

## UNIT - 5

### Introduction to manufacturing

- \* manufacturing process is the process of converting the raw material into finished product using machines.  
Manufacturing process is the part of product process directly concerned with the changes in dimensions, shapes and properties of raw material.
- \* classification of manufacturing process:
  - (1) casting process: (primary shaping processes)
    - In casting process, molten metal such as cast iron or aluminium is poured into the mould of desired shape. After solidification, it attains desired shape.
    - materials: cast iron, alum, copper alloys, plastics
    - various casting processes: sand casting, die casting.
    - E.g. Gear box housing, engine casing, flywheel.
  - (2) Metal Forming or Deformation Processes:
    - In deforming process, a metal is in cold and hot conditions and is plastically deformed into desired shape without changing mass and metal composition.
    - In deforming processes, no material is removed and it is deformed and displaced.

- various deforming processes:

(1) Forging	(3) Rolling
(2) Extrusion	(4) sheet metal working

- E.g. Connecting rods, crankshafts, vehicle bodies.

### (3) machining or metal cutting processes:

- In machining process, the material is removed by means of cutting tools so as to give the desired size and shape to the component.

- As material is removed, these processes are also called as removing processes.

- various processes are: turning, mining, drilling, shaping.

- E.g. Gears, shafts, coupling.

### (4) surface finishing process:

- The surface finishing processes are used for giving good dimensional accuracy and surface finish to components for decorative or protective coating.

- Dimensions of the part are not changed.

- various processes: grinding, polishing, electroplating, coating, lapping.

- E.g. Bore of I.C. engine cylinders, Rolling contact bearings.

### (5) Metal joining processes:

- In these processes, two or more pieces of

metal parts are joined together to make a final component.

- The process can be carried out by fusing, pressing, rubbing.
- most of processes require heat and pressure for joining of metal pieces.
- various processes: welding, brazing, screwing, soldering.
- E.g. Automobile bodies, boilers, steel furniture.

#### (6) Material properties modification processes on processes effecting change of properties.

- These processes are used to enhance certain properties of mechanical elements so as to make them suitable for particular applications.
- Shape of workpiece remains same.
- Processes: Hot and cold working, Heat treatment, shot peening.

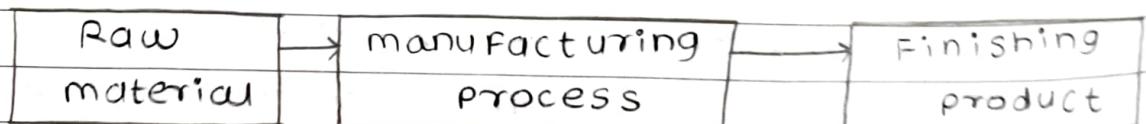


Fig: manufacturing process

#### \* casting:

casting is the process in which the molten metal such as cast iron or aluminium is poured into the mould of desired shape. After solidification it attains desired shape.

- TYPES:

- (1) sand casting process
- (2) die casting process
- (3) centrifugal casting process

(1) sand casting process:

The casting process in which the castings are made using sand mould is known as sand casting process.

(i) pattern making:

The model of casting, used for making cavity / mould.

The material used for pattern is wood, metals, plastic, polystyrene, etc.



Fig: Typical pattern

(2) mould making:

It is the process of making a cavity which can form the shape of desired component in a suitable refractory material like sand, that can withstand the high temperature of molten metal.

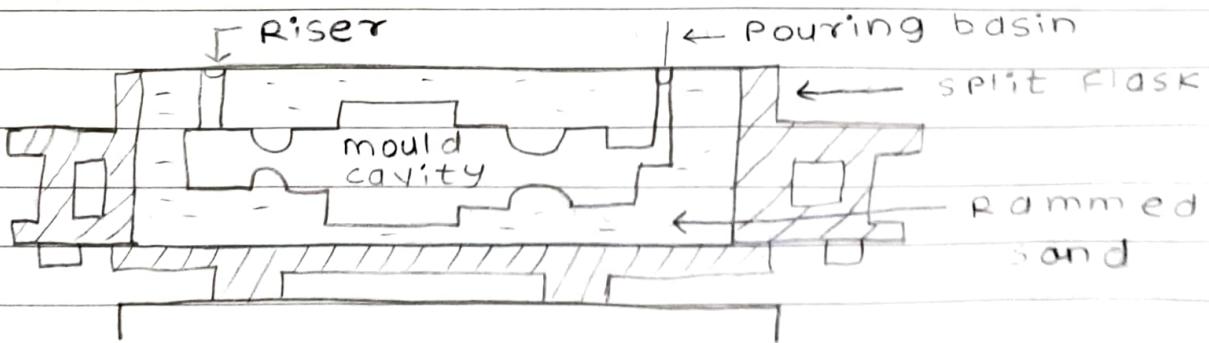
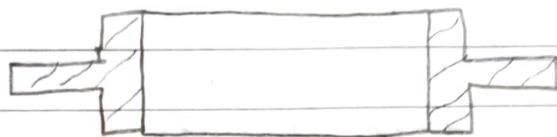


Fig: mould making

### (3) core making:

core is a predetermined shape made from the sand and placed in the mould for provisioning the hole or hollow shape.



