MADANI BOYS SCHOOL YEAR 7 HALF TERM 3

Design , Technology & Engineering

Topic

Engineering Materials and Properties

Material Properties

Strength:
The ability of a material to resist an applied force
Ductility:
The amount a material can be deformed
Malleability:
The ability of a material to be deformed without rupturing
Hardness:
The ability of a material to resist wear and abrasion
Toughness:
The ability of a material to withstand an impact without breaking
Brittleness:
The opposite of toughness; the potential for a material to shatter when it experiences an impact
Stiffness:
The ability of a material to resist bending
Young's Modulus:
the ratio of stress to strain of a material, showing how stiff it is

Polymers

- Polymers are the most commonly used material type in commercial production.

Thermoplastics: Consist of long chains of repeating chemical parts; the individual chains are weakly attached to each other making the material ductile. Therefore when they are heated they soften and can be reshaped; then harden when cooled.
Thermosetting polymers: Consist of long chains that contain extra links that that stop the chains from moving. When reheated the either char or burn
Composites: Are materials made by combining two or more different types of material.

Factors Influencing the Design of Solutions

Energy requirements:
1.Obtaining Material
2.Refining Material
3.Chaging Material Shape
4. Changing Material Properties
5.Transporting Materials

Sources of energy: Renewable & Non-Renewable
Non renewable energy sources: Coal, Oil, Natural Gas
Nuclear energy: uses radioactive material, low cost, can cause issues for health and the environment
Renewable energy sources: Wind Power, Tidal Power, Biomass, Solar Power

Engineering Lifespans

Engineering Lifespans:
Obsolescence(Quality/Function/Desirability)
Maintenance of Engineered Products:
Reactive Maintenance
Proactive Maintenance

Availability of Materials And User Requirements:
Suppliers going out of business
Market forces, where demand for a material is greater than supply
Limits on the ability to obtain a material from a foreign country, such as local wars or trade restrictions

Metals & Alloys

- Metals are made from metal 'ores'. The ore's are rocks/minerals dug from quarries/mines then refined & processed, turning them into usable forms

Alloy: A mixture of two or more metals
Ferrous metals: Contain iron as their largest alloying element.
Non-ferrous metals: Do not contain iron
Aluminium: Commonly found, usually alloyed, corrosion resistant, low density. Uses- drinks cans, aeroplane wings and body panels
Copper: Can be alloyed to make brass and bronze, excellent electrical and thermal conductor, extremely ductile. Uses- electric wires, water pipes
Lead: Relatively soft, malleable, ductile and good corrosion resistance. Uses- construction, around roofs, shielding radiation
Zinc: Low melting point, good for die-casting. Uses- car door handles, camera bodies
Changing the properties of metal products: alloying allows-modifying the structure of the metal, changing the surface chemistry
Available forms: Ingots, flat plates, sheets, strips, bars, rods, tubes, pipes, standard section forms and wire

Material Costs & Supply

Cost: Is the price of the product/material
Availability: How easy it is to get/obtain
Form: The shape and dimensions of a material
Supply: Making something available
Calculating costs: Based on amount of material required including aesthetic and functional considerations

MADANI BOYS SCHOOL YEAR 8 HALF TERM 3

Design , Technology & Engineering

Topic

Engineering Manufacturing Processes

Additive Manufacturing

Sintering: Is a process that is used to make products from metal powders
Rapid Prototyping: Involves using additive manufacturing to make a complete part or component in a single operation.
Fused Deposition Modelling: Is the most common rapid prototyping process; used in 3D printing with ABS, PLA polyamides and nylon
Stereolithography: Is a rapid prototyping process that uses a laser to make polymer products

Joining & Assembly

Threaded Fastenings: Include nuts, bolts and screws. These are available in a wide range of materials, including steel, brass and thermoplastic polymers
Rivets: Are used to hold sheets of material together, for example attaching overlapping metal plates to form the hull of a ship or attaching the skin to an aircraft
Soldering: Is a process in which two (or more) metal parts are joined together. It involves melting solder to form a joint between the pieces being joined

Shaping, Forming & Manipulation

Bending: involves physically deforming a material. The material to be bent must be ductile and malleable; brittle materials tend to shatter
Folding: is bending material over on itself, so that one part covers another
Press Forming: is used in industry to make 3D shapes from metal sheet
Press Moulding: Polymer sheets can be formed into shapes using a similar process to press forming
Punching and Stamping: are used to cut shapes in metal sheets
Composite Lay Up: is made up of thin layers of composite material resulting in a thick shaped composite material using a shaped mould

Material Removal

Cutting: sawing, shearing, laser cutting
Sawing: use of movement to progressively cut away material as it moves against it
Shearing: involves applying force from opposite sides of a sheet of material
Laser Cutting: is used to cut thin sheets of material; the material along the cut line is vapourised
Turning: involves the use of a lathe to make parts with a round profile
Milling: milling machines use a rotating tool to remove metal one thin layer at a time; they can be used to face a piece of material producing a flat surface with a good finish
Drilling: makes holes in the material using a rotating tool to progressively remove material
Chemical Etching: uses chemicals to remove material rather than a tool; usually used to make PCB's

