1a. Discuss motivation for material selection & cost basis for material selection. (10)

Motivation for material selection

There are hundreds & thousands are (materials) available for the diligent. The designer should also Concentrate on probes other that material's only. The two basic situation's that necessitate material selection

1) Development of a new product.
2) Improvement of an existing product.

New product development

The successful product must meet the customer by.

1) Meet the needs of the customer.
2) Beat the competition to the market.
3) Offer either better performance, more features, or both.
4) Be perceived to offer value for money in term of the balance of cost & quality.

Customer & competition driving forward new product development, so pressure may also come from legislation for safer or more environmentally acceptable products.

(Gurudas Hatti)

improvement of an existing

Redesign can become crucial if your product is losing out to be competition. In some case the redesign during the development of a new product; it is clear that the design is not viable & work should be refocused in other area.

Cost basis for selection

The process of selecting a list of promising candidate material for a given material application will carried out initially in terms of the required properties but final decisions will always involve considerations of cost which in many cases will be the dominant criterion.

For any given set of circumstances the competition between materials or components may be finally decided on cost where other wise similar performance is obtainable; level of performance & cost must depends on the type of application envisaged.

(Prof. Gurmeej Kaur)

1b. Explain material selection for mechanical Properties (10)

Selection of mechanical Properties:
Strength, Toughness, Fatigue & Creep.

Strength of a material generally requires the determination of its stress-strain curve either in tension, compression or shear. Because of the relative ease with which the tensile test can be carried out, most strengths data for metals are obtained in tension.

Although strength is traditionally the principal parameter of design it is not the only or even the most important property in case of engineering structure it is important that strengths be combined with toughness. Toughness is resistance to fracture. Absence of toughness is denoted by the term brittle & when a material can be induced to fracture with the expenditure of little effort. It is so

(Prof. Gulmaj Patil)

* Stiffness is the ability of a material to maintain its shape when acted upon by a load. When a metal is loaded, the stress-strain curve is at first approximately linear & its slope is a measure of the stiffness of the metal.

Stiffness is important which concerned with stable deflections. absorbs energy & failure by instability.

* Fatigue is a dangerous form of fracture which occurs in materials when they are subjected to cyclic or alternate fluctuating loads.

Fatigue failure most familiar in metals & other materials in which it occur include concrete & polymers.

Factors influencing fatigue of metals mechanical joints welded joints. Adhesive joints.

* Creep is deformation that occurs over Period of time.

The creep resisting materials are complex & therefore expensive. cost will be the final arbiter of selection & it may be worthwhile relaxing one or more of the three design parameter to allow a cheaper material to be

(Prof. Gowrishankar Hatti)

Q9 Explain the Concept of Corrosion & Wear resistance for Selection?

* Corrosive attack is the result of chemical reaction at the interface between the material & the associated environment.

* Factor Controlling the probability of corrosive attack is whether or not an aqueous electrolyte is likely to provided by Condensation of moisture under prevailing by Condensation of moisture under prevailing climatic condition.

* Differing microclimates can exist as a function of direction of exposure to sun, wind & polluting sources.

* Stainless steels of all types are used satisfactorily, but for outdoor service requires the maintenance of bright finish without any rust staining. The corrosion resistance of the stainless steel is much affected by the content & uniformity of chromium

in the martensitic steels the retention of δ-ferrite leads to segregation of the chromium to higher level in this phase, with reduced corrosion resistance overall.

(Prof. Gunwant Bhatt)

Effect of environment on wear

* There are very marked effect of gaseous environment on wear of dry, unlubricated systems.
- Oxidation at the surface, which represents a degree of degradation; provides a protective film which gives a lower Co-efficient of friction & less wear & atmosphere which limit or exclude oxidation which result in increased wear.
* There are two approaches to problems are.
1) One is to produce hard surfaces.
2) Second is to apply soft lubricating films.

The production of hard surfaces by surface alloying & heat treatment.
Ex:- Specialized treatment may applied in the ranging of elements like carbon on the surface to make it very hard.
Applying surface films.
Ex:- Surface brazing techniques.