• corebox



• core

### (4) Melting and pouring of metal:

The metal is melt in furnace and poured into a mould cavity from pouring basin.

### (5) cooling and solidification:

The molten metal is then allowed to cool and solidify in the mould.

### (6) cleaning and inspection:

After solidification, the sand mould is broken to take out the casting from mould cavity. Then it is cleaned and inspected.

### • Advantages:

- (1) The components of intricate shapes can be easily produced by casting process.
- (2) There is no restrictions on the size of component
- (3) suitable for small as well as mass production
- (4) cost of component is low.

- Disadvantages:

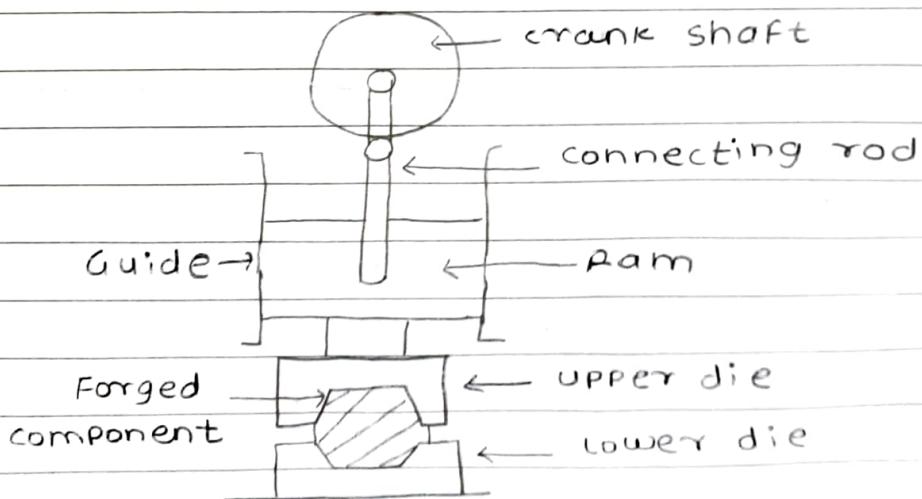
- (1) The components of thickness less than 6mm cannot be manufactured by casting process.
- (2) It involves melting of metal. so high energy consuming process.
- (3) Requires large man power.
- (4) Environmental pollution is very high.
- (5) Requires large space.

- Application:

- (1) Gear box housing
- (2) machine tool beds
- (3) machine tool frames
- (4) gears
- (5) Bearing housing.

- \* Forging process:

It is metal forming process in which the metal is first heated and then plastically deformed to the desired size and shape by app'n of compressive force using a hand hammer or pressure.



The Forging consists of a lower die fixed to the frame while upper die connected to the ram. The hot material is kept on the lower die.

During downward stroke of ram, the upper die exerts sudden compressive force on hot material. Due to sudden compressive force, the hot material is converted into the desired shape. It can be mechanical pressure or hydraulic pressure.

- Advantages:

- (1) High dimensional accuracy.
- (2) Good surface finish
- (3) It produces the components with high strength.
- (4) Better resistance to shock and vibration

- Disadvantages:

- (1) Brittle materials like cast iron cannot be forged.
- (2) Complex components cannot be produced.
- (3) Cost is more
- (4) Cost of dies is more.

- Application:

- (1) For making IC engine parts.
- (2) Small tools
- (3) Gear blanks / levers
- (4) Automobile and aircraft components.



open die forging process  
TYPES

closed die forging process

(1) open die forging process:

The material is deformed beth the two flat dies of very simple shape.



• Before

Die → UPPER

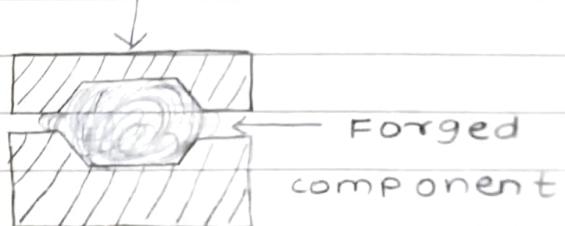
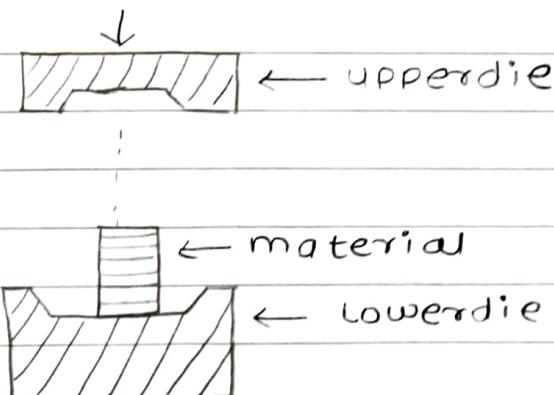


• AFTER

(2) closed die forging process:

The material is deformed beth the two dies which have the compressions of desired shape.

when two dies are closed , the cavity formed is of desired final shape.



