

GOVERNMENT POLYTECHNIC, SONEPUR

Engineering Material

Ashish Meher

DEPARTMENT OF MECHANICAL ENGINEERING

Engineering Material



①

21 Monday

INTRODUCTION :-

पौष सुदी/माघ वदी १५/१-२०७५

→ Material science and engineering plays a vital role in this morden age of science and technology. Various kind of materials are used in industry, housing, agriculture transpotation. etc. to meet the plant and individual requirements.

→ The knowlege of materials and their properties is of great importance for a design engineer.

22 Tuesday

माघ वदी २-२०७५

→ A design engineer must be familiar with the effects which the manufacturing process and heat treatment have on the properties of material.

(* The engineering materials are mainly classified as

(i) Metal and their alloys

Example - iron, steel, copper, aluminium etc.

(ii) Non-Metals

Examples - glass, rubber, Plastics etc

Wednesday 23
माघ बदी ३-२०७५

(*) Metals

→ Metals may further be classified as -

(1) Ferrous metals

(ii) Non-Ferrous metals:

① FERROUS METALS

The ferrous metals are those which have the iron as their main constituent

Example - Cast Iron, Wrought Iron

Thursday 24
माघ बदी ४-२०७५

② NON-FERROUS METALS

The non-ferrous metals are those ~~which~~ which have metal other than iron as their main constituent.

Example - Copper, aluminium, brass, tin, zinc

JAN '19

Q7) Properties of Material

25 Friday

माघ बदी ५-२०७५

(i) Physical properties

(ii) Chemical properties

(iii) Mechanical properties.

JAN '19

(i) PHYSICAL PROPERTIES

→ Physical properties are employed to describe the response of a material to imposed stimuli under conditions in which external forces are not concerned.

26 Saturday

माघ बदी ६-२०७५

→ Physical properties include.

(i) Dimensions (vii) Structure.

(ii) Appearance

27 Sunday

माघ बदी ७-२०७५

(iv) Density

(v) Melting point

(vi) Porosity

① Appearance

⇒ Metal themselves have different appearance.

Monday 28
माघ बदी ८-२०७५

Example - Aluminium is a silvery white metal where as copper appears brownish red

⇒ Appearance include lusture, colour, and finishing of a material.

⇒ Lusture is the ability of a material to reflect light when finely polished. It is the brightness of a surface.

Tuesday 29
माघ बदी ९-२०७५

② Colour

⇒ The colour of the material is very helpful in a identification of a metal. The colour of a metal depends upon the wavelength of the light that the material can absorb

JAN:19

③ Dimensions

30 Wednesday

माघ बदी १०-२०७५

Dimension of a material implies

its size (Length, breadth, width, diameters) and shape (square, circle, channel, angle section etc.)

④ Density

→ The density is the weight of unit volume of a material expressed in metric units.

31 Thursday

माघ बदी ११-२०७५

$$\text{Density} = \frac{\text{mass}}{\text{unit volume}}$$

→ Density depends to some extent on the

(i) Purity of material

(ii) Pours volume

(iii) Treatment, the material has received

→ Density helps differentiating between light and heavy metals even if they have same

size and any other outer ~~protecting~~
protective coating.

Friday 01
माघ बदी १२-२०७५

(5) Melting Point

→ Melting point of a ~~metals~~ materials is that temperature at which the solid metals changed in to ~~molten~~ Molten state.

→ One metal can be distinguished from the other on the basis of its melting point.

(6) Porosity

→ A metal is said to be porous if it has pores within it.

Saturday 02
माघ बदी १३-२०७५

→ Pores can absorb lubricant as in a

FEB '19

(7) Structure

04 Monday

माघ बदी १५-२०७५

→ It means geometric relationship of metals components.

~~It is~~

→ It also implies the arrangement of internal components of matter.

(electron structure, crystal structure and micro structure)

05 Tuesday

माघ सुदी १-२०७५

(11) CHEMICAL PROPERTIES

→ A study of chemical properties of materials is necessary because most of engineering materials when they come in contact with other substances with which they can react, tend to



8

suffer from chemical deterioration.

→ The chemical properties describe

Wednesday 06

माघ सुदी २-२०७५

the combining tendencies, corrosion characteristics, reactivity solubilities etc. of a substance.

→ Some of the chemical properties are -

(i) Corrosion resistance

(ii) Chemical composition

(iii) acidity or alkalinity.

Thursday 07

माघ सुदी २-२०७५

(i) Corrosion resistance

→ It is the deterioration of a material by chemical reaction with its environment.

→ corrosion degrades material properties and reduces economic value of the material.

→ Corrosion attacks metals as well as non-metals

corrosion of ~~concrete~~ concrete by Sulphate in soils is a common problem.

FEB '19



(ii) Chemical Composition

08 Friday

माघ सुदी ३-२०७५

→ Composition of a material is ~~master~~ the constituent atoms and their quantity or percentages.

FEB '19

→ Chemical composition of engineering material indicates ~~that~~ the element which are combine together to form that material.

→ It effect some properties of the material such as strength, hardness,

09 Saturday

माघ सुदी ४-२०७५

ductility, brittleness, etc.

(iii) Atomic Bonding

→ Atomic bonding represent how atoms are bonded to each other to form the material.

10 Sunday

माघ सुदी ५-२०७५

(a) Ionic bond

(b) covalent bond

(c) Metallic bond.



(a) Ionic bond

Exchanges the vacancy element between atoms.

Monday 11
माघ सुदी ६-२०७५

(b) covalent bond

→ covalent bond formed by sharing of electron between atom.

