Lecture Notes
On
Engineering Materials
3rd Semester
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Engineering Material

21 Monday पौष सुदी/माघ वदी १५/१-२०७५

INTRODUCTION :-

→ 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 ~~not~~ 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, alluminium etc.

JAN '19

(ii) Non-Metals

Examples- glass, rubber, Plastics etc

Wednesday 23
माघ बदी ३-२०७५

(*) Metals

⇒ Metals may further be classified as -

(i) 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

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Properties of Material

25 Friday
माघ बदी ५-२०७५

(I) Physical properties
(II) chemical properties
(III) Mechanical properties.

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(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
(II) Appearence
27 Sunday
माघ बदी ७-२०७५
(III) Colour
(IV) Density
(V) Melting Point
(VI) Porosity
(VII) Structure.

(1) Appearence

Monday 28
माघ वदी ८-२०७५

⇒ Metal themselves have different appearence.

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

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

⇒ Lustuse is the ability of a meterial 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

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Scanned with CamScanner

(3) Dimensions

30 Wednesday
माघ बदी १०-२०७५

Dimension of a material implies its size (Length, breadth, width, diameter) and shape (Squre, Circle, channel, anglesection etc.)

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(4) Density

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

31 Thursday
माघ बदी ११-२०७५

Density = mass / unit volume

→ Density depends to some extent on the
(i) Purity of material
(ii) Pour volume
(iii) Treatment, the material has received

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

size and any other outer protecting protective coating.

Friday 01
माघ बदी १२-२०७५

(5) Melting Point

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

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

(6) Porosity

Saturday 02
माघ बदी १३-२०७५

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

→ Pores can absorb lubricant as in a

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(7) Structure

04 Monday
माघ बदी १५-२०७५

→ It means geometric relationship of metals components.

→ 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

FEB '19

suffer from chemical deteriation.

→ The chemical properties describe the combining tendencies, corrosion characterstics, reactivity solubilities etc. of a substance.

Wednesday 06
माघ सुदी २-२०७५

→ Some of the chemical properties are -

(i) Corrosion resistance
(ii) Chemical composition
(iii) acidity or alkalinity.

Thursday 07
माघ सुदी २-२०७५

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(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 by Sulphate in soils is a common problem.

(ii) Chemical Composition

08 Friday
माघ सुदी ३-२०७५ → Composition of a material is the constituent atoms and their quantity or percentages.

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→ Chemical composition of engineering material indicates 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 doctility, Britleness, etc.

(iii) Atomic Bonding

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

10 Sunday
माघ सुदी ५-२०७५ material.

(a) Ionic bond
(b) covelent bond
(c) Mefalic bond.

(a) Ionic bond

Monday 11
माघ सुदी ६-२०७५

→ Exchanges the vacancy element between atoms.

(b) covelent bond

→ covelent bond formed by sharring of electron between atom.

(c) Metalic bond

It is found in metals.

(4) Aciality

Tuesday 12
माघ सुदी ७-२०७५

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

→ But PH value 7 is Consider as neutral

→ Acidity indicate that how they react with other material.

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

There are various mechanical properties that influences its effects on the engineering materials which are given below

14 Thursday
माघ सुदी १-२०७५

1. Elasticity.
2. Plasticity
3. Ductility
4. Maleability
5. Hardness
6. Brittleness
7. Tenacity
8. Fatigue resistance
9. Impact Resistance
10. Machineability

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① Elasticity

Friday 15
माघ सुदी १०-२०७५

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 = $\frac{\text{stress}}{\text{strain}}$

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② Plasticity

Saturday 16
माघ सुदी ११-२०७५

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

Sunday 17
माघ सुदी १२/१३-२०७५

For most of the materials, the Plastic deformation is followed immediately after the elastic deformation.

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(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 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.

(5) Hardness.

Wednesday 20
फाल्गुन बदी १-२०७५

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.

FEB 19

(6) Toughness

Toughness can be defined as the ability of the material to withstand bending on application of shear stress

Thursday 21
फाल्गुन बदी २-२०७५

with out 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.

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, 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 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, the material do not break after the force will be applied on it.

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(9) Fatigue Resistance

Monday 25
फाल्गुन बदी ७-२०७५

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 ~~fail~~ failure that takes place under repeated fluctuating stress.

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.

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(11) Machinability

27 Wednesday
फाल्गुन बदी ९-२०७५

Machinability of a material is an important factor of the material tath 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 forcess with out breaking.

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A:) Performance Requirement

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

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

→ Performing of a part of material function without failure.

→ While it is not always possible to assign quantitative values to these functional requirements, they must be related as precisely as possible to specified values of most closely applicable Mechanical, Physical, electrical, or thermal properties.

Friday 01 फाल्गुन बदी १०-२०७५

Saturday 02 फाल्गुन बदी ११-२०७५

Sunday 03 फाल्गुन बदी १२-२०७५

MAR '19

(*) Material realiability

04 Monday
फाल्गुन बदी १३-२०७५

MAR '19

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

→ If a material is corrods 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 gives off spark when struck are safety hazards in a coal mine.