### FMA DTS

Parameter	Hot Forging (Hot working)	Cold Forging (cold working)
Definition	Deformation of material into predetermined shape carried out at a temp. above its recrystallization temp.	Deformation of material into predetermined shape carried out at a temp. below its recrystallization temp. (room temp)
Force and energy requirement	Low	High
Machine requirement	Light	Heavier and Powerful
Accuracy	Poor	Good
Ductility	Increase	Decrease
Type of material used	Hard	Soft (Alum)
Surface finish	Poor	Better

#### \* metal forming:

##### (i) Extrusion :

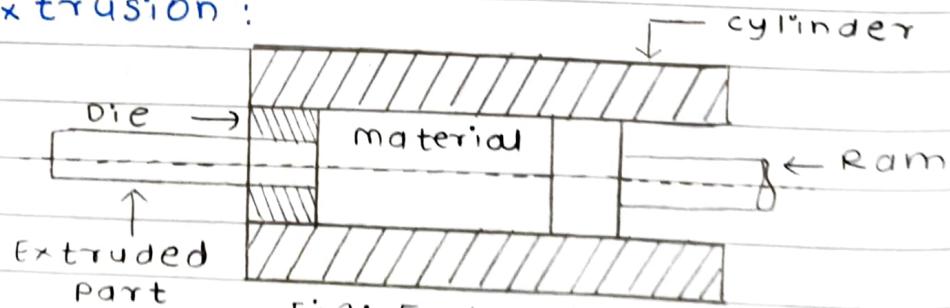


Fig: Extrusion

It is a metal forming process used for manufacturing the long and straight parts of fixed cross-section.

- Material : steel, aluminium alloy, magnesium

- Advantages:

- (1) High accuracy
- (2) Good surface finish
- (3) Cost of component is low
- (4) High rate of production

- Disadvantages:

- (1) High initial cost setup
- (2) It cannot produce components of varying cross-section.

- Types

(1) Hot

(1) collapsible tubes

(2) cold

(2) Aluminium cans and cylinders

(3) Bars

(4) Gear blanks / levers

(2) Wire drawing:

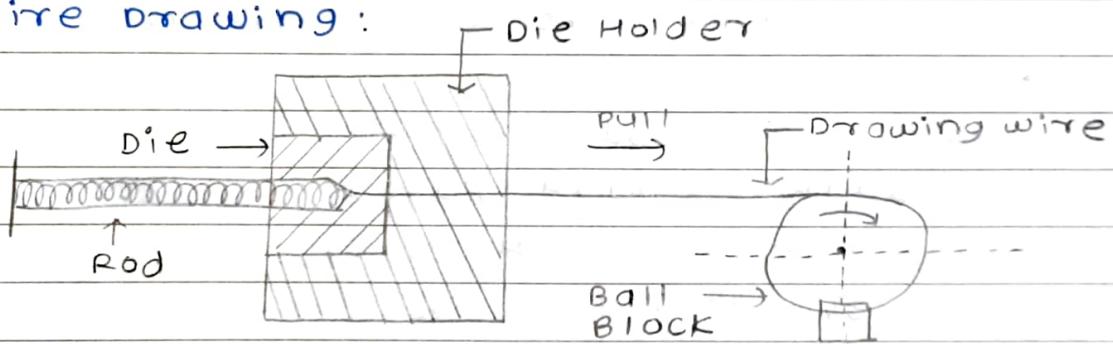


Fig: Wire Drawing Process

wire drawing is cold working process of producing the wire from the rod through the successive reduction of diameter.

speed (1 m/s to 50 m/s)

The material must have good ductility

\* sheet-metal working:

It is the process of manufacturing the

## \* sheet metal working:

It is the process of manufacturing the components from the sheet metal of thickness ranging from 0.1 mm to 0.8 mm. The sheet metal working is carried out with machine tool called press. Therefore it is also called as press working.

- Advantages:

