rpm ↻ cl



Given data

no. of gear = 4

$z_1 = 30$ $z_2 = 40$ $z_3 = 50$

$z_4 = 60$ To find = N_{last} follo = N_4

$$i = \frac{N_1}{N_4} = \frac{z_4}{z_1}$$

$$N_4 = \frac{N_1 z_1}{z_4} = \frac{600 \times 30}{60_2} = 300$$

$N_4 = 300$

Speed of last follower = $N_4 = 300$

b) Difference b/w machine & mechanism

Sl_No	machine	mechanism
1)	If the system is used with the objective of transforming mechanical energy, then it is called machine	If the objective is to transfer or transform motion without considering forces involved, the system is said to be a mechanism
2)	Every machine has to transmit motion because mechanical work is associated with the motion and thus makes use of mechanism	- It is concerned with transfer of motion only
3)	A machine can use one or more than one mechanism to perform the desired function every machine has several mechanism	- It is not the case with mechanism A mechanism is a single system to transfer or transform motion

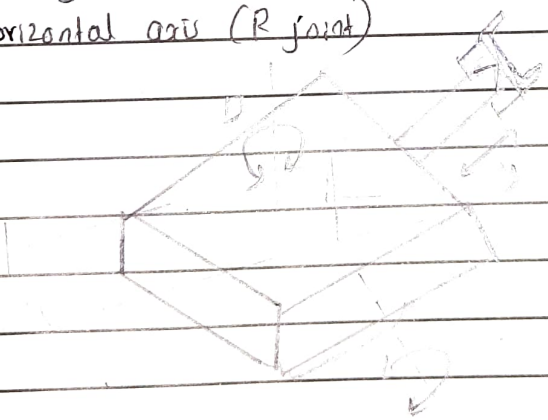
11) Explain briefly Robot Anatomy with neat figure

* Robots are devices that are programmed to move parts, or do to work with a tool

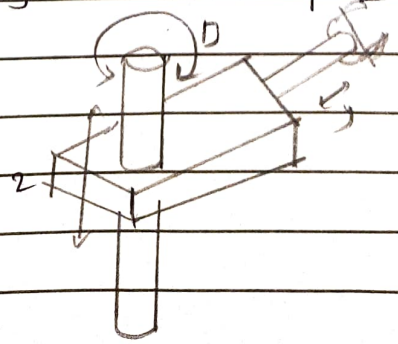
* Robotics is a multidisciplinary enginering field dedicated to the devices including manipulators and mobile vehicles

Classification based on robot configuration
- polar Coordinate
- Cylindrical coordinate
- Cartesian Coordinate

→ polar coordinate:
This configuration consist of a sliding arm (L joint) actuated relative to the body, which can rotate about both a vertical axis (T joint) and horizontal axis (R joint)

