B.TECH. EME-201

SECOND SEMESTER EXAMINATION, 2009-2010

MANUFACTURING PROCESSES

Time : **3** *Hours* *Total Marks :* **100**

Note : 1. *Attempt all questions.*
2. *Be precise and scientific in writing.*

SECTION - A

1. This section contains 10 questions. All questions are compulsory : (10×1=10)

(a) The castability of cast iron is poor. (True/False).

Ans. This Statement is - FALSE.

(b) Stainless steel Is an alloy steel. (True/False).

Ans. This Statement is - FALSE.

(c) Define malleability.

Ans. Malleability is the property that enables a material to be converted into flat sheet. Material that can be pressed into the form of a sheet under compressive load is said to be Malleable. Silver is most Malleable metal followed by Gold.

(d) Bronze is an alloy of :

(i) Aluminium and zinc

(ii) Aluminium and nickel

(iii) Copper and tin

(iv) Copper and zinc

Ans. (iii) copper and tin.

(e) Write two casting defects.

Ans. Casting defects are:

(i) Blow holes

(ii) Porosity

(iii) Dirt

(iv) Pin holes

(v) Swell.

(f) Ductile failure occurs when a part is subjected to :

(i) Compressive stress

(ii) tensile stress

(iii) fluctuating stress

(iv) uniform stress

Ans. (ii) Tensile stress.

(g) Material removal is a :

(i) Machining process

(ii) Welding process

(iii) Joining process

(iv) Metal forming process

Ans. Machining Process.

(h) Holes is produced in casting with the help of .....

Ans. Hole is produced in casting with the help of Core.

(i) Write two properties of molding sand.

Ans. Moulding Sand Property:

(i) Permeability

(ii) Strength

(iii) Flowability

(iv) Refractories.

(j) Name the two major advantages in favour of powder metallurgy process.

Ans. Advantages of Powder Metallurgy:

1. Metallic & Non Metallic materials can be combined.
2. High Production Rate.
3. Complex Shapes Can be Produced.
4. Bimetallic and laminated special purpose parts can be made from mould layers of different metal powders, securely an permanently inter locked.

SECTION-B

2. Attempt any three questions.

(a) Explain the following terms :

(i) Fatigue

(ii) Stiffness

(iii) Creep

(iv) Brittle fracture

(v) Elasticity

Ans.

(i) **Fatigue:** The behavior of materials under fluctuating and reversing load (stress) is known as fatigue.

(ii) **Stiffness:** The ability of a material to result elastic deformation or deflection is called stiffness. It depends on the shape of the structural or machine member for identical geometries of components their stiffness is proportional to the elastic modulus of materials.

(iii) **Creep :** The permanent deformation (Strain) of a material under steady load as a function of time is called creep. A very common observation in which the length of our waist belt increases after some duration, is due to creep effect.

(iv) **Brittle fracture :** Brittle fracture occurs after little or no plastic deformation. Propagation of crack is rapid in this case. Brittle fractures can cause disastrous failure without prior notice.

(v) **Elasticity :** Behaviour of a material by virtue of which the stains (deformations) disappear on removal of load, is known as elasticity.

(b) Explain with neat sketch and suitable example, the stress-strain diagram of :

(i) ductile material and

(ii) brittle material

Ans. Please see Q. No. 2(b) Ist Sem of 2008-09.

(c) With help of neat sketch, explain the basic components of lathe machine and various operations performed on it.

Ans. Please see Q. No. 2 (d) Ist Sem of 2008-09.

(d) Write short notes on :

(i) Galvanizing

(ii) Electroplating

Ans. Electroplating and Galvanizing :

(i) **Galvanising :** In this process, coating of zinc is done on iron. Galvanised iron is used for making buckets, roofing articles and G.I. pipes etc.

(ii) **Electroplating :** Electroplating is an electro-deposition process of metals. The coating materials is deposited on the base metal by passing d.c. through an electrolytic solution. Quality of the coating depends on the composition of electroplating solution, current density, agitation, temperature of solution etc. Electroplating is done for

(i) corrosion protection, and

(ii) decoration purposes.

Nickel, tin and zinc are coated on iron to protect against corrosion whereas silver is used for plating fancy articles to enhance their beauty. Machinery parts are electroplated with chromium

to protect them form wear and corrosion. The electro-deposited metals possess crystalline structure. Finert the crystals: brighter, smoother and stronger is the deposit.

During the process of electroplating, the article to be electroplated is made cathode while the metal to be deposited becomes anode. The electrolyte may be a simple soluble salt of the metal of be deposited. In silver plating, the anode is of pure silver and the electrolyte is a solution of potassium argemetocyanide $KAg(CN)_2$.

(e) Describe with suitable examples, plant layout and its different types and applications.