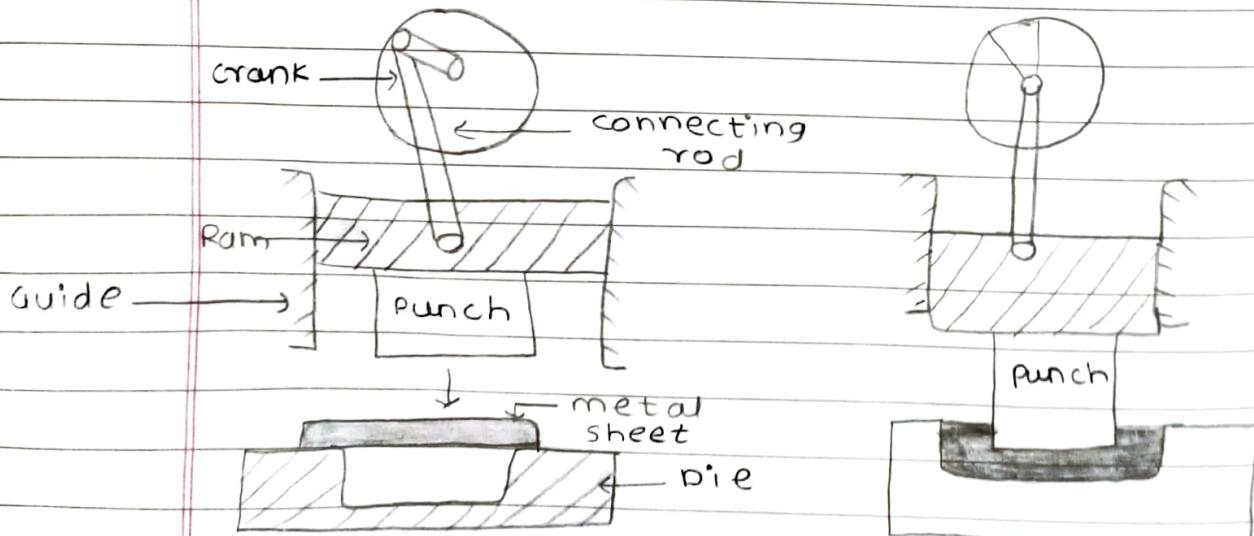
- (1) Components are light weight
- (2) cheap
- (3) Good surface finish
- (4) High accuracy.
- (5) Does not require skilled labour.

- Disadvantages:

- (1) Thickness only upto 8mm of metal sheet used
- (2) components have low strength.

- Applications:

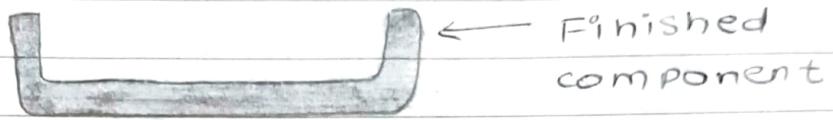
- (1) Automobile body parts
- (2) Aircrafts body parts
- (3) electronic appliances
- (4) steel furniture.



• BEFORE

• AFTER

Teacher's Signature.....



← Finished component

#### \* sheet metal working processes:

- (1) Punching: It is the operation of producing a circular hole in a metal sheet by using punch and die.
- (2) Blanking: It is the operation of cutting out a piece of required shape from a metal sheet using a punch and die.
- (3) Bending: It is a metal forming process by which a straight length metal sheet is transformed into a curved length.

#### • Types :

- (1) V-bending as U-bending
- (2) Edge bending as Angle bending
- (4) Shearing: It is an operation through which a metal is cut along a straight line which is generally a straight line.

PBBS

#### \* metal joining:

The parts which are manufactured individually are joined together to form the product.

#### • Types:

- (1) Welding
- (2) Brazing
- (3) Soldering
- (4) Mechanical Fasteners
- (5) Adhesive Bonding.



## \* Welding:

It is process of joining the two metallic parts together by heating them to a plastic or semi-molten state, with or without the appln of a pressure and without a filler material.

### • Types:

- (1) Pressure welding - with pressure without filler material.
- (2) Non-pressure welding - without pressure with filler material.
  - (a) Electric arc welding
  - (b) gas welding.

### • Advantages:

- (1) Light weight constructions
- (2) low cost metal joining process
- (3) welding can be used for producing the complicated structures.

### • Disadvantages:

- (1) It is permanent joint, not possible to disassemble.
- (2) Joints are weak against vibrations.
- (3) It gives harmful radiation like light.

### • APPN:

- (1) fabrication of bridges, electric towers.
- (2) manufacturing of 2/4 wheelers.
- (3) window, door, etc.

Electric arc is stuck b/w electrode and workpiece, due to gap - large current - produce heat melting metal

