BASIC MECHANICAL ENGINEERING
BT - 203

Department of Mechanical Engineering

Course Completion Unit Plan

Document	Revision	Effective Date	Pages
CCUP-BT 203	-	01-11-2022	1-3

Delivery Methods: Course shall be covered by using conventional as well as modern teaching methods like Chalkboards, PPT, Animation, Videos Lectures, and Research Articles etc.

Lecture No.	Name of Topics	Delivery Methods	Book
	CO –I		
1	Introduction to materials	Chalk Board/PPT	B-6
2	Classification of materials	Chalk Board/PPT	B-6
3	Mechanical properties of materials	Chalk Board/PPT	B-6
4	Stress strain diagram	Chalk Board/PPT	B-6
5	Useful Engineering materials, wrought & cast Iron	Chalk Board/PPT	B-6
6	Classification of cast iron	Chalk Board/PPT	B-6
7	Composition of cast iron and its properties	Chalk Board/PPT	B-6
8	Steel and Classification of Steel	Chalk Board/PPT	B-6
9	Properties of Steel	Chalk Board/PPT	B-6
10	High speed steel	Chalk Board/PPT	B-6
11	Testing of materials	Chalk Board/PPT	B-6
12	Destructive testing	Chalk Board/PPT	B-6
	CO -II		
13	Introduction to measurement, Types of measurement	Chalk Board/PPT	B-6, B-2
14	Error- definition, Types of error	Chalk Board/PPT	B-6, B-2
15	Temperature measurement-Principle	Chalk Board/PPT	B-6, B-2
16	Types of Temperature measuring instruments	Chalk Board/PPT	B-6, B-2
17	Types of pressure measuring instruments	Chalk Board/PPT	B-6, B-2
18	Strain measurement	Chalk Board/PPT	B-6, B-2
19	linear measurement and angular measuring instruments	Chalk Board/PPT	B-6, B-2
20	Force measurement, torque measuring instruments	Chalk Board/PPT	B-6, B-2
21	Flow measuring instruments	Chalk Board/PPT	B-6, B-2
22	Introduction of welding	VIDEOS/PPT	B-6, B-2
23	Introduction of casting, carpentry	VIDEOS/PPT	B-6, B-2
24	Lathe machine principal, operation,	VIDEOS/PPT	B-6, B-2
25	Drilling machine principal, operation,	Chalk Board/PPT	B-6, B-2
	CO -III	VIDEOS/PPT	B-6, B-2
26	Fluid-Definition, Fluid- Properties	VIDEOS/PPT	B-6, B-1
27	Pascal's law	VIDEOS/PPT	B-6, B-1
28	Newton's law	Chalk Board/PPT	B-6, B-1
29	Bernoulli equation	Chalk Board/PPT	B-6, B-1

30	Hydraulic machine	Chalk Board/PPT	B-6, B-1
31	Types of Hydraulic machine	Chalk Board/PPT	B-6, B-1
32	Working of Pelton turbine	Chalk Board/PPT	B-6, B-1
33	Working of Kaplan turbine	Chalk Board/PPT	B-6, B-1
34	Working of Francis turbine	Chalk Board/PPT	B-6, B-1
35	Pumps –classification	Chalk Board/PPT	B-6, B-1
36	Working of centrifugal pump	Chalk Board/PPT	B-6, B-1
37	Working of reciprocating pump	Chalk Board/PPT	B-6, B-1
	CO -IV		
38	Thermodynamics- introduction	Chalk Board/PPT	B-6, B-3, B-7
39	Thermodynamic system, properties, state, process	Chalk Board/PPT	B-6, B-3, B-7
40	Laws of thermodynamics	Chalk Board/PPT	B-6, B-3, B-7
41	Thermodynamic processes	Chalk Board/PPT	B-6, B-3, B-7
42	Boiler, Working, Classification, Parts	Chalk Board/PPT	B-6, B-3, B-7
43	Mountings & Accessories, Function, Importance	Chalk Board/PPT	B-6, B-3, B-7
44	Draught & Types of artificial draught	Chalk Board/PPT	B-6, B-3, B-7
45	Equivalent Evaporation, Efficiency of boiler	Chalk Board/PPT	B-6, B-3, B-7
46	Steam and Steam Formation	Chalk Board/PPT	B-6, B-3, B-7
47	Types of steam	Chalk Board/PPT	B-6, B-3, B-7
48	Properties of Steam	Chalk Board/PPT	B-6, B-3, B-7
49	Enthalpy & Entropy of steam	VIDEOS/PPT	B-6, B-3, B-7
50	Use of steam table in numerical	VIDEOS/PPT	B-6, B-3, B-7
	CO -V		
51	Reciprocating machines, Working principle of steam Engine	VIDEOS/PPT	B-6, B-4
52	Hypothetical and actual Indicator diagram of steam engine	VIDEOS/PPT	B-6, B-4
53	Carnot cycle with P-V & T-S Diagrams	VIDEOS/PPT	B-6, B-4
54	Otto cycle with P-V & T-S Diagrams	VIDEOS/PPT	B-6, B-4
55	Diesel cycle P-V & T-S Diagrams	Chalk Board/PPT	B-6, B-4
56	Dual cycle P-V & T-S Diagrams	Chalk Board/PPT	B-6, B-4
57	Working of 4–S petrol & 2-S Petrol engines	Chalk Board/PPT	B-6, B-4
58	Working of 4–S diesel & 2-S diesel engines	Chalk Board/PPT	B-6, B-4
59	Comparison of 4–S & 2-S engines	Chalk Board/PPT	B-6, B-4
60	Comparison of SI & CI engines	Chalk Board/PPT	B-6, B-4
61	Air compressor working	Chalk Board/PPT	B-6, B-4

List of Reference Books

Book No.	Title of Book	Author/Publisher/Edition
1	Fluid Mechanics & Machinery	Kothandaraman & Rudramoorthy/New Age/3rd
2	Instrumentation, Measurements and Analysis	Nakra & Chaudhary/TMH/4th
3	Engineering Thermodynamics	PK Nag /TMH/6th
4	Internal Combustion Engines	V Ganesan /TMH/ 4th
5	Basic Mechanical Engineering	CM Agrawal& Basant Agrawal/Wiley/ 1st
6	Basic Mechanical Engineering	RK Rajput/S. Chand/3rd
7	Engineering Thermodynamics	M Achuthan/PHI/2nd

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UNIT- 1

Materials

→ Material science
→ Engineering material
→ Mechanical properties :-

Elasticity :- rubber जो अपना shape regain कर ले।
Plasticity :- Permanent deformation after remove of load
Ductility :- streched into wires
Malleability :- convert into thin sheets
Hardness :- scratching property जैसे - पत्थर
Toughness :- load का absorbed करके
Creep :- Time dependent like strain
Fatigue :- cyclic load failure with cycle
Stiffness :- (spring material)

It is the stiffness of material denotes its resistance to deformation under the action of external source. The modulus of elastility of material is a measring unit of stiffness.

Resilience :- (stored energy of spring)

Resilience is the capacity of material to absorbe energy within to elastic limit which makes be material able to bear shock & vibration. The stored energy is given off on the removal of the load.

- Machinability
- castability
- weldability.

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10) * Proof resilience :- The max^m energy stored in spring upto elastic limit.

11 Brittleness :- easily breakable material

Classification of Engg. Material

Engg. Material
- Metal
  - Ferrous
    - steel
      - plain
      - carbon
      - alloy
    - cast iron
      - White C.I.
      - Grey C.I.
      - Nodular C.I.
      - Ductile C.I.
      - Malleable C.I.
  - Non-ferrous
    - copper
    - Tin
    - lead
    - Aluminium
- Non-Metal
  - Organic
    - plastic
    - wood
    - Rubber
    - leather
  - Inorganic
    - minerals
    - ceramic
    - glass
    - cement
    - Graphite

(1) Metal & alloys

Metals are polycrystalline bodies which are having different oriented fine crystals normally major metals are in solid state at normal temperature.

Alloys are a combination of two metals, it is non-ferrous based

on metallic bonding character.

(2) Ceramics:-
Ceramics can be define as ~~an~~ inorganic crystaline material beach ~~shine~~ sand & rocks are example of ceremics.
Advance ceramics are material made by refining with that help of special method.

(3) Polymers:-
Polymers are organic materials they are produce by process of polimari-zation. Polymer materials includes rubbers & other type adesives.

(4) Semiconductors:-
semiconductors is an intermidiate conducting material there conductivity not higher as like metals and not low as insulating ceramic material.

(5) Composite:-
composite material is the composition of two or more material with different physical and chemical properties to produce a diff. material with specific property.

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* Ferrous material:-
The primary element of ferrous metal is iron and carbon. The ferrous metals megnatic in nature, and being damaged by the application of rust when exposed to moistures.
ex:- iron, steel, cast iron

* NON Ferrous:-
In this category iron is not the primary element due to that the non ferrous metal having high resistance to rust and corrosion. and they are not megnatic in nature.
Ex:- Copper, brass, aluminium.

* Organic material
The organic material are of plant or animal origine and once they will part of living system basically organic material have a complex structure and consist of different combination of carbon, hydrogen, oxygen and other non metallic element.

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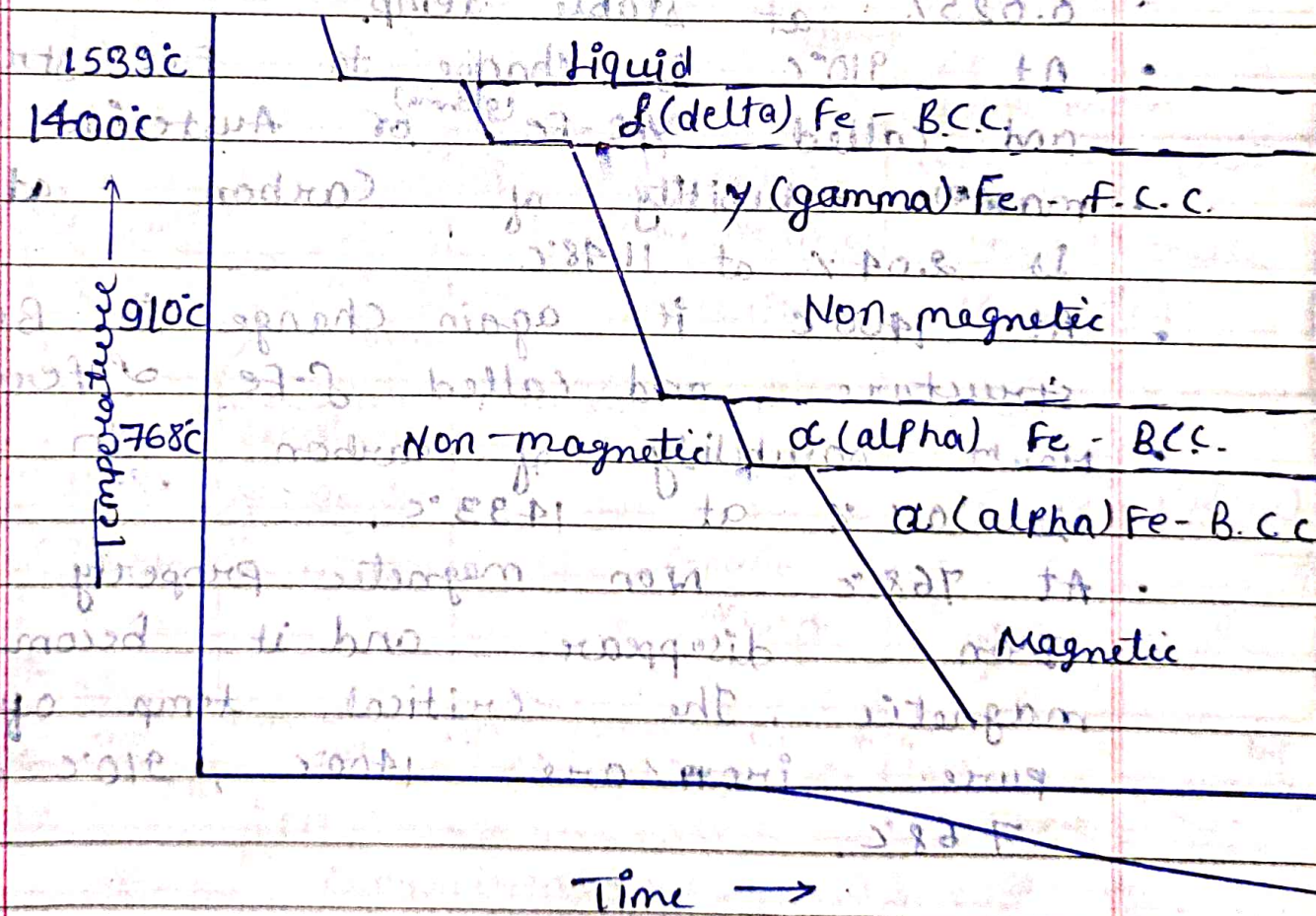
* Inorganic material :-
Inorganic material are compound of metallic and non-metallic materials but do not contains any animal or plant cell the common inorganic materials are glass, ceramic, cement etc.

* Cooling curve of iron.



all statements created by the help of above diagram.

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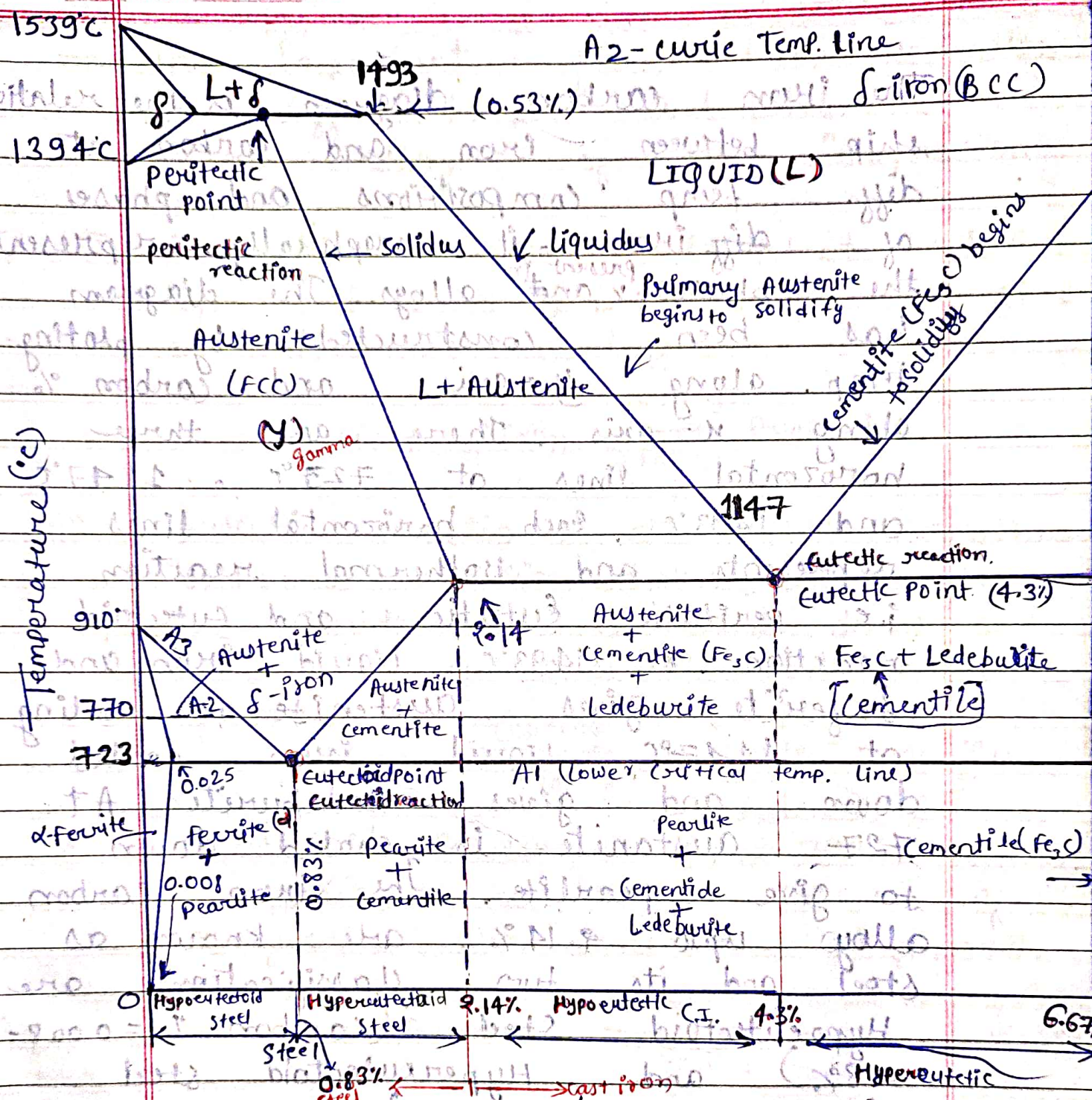
- Iron is relatively soft and ductile.
- It show the property of allotropy i.e. more than one crystle structure.
- Its melting point is 1539°C.
- At normal room temprature iron has B.C.C structure and its called α (alph) Fe or α (alpha) ferrite.
- Solubility of carbon in α ferrite is very low. i.e. 0.005% at room temp 0.025% at stable temp.
- At 910°C it change to FCC structure and called γ-Fe (gamma) or Austenite
- Max^m solubility of Carbon at γ-Fe is 2.04% at 1148°C
- At 1400°C it again change to BCC structure and called δ-Fe δ-ferrite
- Max^m solubility of carbon in δ-Fe is 0.1% at 1493°C.
- At 768°C Non magnetic property of Iron disappear and it become magnetic, The critical temp. of pure iron are 1400°C, 910°C and 768°C.