Ans. Types of Plant Layout : Plant layouts can be classified as :

1. Process layout or functional layout
2. Product layout or line layout
3. Mixed layout
4. Static layout

1. Process Layout : It is also called functional or job lot layout. In a process all similar machines are grouped together. As an example, all lathes the grouped together in turning section, milling machines grouped together in milling section etc. So there are different sections or shops such as turning section, milling section, drilling, welding section, assembly line etc.

Process layout is used in job and batch production, and non-repetitive type of work. It is employed when part and product designs are not stable or the volume of production is small. This type of layout makes production planning and control more difficult since work must be round back an forth among the section.

The primary requirement in process layout is flexibility, routing flexibility, part design flexibility, volume flexibility. The process layout leaves the equipment in the flexible condition; so, it can be used on various parts. Equipments utilization is this very good and total investment is equipments is low.

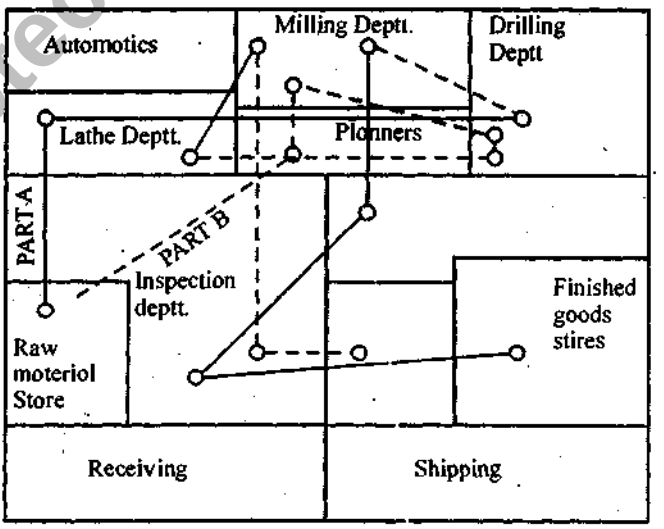

Fig. Process or functio nal layout

2. **Product or Line Layout :** In this type, the machines and auxiliary services are arranged in line according to the sequence of operations to be performed on the work. The raw-material enters in the line at one end, the operations are carried out in succession, in a smooth flow and the finished product is delivered at the other end of the line. In this type of layout, there will be a separate production line of each type of product. Each line may have same machines though they may be arranged definitely, or the machines for each line may be different. Product layout is suitable for continuous production.

The conditions for line layout are :

(i) Adequate volume of production for reasonable equipment utilization.

(ii) Reasonably stable product demand.

(iii) Product standardization.

(iv) Part interchangeability.

(v) Continuous supply of material.

When these conditions for line layout are met the result is very low cost of manufacture. Line layout has found its great field of application in assembly rather than in fabrication.

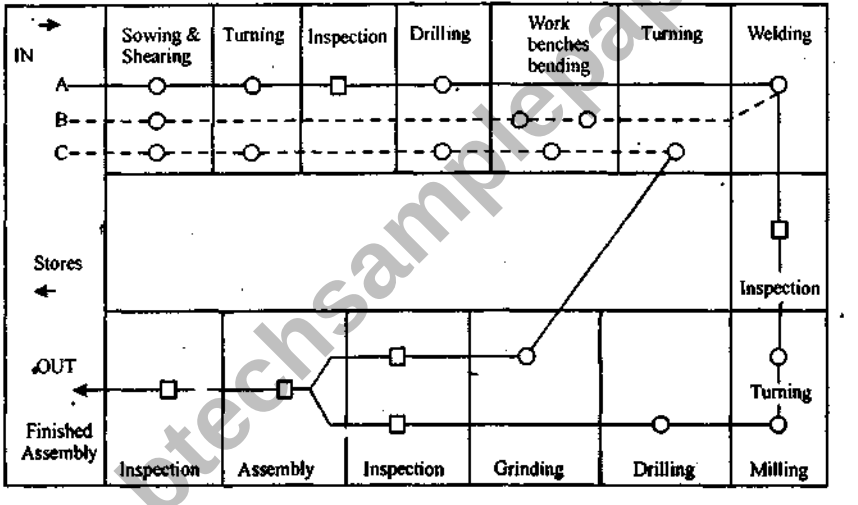

Fig. Product or Line layout

3. **Mixed or Combined Layout:** Pure process or pure line layouts are rare. The combination of these are very commonly used in industry. The combined layout incorporates the benefits of process and product layout. Combined layout is developed as under :

(i) The production shops may be arranged by process layout, while the assembly is accomplished on line.

(ii) Product layout for the main product with a process layout for by-product, utilizing the idle capacity of the product layout alongwith the marginal investment required in process layout.