(Prof. Gururaj Katti)

Q.6 Write a short note on materials used in the materials selection with aero. & automobile application.

* Aerospace industry is in business to provide a mean of transport & the broad service requirement to convey maximum cargo at minimum cost is the same as for other forms of transport.

* Lifting a payload against gravity in order to transport it by air is an expensive process, so that design must be as efficient & light as possible. The aerospace industry therefore make great demands upon its materials.

* These different type of air craft cover a wide range of designs requirement.

* Wood materials are used in the airframes of early powered aircraft & even as late as the second world war.

* Magnesium alloys are attractive by reason of their low density, application have been generally limited by cost & by concern over the relatively poor corrosion resistance associated with this metal.

* Aluminium alloys are still the major materials for airframe construction at least for civil application. 2xxx series alloy are used in air craft due to stress corrosion & exfoliation corrosion.

Dinesh Gurung Matte

* Materials for automobile structure.

Steel.

* Manufacturing of car bodies has been primarily developed around the long established use of mild steel.
* Rephosphorization of (0.07-0.12P) of low Carbon steel results in substantial Solid Solution Strengthening for automotive uses.
* High strength low alloy steels are finding increasing application in automobile structure. Both for Clitical regions in Conventional Steel Construction & for the frame to which alternative frame material are attached.
* Aluminium & its alloys for example 1000 Al. Series:- Excellent processability and surface treatability. The most Corrosion resistant of all aluminium alloy (1050) alloy.

2000 Al-Cu. Series:- Very strong alloy used for structural components (AA - 2014, 2017, 2024.).

AA-2618. High strength at high temperature

4000 (AA-Si):- Excellent abrasion resistance & forgability

(Prof. Gururaj Katti)

3a. Write a short note on fibre reinforced Composites, Laminated & dispersed material Composites

Fibre reinforced Composites

* Fibre are the important class of reinforcement as they satisfy the desired Conditions & transfer strengths to the matrix Constituents influencing & enhancing their Properties as desired.
* Glass fibers are the earliest known fibers used to reinforce materials. Ceramic & metal fibers will subsequently found out & put to extensive use, to render Composites stiffer more resistant to heat
* Fibers fall short of ideal Performance due to several factors. The Performance of a fiber Composite is judged by its length, shape, orientation, & Composition of the fibers & the mechanical properties of the matrix.
* organic & inorganic fibers are used to reinforce Composite materials. Almost all organic fibers have low density, flexibility & elasticity.
* Inorganic fibers are of high modulus high thermal stability & possess greater rigidity than organic fibers. & not withstanding the diverse advantages of organic fibers which render the Composites in which they are used.

Laminar Composites / Laminate reinforced Composites

* Laminar Composites are found in a many combination as the number of matrices. They can be described as material comprising of layers of materials bonded together. This may be of several layers of two or more metal materials ordering alternately or in a determined order more than once & in as many numbers as required for a specific purpose.

* Clad & Sandwich laminates have many area as it ought to be, although they are known to follow the rule of mixture from the modulus & strength point of view.

Particulate reinforced Composites.

* Microstructures of metal & ceramic Composites, which show particles of one phase strewn in the other, are known as particle reinforced Composites.

* Square, triangular & round shape of reinforcement are known but the dimensions of all their sides are observed to be more or less equal. The size & volume concentration of the dispersoid distinguishes it from dispersoid hardened materials.