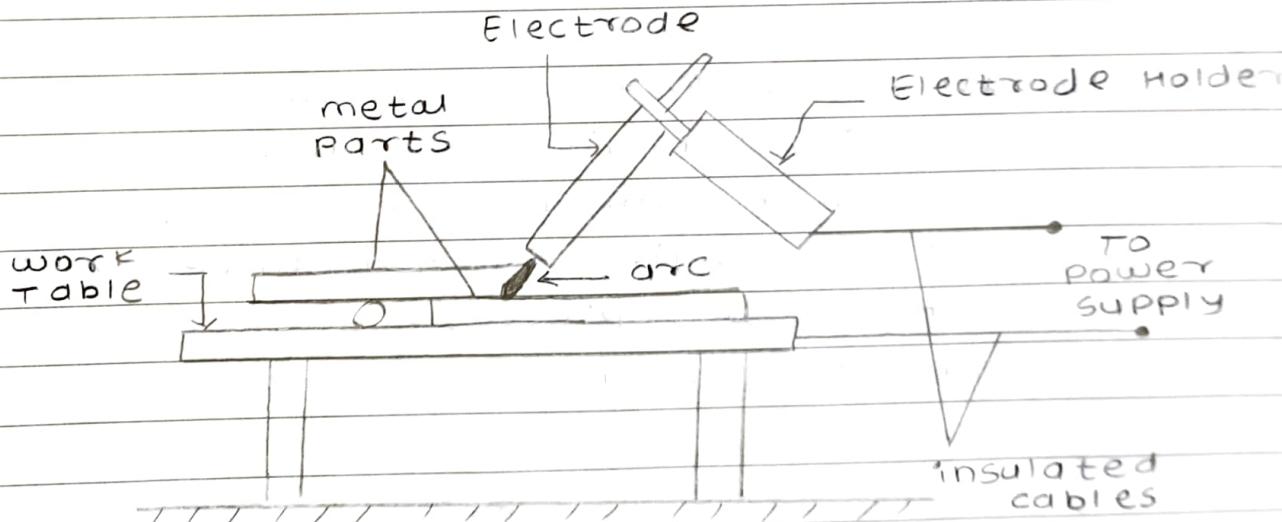


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### \* Electric arc welding:

Electric arc welding is a fusion welding process in which welding heat is obtained from an electric arc b/w electrode and workpiece. In this process, low voltage and high current D.C or A.C supply is used as power source.

- TYPES : current D.C or A.C supply is used as power source
  - (1) shielded metal arc welding (SMAW)
  - (2) gas tungsten arc welding
  - (3) gas metal arc welding one terminal of power source is
  - (4) Electroslag attached to electrode while other
  - (5) Plasma to workpiece. In D.C. supply, -ve to
  - (6) stud arc welding. electrode and +ve to workpieces.



#### • Advantages:

- (1) welding of complicated shapes can also be done.
- (2) Equipments are portable and less expensive.

#### • Disadvantages

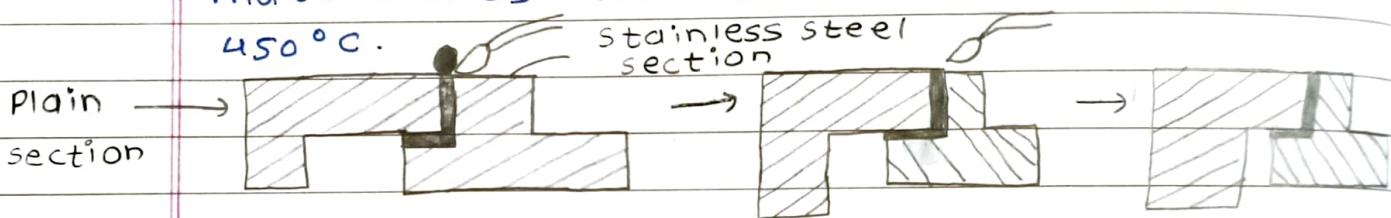
- (1) control is difficult and very slow.
- (2) Filter material needed.

- APPIN :

- (1) manufacturing of bridges
- (2) manufacturing of boilers, pipelines.
- (3) Nuclear reactors.

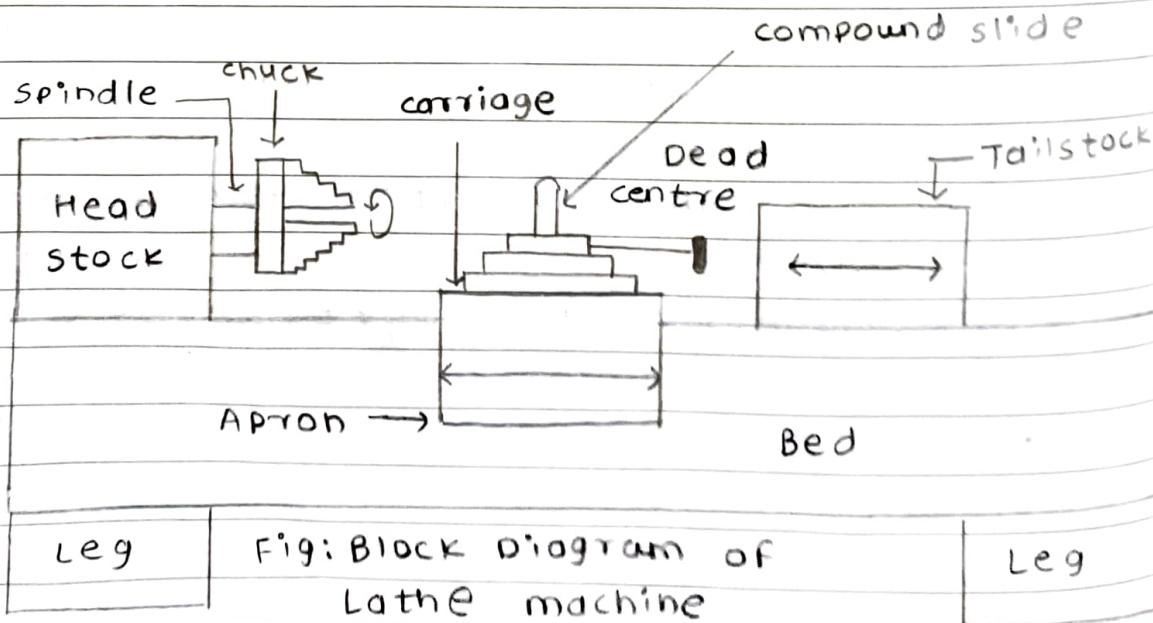
- \* Brazeing:

Brazeing is the process of joining two workpieces made of similar or dissimilar materials by heating them to temp. above  $450^{\circ}\text{C}$ .