Casting & Moulding

Sand Casting: is used to make metal parts. It gets its name from using a mould that is made from bonded sand
Pressure Die Casting: is mainly used to make parts from non-ferrous metal. The special type of mould called a 'die' usually has two halves
Injection Moulding: is a similar process to pressure die casting but it is used for parts made from polymer

Heat and Chemical Treatment & Surface Finishing

Normalising: is carried out on steel that has been work hardened
Annealing: involves heating the metal to a suitable temperature and holding it there for a given time
Hardening and Quenching: High-carbon steel, can be hardened by heat treatment. The steel can then be put through the process of quenching which involves cooling it rapidly by immersing it in oil or brine (salt water)
Tempering: involves heating it to a temperature of 230-300 °C, then quenching it again in oil or brine
Painting: is one of the most common surface finishing processes; it can increase corrosion resistance and visual appearances
Dip Coating: is used to apply polymer coatings such as PVC, nylon or polyethylene to metal parts
Electroplating: uses electricity and a chemical solution to create a coating on a metal part
Polishing: is a physical process that gives a material a shinier appearance. It also makes the surface smoother

MADANI BOYS SCHOOL YEAR 9 HALF TERM 3

Design , Technology & Engineering

Topic

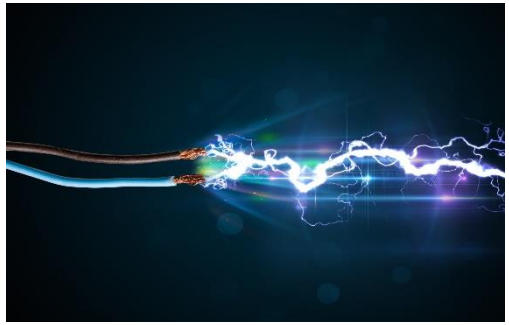
Engineering Systems

Describing Systems

System Block Diagrams: On a system block diagram, the blocks represent the functions or sub-systems; the arrows represent the signals that are sent from and to each block
Schematic Drawings: Show the individual components required and how they are connected together
Flowcharts: Are used to show the order in which a set of events is carried out. For example, they can be used to show how a set of manufacturing processes is carried out or how quality control procedures are applied to it

Electrical Systems

Electric Current: An electric current is a flow of electric charge through a conductive medium, such as a wire
Output Devices: Can be used to provide light, sound or movements. As with inputs, the outputs selected depend on the requirements of the system



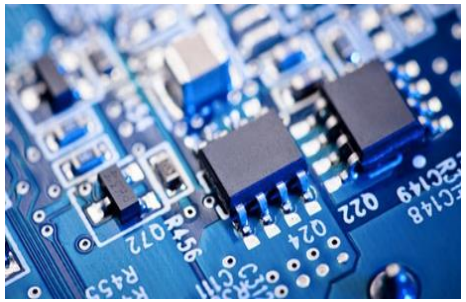
Structural Systems

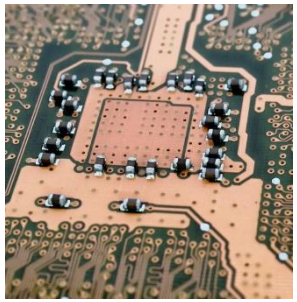
Structural Systems: The purpose of a structural system is to resist loads and forces that could otherwise cause the main structure to deform or fail.

- Space frame structures
- Monocoque structures

Electronic Systems

Analogue and Digital Signals: Electronic systems and sub-systems collect, transmit, alter and output both analogue and digital signals
Sensor Inputs: Allow systems to gather information about the environment around them; for example changes in light or temperature
Process Devices: Are often thought of as the 'brain' of an electronic system; they work by responding to signals
Programmable Devices: Can be used to perform more complex operations than discrete circuits
Interfacing Components: Also known as drivers, boost the output signal going from the process block of an electronic system
Output Components: Turn an electronic signal into real world signals such as light/sound/movement
Discrete Components within a Circuit: Are components that are not inputs or outputs but still play an important role
Simple Programming for Monitoring and Control Processes: Are designed to make sure engineered products are produced to a high level of consistency





Pneumatic Systems

Pneumatic and Hydraulic Circuits: Hydraulic systems use a liquid, such as oil or water to control a medium. Pneumatic systems use a compressible gas, such as air
Pneumatic Systems versus Hydraulic Systems: Consider the speed of operation
Common Pneumatic Circuits and Components: Single and double acting cylinders, delay circuits, logic circuits
Applications of Pneumatics: High speed, accurate and precise; therefore used for- robotic applications, drills, saws, screwdrivers, hammers, jackhammers and assembly tools

Mechanical Systems

Linkages: Are used to change the size of a force, the direction of motion and/or the type of motion
Mechanical Advantage: Linkages can be used to provide mechanical advantage; which is the ability of a mechanism to move a large load with a small effort force, usually written without any units
Conversion of Motion: Mechanical systems can be used to change the direction of motion in a system
Gear Trains: Transmit rotary motion and torque
Chain and Sprocket: A series of links are joined together with steel pins to make the chain. The sprockets are toothed wheels which the chain fits over
Cams and Followers: Cams and followers turn rotary motion into reciprocating motion
Pulleys: Pulley systems are used to reduce effort when lifting loads and to transfer power within a system. They transmit rotary motion
Bearings: Are machine parts; their role is to control motion and reduce friction between moving parts