(Gurmaj Nath)

3b. Write a note on Aluminium matrix Composites (AMC). (10)

* Aluminium matrix Composites are metal made Composites.
* AMC is different from aluminium alloys.
* Comes under the class of light weight high performance aluminium Centric material systems.
* Combination of at-least two chemically distinct materials, with a distinct interface separating the Constituents, one necessarily being aluminium.
* The Separate materials must be Combined 3-Dimensionally.
* Should create Properties which could not be obtained individually

Properties

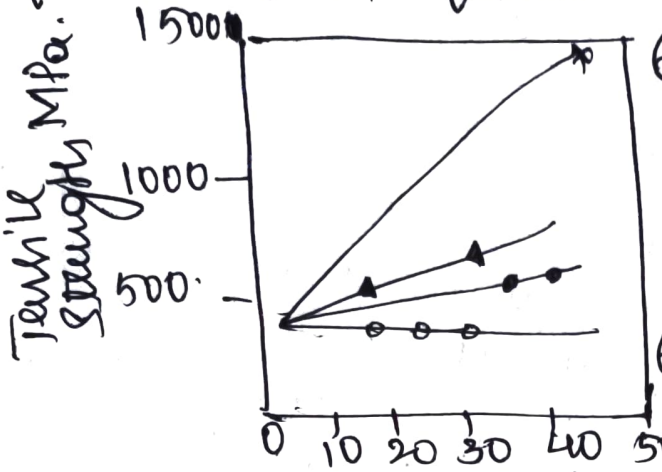
Plasticity:-

* Strength & ductility are difficult to predict by mathematical expressions.
* Both are determined by help of
  * Matrix alloys,
  * The reinforcement &
  * The processing.

Strength for different reinforcements types & volume fractions

(Prof. Gururaj Katti)

influence of reinforcement volume fraction on Tensile Strengths



Fatigue Strengths

- Continuous fibre Composites
uniaxially reinforced alloys usually poses excellent fatigue properties when loaded parallel to the major fibre axis.
- Discontinuously reinforced Composites The fatigue strengths is improved particularly under low cycle conditions.

Wear resistance

* Wear is a "System" Property, rather than a "material" Property.
* the wear of MMC's depends on the Particular wear conditions, but there are many circumstances where Al-based Composites have excellent wear resistance.
* Al-based Composites are far superior to the matrix alloy

(Gururaj Hatti)

4a. Write a short note on titanium matrix Composites & Copper matrix Composites.

Titanium matrix Composites (TMC)

* TMC offer up to 50% weight reduction relative to monolithic superalloys while maintaining equivalent strength & stiffness in jet engine propulsion systems.
* Regardless of the reinforcement are continuous fibres or discontinuous particulate, the unique properties of TMC's have thrust them to the forefront of extensive research & development program around the world.
* Titanium & its alloys are fast becoming a part of significant research interest for wide range of applications such as automotive & aerospace industries.
* These materials are light weight & generally have attractive properties such as high specific strengths, excellent chemical resistant & excellent biocompatibility. The combination of such properties makes them an ideal candidate for structural, chemical, mechanical, marine & biomedical applications.

(Prof. Gururaj, Matter)

Copper metal matrix Composites

* Copper metal matrix Composites gained popularity because of their wide range application in board pads for thermal & thermal management applications.
* Copper metal matrix Composites exhibit excellent properties such as higher thermal / electrical Conductivity, higher mechanical Strengths & Corrosion resistance.
* The addition of hard Ceramic particles to the soft copper matrix can significantly improve the tribological & mechanical Properties without any significant loss of its thermal & electrical Properties.
* Copper metal matrix Composites are preferred over Pure Copper or Copper alloys due to its good mechanical Properties & higher wear resistance as Compared to pure Copper or its alloys.

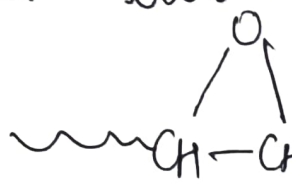
(Prof. Gurunaj. Hatti)

4b. Write a note on Polyester resin & epoxy resin.

* Polyester resin are defined as Polymer containing recurring Co-O-groups in the main chain.
* A large number of polyester is Commercially available.
  * Unsaturated Polyester.
  * Poly
  * PET
* Unsaturated Polyester resin
* Linear Polyester containing aliphatic unsaturation which provide for subsequent cross-linking
* Linear unsaturated Polyester are Prepared Commercially by the reaction of a Saturated diol with a mixture of an unsaturated dibasic acid.