(c) metallic bond

It is found in metals.

(4) Acidity

→ Acidity is decided by the pH value of the material which is varies from 0 to 14.

Tuesday 12
माघ सुदी ७-२०७५

→ But pH value 7 is consider as neutral

→ Acidity indicate that how they react with other material.

FEB 19

depends on the mechanical properties since it determines the behaviour of engineering material under applied forces.

There are various mechanical properties that

14 Thursday

माघ सुदी ९-२०७५

influence its effects on the

engineering materials which are given below

① Elasticity.

⑦ Brittleness

② Plasticity

⑧ Tenacity

③ Ductility

⑨ Fatigue Resistance

④ Malleability

⑩ Impact Resistance

⑤ Hardness

⑪ Machinability

① Elasticity

Elasticity can be defined

as the tendency of the material to recover from its deformation effect, when the force is released.

Elasticity is measured in terms of Young's modulus of elasticity

Young's modulus of elasticity = $\frac{\text{Stress}}{\text{Strain}}$

② Plasticity

Plasticity is the tendency of the material to get permanently deformed gradually up to the yield point when the material is subjected to an external force.

For most of the materials, the

plastic deformation is followed immediately after the elastic deformation.

Friday 15

माघ सुदी १०-२०७५

FEB '19

Saturday 16

माघ सुदी ११-२०७५

Sunday 17

माघ सुदी १२/१३-२०७५

③ Ductility

18 Monday

माघ सुदी १४-२०७५

Ductility is the capacity of a

material to undergo deformation under tension with out breaking.

Ductility can be expressed as the percentage of elongation or percentage of reduction from tensile test.

④ Malleability

19 Tuesday

माघ सुदी १५-२०७५

Malleability is the ability of a metal or

or alloy to withstand deformation

under compression.

Generally hammering and rolling operations

are performed only on materials having

good malleability. Malleability is mainly

concerned with the ability of a metal to

be made as thin sheets by hammering.

FEB '19



(5) Hardness

Hardness is the properties of material by virtue of which it is able to resist plastic deformation, indentation, penetration, and scratching. Hardness mainly signifies the resistance to penetration.

Wednesday 20

फाल्गुन बदी १-२०७५

FEB 19

(6) Toughness

Toughness can be defined as the ability of the material to withstand bending on application of shear stress without fracture. Toughness also can be defined as the ability to absorb energy and deform plastically before fracturing. Copper is found to have greater toughness than cast iron.

Thursday 21

फाल्गुन बदी २-२०७५

Toughness mainly depends on tensile strength and ductility.



⑦ Brittleness

22 Friday

फाल्गुन बदी ३-२०७५

When a material subjected to

stress, it breaks with little elastic

deformation and with out significant plastic

deformation, ~~then~~ it is called Brittleness.

In other words if the material cannot under

go any dimensional changes and lacks plastic

deformation, it is brittle.

⑧ Tenacity

23 Saturday

फाल्गुन बदी ४/५-२०७५

Tenacity of a material which

~~do not break~~ keeps the material from parting

without considerable force, as distinguished

from brittleness, fragility, mobility etc.

24 Sunday

फाल्गुन बदी ६-२०७५

Tenacity of materials means,

~~when~~ the material do not break after

the force will be applied on it.

FEB '19



(9) Fatigue Resistance

Fatigue is a kind of failure in metals or alloys, which is caused by repeated fluctuating force. This is an important ~~properties~~ property to be noted for the proper maintenance of machine part. Fatigue is a phenomenon that leads to fracture or ~~fracture~~ failure that takes place under repeated fluctuating stress.

Monday 25

फाल्गुन बदी ७-२०७५

FEB '19

Tuesday 26

फाल्गुन बदी ८-२०७५

(10) Impact Resistance

Impact Resistance is essential for the study of machine component working under dynamic loading. Impact Resistance of material is the capacity of a material to resist or absorb shock energy.



(11) Machinability

27 Wednesday

फाल्गुन बदी ९-२०७५

Machinability of a material

is an important factor of the material

if it can be easily machined by a

tool with little energy producing the

required shaped product. ~~The machin~~

The machinability of a metals can

be improved with certain alloying element.

(12) Strength

28 Thursday

फाल्गुन बदी १०-२०७५

It is the ability of a material

to resist the externally applied force

without breaking.

FEB '19



*1) Performance Requirement

→ The material of which a part is composed must be capable of performing a part's function without failure.

Friday 01

फाल्गुन बदी १०-२०७५

MAR '19

→ for example - if a component part to be used in a furnace must be of that material which can withstand high temperature

→ Performing of a part of material function without failure

Saturday 02

फाल्गुन बदी ११-२०७५

→ While it is not always possible to assign quantitative values to these functional requirements, they must be related as precisely as possible to

Sunday 03

फाल्गुन बदी १२-२०७५

specified values of most closely applicable Mechanical, Physical, electrical, or thermal properties.



(*) Material Reliability

04 Monday

फाल्गुन बदी १३-२०७५

Reliability is the degree of

probability that a product, and the

material of which it is made will

remain stable enough to function in

service for the intended life of

the product without failure.

MAR '19

→ If a material is corroded under

certain conditions, then it neither

05 Tuesday

फाल्गुन बदी १४-२०७५

stable nor reliable for those conditions.

(*) Safety

A material must safely perform its

function, otherwise, the failure of the product made out of it may be catastrophic in air-plane and high pressure system.

As another example, materials that give off sparks when struck are safety hazards in a coal mine.