IRON – CARBON DIAGRAM

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The iron carbon diagram is the relationship between iron and carbon at diff. temp compositions and phases of ~~diff~~ iron. it graphically represents the phases present in alloys. The diagram has been constructed by plotting temp. along y-axis and carbon % along x-axis. There are three horizontal lines at 727°C, 1147°C and 1493°C. Each horizontal lines represents and isothermal reaction i.e peritectic, Eutectic and eutectoid reaction. At 1493°C liquid iron and δ-ferite gives austenite on cooling at 1147°C, Liquid iron cooled down and gives Ladeburite. At 727 austanite is cooled down to give pearlite. The iron carbon alloys upto 2.14% are known as steel and its two classifications are Hypoeutectoid Steel (carbon % = 0.008-0.8%) and Hypereutectoid steel (carbon % = 0.8-2.14%). Further, on adding carbon more then 2.14% is known as cast iron. Its two classifications are Hypoeutectic cast iron (2.14% - 4.3%) and Hypereutectic Cast iron (4.3% - 6.67%)

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→ The Important face transformation at diff temp. and with iron carbon alloy of diff. Composition are

ⓐ Peritectic reaction :- (1493°C) At 1493°C Liquid iron + δ iron mixed and gives austenite on cooling

$$\text{Liquid} + \delta\ \text{iron} \underset{\text{heating}}{\overset{\text{cooling}}{\rightleftharpoons}} \text{Austenite}$$

ⓑ Eutectic reaction :- at 1147°C another isothermal reaction takes place when be liquid iron is cooled down and a mixture of austenite and cementite formed.

$$\text{Liquid} \underset{\text{heating}}{\overset{\text{cooling}}{\rightleftharpoons}} \underbrace{\text{Austenite} + \text{cementite}}_{\text{Ledeburite}}$$

ⓒ Eutectoid Reaction :- At 727°C when austenite is cooled a mixture of α ferrite and cementite is formed

$$\gamma\text{-Austenite} \underset{\text{heating}}{\overset{\text{cooled}}{\rightleftharpoons}} \underbrace{\text{Ferrite} + \text{cementite}}_{\text{Pearlite}}$$

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Steel & cast iron :-

(a) Steel and its classification :-

Steels are alloy of iron, carbon, and other alloying elements. Alloying is necessary for many reasons like improving properties, stregth, corrosion resistance and other mechanical property of steel are dependent on carbon contain. Hence, steel classified on the basis of there carbon % basically there are three types :- 1) Low carbon steel. (less then 0.3% carbon)

2) Medium carbon steel (~~less then~~ 0.3% to 0.6% carbon)

3) High carbon steel (more then 0.6% carbon)

1) Low Carbon steel :-

carbon in this alloys is limited and is not enough to give stregth to these material during heat treatment. Hence, By cold working stregth is improve there micro structure consist of ferrite, pearlite these alloys relatively soft and ductile and these materials are easily machinable and weldable.

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2) Medium carbon steel:-
These are stronger then low carbon steel. These material are less ductile and heat treated to improve their stregth. the applications of medium carbon steel are for making railway tracks, railway wheels and gear.

3) High carbon steel:-
These are strongest and hardest of carbon steel. so, ductility is very limited these posses very high wear resistance. Hence they are used for tool making application like knife, razers etc.

Stenless steel:-
These are high resistance to corossion. It is used for making utensils by adding chromium in it.

B. CAST IRON and Classification:-
Alloy with more then 2.14% of carbon is known as cast iron. Comertially cast iron contains above 3% to 4.5% of carbon along with some alloying element. Alloy with this carbon content melt at

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lower temp. then steel. The ~~cast~~ cast iron classified as:-

IMP → Grey cast iron
→ white cast iron
all type → nodular cast iron
→ mallable cast iron

1) Grey cast iron:-
These alloy consist of ~~the~~ carbon in graphite form (flakes) which are surrounded by either ferrite or paralite. Due to graphite grey cast iron are weak and brittle but it posses good dempic property. Hence it is used in construction - bed for heavy machines.

2) white cast iron:-
In this silicon is added less than 1% in combination with faster cooling rate. There is no time left for formation of cementite. Because of presence of cementite fractured surface appeared looks like white color hence it is named as white cast iron. These materials are very brittle and extremely difficult to machine. Hence, the applications a

in form of rolers in rolling mills.

5) Nodular cast iron:-

Small addition of mangnese to grey cast iron result deformation of Nodular ~~cast iron~~. In which sphere ~~spearti~~ ~~te~~ like particle appears these ~~and~~ are ductile then grey cast iron. The application ~~to~~ crank shaft. Automatic components and pump bodies.

1) Malleable :-

It is formed by heating white cast iron by which the cementite decom-posed into form ferrite. Application are connecting rodes having duty services like, In ships, rail roads,

* Stress - strain diagram

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Hardness:-

→ Hardness represents the resistance of material to indentation, scraching.

→ In hardness testing a loaded ball or diamond tip is pressed against ~~to~~ the surface of a material which creates plastic deformation and this diformation measured for calculating hardness of material. Hardness test is classified as

- scratch test
- Rebound test
- Indentation test

→ In ~~scra~~ scratch test the material ~~is~~ are rated on the ability to scratch to ~~aware~~ other material.

→ In rebound hardness test a standard hard body is usually is dropped on the material surface and the hardness is calculated in terms of height of its rebound.

→ In indentation test the indentat is usually a ball or pyramid shape tip of a material much harder then the test specimen. A load is applied by pressing the indenter at right angle to the surface being tested

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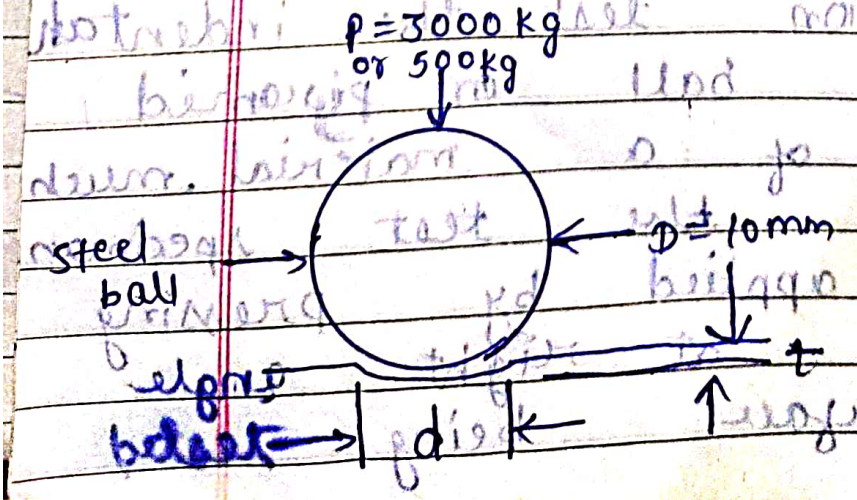
and the hardness ~~was~~ is calculated by standard formulae and the direct reading on dial indicator.

→ Indentation test classified as:-

(a) Brinell Hardness test.
(b) Vicker's Hardness test
(c) Rockwell Hardness test.

(a) Brinell Hardness test:- In this method a steel ball is pressurised into the surface of material under a specified load. The load is held in the position for a fixed period and then released. This leaves a permanent impression on the surface of material then either measure the diameter or the depth of impression. The ~~grin~~ Brinell Hardness number is define as the ratio of the applied load to the area of impression.



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$$BHN = \frac{P}{\pi D t} = \frac{2P}{\pi \left[D - \sqrt{D^2 - d^2}\right]}$$

where,

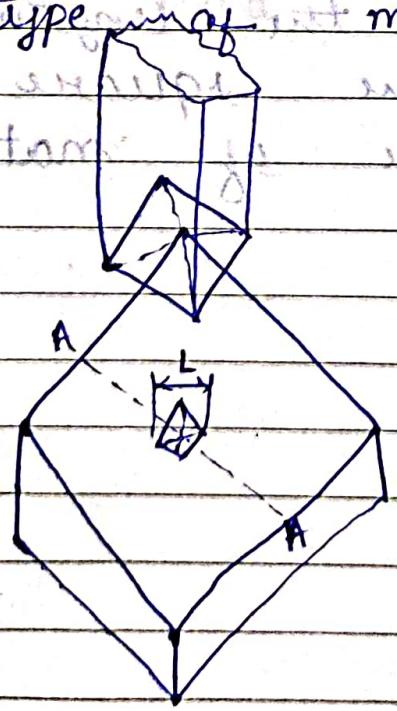
D is diameter of ball in mm,

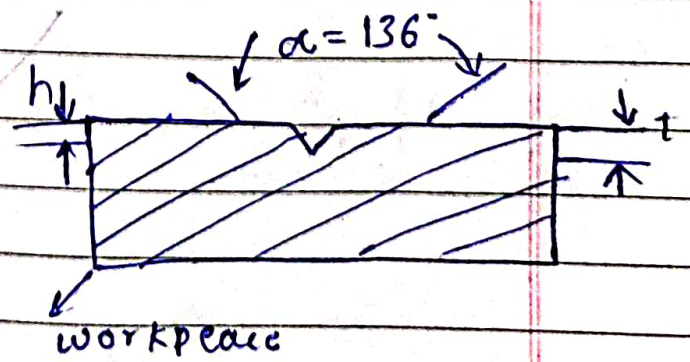
d is diameter of the indentation at the surface in mm.

t is the depth of the indentation from the surface.

(b) ★ Vicker's Hardness test:-

→ This method is also similar to Brinell hardness test. The change in this method is only indenter of pyramid diamond shape on a square base with an angle of 136°. The hardness of diamond is very high. Hence, this method is used for all type of material range





Vicker's hardness test

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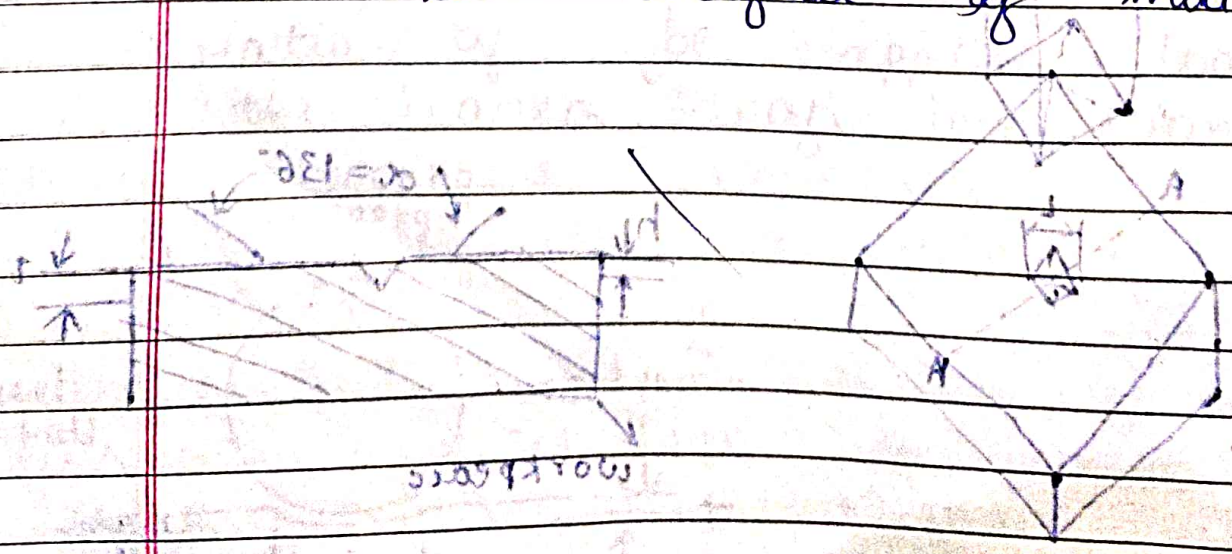
$$VHN = \frac{2P}{L^2} \sin\frac{\alpha}{2}$$

where, P ⇒ is the indentation load which typically ranges from 0.1 to 1 kg but as high as 120 kg, L is the diagonal of the indentation in mm and.

L ⇒

α ⇒ is the included angle of 136°

→ The vicker's pyramid number (VPN) or vicker's hardness number (VHN) is define as the ratio of applied load to the impressed area. The area is calculated by measuring the length of diagonal of the square impress on the surface of material.



sustain diagram
iron diagram

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(C) Rockwell hardness test :-

→ The scale range between 0 - 100. In this test a diamond cone indentor of 120° angle or a steel ball is used. during the testing of hardness in rockwell hardness teste : Firstly applied minor load of 10 kg and then according to the type of material the major load is applied of 50 kg, 90kg and 140kg A/c to ~~RA~~ R_A, R_B, R_C & HR_A, HR_B, HR_C.

→ The impression is recorded or a dial and the resulting number is called rockwell hardness no. like HR_A, HR_B, HR_C.

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Assignment - 1

Q.1 Explain stress strain diagram for mild steel and compare it with stress strain diagram of Brittle material.?

Q.2 Draw and explain iron carbon diagram ?

Q.3. A rod of 200 cm long and diameter of 3 cm is subjected to an axial load of 30 kN. If the young modulus of material of rod is 2×10^5 N/mm² determine.

① stress
② Strain
③ Elongation of rod.

UNIT - 2

Measurement & Production

* **Measurement:-**
Measurement is the process of comparing unknown magnitude of certain parameter with the known pre defined standard of that parameter.

* **Types of measurement:-**

1) **Direct measurement:-**

→ In this type of measurement the value of measured quantity is taken directly without doing any calculation.
ex:- ~~wait~~ weight of any substance is measure directly with using a physical balance.

2) **Indirect measurement:-**

→ The value of quantity is obtain from measurement carried out by direct method and with the help of calculation. ex:-
ex:- Volume of any substance.

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3) Measurement without contact :-

→ With the help of sensors the measurement is carried out without contacting the object.

Ex:- Temperature measurement devices with infrared senses.

4) Measurement by comparison :-

→ In this ~~typ~~ measurement the measured value of any quantity is compared with a known value of same quantity.

* Measurement errors :-

→ The measurement error is defined as the difference between the standard value to actual value.

Error
- Cross error
- Systematic error
  - Instrumental error
  - Environmental error
  - Observer error
- Random error

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(1) Gross error :- This type of error takes place due the lack of experience of the observer by while taking the measurement values. The value of gross error will change observer to observer. Some time the gross error may takes place due to improper selection of instrument.