Epoxy resins

* Epoxy resins have chemical group



* When reacted with a hardener, they set to a hard mass which does not melt or dissolve in Solvent.

Prof. Gurmeet Kaur

Advantages of Epoxies

* Bonds strongly to most material including metals, concrete, glass, stone, wood, leather.
* Excellent resistance to chemical & solvent.
* Very good electrical insulating properties.
* They can be used has coating & mortar in civil engg & construction application.

Bonding (Epoxies for civil Engg. & construction)

* Bonding of prefabricated elements in bridges & other structures.
* Bonding new to old concrete.
* Bonding external reinforcement to concrete.

injection System

* Grouting & repair of concrete cracks.

(Prof. Gaurang Patel)

5a. Discuss about various bioceramics

Inert ceramics

* Dense, non porous ceramics attach by bone growth into surface irregularities by cementing the device into the tissue or by press-fitting into a defect.

Example:
- Dense & porous aluminium oxide
- Zirconia ceramics
- Calcium aluminates

* If mechanically fit & used under compression: fine
* If interfacial movement: Loosing
* Maintain their physical & mechanical properties while the host
* resist corrosion & wear

Uses

A. as Structural - Support implants
- Bone plate, bone screws, & femoral acetabular cups

B. - Non structural support
- Ventilation tubes, Sterilization devices, drug delivery.

(Prof. Gururaj. Katti)

Porous ceramics

* Bone ingrowth occurs, mechanically attaches the bone to the material
  Example: Al_2O_3 (Polycrystalline)
  Hydroxyapatite coated porous metals
* ingrowth of tissue
  - increase the resistance to movement of the device in tissue
  - Serves as a structural bridge or scaffold for bone formation
* An interface is formed "Biological fixation"
* With stand more complex stress states.

Bioactive glass & Glass ceramics

* Glass ceramics are polycrystalline ceramics made by Controlled Crystallization of grains developed.
* Dense, nonporous, surface-reactive ceramics, glasses, & glass-ceramics attach directly by chemical bonding with the bone.
* A time-dependent, kinetic modification of the surface that occurs upon implantation

Ex:- Bioactive glasses, Bioactive glass-ceramics, Hydroxyapatite.

(Prof. Gururaj Patil)

5b. Write a note on Calcium phosphate Ceramics (CPCs)

Calcium phosphate ceramics are a class of tunable bioactive materials that have been widely used for bone tissue repair & augmentation.

* Calcium phosphate are minerals composed of calcium cations & phosphate anions. They are known as the major inorganic material in approximately 60% of all native human bones.
* The existence of Calcium phosphates in bone was first discovered in 1769.
* The Properties of Calcium phosphates affect bioactivity. Such as adhesion, proliferation, & new bone formation in osteoblasts. To exhibit these bioactive features, degradation & ion release in Calcium phosphate are important. These phenomena increase the local concentration of Calcium & phosphate ions & stimulate the formation of bone minerals on the surface of Calcium phosphates.

(Prof. Gururaj Kattl)

Application of Calcium phosphate

Coating

* Calcium phosphate coating can be applied to various material to enhance bioactivity
Coating of Calcium phosphate is mainly Performed using Sol-gel & electrodeposition method.
* Coating is mainly conducted for metal implants application, aiding to prevent implant corrosion & increase bioactivity.
* Coating technology increased bioactivity, cyto Compatibility, osteo conductivity & osteogenesis

Cements

* Calcium phosphate cements are used to fix & heal bone defects.
* Cements are mainly incorporated with polymer such as alginate, chitin, collagen & synthetic polymers.

Scaffolds

* Calcium phosphate scaffolds provide stable properties & allow the control of porosity & bio compatibility.

(Prof. Gurmeej Kaur)

6a. Define the superalloys. Discuss various phases in superalloy & applications of superalloy.