- \* Lathe Machine:

- (1) Lathe machine is a machine tool basically used for removing the undesirable material in the form of chips from the cylindrical surfaces to give desired shape or size.
- (2) It holds workpiece securely beth two rigid and strong supports called as centers.



1. Bed:

- (1) The bed is the base of lathe.
- (2) It has two guideways to provide support surfaces - carriage and tailstock
- Functn: To support all other elements of lathe.

2. Headstock:

- (1) The headstock is a box-like casting mounted permanently to left hand end of lathe bed.
- (2) It supports spindle and contains gearbox.
- (3) chuck is mounted on spindle.

• Functn:

- TO support the spindle
- To give multiple speeds to spindle

3. Tailstock:

- (1) Tailstock is also called as loose headstock or puppet bed.
- (2) It is located at right hand end of the lathe bed

• Functn:

- To hold dead centre which support the workpiece during machining.
- To hold tools like drill, reamers or tap.

4. Carriage:

- (1) It is located in between the headstock and tailstock of lathe bed.
- (2) It can be moved left or right either by handwheel or power feed
- Functn

- To hold cutting tool
- used for supporting, guiding and feeding the tool.

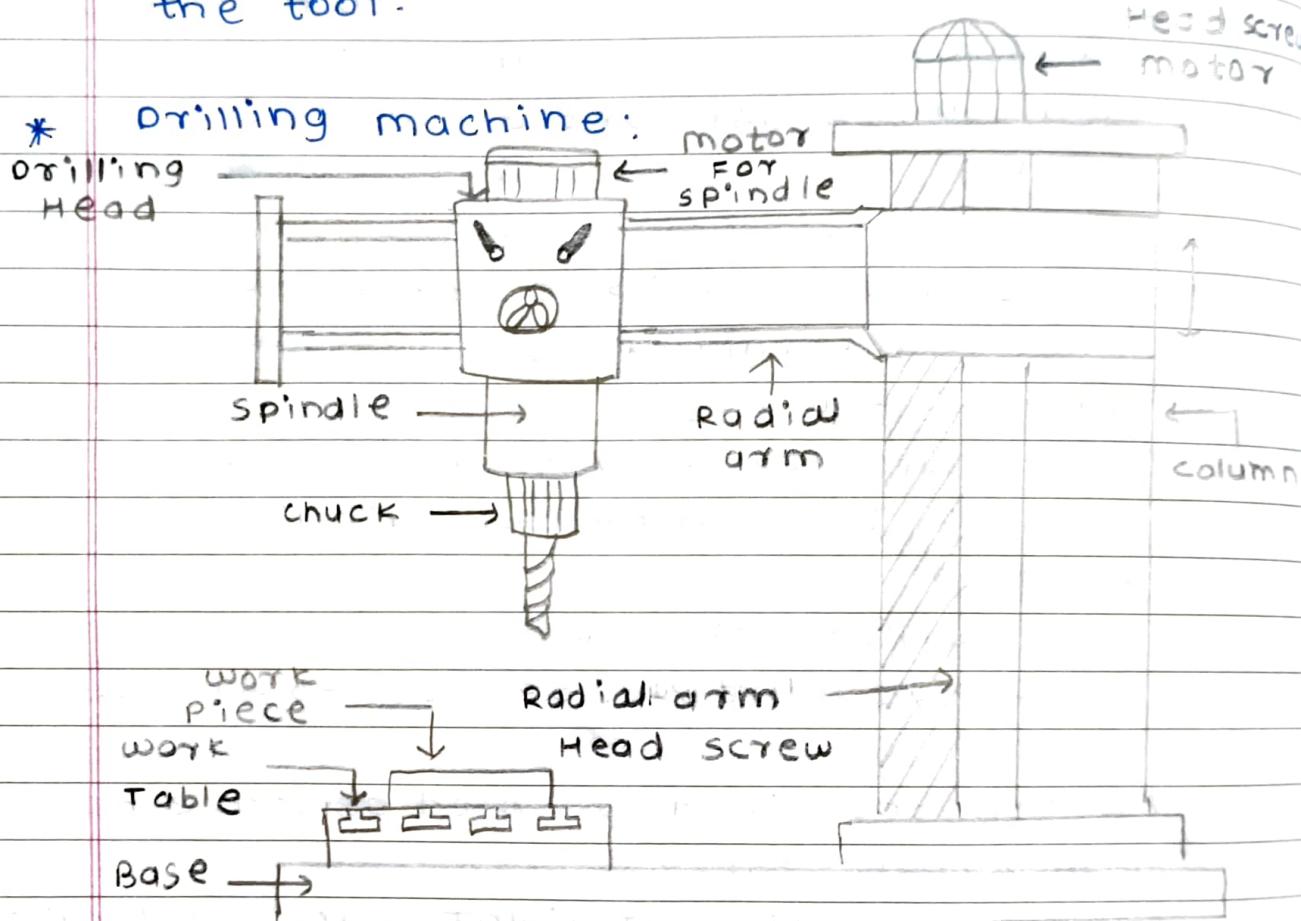


Fig: Drilling machine

- Basic elements:

- (1) Base: Lowermost part of machine to support entire structure.
- (2) worktable: It is mounted on base to support workpiece
- (3) column: It is vertical part fixed on base to support radial arm.
- (4) Drilling Head: The drilling head is mounted on radial arm.  
radial arm → A large arm supported to column.



(5) Spindle: It is driven by electric motor through gear drive. The gear drive provides the no. of spindle speeds.

\* Operatin on drilling machine:

- (1) Drilling: It is the process of making the cylindrical hole in workpiece. The tool used is called 'drill'.
- (2) Reaming: It is the process of smoothly finishing and accurately sizing the drilling hole. The material removal is negligible.
- (3) Boring: It is the process of enlarging the existing hole to meet required size and finish.
- (4) counter boring: It is the process of enlarging the existing hole to a larger diameter.
- (5) counter sinking: It is the process of chamfering the entrance of drilled hole.
- (6) Tapping: It is the process of making the internal threads in drilled hole.

\* micromachining:

It is a technique of producing or machining the features with dimensions ranging from few microns to a few hundred microns.

The components to be machined are 2D or 3D and may have a size of few millimeters.

(1 μm to 999 μm)

• Need:

- use of MEMS (micro Electro mechanical system)

is increasing in engg. appin.

- In medical field, diagnosis and surgery without pain can be achieved.

miniaturization

- micromachining process:

micro-turning

micro-milling

micro-drilling

micro-laser machining

micro EDM (Electro discharge machining)

- Examples:

(1) microsurgical equipment

(2) Aerospace components

(3) Biomedical implants

- \* Reconfigurable manufacturing system (RMS):

It is a process of manufacturing system designed for rapid change in its-

- structure

- hardware components

- software components

- Basic elements:

- Reconfigurable machine tool

- " transport systems

- " software system

- Advantages

- (1) It improves productivity.

- (2) It avoids obsolescence of manufacturing system.

- limitations:

- (1) It can be used for limited variation of product design.
- (2) modular design affects accuracy of system.

- \* 3 D Printing ( 3 - Dimensional printing):

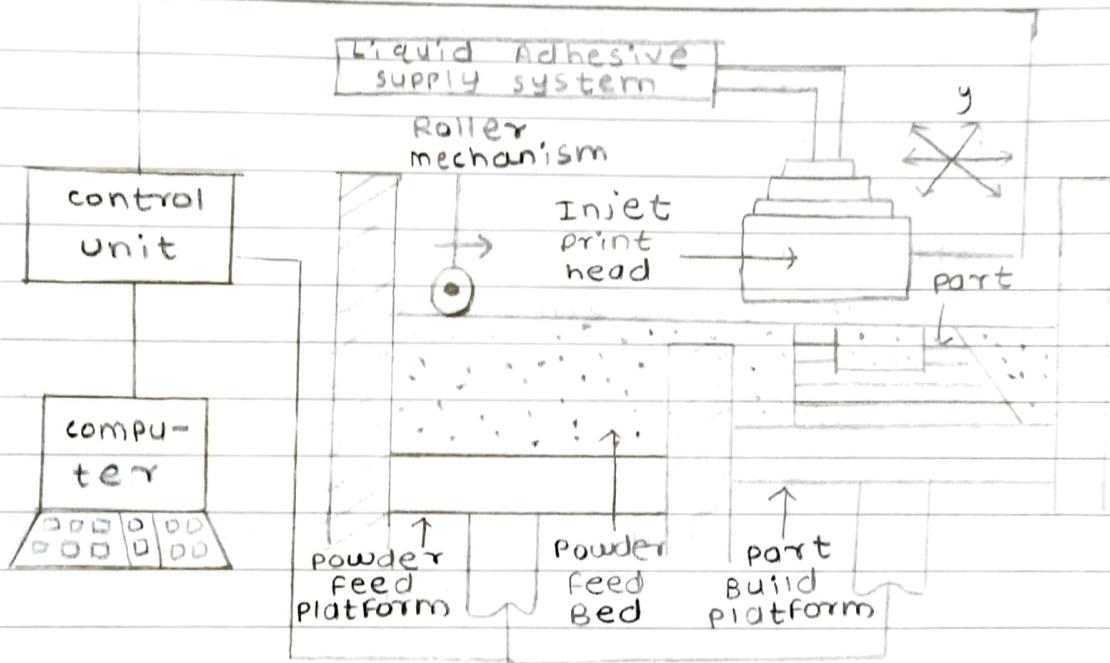


Fig: 3D Printing system

In 3-D printing process , in order to create 3D - prototype , the layers of deposited powder are solidified by injection liquid adhesive binder using multi - jet printer head.