(2) Random error :- These error are takes place due to sudden change in atmospheric condition or we can say these error arise due to random and unpredictable fluctuation in experimental conditions like, change in temp., voltage supply, or mechanical vibration.

(3) Systemetic error :- If the instrument produce an error which is of constant, uniform deviation during the operation is known as systemetic error. It is classified as

(a) Enviromental error :- These error are due to external condition or change in environment

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the external condition includes change in temp., pressure and humidity.

(b) observational error:- such types of error are due to the wrong observation of reading or an individuals carelessness.

(c) instrumental error:- These error arise due to the faulty construction and calibration of measuring instruments.

* Linear & Angular measurement

(1) Vernier caliper
(2) micrometer
(3) slip gauge
} linear measurement

(4) sine Bar
(5) Dial gauge
} angular measurement

(1) **Vernier caliper:-** It is an instrument that measure internal and external dimension and the depth. It consist of a main scale fitted with the fow at one end and another Jaw having the vernier scale move over the main scale. when jaw are in contact the zero of main scale must coincide at zero of ~~vernier scale must~~ main coincide

of vernier scale. If the both zeros do not coinsi
There will be a (+) or (−) zero error

Least count is the smallest reading which the instrument can calculate.

Least count L.C. = $\frac{\text{One main scale division}}{\text{No. of division in vernier scale.}}$

True value = main scale reading + L.C. × vernier scale reading

(2) Micrometer or screw gauge :-

A micrometer is also known as screw gauge it is a instrument which is widely used for presize measurement of components in mechanical engg. and machining as well as most mechanical ~~plates~~ ~~plates~~ trades along with other metrological instruments. It is used for measuring external diameter like cylindrical gibody the least count = 0.01mm which is calculated as

$$\boxed{\text{Least count} = \frac{\text{Pitch}}{\text{No. of division on circular scale}}}$$

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(3) DIAL Gauge or DIAL Indicator :-

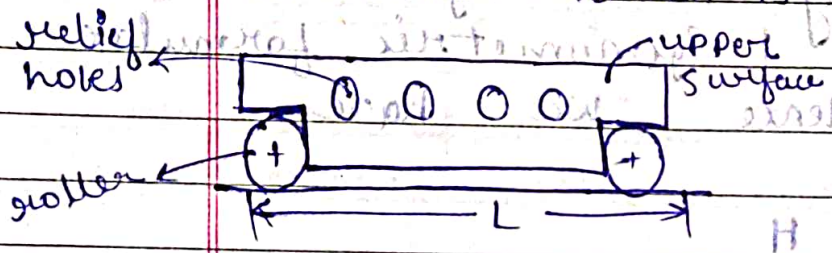
Dial indicators are important device used in manufacturing and metal engg. This device measure small linear distance that are important in establisment of precision and ~~accuracy~~ accuracy. Dial gauge used to measuring ovaling surface finish and squareness.

(4) Slip gauge :-

Slip gauges are the rectangular block of steel having cross section of 30 mm ~~phase~~ length and 10 mm face bridth. These blocks of steel have ~~the~~ been harden and stabilised by heat treatment. They have of diff. size (0.100mm). These blocks are of higher accuracy and surface finish. Hence, it is used

for calibration of tools or instrument.

(5) Sine Bar :- It is the precial measuring instrument and it is the good example of combination of linear or angular measurement. The sine Bar consist of suitable pair of roller set and distance b/w two rollers is important which is available in 100mm, 200 mm & 300mm which is known as centre distance.



It is made of high carbon, high cromium steel.

→ Working principle of sine Bar :-

→ For the measurement purpose the component sine Bar and slip gauges are used. The all elements kept on surface plate. The work piece is placed on the sine Bar or under sine Bar.

→ The surface angle is to be measured on upward direction. The arrangment is completed with the help of slip gauges.

→ The slip gauges are arranged below 1 end of the roler of sine Ba

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Hence, one end is kept on surface plate.

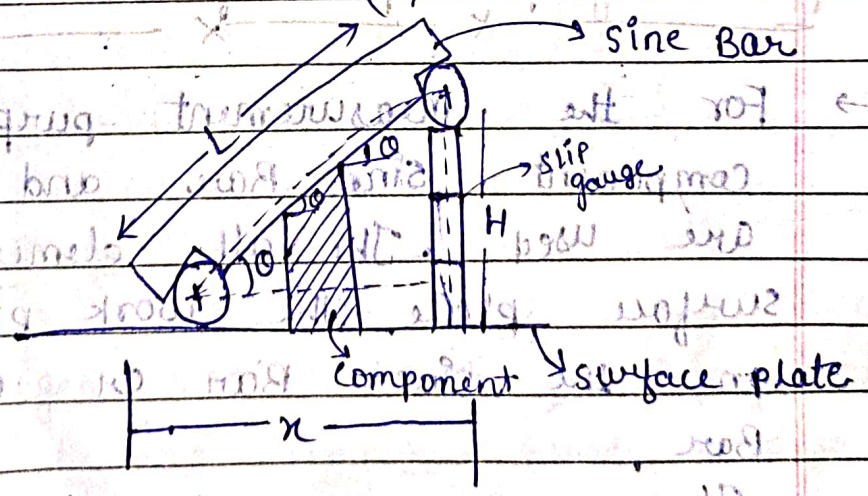
→ In some cases dial indicator are also used for the purpose of levelling of upper surface of sine Bar or component.

→ For given sine Bar the central distance is (L). The heigh of slip gauges is denoted by (H).

→ For calculating the angle we are using the trigonometric formulae of sine θ. Hence we have,

$$\sin\theta = \frac{H}{L}$$

$$\theta = \sin^{-1}(H/L)$$



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* Advantages of Sine Bar:-

→ It is used for accurant and presize angular measurement.

→ It is available easily.

→ It is cheap ~~as~~ in terms of purchasing

* Disadvantages:-

→ The application is limited for a fix centre distance b/w two rolers

→ It is difficult to handle and positioning of slip gauges

→ If the angle is more then 45° there is a possibility of inaccuracy in the results.

→ The angular

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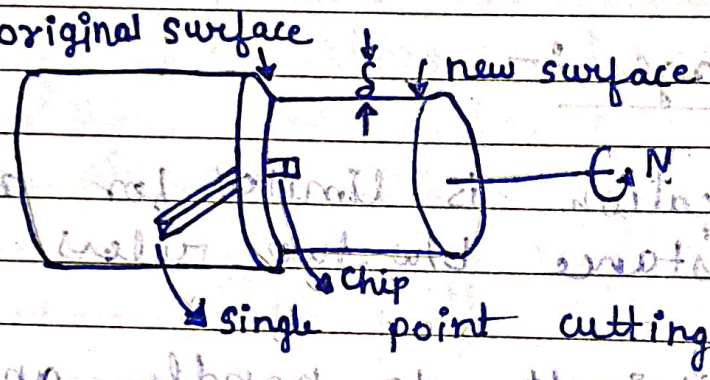
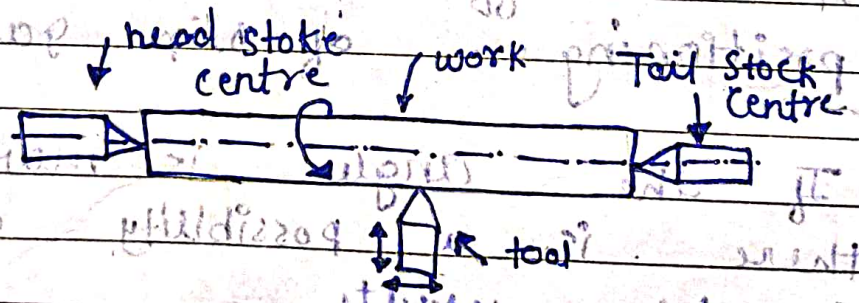
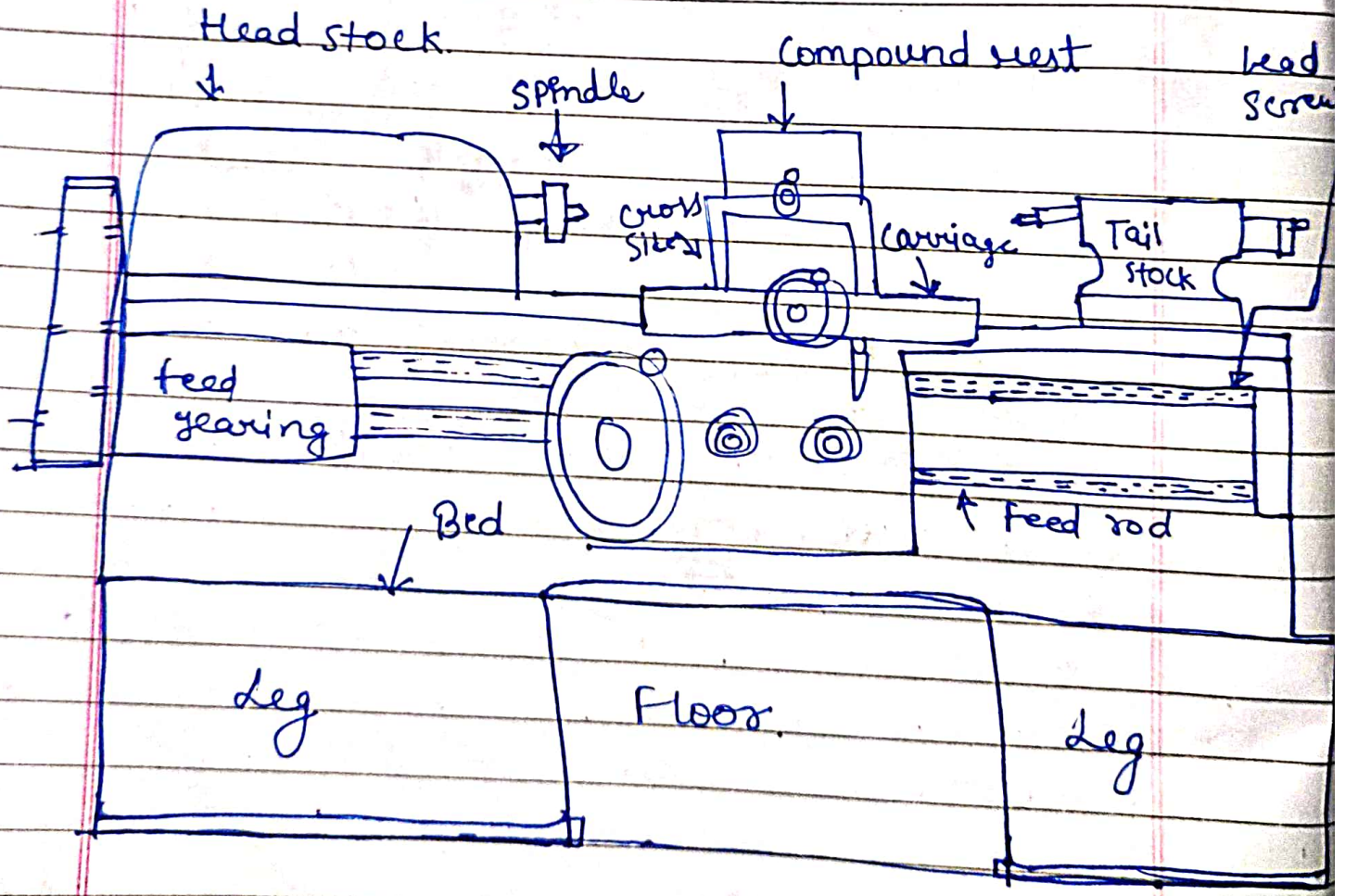
LATHE :-

→ Lathe is one of the most used machine tool in metal cutting work. It is used for machining the raw which is rotated and a cutting tool (single point cutting tool) is used against the work piece.

→ Hence the cutting action is complete.






Head stock.
Spindle
Compound rest
Lead Screw
cross slide
carriage
Tail stock
feed gearing
Bed
feed rod
Leg
Floor.
Leg

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Legs:-

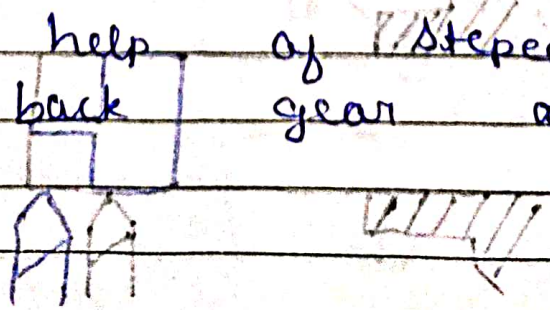
→ The whole machine is supported on two legs, the leg on left side also houses and electric motor which rotates the headstock spindle with the help of stepped cone pulley and back gear mechanism.

★ Classification of Lathe:-

1) Bench lathe:- It is a small machine mounted on a bench or cabinate. It is generally employed for small and presize work.

2) Speed lathe:- It is simplest form of lathe, generally it is used for wood turning. The operations are manual in this type of lathe.

3) Centre lathe:- It is the most used machine in general purpose in metal working industries. A number of different speed on the spindle can be made with the help of steped cone pulley and back gear arrangement.



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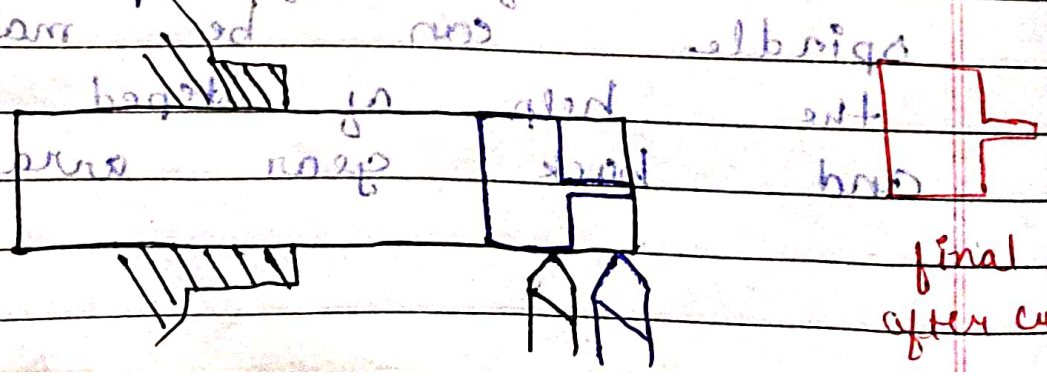
(4) Tool Room lathe :- It is basically a small lathe specially design for presize work in tool room. It has fully gear head stoke to operate on a wide range of spindle speed generally it is used for making tools, dies and gauges.

(5) CNC Lathe :- Lathe that are controlled by a compter and some M & G- codes.

(6) Automatic lathe :- In Automatic lathe all the element of machining process such as feeding of Job movement of all the cutting tools cutting of final Job and unloading of the finish Job are performed automatically all these process are in proper sequence. This type of machines are used in mass production.



IMP ⇒ differ. → (7) & (8)

→ इसमे 6 से ज्यादा tools भी use कर सकते है लेकिन carston tool lathe मे सिर्फ 6 ही tool use कर सकते है

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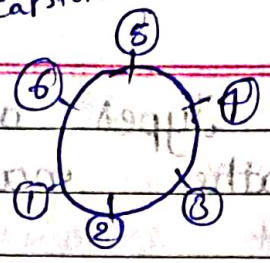
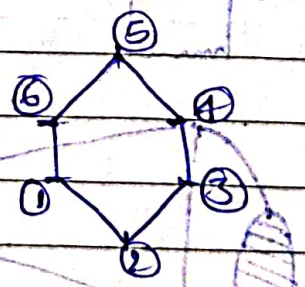
(7) Turret lathe :- 

indexable tool holder called turret

A turret lathe is used for medium production of repetitive work with the help of semiautomatic condition. In this machine tailstock is replaced with an indexable tool holder called turret. The turret is directly mounted on the lathe back and can be fixed at any desired position. generally it is a heavy duty machine.

IMP

(8) capstan lathe :- It is a semi-automatic production lathe similar to turret lathe. Here the tail stock is replaced by a hexagonal tool holder which carry six different tools at a time. Capston lathe is small size light duty machine.