Superalloy are high temperature alloys which display excellent mechanical strength Stable chemical composition & excellent creep deformation resistance

Various phases in superalloys

1. Gamma matrix: The continuous FCC arrangement of the majority elements (5).
2. Gamma prime: The precipitated particles which provide resistance to dislocations improving strengths of alloy
3. Carbides: Generally, metal carbides which provide resistance to hot corrosion, oxidation & increase rupture strengths E.g. TiC, TaC, HfC etc.
4. TCP's: Though undesirable, topologically close packed phases are unavoidable. These are clusters of closely packed species separated by great atomic / molecular distance.
5. Grain boundary elements: These are elements specialized in forming the grain boundary & providing protection in micro structure.

(Prof. Gururaj Hatti)

Applications of Superalloys

* Reciprocating engines: Turbochargers, exhaust valves, nut plugs, valve seat inserts.
* Metal processing: hot-work tools & die, casting dies
* Medical application: Dentistry uses, prosthetic devices.
* Space vehicles: Aerodynamically heated skins, rocket engine parts
* Heat treating equipment: Trays, fixtures, conveyor belt, basket, fans, furnace muffles
* Nuclear power systems: Control rod drive mechanisms, valve stems, spring
* Pollution control equipment: Scrubbers
* Metal processing mills: Vanes, afterburners, exhaust fans.
* Coal gasification & liquefaction systems: heat exchangers, reheaters, piping.

(Prof. Gururaj Patil)

6b. Explain the mechanical properties of low temperature materials

Mechanical properties are
1. Yield & ultimate strengths
2. Fatigue strengths
3. Impact strengths
4. Hardness & Ductility
5. Elastic moduli

Yield & ultimate strengths

* The yield strength of various commonly used material increases with decrease in the temperature.
(304 Stainless Steel, 9% Ni Steel, C1020 Carbon Steel, 2024-T4 Al)
* These materials are normally alloys of iron (Steel) & Al etc.
* The ultimate strengths of the material increases with decrease in temperature.
* Stainless Steel has high strengths is mostly preferred.

The ultimate & yield strengths of the material largely depends on the movement of dislocation, because at lower temperature, the internal energy of atoms is low

(Prof. Gururaj Patil)

when these agitations are low, the movement of dislocation is hampered.

Fatigue Strength

* Materials exhibit fatigue failure when they are subjected to fluctuating loads.
* These failures can happen even if the stress applied is much lower than the ultimate stress value
* The fatigue strength increases as temperature decreases. This is due to a large stress is required to stretch the crack due to increase in ultimate strength.

Impact Strength

* The impact strength of the material decreases with decrease in temperature because material is largely governed by its lattice structure.
* Materials with BCC lattice, break easily because of slip plane & movement of dislocations.
* BCC (material) with this lattice are not preferred.
* Material with FCC lattice structure have more slip planes.

(Prof. Gurmaj Patel)

7a. Explain Dual steel, high strength low alloy (HSLA) steel, Maraging steel.

Dual phase steel (DP steel).

DP steel is a high-strength steel that has a ferritic martensitic microstructure.

DP steel are produced from low or medium carbon steel that are quenched from a temperature above A_1 but below A_3 determined from continuous cooling transformation diagrams.

After cold rolling sheet steel are continuously heated to the temperature region at which the structure is part austenite & part ferrite.

DP steel have high ultimate tensile strength combined with low initial yielding stress.

There are used for automobile body panels, wheels & bumpers.

High strength low alloy (HSLA) steels

HSLA steel or micro alloyed steel, are designed to provide better mechanical properties &/or greater resistance to atmospheric corrosion than conventional

Carbon Steels.

The HSLA Steel in sheet or plate form have low carbon content (0.05 to 0.25 %C) in order to produce adequate formability & weldability & they have manganese content upto 2.0%.

HSLA Steel posses.

* High strengths to weight ratio
* Improved low temperature toughness
* Fatigue - resistance

Maraging Steel.

Maraging steel are steel that are known for possessing superior strength & toughness without losing malleability although they cannot hold a good cutting edge.

The term maraging is derived from the strengthening mechanism which is transforming the alloy to martensite with subsequent age hardening.