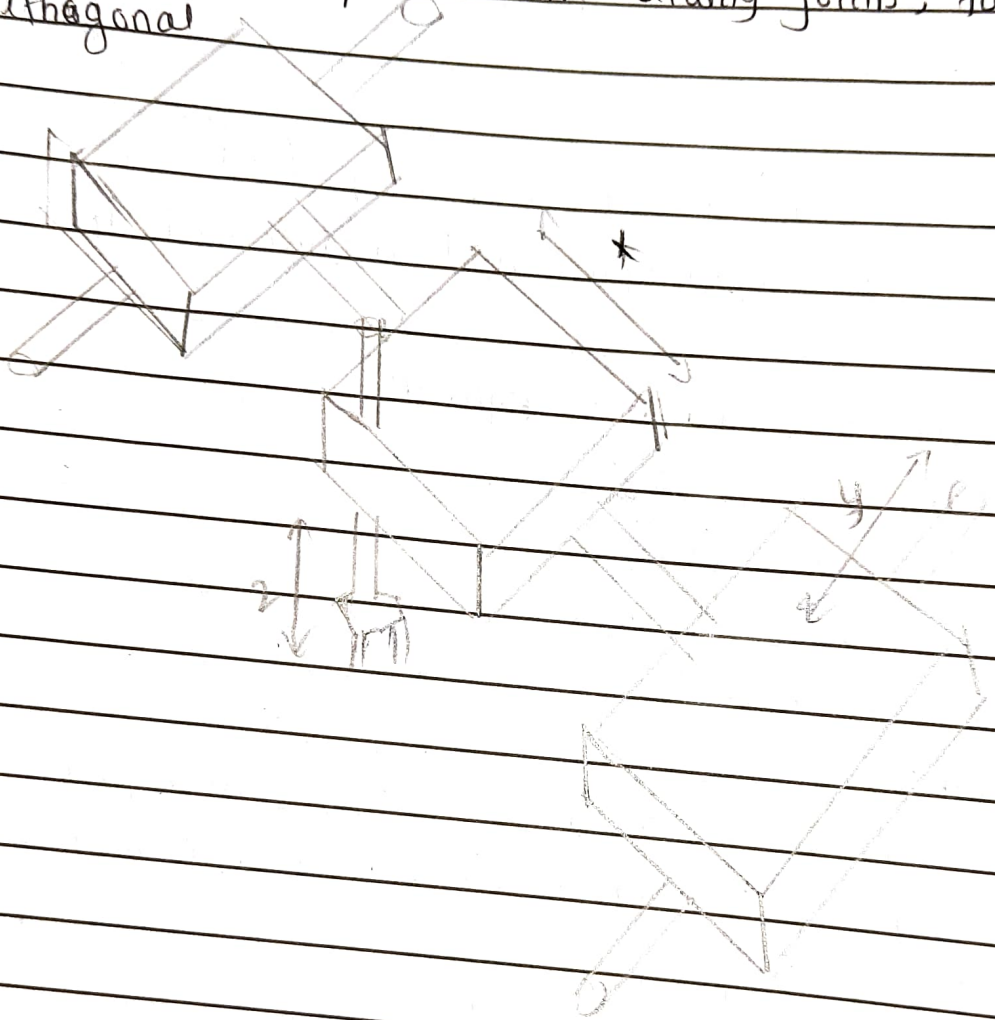


→ Cylinder Coordinate
This configuration consist of a vertical column, relative to which an arm assembly is moved up or down



Cartesian coordinate

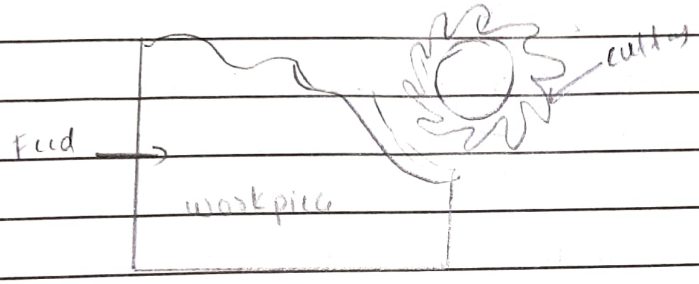
other name for this configuration include rectilinear robot and x-y-z robot. It is composed of three sliding joints, two of which are orthogonal



Joint-arm-configuration is combination of cylindrical & articulated configuration. This is similar to human arm

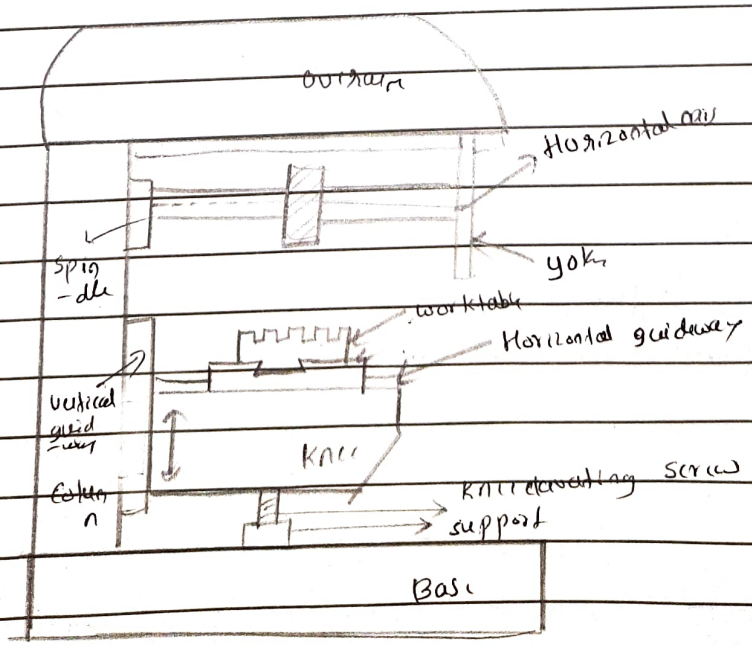
12) with neat sketch explain the construction & working of milling machine & application

working principle: The workpiece is holding on the worktable of the machine the table movement controls the feed of workpiece against the rotating cutter. The cutter is mounted on spindle or arbor and revolves at high speed