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* Various Types of operations performed in lathe machine

1) Straight turning:-

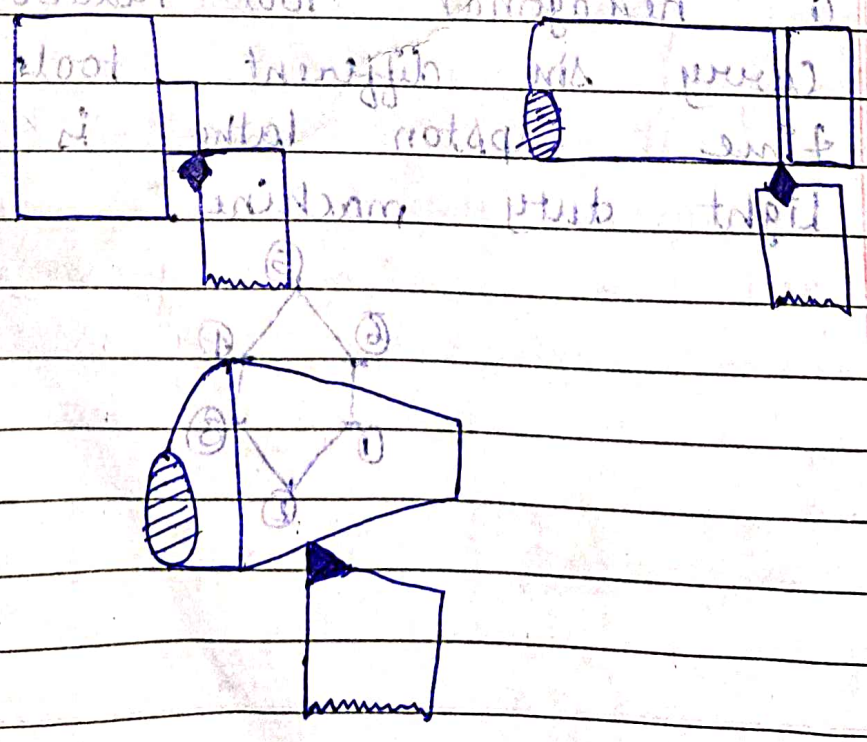
Turning is a lathe operation in which cutting tool removes metal from outside diameter of workpeace in other words.

Reduction in diameter of a work piece is called turning, depending upon the Job requirement the turning operation may be classified as.

→ straigh turning

→ Taper turning :-

- Taper turning is the operation of removing excess material from the workpiece with reference to diff. diameter or Taper angle.



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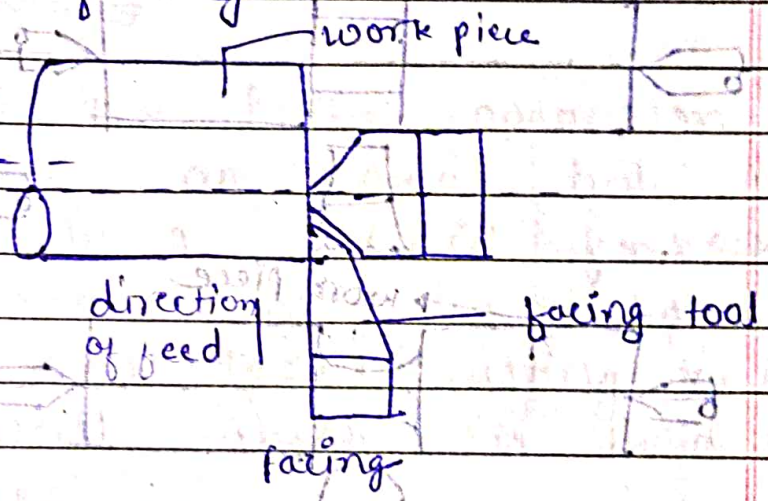
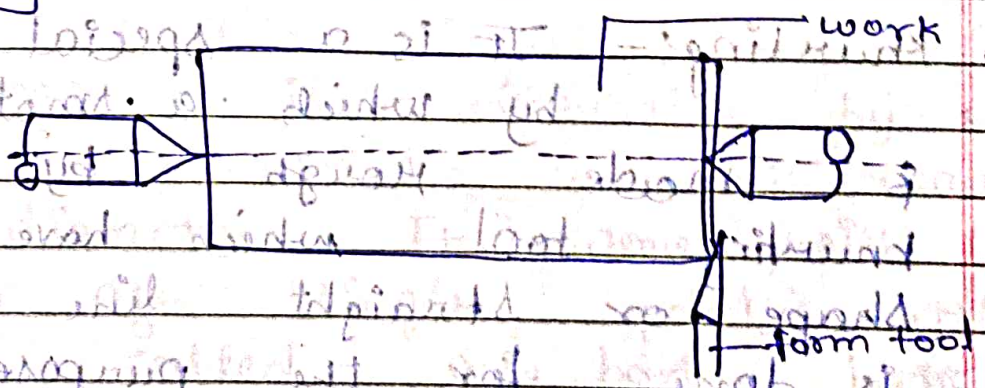
→ **Facing:-** Facing is the operation of the removing metal from the end of workpiece to produce flat surface. In other word.

A reduction in length of workpiece is called facing.

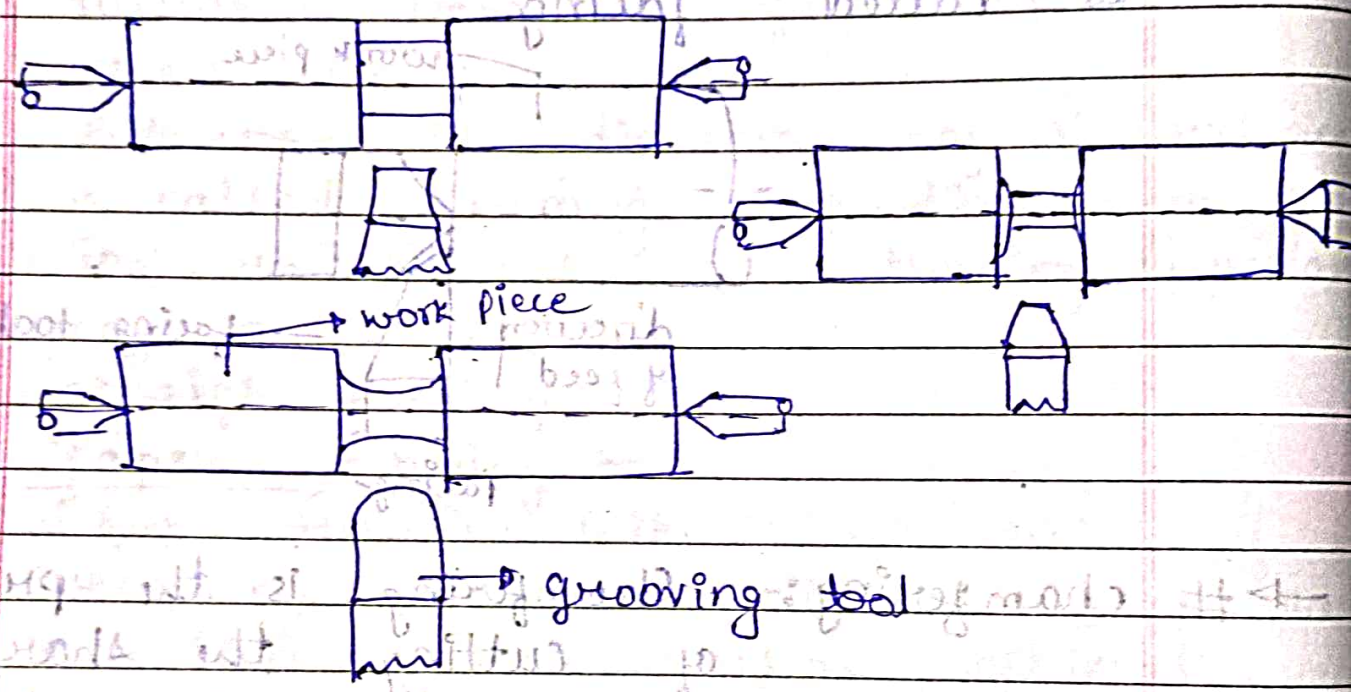


→ # **Chamfering:-** Chamfering is the process of cutting the sharp edge at the end of the jaw at desired angle. So, the meeting part connect easily.



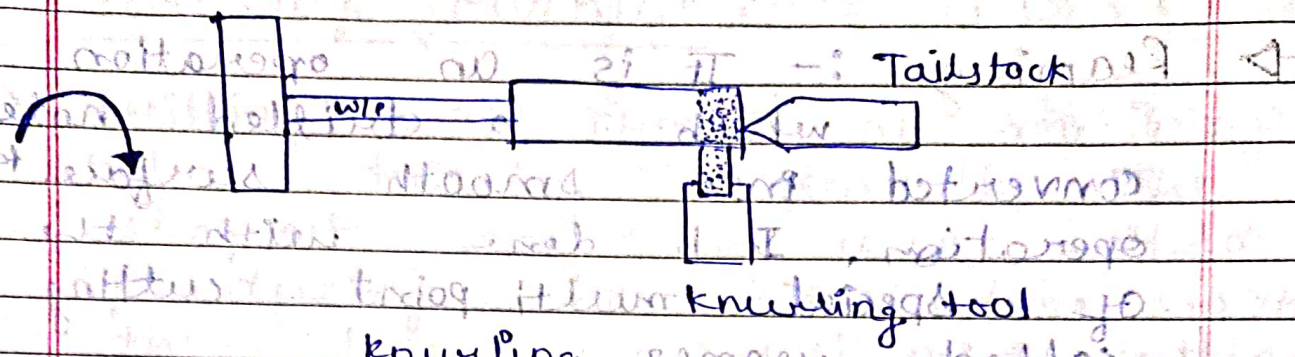
Chamfering

→ Grooving:- It is an operation of reducing diameter of workpiece in the form of neck or a narrow groove of desired shape. The shape may be round, square, or V-shaped.



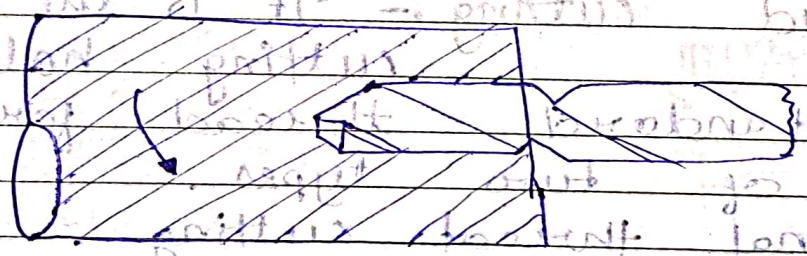
Grooving

→ Knurling:- It is a special operation by which a smoth surface is made rough by using knurling tool which have diamond shape or straight line pattern. It is done for the purpose of creating a better gripping surface on work piece.

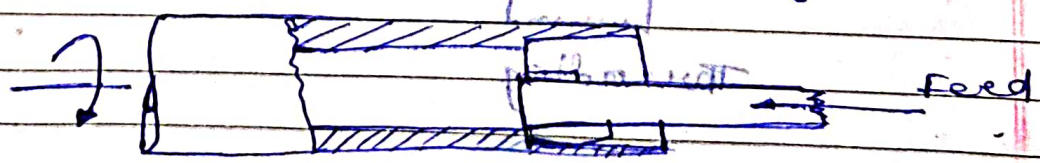


Knurling

→ Drilling :- It is a lathe operation by which an axial hole is created in a solid workpiece. It is done with the help of a special multiple point cutting tool called drill which is held on tailstock.



→ Boring :- It is an Operation by which a drilled hole is enlarged in diameter. It is done with the help of single point cutting tool called a boring bar.



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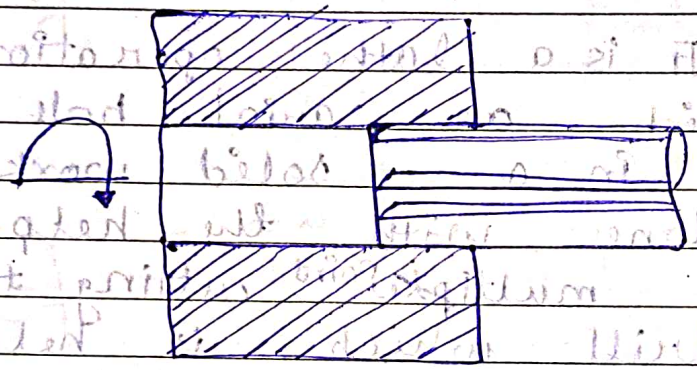
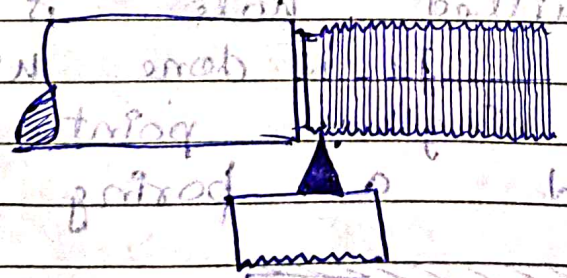
→ Reaming :- It is an operation by which a drilled hole is converted into smooth surface for further operation. It is done with the help of special multi point cutting tool called reamer.



→ Thread cutting :- It is done with leaf screw. It is the process of cutting helical groove of standard thread form. It may be of two types.

→ Internal thread cutting.

→ External thread cutting.



Threading

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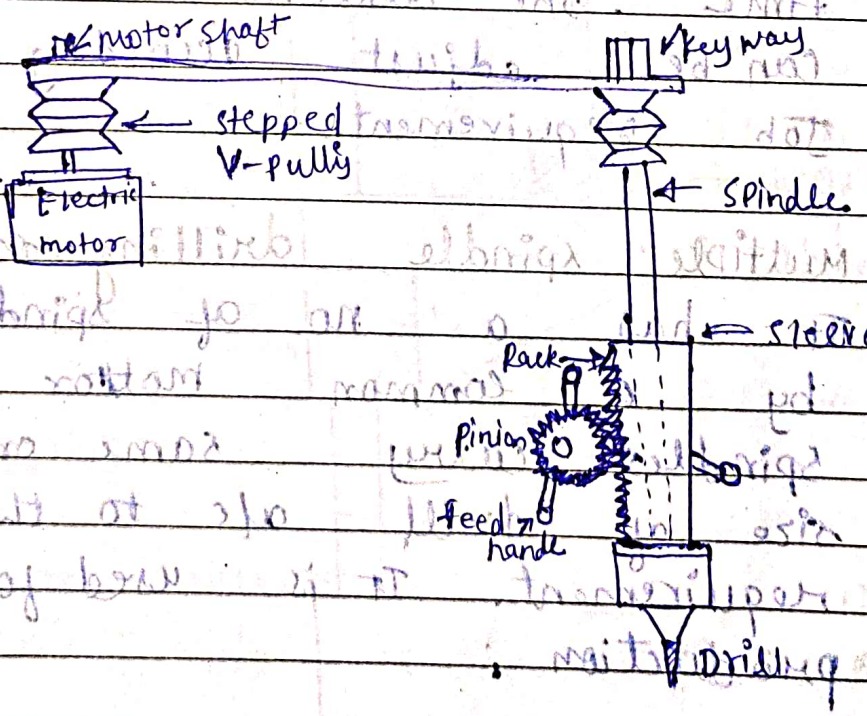
Drilling Machine :-

→ Drilling is the process of machining holes, drilling is generally the simplest and most used method to producing holes. It is done with the help of multi point cutting tool called drill. The drill is the cylindrical bar with helical flute, and radial cutting edge at one end. The machine employed for drill holes are called drilling machine. The drilling machine is single purpose machine for production of holes.



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Classification of drilling machine :-

(1) Portable drilling machine :- (18mm)
It is small drilling machine designed to drill ~~for~~ small holes upto 18mm holes. It is light in weight & can be taken as one to another place.

(2) Gang drilling m/c (2-6) :-
It is a kind of multiple drilling spindle machine in which two to six (2-6) spindle of same or diff. size are arranged in a row. This machine is designed to produce a no. of holes at same time. The distance b/w the spindle can be adjust according to the job requirement.