The principal alloying elements is 15 to 25 wt% nickel.

Application

They are suitable for engine components such as crankshaft & gears & firing pins of automatic weapons.

(Prof Gururaj Hatti)

7b. Write a note on intermetallics, nickel & titanium aluminides.

* An intermetallic compound can be defined as an ordered alloy phase formed between two metallic elements where an alloy phase is ordered if two or more sub-cells are required to describe its atomic structure.

* The ordered structure exhibits superior elevated temperature properties because of long-range ordered superlattice which reduces dislocation mobility & diffusion processes at elevated temperature.

* It is a phase formed at intermediate composition between the two primary components (pure metals).

* An intermetallic is a type of metallic alloy & a long-range ordered alloy is a type of metallic alloy that forms a solid-state compound exhibiting defined.

(Prof. Gururaj Kattti)

Nickel & titanium Aluminide

* Nickel aluminide is an intermetallic alloy of nickel & aluminium with properties similar to both a ceramic & metals.
* Nickel aluminide is used as a strengthening constituent in high-temperature nickel-base superalloy.
* Nickel aluminide can be formed by hot pressing or by cold pressing & sintering.

Titanium aluminide

* Titanium aluminide, TiAl is a intermetallic chemical compound.
* It is light weight & resistant to oxidation & heat, however it suffers from low ductility.
* Ti aluminide has excellent mechanical properties at high temperature such as Ts, Ym & creep behaviour.
* TiAl based alloys have a strong potential to increase the thrust-to-weight ratio in the aircraft engine.

(Prof. Gururaj Hatti)

8a. Discuss formation of polymeric structure.

* Polymerization may be defined as the process of growing large molecules from small ones.
* Polymerization is together monomers
* There are 3 mechanisms of Polymerization
  - Addition Polymerization
  - Co-polymerization
  - Condensation polymerization

Addition Polymerization

* Initiation- This step involves the dissociation of an initiator or Catalyst into two free radicals (R^*).
  * Dissociation : $I \longrightarrow 2R^*$.
* And addition to the monomers molecules M to form an active radical.
  * Initiation : $R^* + M \rightarrow R-M^*$

Chain Propagation- This step involves the growth of the polymeric chain resulting in successive addition of other monomer to the active group

$R-M^* + M \longrightarrow R-M-M^* \rightarrow R-M^*$

(Prof. Gurunaj Katti)

Termination:- This step may take place because of the collision between the active ends of two growing chains resulting in their Combination.

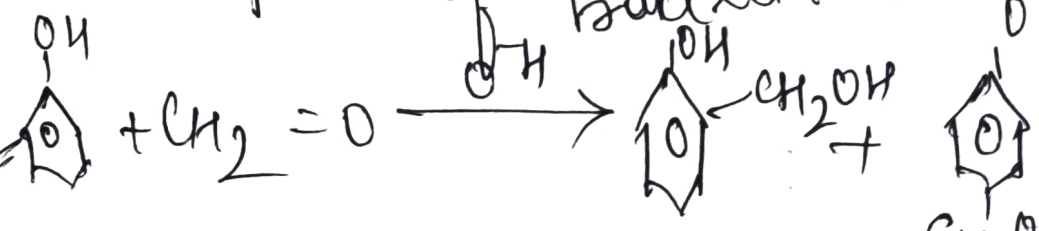
$$R\text{---}M^{\bullet} + {}^{\bullet}M\text{---}R \rightarrow R\text{---}M\text{-}M\text{-}R$$

Co-polymerization reaction

* Co-polymerization is another kind of addition polymerization.
* Many monomers will not polymerize with themselves, but will polymerize with other compounds.
* Copolymerization is the addition polymerization of two or more different monomers.

Condensation polymerization

* Condensation polymerization occurs as the combination of a compound with itself or other compounds accompanied by the elimination of some simple compound molecules such as H_2O, or HCl etc. this resulting in the formation of the required Polymer.
* Example could be the formation of bakelite.