- working steps:

- (1) creation of 3D CAD - model
- (2) Preprocessing
- (3) Transfer of STL format data
- (4) formation of one layer of plant
- (5) Lowering of part build platform.



- (6) Formation of new layers of Plant
- (7) Removal of part from platform
- (8) Post processing.

- Advantages:

- (1) The prototype can be produced in short period of time.
- (2) It reduces the cost of making prototype.
- (3) Reduces material waste.
- (4) complex parts can be manufactured.

- Limitations:

- (1) Poor strength
- (2) machine is expensive
- (3) Low cost 3D printing machines can not build parts with high accuracy.

- Applications:

- (1) It is used for making prototypes for concept models e.g. Adidas, Reebok.
- (2) used for making ceramic moulds.

#### \* IOT - Internet of Things:

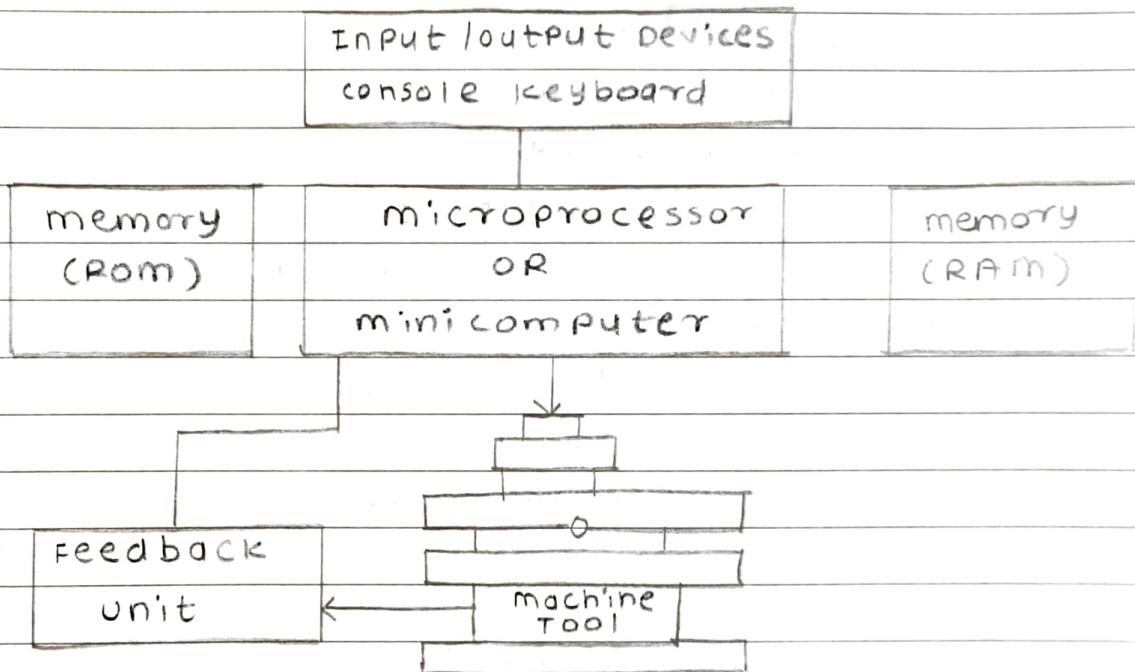
- (1) The wireless internet connectivity has been conventionally used for connecting the computers, laptops, printers.
- (2) Due to IOT, there can be data exchange and communication among the devices and machines.
- (3) IOT is a technology that enables automation and management of connected devices and machines within IOT Network.
- (4) It allows real time monitoring and controlling.

of devices and machines from remote places using wireless connectivity.

- Advantages:

- (1) Improve safety and security of machines, equipment and plant.
- (2) Reduce breakdown time.
- (3) Predict machine failure in advance.

\* CNC (Computer Numerical Controlled) machines :



CNC machines are the machine tools of which various functions are controlled by a computer through programs fed to it, without human operator.

- Elements:

- |                     |                   |
|---------------------|-------------------|
| (1) I/P, O/P device | (4) machine tool  |
| (2) memory          | (5) feedback unit |
| (3) microprocessor  | (6) interfaces.   |

- (1) The data is fed to CNC machine tool through Keyboard.
- (2) The memory (RAM and ROM) stores programs and other machine tool control information.
- (3) microprocessor is brain of CNC machine tool. It receives data stored in memory as part program.
- (4) Data is converted into instructions.
- (5) Interfaces provides the connections b/w microprocess, machine tool and other element.
  - Advantages:
    - (1) manufacturing of complex components
    - (2) High accuracy
    - (3) Reductn of wastage
    - (4) Greater operator efficiency
  - Limitations:
    - (1) High initial cost
    - (2) High maintenance cost
    - (3) High operational cost
  - Applications:
    - (1) CNC turning centre
    - (2) CNC drilling machine
    - (3) CNC milling machine
    - (4) CNC laser cutting machine.