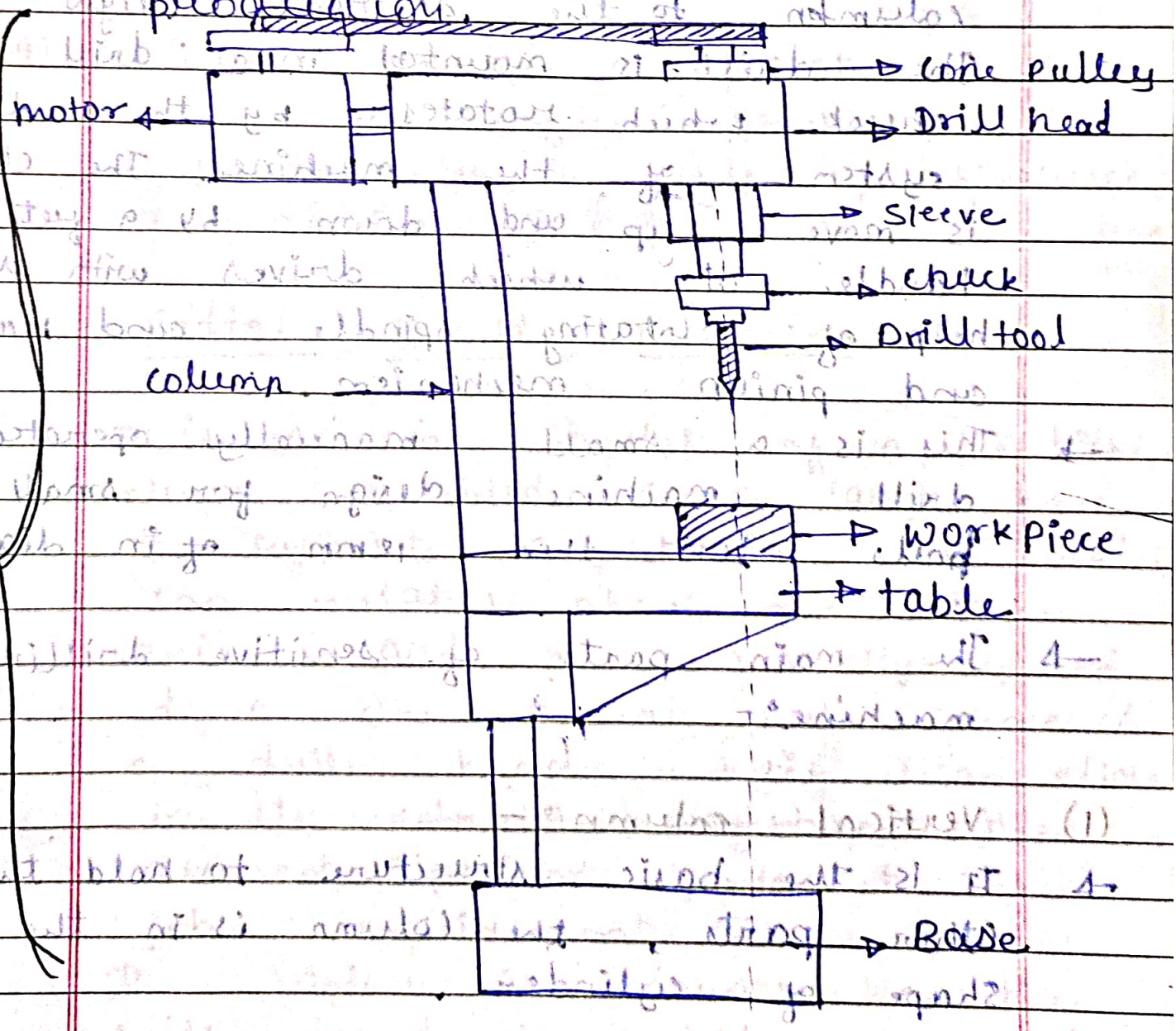
(3) Multiple spindle drilling machine :-
It has a no. of spindle drilled by a common motor all the spindles carry same or diff. size of drill a/c to the job requirement. It is used for mass production.

(4) CNC ~~lathe:~~ Drilling m/c :-

In this machine the work table movement and spindle rotation are programmed with the help of computer numerical control system. This machine is suitable for prototyping and batch production.

Imp

Sensitive drilling machine



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Sensitive drilling machine :-

→ This machine is mounted and clamp on a bench. The work piece can be held on table or on the base with the help of T-slot. The work table can be move up and down along the vertical column to the desired height. The drill is mounted in a drill chuck which rotates by the drive system of the machine. The chuck is move up and down by a feet handle at which drives with the help of rotating spindle and rack and pinion mechanism.

→ This is a small manually operated drill machine design for small holls less then 12mm ~~of~~ in diamet

→ The main parts of sensitive drilling machine :-

(1) Vertical column :-

→ It is the basic structure to hold the other parts, the column is in the shape of cylinder.

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2) Drilling Head:- It has a box type structure. It houses the Power drive and gear box mechanism for changing the speed and feed.

(3) Spindle:- It coats and provide rotoring motion and feedom motion to the drill i.e. spindle.

(4) Table:- It has a T-slot on the top surface where the saw is fixed with the help of fixtures or machine vice.

Radial × Drill × machine :-

This machine consist of a vertical column mounted on a large base. It supports a radial arm which can rotates about the column axis and move vertically up and down. The radial arm carries a drill head which can slide in its ~~drid~~ guide ~~ways~~ base to the desired position as to the job requirement.

The motor is mounted on the drill head to rotates the drill spindle. A feed lever on the drill

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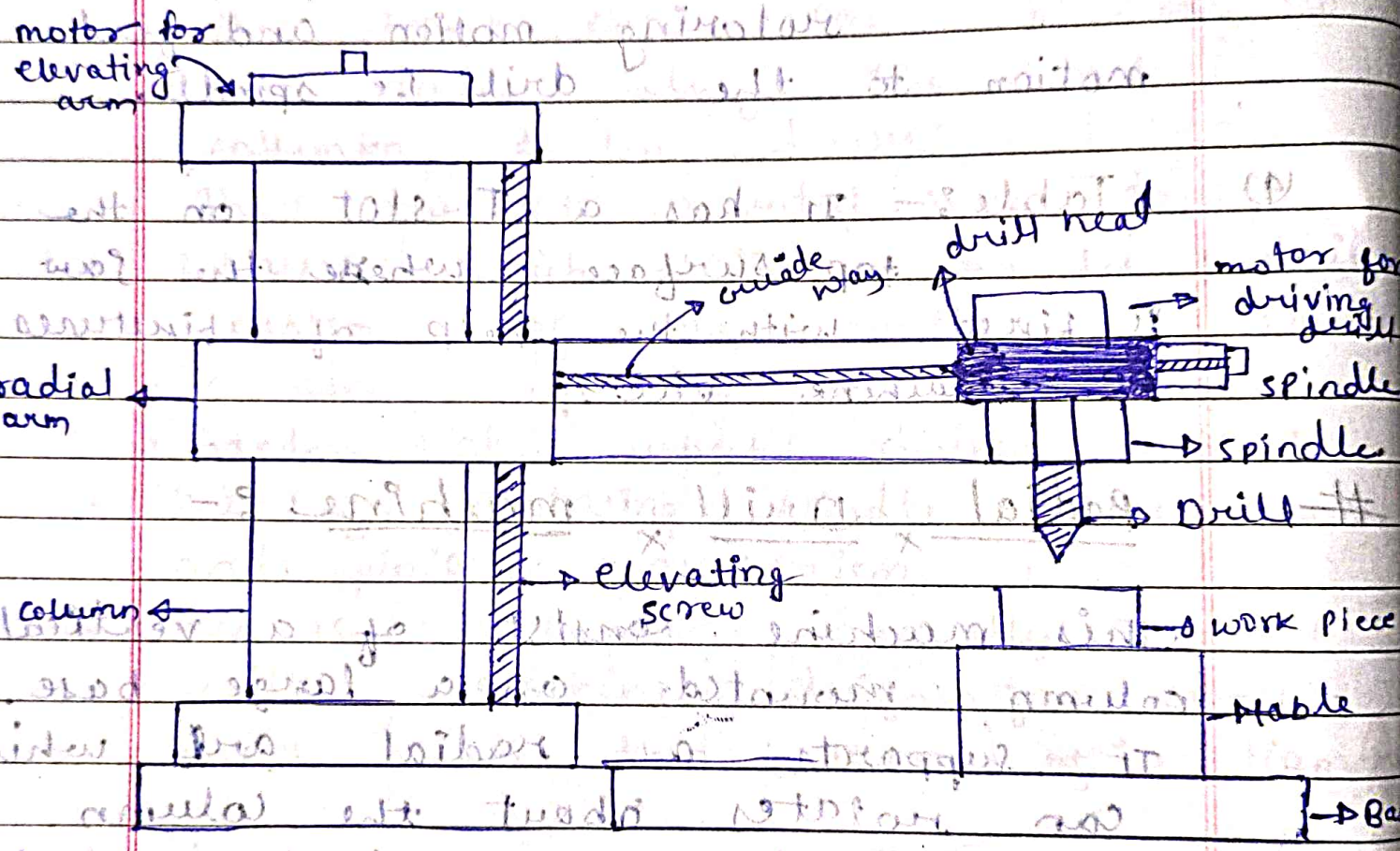
→ The radial, vertical and rotation movement of the drilling head helps the drill spindle to any location at any desired point on the jaw.



#

1) Drilling → छेद करना (MPCT)
2) Boring → छेद बड़ा करना (SPCT)
3) Reaming → finishing देना (MPCT)
4) Counter Boring → Perticular साइज में छेद बड़ा करना
5) counter shinking → conical shape में hole बड़ा करते है।
6) Tapping → creating internal holes etc threads
7) Trepanning → for creating large holes.

↓ rotation ○ cutting material

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Casting / Metal casting / sand casting :-

(1) Flask / Moulding box :- A frame made of metal, wood or plastic in which the mould is repaire the lower holding flask is known as drag and upper moulding flask is known as cope. For large casting a intermediate section is also used is known as check. This is known as three piece moulding

(2) Pattern :- The replica of the object ~~is the~~ to be cast is known as pattern. The cavity in the mould is created with the help of pattern

(3) Parting line: It is a imaginary line which devides the two moulding boxes i.e cope & drag.

(4) Moulding sand: The sand which is used for making mould is known as moulding sand. It is a mixture of silica sand, clay and moisture in suitable proportion.

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(5) Facing sand:- In order to give a better surface finish to the casting a fine sand is used which is usually strinkled on the surface of the cavity.

(6) Core:- The part of mould made of sand used to create hollow section in the casting.

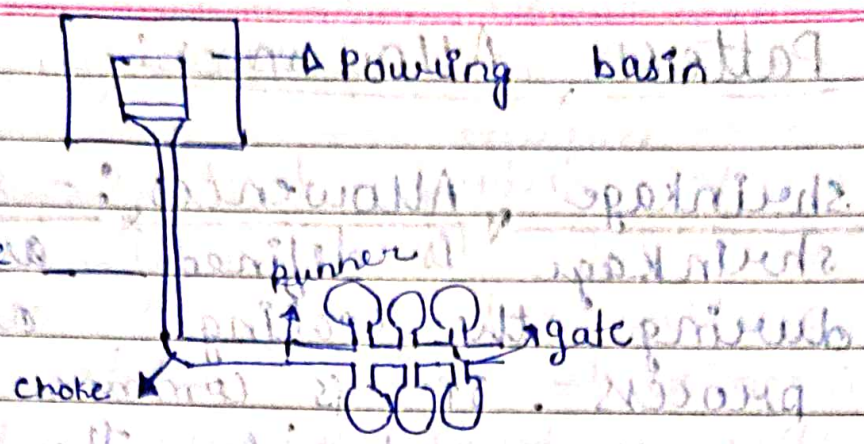
(7) Pouring Basin:- A funnel shaped cavity at the top of the mould into which the moulten metal is poured.

(8) Sprue:- The passage through which the molten metal flow from the pouring basin and reach the mould cavity. It controls the flow of metal into the mould.

(9) Runner:- A channel through which the molten metal enters the mould cavity.

(10) Gate:- A passage through which a molten metal enters the mould cavity.

similar working



(11) Chaplets:- Chaplets are used to support the pour inside the mould cavity. The chaplets also helps to prevent the core against buckling.

(12) Riser:- The shape of riser is same as sprue which is placed after the casting which is going to the solidify. The purpose of providing riser is to take care of the shrinkage of the solidify metal.

(13) Vents: Small openings in the mould is provided so that the air and gases release from the mould cavity.

(14) Drag:- The bottom half of the horizontal parted mould box & cope is known as Drag and the upper portion is known as cope.

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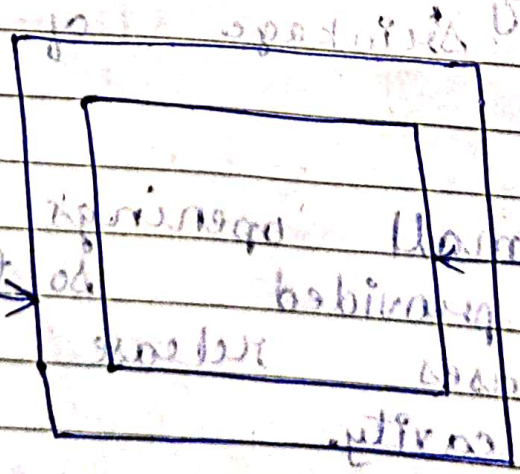
Pattern Allowances :-

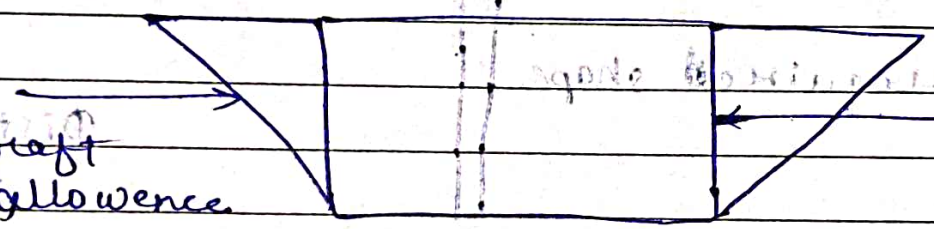
(1) Shrinkage Allowences :-

Shrinkage is defined as the reduction during the cooling, or solidification process. It is common property of all material. The magnitude of shrinkage is measured in terms of mm/m (millimeter per meter) for avoiding shrinkage the pattern is made larger than the required size of the casting product with the help of shrink rule. The difference b/w actual size of pattern and the required size of casting is known as shrinkage allowence.