(Prof. Gururaj Hatti)

8b. Write a note on Coatings & Adhesives.

Coatings: It is a layer of an inert substance relatively, on the surface of the component & it usually minimizes the chemical or electrochemical attack by the service environment

* To protect the item from the environment that may produce corrosive or deteriorative reactions.
* To improve the item's appearance
* To provide electrical insulation
* Coating can be applied on the components depending on its type.

Metallic Coatings

* Hot dipping: involves immersing the product in the molten bath of the coating metal.
* Metal Spraying: The surface to be coated is exposed to a fine spray of coating metal from a fine wire volatized in a high temp flame or with help of a spray gun.
* Electro plating: It means electro depositing the protective metal on the surface to be protected.

(Prof. Gowraj. Katti)

- Adhesive: An adhesive could be defined as any substance capable of holding materials together by surface attachment.

* They are basically used to join two solid materials as a thin uniform layer.
* They have the advantage over the other joining methods in that they can be applied for any surface of material.

Various types of adhesives are as follows:

Contact adhesives: Contact adhesives are used in strong bonds with high shear-resistance like laminate, such as bonding formica to a wooden counter & in footwear, as in attaching out sole to uppers.

* Contact adhesives must be applied to both surfaces & allowed some time to dry before the two surfaces are pushed together

Hot adhesives: Hot adhesive, also known as hot melt adhesives, are thermoplastics applied in molten form which solidify on cooling to form strong bonds between a wide range of materials.

(Prof. Gururaj Hatti)

9a. Briefly explain the applications of Shape memory alloys

Bioengineering

Bone:- Broken bones can be mended with Shape memory alloys. The alloys plate has a memory transfer temperature that is close to body temperature, & is attached to both ends of the broken bone. From body heat, the plate wants to contact and retains its original shape, therefore exerting a compression force on the broken bone at the place of fracture.

Memory metals also apply to hip replacements, considering the high level of super-elasticity.

Reinforcement for arteries & veins:-

For clogged vessels, an alloy tube is crushed & inserted into the clogged veins. The memory metal has a memory transfer temperature close to body heat. So that memory expands to open the clogged arteries.

Dental Wires:- used for braces & dental arch wires, memory alloys maintain their shape since they are at a constant temperature & because of the super elasticity.

Sir
Prof Gururaj Hatti

of the memory metal, the wires retain their original shape after stress has been applied & removed.

Anti-Scalding reaction:-
Temperature sensors & control systems for baths & showers memory metals can be designed to restrict water flow by reacting at different temperature, which is important to prevent scalding

Helicopter blades:-
Performance for helicopter blades depend on vibrations with memory metals on micro processing control tabs for the trailing ends of the blades, pilots can fly with increased precision.

Eye glass frames:-
In certain commercials, eye glass companies demonstrate eyeglass frames that can be bent back & forth, & retain their shape. These frames are made from memory metals as well & demonstrate super-elasticity.

(Prof. Gururaj Patil)

9b. Define Smart materials. Discuss classification & types of Smart materials.

* Smart material are those material that can significantly alter one or more of their inherent properties in response to an external stimulus in a controlled manner.

Classification of Smart material

Active Smart material:

Possess the capacity of modifying their geometric & material properties under the application of electric, thermal or magnetic field. They by acquiring an inherent capacity to transduce energy.

Passive Smart material:

These material lack inherent capability to transduce energy.

Types of Smart materials

* Piezoelectric material:- are materials that produce a voltage when stress is applied.

(Prof. Gururaj Katti)

Material used:- Quartz, Rochelle salt, topaz.

* Magnetic shape memory alloys are materials that change their shape in response to a significant change in the magnetic field.

* Photo Voltaic materials:- or optoelectronic Convert light to electrical current

* Smart inorganic polymers showing tunable & responsive properties.

* Temperature - responsive Polymers are materials which undergo changes upon temperature

* Artificial cilia:- which change its Colour & structure in different conditions.