Horizontal milling machine Construction: The main part of machine is base, Coloumn, knee, saddle, Table, overarm, Arbor, support & Elevating Screw

it is Horizontal milling machine because of horizontal position of the spindle



a) The base is usually a strong and a hollow part which forms the foundation of machine & upon which all other parts are mounted

b) Column: is a vertical hollow casting and is usually combined with the base to form a single casting

c) The spindle: is a hollow shaft supported by the column with a suitable bearing that absorbs both radial & thurst load

d) Overarm: mounted on the vertical column supports the yoke, this in turn, support the free end of the arbor

e) Knee: is casting slide up & down the on the vertical guide ways provided on the column by means elevating screw

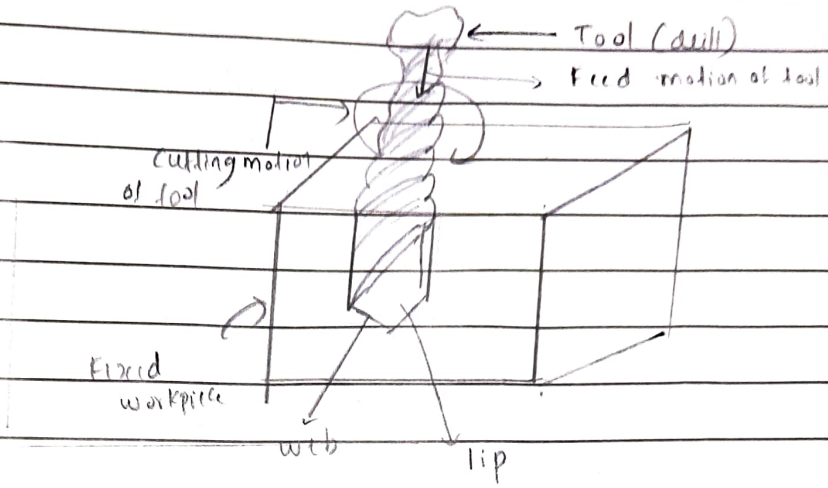
f) Saddle: mounted on the knee is provided with two slide on its top & bottom surface, lowy guide ways help to facilate horizontal movment of the saddle

g) Worktable is large in size & rest on the saddle. This enables the workpiece to be clamped rigidly on the table

Application

* To cutting gears
* To make keyway
* To planing, dulling opeations

13) with neat sketch explain the construction & working of milling simple drilling machine



Construction of drilling machine

- The basic parts of a drilling machine are a base, coloumn, drill head & spindle
- The made of cast iron may rest on a bench, pidestal or floor depending upon the design
- larger & heavy duty machines are grounded on the floor. The coloumn is mounted vertically upon the base
- It is accurately machined & table can be moved up & down on it the drill spindle; an electric motor & the mechanism meant for driving the spindle at different speeds are mounted on the top of column
- power is transmitted from electric motor to the spindle through a flat belt or 'v' belt

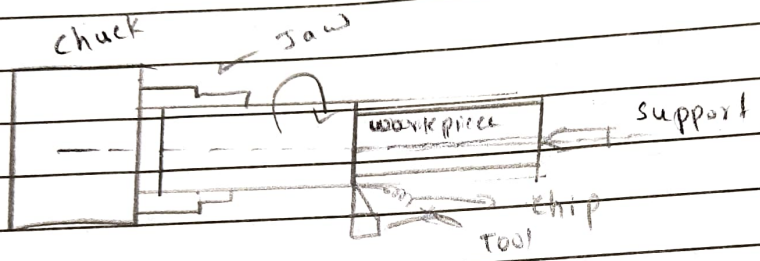
working principle.