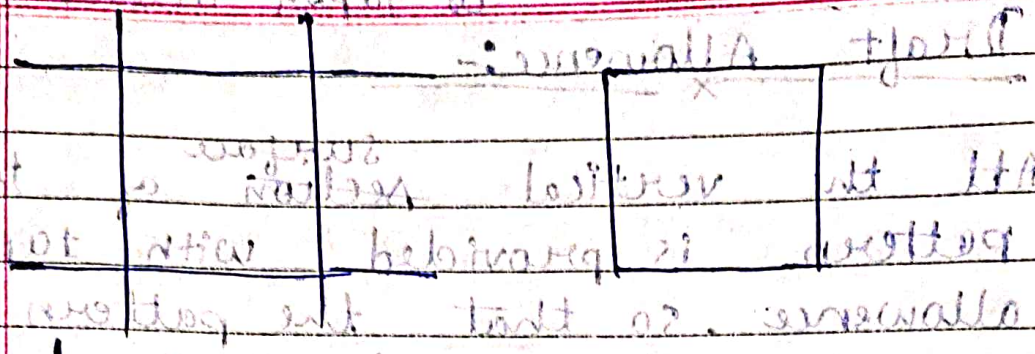
Draft Allowence :- or Taper allowance

All the vertical ~~section~~ surface of the pattern is provided with tapper allowence. so that the pattern can remove easily and ~~shaking~~ safely from the moulding sand without tearing of the sides of mould. This taper ~~is~~ allowence is also known as draft allowance



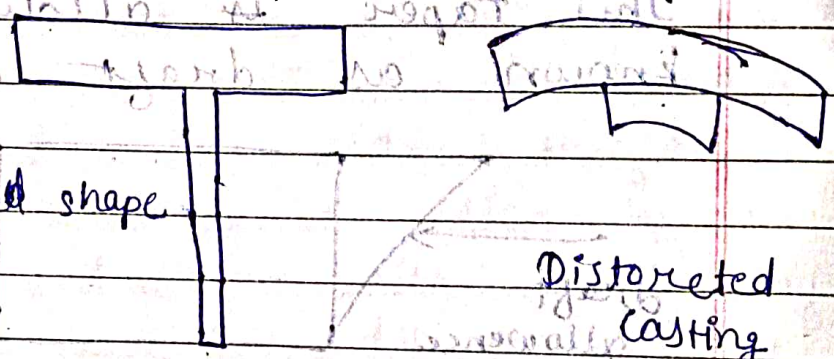
Machining Allowence :- or finishing allowance

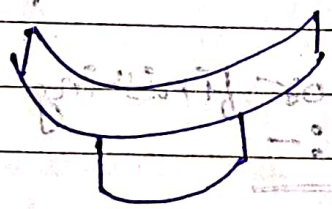
This allowence provided on the pattern to take care of dimesional accurency and surface finish of the end product, is known as machining or finishing allowence. Generally sand casting provides poor ~~fine~~ surface finish. In order to achieve a desired surface finish, the casting need to be maching



before machining After machining

(4) Distortion Allowance:-





The distortion in casting takes place due to its complex cambered shape for example pattern. If the casting has the form of letter U, V, T, L, I. It bends from the end side due to the internal stresses or the thermal stresses developed into the mould during the solidification to prevent that bending the pattern is made opposite to the distorted face.

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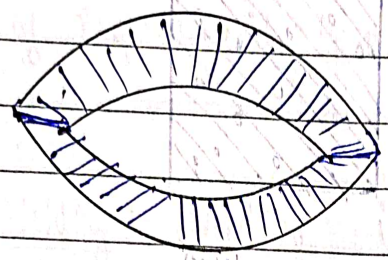
Casting Defects :-

(1) Shift or mismatch



circular requirment

This defect takes place due to mis alignment of upper & lower part of casting and due to misplacement of core.

(2) Swell :-

It is the enlargement of mould cavity because of the moulten metal pressure which results and overall enlargement of casting.

(3) Blowholes :-

When gases extract on the surface of casting due to solidification a rounded or oval cavity is formed which known as Blowholes. These defects are always present

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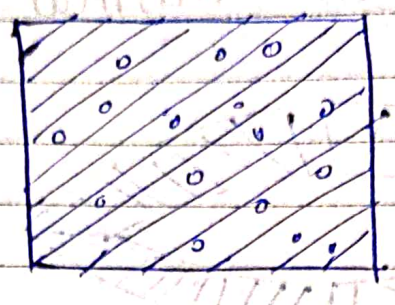
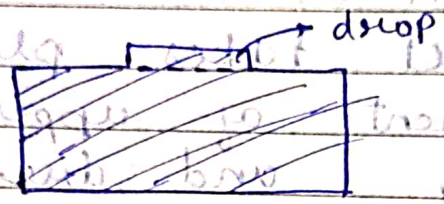
in the cope part (upper part) of the mould.

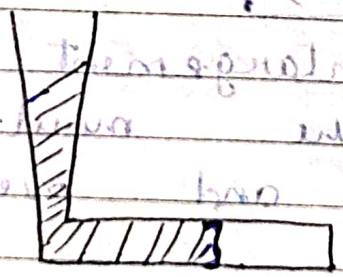


(4) Drop:-



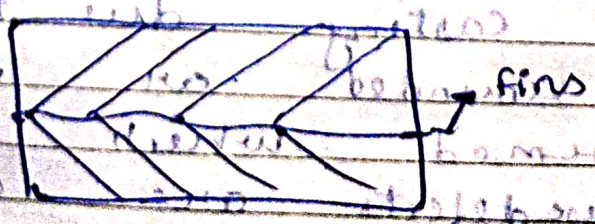
This defect takes place when the cracking of upper surface of the mould and the sand peices fall into the molten metal.

(5) Misrun:-



When the molten metal solidify before completely filling the mould cavity and leaves a space in the mould is called misrun.

(6) Fins:-



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A thin projection of metal which is not considered as a part of casting is known as fins. It is usually ~~happen~~ occurs at the parting section of the mould box.

Welding :- Welding is the process by which two similar or dissimilar metal pieces are joine together by the application of heat with or without external pressure and addition of filler material. Welding is mainly used for metal and their alloys. In this process we heat material about its melting point and allow it for solidify to make a permanent joint.

(1) Arc welding :- The principle of arc welding consist of establising and electric arc b/w a metal electrode and the work piece to be welded. Arc welding is type of welding process using an electric arc to create heat to melt and to joine the ~~the~~ base material.

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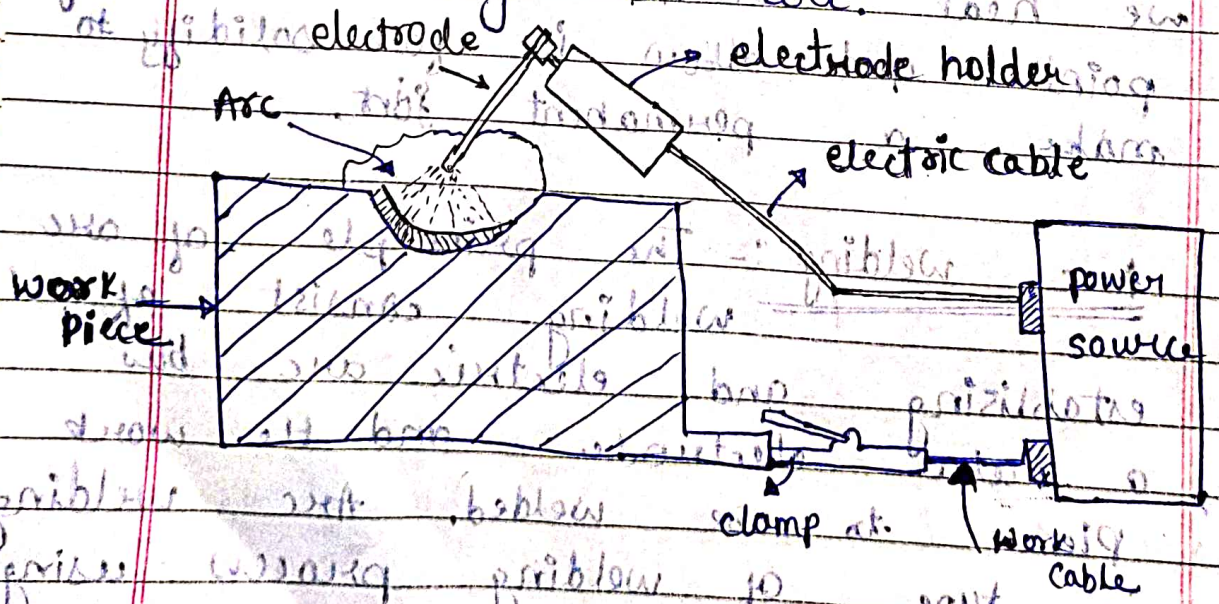
A power supply is provided in form of AC or DC current. By AC supply a step down transformer is used which reduce the main supply voltage from (220 - 440V) to (80 - 100V) which is required for producing the arc and (30-40V) are required for maintaining the arc. The DC supply is made by means of a generator driven by either by an electric motor or an IC engine. The voltage required for creating are (60-80V) and (15-25V) for maintaining the arc.



Arc Welding

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Advantages of Arc welding :-

Lowest cost joining method as compare to other welding processes.

It Joint all comercial metal.

Now a days lighter weight machines are available.

Disadvantages:-

Defects are hard to detect at joints.

It need high energy consumption.

for welding process we need skilled workers.

Cylinders of (oxygen + acetelene)

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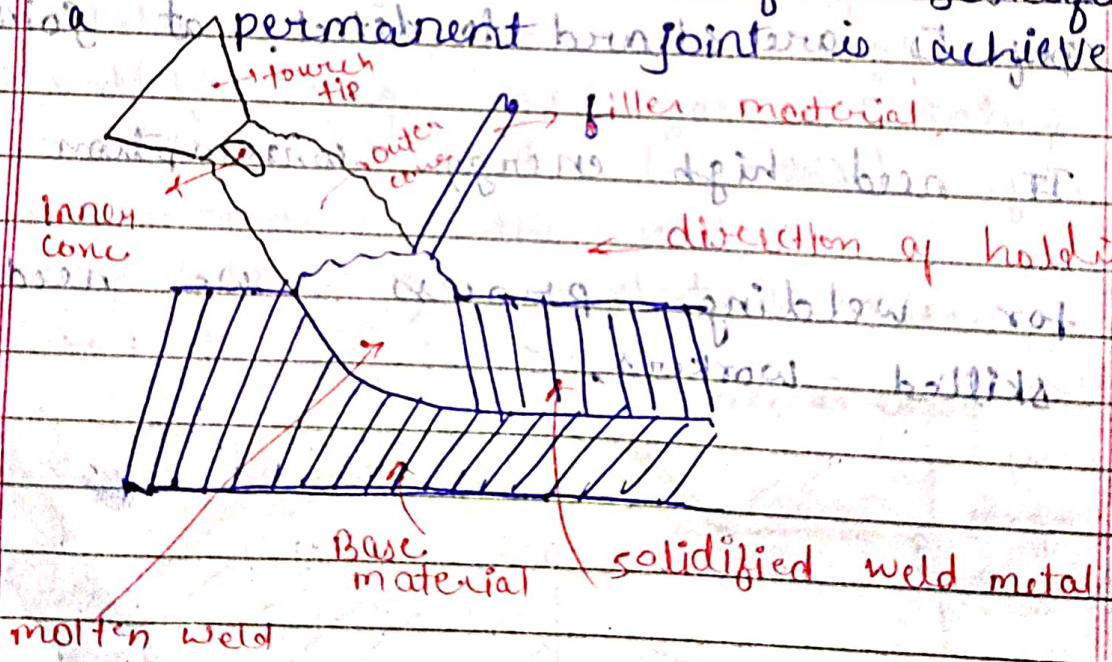
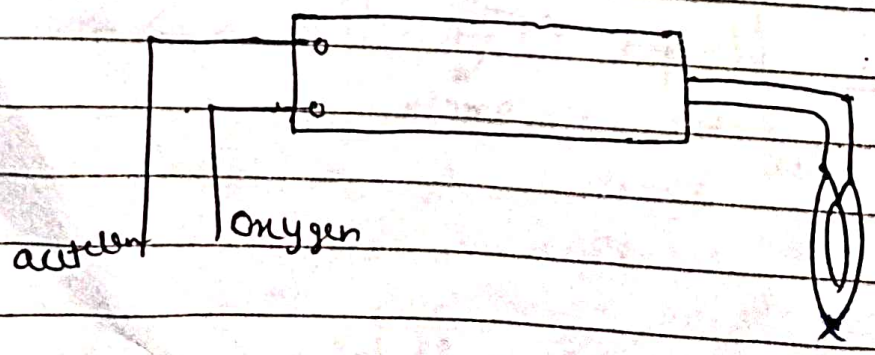
(2) Gas welding :-

→ When the acetelene is mixed with oxygen in appropriate proportion. In a welding torch at a tip of the torch a flame is generated.

→ The flame resulting at the tip of the torch is sufficiently heat the base material and melt the filler material. After solidification a permanent bond joint is achieved.





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→ Advantages of gas welding :-

→ Cost and maintanance of welding equipment is lower as compare to other welding processes.

→ The gas flames temp. can be controlled with the help of regulators mounted on cylinder and welding torch.

→ Equipments are more portable then other welding process.

→ It can be also used as gas cutting

→ Disadvantages.

→ Oxygen and Acytiylene cyli gases are expensive.

→ It provides low Surface finish and the joining rate is very slow.

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Gas welding Flame & its types.

In gas welding the flame produced by mixing a flameable gas (acet) and oxygen in the nozel or tip of blow pipe is called flame.

There are three basic types of gas welding flame.

(1) Neutral flame
(2) carburizing flame (access acetylene)
(3) oxidizing flame (access oxygen)

(1) Neutral flame:-

→ The neutral flame is made by mixing both oxygen and acetylene in equal quantity. its temp. is around 3200°C it is also known as balanced flame.

There are two regions of this flame.

→ First one is inner cone.
→ second one is outer envelop.

→ The inner zone is white in colour and a temp. range is (3100°C - 3500°C)

→ And outer zone is blue in colour and temp. rang. is (1275°C - 1400°C)

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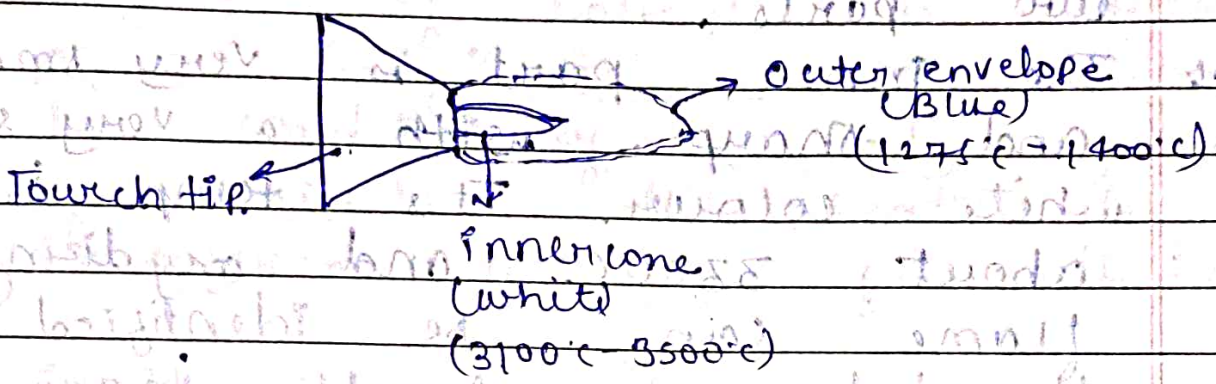
This flame is used for welding mildsteel, cast iron, stenless steel, copper and alluminium.



(2) Carburizing flame (access acetylene)

→ The amount of acetylene in this flame is high. It has three parts.

① inner zone and it also has the middil part
② which is called intermediate zone and
③ last part of the outer zone.

In this flame the inner zone white in colour.

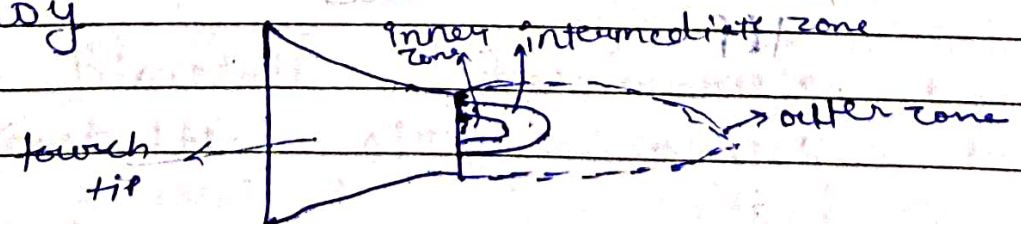
Intermediate → Red.

Outer → Blue.