10. a. Define nano materials. write a note on Carbon nano tubes & nano Composites. (10)

* Nano scale materials are defined as a set of substances where at least one dimensions is less than approximately 100 nano metres.

(Prof. Gururaj. Patil)

Carbon nanotubes:

Carbon nanotubes (CNTs) are an allotrope of Carbon.

Allotrope: each of two or more different physical forms in which an element can exist.

* Carbon nanotubes (CNT) are long, thin cylinders of Carbon.
* They can be thought of as a sheet of graphite rolled into a cylinder
* Nanotubes have been constructed with lengths-to-diameter ratio of up to 1,32,000,000:1.

The structure of a Carbon nanotube is formed by a layer of Carbon atoms that are bonded together in a hexagonal mesh. This one-atom thick layer of Carbon is called graphene; & it is wrapped in the shape of a cylinder & bonded together to form a Carbon nanotube.

Nanotubes can have a single outer wall of Carbon or they can be made of multiple walls.

Nano Composites:

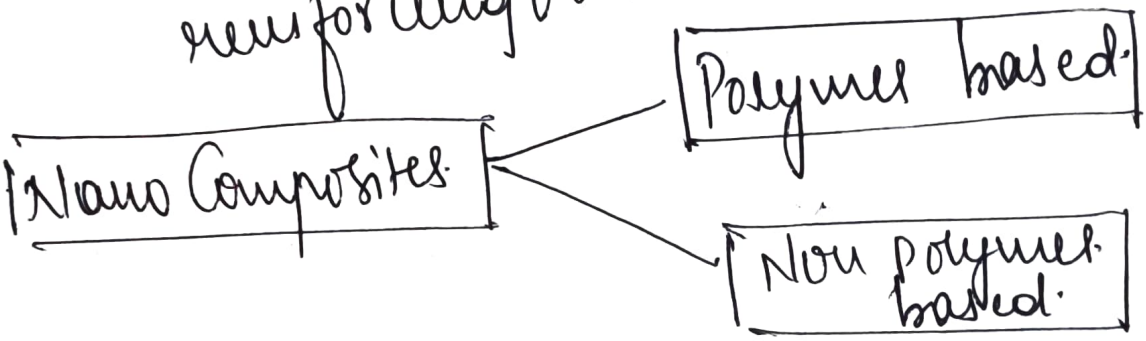
A Nano Composites is a Composite material in which one of the Components has at least one dimension that is around 10⁻⁹ m.

Prof. Gururaj Kadi

* Mechanically the new nanocomposites are differ from conventional composites due to the exceptionally high surface to volume ratio of the reinforcing & / or its exceptionally high aspect ratio.

General Characteristics

* Consist of one or more discontinuous phase distributed in one continuous phase.
* Continuous phase is called "matrix" whereas discontinuous phase is called "reinforcement" or reinforcing material.



10.b Discuss mechanical Properties of nano materials with applications of nanomaterial. (10)

" Mechanical Properties of nanoparticles" discuss with bulk metallic & Ceramics. materials influence of porosity, influence of grain size, Superplasticity in filled polymer Composites, particle filled polymer, Carbon nanotube.

(Prof. Gopinath Hatti)

based Composites.

Polymer which contain nanoparticles or nanotubes to improve their mechanical behaviour & usually plastic-deformed metal. which exhibit astonishing properties.

Nanomaterials have excellent mechanical properties due to the volume, surface & quantum effect of nano particles.

Application of nanomaterials

Fuel cells:

A fuel cell is an electrochemical energy conversion device that converts the chemical energy from fuel & oxidant directly into electricity.

Nanomaterial application in biomedical field

* Biological imaging using quantum dots
* quantum fluorescent biomarker imaging.
* quantum gold labelling.
* Targeted drug delivery using nanoparticles.

(Asst. Gurudaj Patil)

Surfaces & Coating

The most prominent application of nano technology in the household is Self-Cleaning or easy-to-Clean surface on ceramic or glasses.

(HOD, MCEH)

Prepared by
(Prof. Vinay Patel)

Dean, Academics.