- The when the power is given to motor, the spindle rotates & thereby the steppid pulley attached to it also rotates.
- nowa v-belt is placed in blw the steppid pulleys as to drive the power transmission.

nowa drill bit also rotates which also was placed in the chuck & which was in connection with the spindle

- As the pulley rotates the spindle also rotates which can rotate drill bit now by the rotation of hand wheel the spindle move up & down in the vertical direction in order to give the necessary placed in the machine vice

14) Explain Construction & working of lathe



working principle lathe

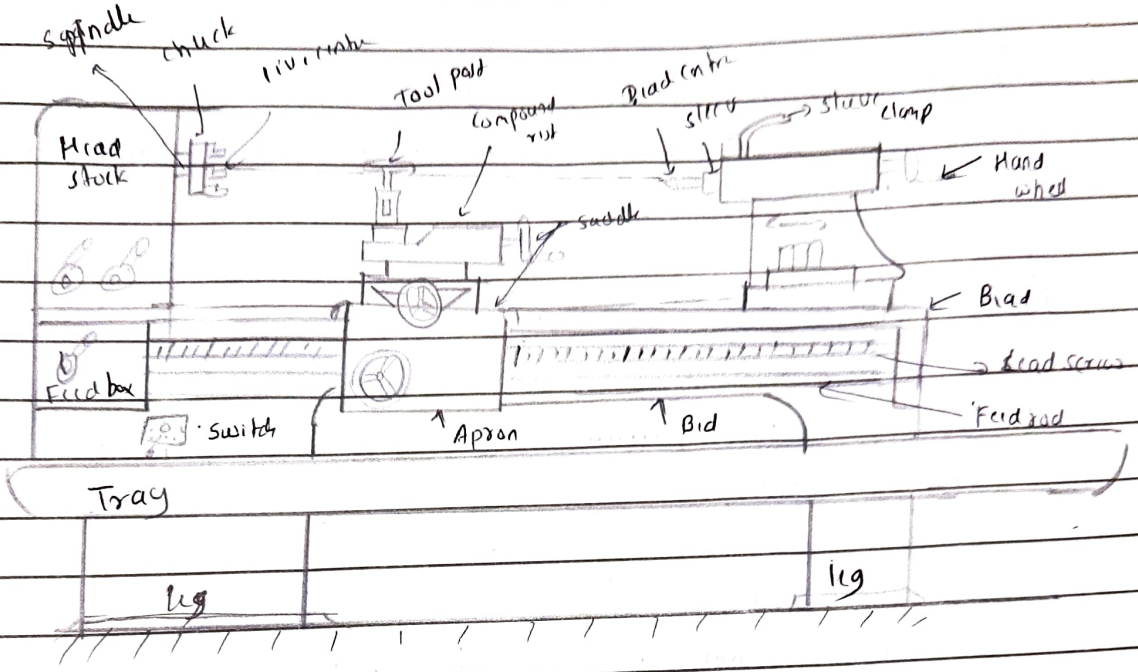
- A lathe, basically a turning machine works on the principle that a cutting tool can remove material in the form of chips from the rotating workpiece to produce circular objects

- This is accomplished in a lathe which holds the workpiece rigidly & rotate them at high speed while a cutting tool is mould against

- workpiece held rigidly by one of the work holding device, known a chuck, and is rotated at very high speed

- The material of the tool will be harder & stronger than the material of the workpiece

parts of centre of lathe



1) Bed: it is rigid structure which forms the base or foundation to support all the other parts such as headstock, tailstock. It is usually made from grey cast iron

2) Headstock: it is mounted at the left end of the lathe. bed serves as housing for the spindle, driving gears or pulleys by means of which the workpiece can be rotated at different speeds

3) tailstock:
→ provide support to other the end of the rotating workpiece
→ Hold a tool for performing opeation like drilling, reaming tapping

4) Carriage: saddle: it is part of carriage that can be made to slide along the bed ways

Apron: It is fitted breath the saddle facing the operator

Feed rod: the feed rod is a long shaft that gives automatic feed to Carriage for various opeation - namely boring, turning etc. except thread cutting

15) What is CNC machine? Discuss the advantages & application of CNC machine

Computer Numerical Control (CNC) is defined as an NC system whose MCU is based on a dedicated microcomputer rather than on a hard-wired control

Advantages
Application of CNC

- It eliminates human work
- Higher flexibility
- High accuracy
- lower wastage
- Suitable for batch production. less space is required
- Reduce inspection cost
- more operational safety
- Quality of product is high

Application of CNC

- Automotive industry
- Aerospace industry
- machinery industry
- Electrical industry
- Instrumental industry