The temp of flame is 3100°c

It is also known as reducing flame

It is used for welding high carbon, steel, Alluminium and alloy



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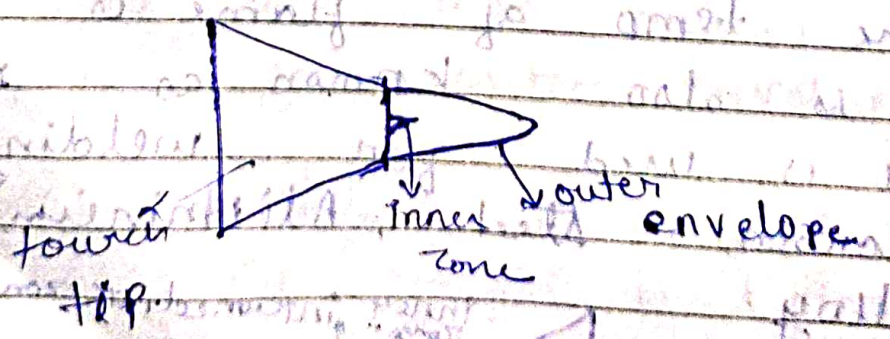
(3) Oxidizing flame :-

→ In this flame the amount of oxygen is higher. It consist of two parts.

→ The inner part is very small and sharp with a very shiny white colour. Its temp is about 3300°C and oxydizing flame can be identified with the help of small inner cone which is more pointed as compare to neutral flame.

→ The outer flame envalope is also small but hotter than neutral flame.

→ Due to the access amount of oxygen the temp become higher. Hence, this flame is not suitable for welding of steel. This flame is used for welding of copper and cast iron.



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Temperature measurement :-

~~(1) Liquid~~

Temperature can be defined as the degree of hotness or coldness of a body. It is also define as the condition of a body by action of which the heat is transferred to or from the bodies

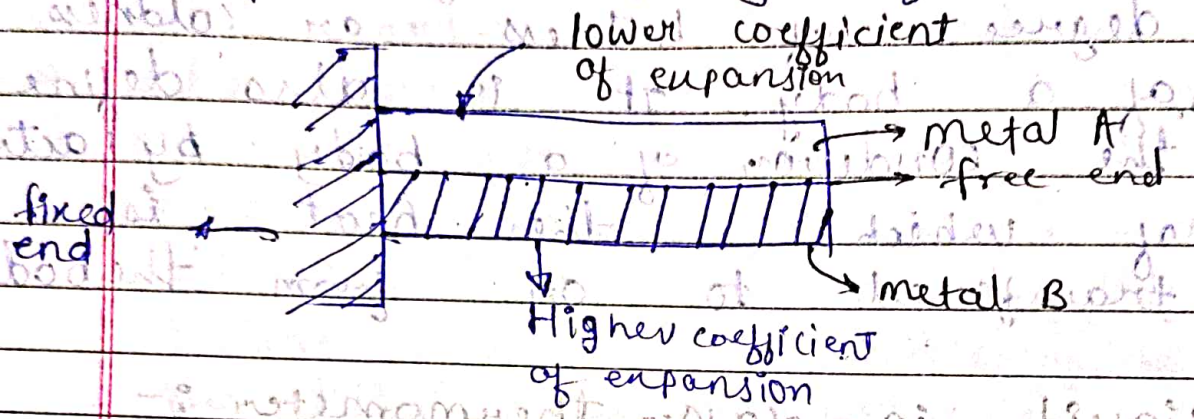
(1) Liquid in-glass-thermometer :-

It consist of a liquid filled glass bulb at the lower end connected to a capillary tube when the glass bulb is placed in contact with the body for which the temp is to be measured for the differential expension b/w the glass and the liquid results the liquid to rise in the capillary tube. The level of liquid on the calibrated scale indicates the temp. of body.

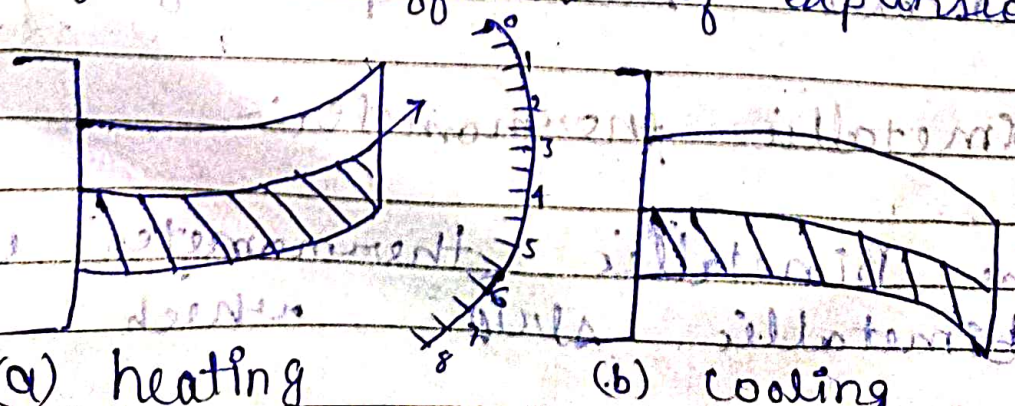
(2) Bimetallic thermometer :-

The Bimetallic thermometer use the bimetallic strip which converts

the temp. into mechanical displacem
The working of bimetallic strip depends on thermal expension property of metal.



In Bimetallic thermometer the bimetal strip is constructed by bonding of two thin strips of diff metal. The metals are joint together by welding or riveting process to form a cantilever beam. When the temp increases the ~~straight~~ strip bends towards the metal A which has lower coefficient of expansion.
When the temp decreases the strip bend towards metal B which has higher coefficient of expansion



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* Advantages of Bimetallic thermometer:

→ Thermometer is simple in construction and less expensive.

→

* Disadvantage:-

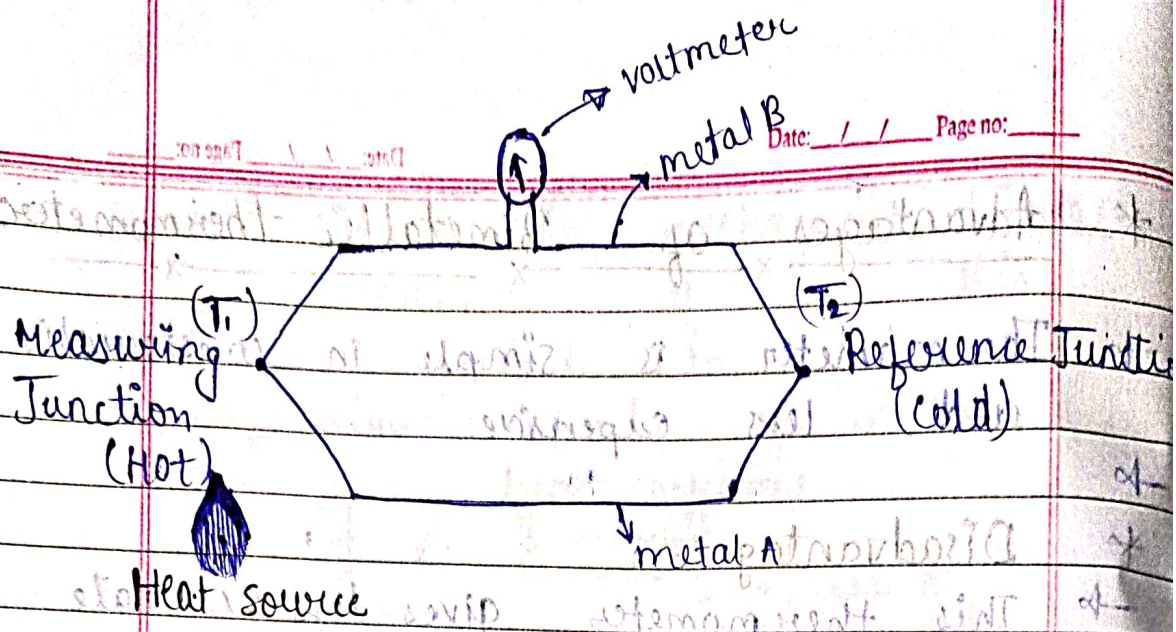
→ This thermometer gives less accurate results while measuring low temp.

* Application :-

→ The bimetallic therm is used in household devices like oven, air conditioner and in industrial apparatus like hot wires, heaters, and refinaries for the purpose of temp. measurement.

(3) Thermocouple :-

Thermocouples are the temp. sensors which are extensively used for measurement of temp. variation. It works on C-beck effect which states that when any two diff. metals connected together and electromagnetic force i.e EMF which is a function of temp ~~which~~ generated at the junction b/w the metals.



A thermocouple consist of two wire each made of diff. metal or alloy, the wires are joint at one end to form a measuring Junction and another end of wire form a reference wire which is maintain at some constant temp. such as 0°C. when The two junctions are at diff. temp. The current flow through the circuit and the voltage is calculated with the help of a voltmeter. The results are in millivolts (mV) by which the temp. of measuring junction is determined.

★ Advantages:-

- It is an active transducer it operates without any external source.
- The measurement of wide range temp. -200°C to 2800°C is possible

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- The response time is fast which can measure fast changing temp.
- The cost of thermocouple is low as compare to other instrument.

Disadvantages:-

- The output voltage produced is low due to negnatei field changes of error in output voltage.
- Accuracy is low as compare to other instruments.

Applications:-

- It can be used for measuring voltang and current.
- It is also used for measurement of vaicum pressure and thermal conductivity.

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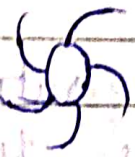
→ Hydrolic Machines

- → Turbine → Hydraulic → mechanical → electric en
- → Pump → electric energy → mechanical → Hydr en

→ ① Turbine (water turbine)

- → Pelton wheel tu
- → Francis tu
- → Kaplan tu



← water supply

Hydrolic machines are defined as the machines which converts either Hydraulic energy into mechanical energy or mechanical energy into,

→ Hydralic ~~mo~~machines which converts hydralic energy into mechanical energy,

→ On other hand machines which convert mechanical energy into hydraulic energy are called pump

→ Turbines:-

→ Classification of Turbine

① A/c to the head at the inlet of turbine take:- (i) <u>high head turbine</u>:- These turbines work under head more then 250m

ex:- pentan wheel

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(ii) medium head turbine
The turbines which work under the ~~work~~ head of 45m to 250m.
ex:- France's turbine

(iii) Low head turbine:-
Turbines which work under the head of less then 45m.
ex:- kaplan turbine

(2) classification to the type of energy at inlet

(a) impulse turbine:
If the runner of turbine rotates by the impact or impulse action of water is known as impulse turbine

(b) reaction turbine:-
These turbine works to reaction of pressure diff of inlet or outlet of the runner.

(3) A/c to the direction of flow of water:

(a) Tangential flow:- when the flow is tangential to the wheel circle. it is known as tangential flow turbine

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ex:- Pelton wheel.

(b) Radial flow:-

In a radial flow turbine the flow is radial w.r.t. to runner or we can say that the path of flow of water remains in radial direction and in a plane normal to the runner shaft.

Nowdays these turbines are not use.

(c) Axial flow turbine:-

When the path of flow of water remains parallel to the axis of the shaft is known as Axial.

ex:- Kaplan turbine

(d) Mixed flow turbine:-

When there is a gradual change of flow from radial to axial in a runner the flow is called mixed flow.

ex:- Francis turbine.

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④ A/c to the specific speed of turbine :-

ⓐ Low spesific speed turbine:-

The turbine which works in the range of 10 - 50 is known as low ---

ex:- Pelton wheel.

ⓑ Medium specific speed turbine :-

50 - 350

ex:- Francis turbine

ⓒ High specific speed turbine:-

250 - 850

ex:- Kaplan turbine.

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★ Strain gauge:- When a material is subject to a load it get deform then the strain is produce. By measuring this strain force or torque is produce in system is estimated. A strain gauge is used for measuring strain. A strain gauge is a sensor that translate force, pressure, tension, & weight into a change in electrical resistance which works on the principle of electrical conductance which is dependent on the conductance geomently. whenever the conductor is stretched with the elastic limit it will become thin & longer.

→ Similarly, when it is compressed it gets thick and shorter.

→ Hence ultimately we observe change in resistance.

→ The strain gauge is employed with circuit using potentiometer or whetestone bridge network for other ~~not~~ use.

★ Advantages.

→ There is no moving parts.

→ These are cheap and inexpensive.

→ As they are small in size.

→ Hence they are easily handled.

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* Disadvantages:-

→ It required regular calibration in order to use and to take proper reading.

* Load cell:-

→ A load cell is a type of force transbuiser or force sensor.

→ It convert force applied on the load cell such as tension compression or pressure. Into an electrical signal.

→ The stregth of ~~str~~ signal is directly proportional to force applied.

→ A strain gauge load cell is the ~~to~~ most commonly used in industrial application.

* Uses:- (Application)

→ It is used for load transportation vehicle.

→ For monetry the crane load.

→ To draw bar and tool force for dynamometer.

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* Properties of fluid :-

① Density :-

$$\rho = \frac{\text{mass of fluid}}{\text{Volume of fluid}} = \frac{m}{V} \quad (kg/m^3)$$

② weight density :-

$$W = \frac{\text{weight of fluid}}{\text{Volume of fluid}} = \frac{w}{V} = \frac{Mg}{V}$$

$$= \rho g$$

m = mass of fluid

g = gravity = 9.81 m/s

(N/m^3)

③ Specific gravity :-

$$S = \frac{\text{density of fluid}}{\text{density of std. fluid}} = \frac{\rho_{fluid}}{\rho_{std.\,fluid}}$$

(It is dimensionless quantity)

Density of water = 1000 kg/m³

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(4) Specific volume :-

$$v = \frac{\text{volume of fluid}}{\text{mass of fluid}} = \frac{V}{m} = \frac{1}{\rho}$$

(m^3/kg)

(5) Viscosity :-

$$\text{viscosity } (\mu) = \frac{\tau}{du/dy} \quad (\text{Poise})$$

1 poise = 1000 centipoise

$1\ N\text{-}s/m^2 = 10$ poise

(6) Kinematic viscosity (ν)

$$\nu = \frac{\text{dynamic viscosity}}{\text{density of fluid}} = \frac{\mu}{\rho}$$

(m^2/sec)

$(cm^2/sec \rightarrow 1 \text{ stoke})$

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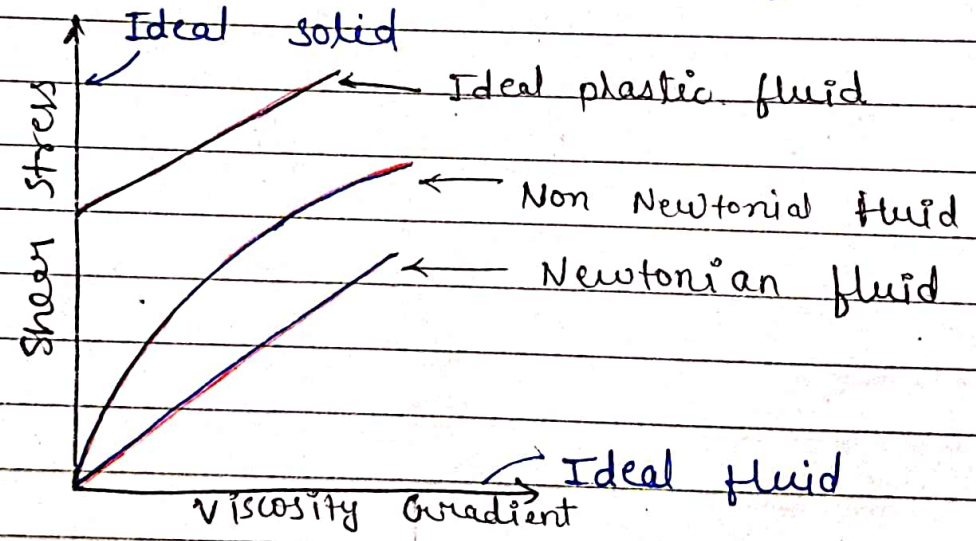
Type of fluids

(1) Ideal fluid:-

It has no properties other then its density such type of fluids is theoritical fluid and does not exist in nature.

These fluids are based on asumpsion for simplification of calculati or we can say that the fluid which is having zero viscosity is known as Ideal fluid.



(2) Real fluid:-

All fluids are real fluids they have viscosity surface tension compressivility & density or we can say that

The fluid which has some viscosity is known as real fluid.

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Newtonian fluid:-

The fluid which obeys Newton's law of viscosity is known as newtonian fluid.

If for a fluid the shear stress is directly proportional to the rate of shear strain then such fluids are known as Newtonial fluids.

$$\boxed{\tau = \mu \, du/dy} \qquad \boxed{\mu = \frac{\tau}{du/dy}}$$

Non-Newtonian fluid:-

The fluid which does not obey Newton law of viscosity is known as Non-Newtonial fluid.

Ideal plastic fluid:-

A fluid in which shear stress is more then the yeild value and the shear stress is directly pro. to the rate of shear strain is known as ideal plastic fluid

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Numericals

Q.1 (2l) (1 litre = 10^{-3} m^3)

Two litre of petrol weight 14 N. Calculate the weight density, Mass density, specific valume, and specific gravity of petrol with respect to water.

Given :-

Quantity = 2 litre

weight = 14 N

Weight density = $\frac{\text{weight of fluid}}{\text{volume of f}}$

$= \frac{14\ N}{2\ m} = \frac{14\ N}{2 \times 10^{-3}\ m^3} \Rightarrow 7000\ N/m^3$

Mass density = $\frac{\text{mass of fl}}{\text{volun. of f.}}$

~~= 714 kg/m³~~

$M = \frac{14}{9.81} = 1.428 \Rightarrow \frac{1.428}{2 \times 10^{-3}} = 714\ kg/m^3$

Specific valume = $\frac{1}{\rho} = \frac{1}{714} = 1.42 \times 10^{-3}\ m^3/kg$

Specific gravity = $\frac{\rho_{petrol}}{\rho_{water}} = \frac{714}{1000} = 0.714$

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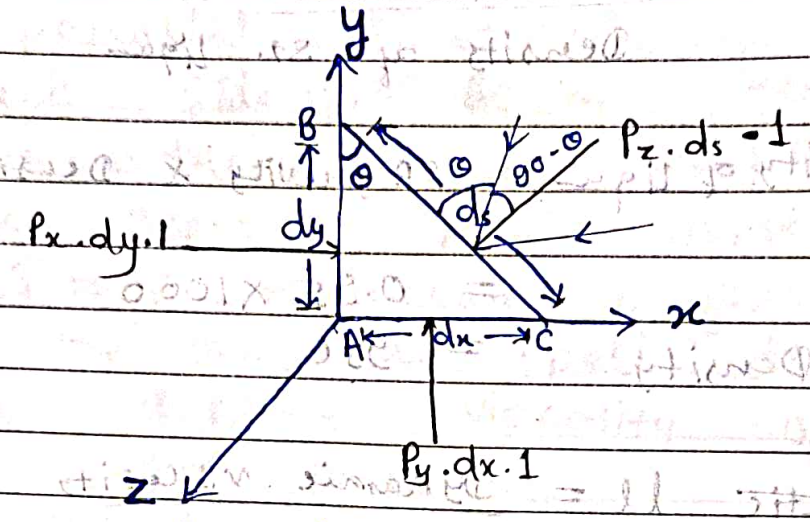
Pascal's law :-



→ The pascals law states that the pressure at a point at rest is same in all direction.

→ In other words, A pressure applied at a point in a fluid at rest is equally transmitted in all direction and to every other point in the fluid.

→ Consider an arbitrary wedge shape element of a fluid at rest let the ~~bre~~ width of the element be unity and P_x, P_y & P_z be the intensity of pressury acting on face AB, AC & BC respectively. Also let θ be the angle of the wedge shaped element of liquid i.e.

$\angle ABC = \theta$

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As the fluid is at rest therefore, there will be no shear stress the only force acting on the element are the pressure forces normal to the surfaces and self weight of element in vertical direction

Pressure on Face AB = $P_x . dy . 1$

— " — BC = $P_z . ds . 1$

— " — AC = $P_y . dx . 1$

Let the weight of liquid is = 'W'

$= \rho g$

$= \frac{1}{2} AC \times AB \times \rho g$

Total ~~to~~ weight 'W' $= \frac{1}{2} dx\, dy . \rho g$

→ Now resolving the forces in horizontal direction.

$P_x dy . 1 = P_z . ds . 1 \sin(90 - \theta)$

$P_x . dy = P_z ds . \cos\theta$

ΔABC, $\angle B = \theta$

$\cos\theta = \frac{AB}{BC} = \frac{dy}{ds}$

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$$P_x \cdot dy = P_z \cdot ds \cdot \frac{dy}{ds}$$

$$\boxed{P_x = P_z} \quad \text{—— (1)}$$

→ Now resolving the forces in a vertical direction.

$$P_y \cdot dx \cdot 1 = P_z \, ds \cdot 1 \cos(90 + \theta) + W$$

$$P_y \cdot dx = P_z \cdot ds \cdot \sin\theta + W$$

ΔABC, $\angle B = \theta$

$$\sin\theta = \frac{AC}{BC} = \frac{dx}{ds}$$

$$P_y \cdot dx = P_z \cdot ds \cdot \frac{dx}{ds} + W$$

as the weight of element is very small hence it is neglected so,

$$P_y \cdot dx = P_z \, dx$$

$$\boxed{P_y = P_z} \quad \text{—— (2)}$$

from eqn (1) & (2)

$$\boxed{P_x = P_y = P_z}$$

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Hence, the pressure at any point is equal or same in all direction.

Bearnoulli's equation for incompressible fluid

$$\boxed{\frac{p}{\rho g} + \frac{V^2}{2g} + z = \text{constant}}$$

Bearnoulli's eqn states that, "In an incompressible fluid when the flow is steady & continue the sum of pressure energy, potential energy & kinetic energy is constant at every section. Since in incompressible fluid flow there is no change in temp. Hence, internal energy is not consider

→ The following assumptions ~~are~~ - ~~preconsidered~~ have been considered for Bearnoulli's eqn.

(1) Flow is steady :-
At a given point there is no change in fluid ~~ste~~ properties w.r.to. time.

(2). Fluid is ideal :-
It does not exebit any friction

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effect due to fluid viscosity.

(3) Flow is incompressible:-
There is no variation in fluid density.

(4) Flow is one dimensional:-
The flow should be along a stream line.

(5) Flow is continuos & uniform velosity.

(6) Only potential energy pressure energy & kinetic energy are considered. No energy in the form of heat & work is either added or subtracted from the fluid.

$$\boxed{\frac{P}{\rho g} + \frac{V^2}{2g} + Z = \text{constant}}$$

Where,

$\frac{P}{\rho g}$, is pressure head

$\frac{V^2}{2g}$, is kinetic head

Z, is potential head or datum head

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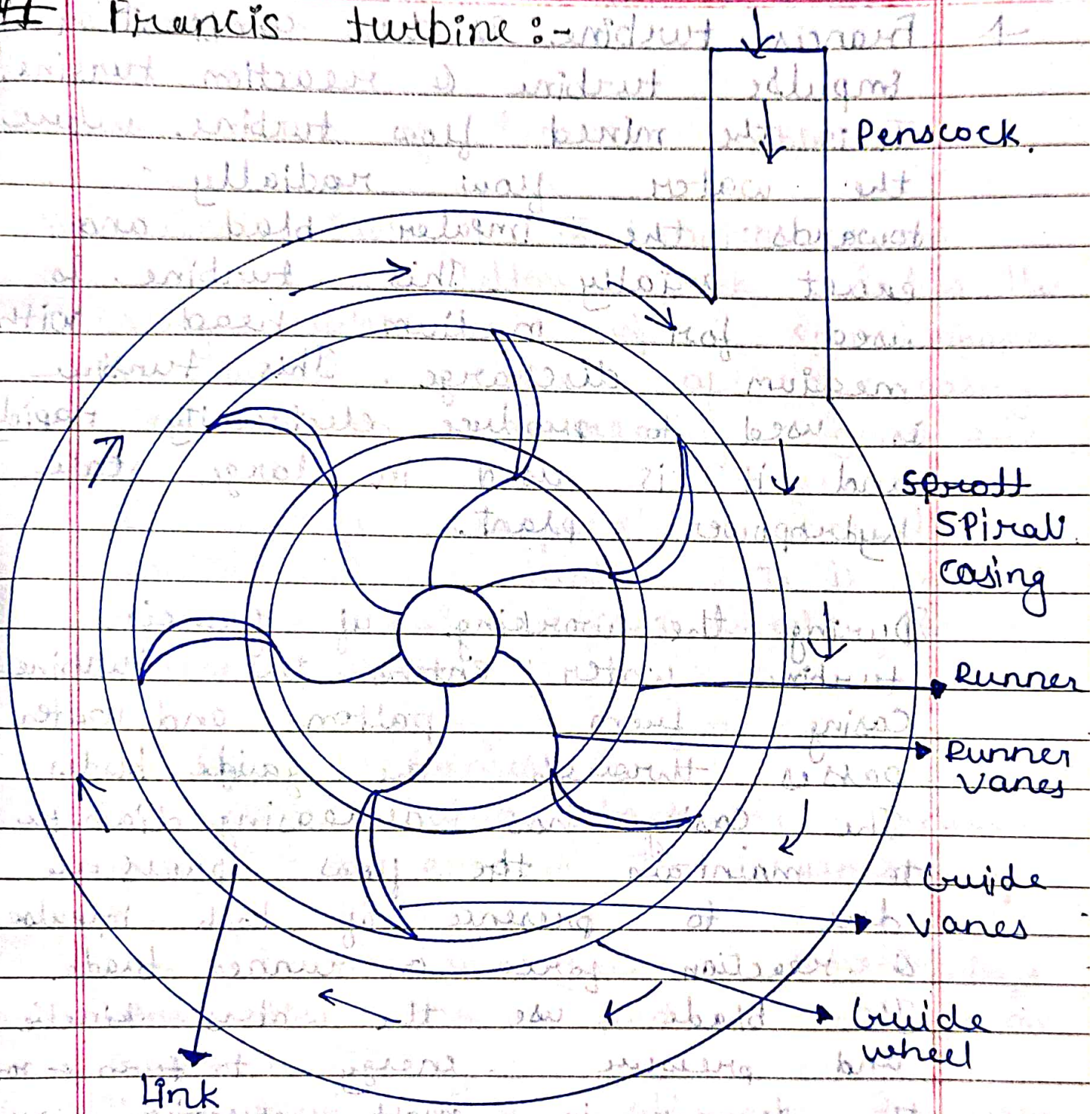
where, $P =$ Pressure $(N m^2)$
$V =$ fluid velocity (N/s)
$g =$ acc^n due to gravity (m/s^2)
$z =$ height of the point above datum (m)
$\rho =$ fluid density (kg/m^3)

Francis turbine :-



* Francis turbine :-

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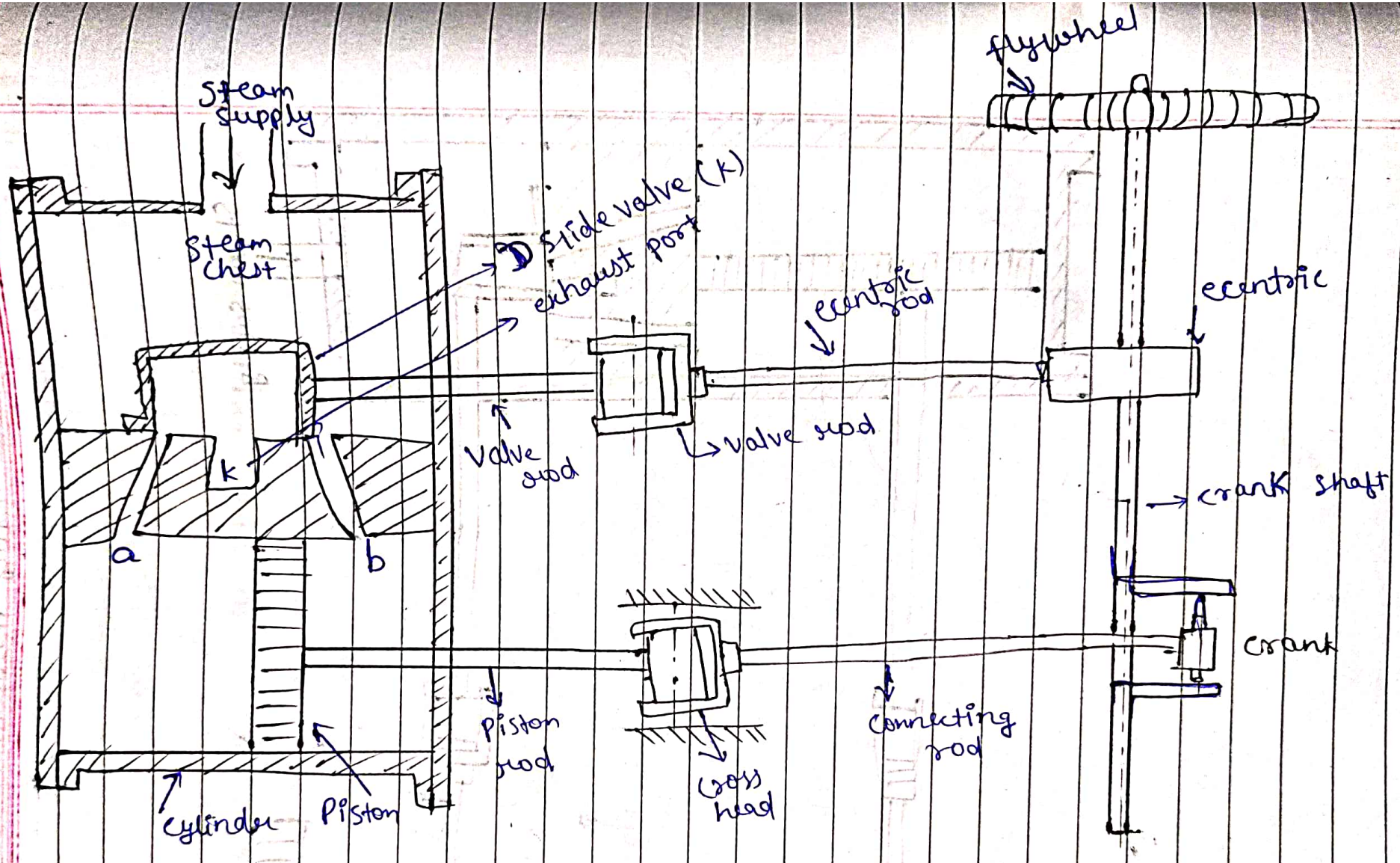
Francis turbine is the combination of impulse turbine & reaction turbine. It is the mixed flow turbine where the water flow radially towards the impuler blad and exact axially. This turbine is used for medium head with medium discharge. This turbine is used to produce electricity rapidly and it is used in large state hydropower plant.

During the working of francis turbine water enters the turbine casing from palton and water passes through the gaide blades. The casing has decreasing diameter to maintain the flow pressure due to presence of both impulse & reaction force on runner blade. The blade use the waters kinetic and pressure energy to turn or rotat the runner in most effective way. When the water strikes the runner blade. It force the runner to rotate which further drives a generator to generat electricity at the end water after striking blades leaves through draft tube



Single cylinder Double acting Horizontal reciprocating steam engine.

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* Working Principle of single cylinder Double acting steam engine:-

In the piston cylinder of arrangement there are two inlet ports a & b the super heated steam from high pressure from boiler enters into the steam chest. If the piston is at inner dead position, the steam enters the cylinder through the port a. and it push the piston towards right side. At this stage the slide valve covers the exhaust port and the steam port b. Since the pressure of steam of is greater on left side then right side as the piston moves to right.

The steam port b get open when the piston reach near to the end of piston the steam port a and exhost port. Now the steam enters into the cylinder through the right side Port b. and it push piston to the left side and at the same time the exhaust steam goes out through the exhaust pipe. and so the cycle of operation get completed and the same process

is repeated in other cycles of operation and the workdone is taken by engine.

* Components of steam engine

(1) Frame:- It is a heavy cast iron part which supports all stationary and moving parts and holds them in proper position.

(2) cylinder:- It is also a cast iron cylindrical hollow part in which piston moves in forward and backward direction under the steam pressure, both ends of cylinder are closed and made steam tight.

(3) Steam chest:- It is casted as an integral part of cylinder and is closed by separate cover. It can be a rectangular or a circular section As to the type of valve used.