(iii) In the product layout, some processes may be segregated form the product line, e.g., objectionable, hazardous, requiring special treatment and repetitive performance etc.

4. **Static or fixed Position Layout :** Static product layout or layout by fixed position, is adopted when work piece is very big or

too heavy to move from one position to the other and is consequently fixed in one place. The machines and men move with respect to the work to perform the required operation. This type of layout is typical in custom order type production for example, in construction work, ship-building, in fabrication of large tanks, pressure vessels, locomotives, air craft.

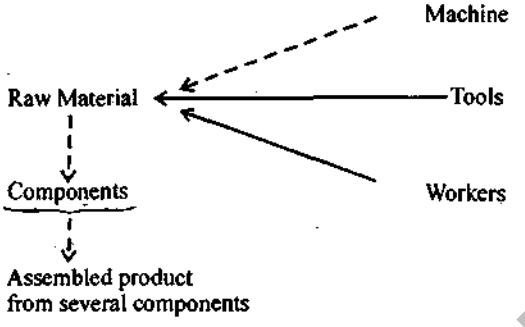

Fig. Static product layout.

Advantages :

1. It is possible to assign one or more skilled workers to a project from start to finish in order to ensure continuity of work.
2. It involves lest movement of materials.
3. There is a maximum flexibility for all sorts of changes in product and process.
4. A number of quite different projects can be taken with the same layout.

Disadvantages :

1. Highly skilled workers are required.
2. Machine and tools etc. take more time of reach to the work place.
3. There is law utilization of labor and equipment.

SECTION - C

3. Question (a) is compulsory and carries Seven marks. Attempt any three more questions more questions from the remaining (all carry equal marks of Six). **(25)**

(a) Name three alloys each of ferrous and non-ferrous metals. Write their applications.

Ans. Ferrous alloys :

Alloy	Co mposition (%)	Appllcation
Cr-steel		
Ferritic stainless steel	Cr 16%, Mn 1%, Si 1%, C 0.12% max, S ,.0.04% max, P 0.04% max. rest Fe	Surgical instruments, cutleries, dairy industry, decorative pieces
Martensitic stainless steel	Cr 12.5%, Mn 1%, Si 1%, C 015% max, P 0.04% max rest Fe	Utensils, springs, valves and valve seats
Austenitic stainless steel	Cr 17%, Ni 12%, Mn 2%, Mo 2.5%, Si 1%, C 0.08% max, rest Fe	High temperature components under severe stresses
Duplex stainless steel	Cr 22.5%, Ni 4.8%, Mo 3.0%, Mn 1.3%, Si 0.7%, C 0.03%, N 0.1%, rest Fe	Components of jet aeroplanes

Ni-steel		
Maraging steel	Nl 18%, Co 7%, Mo .45%, C 0.02%, Mn 0.1%, Si 0.1%, Ti 0.2%, B 0.003%, rest Fe	Aircraft undercarriage parts, portable bridges, booster motors in missiles
Hastelloy A	Ni 60%, Mo 30%, Fe 5%	Parts of chemical plants
Timken alloy	Ni 25%, Cr 16%, Mo 6%, C 0.1%, N_2 0.15%, rest Fe	'Silver' coin
W-steel	W 10%, Co 10%, Ni 59%, Cr 9%, Hf 1.5%, Fe 0.25%, others	Permanent magnets, cutting tools, spark plug electrodes, gas turbine blades

Non-Ferrous Alloys

Alloy	Composition	Application
Mg-alloy		
Electron	Al 3-12%, Mn 0.03%, Zn 2%, rest Mg	Parts of aircraft and automobiles, collapsible tubes, coating on steel untensils, solder, coating of petroleum containers and mild steel sheets
Al-alloy		
Duralumin	Cu 4%, Mg 0.5%, Si 0.7%, rest Al	Electrical cables, components of aeroplanes and automobiles
Y-alloy	Cu 4%, Mg 1.5%, Ni2%, Fe 0.6%, rest Al	Casting of engine parts
Cu-alloy : Brass		
Muntz metal	Cu 60%, Zn 40%	Brass castings, stampings and extruded parts
Yellow brass	Cu 90%, Zn 10%	Screw, wires, hardwares
Admiralty brass	Cu 70%, Zn 29%, Sn 1%	Marine uses, pump parts, ship parts
Catridge brass	Cu 70%, Zn 30%	Bullet shots, cistorn, storage batteries, military ammunition, foils
Arsenial copper	As 0.3%, rest Cu	Heat exchangers, condensers

(b) Differentiate between hot and cold working of metals. Mention two advantages and disadvantages of each of these techniques.

Ans. Difference betwen Hot & cold workings

Hot working :

1. Hot working is done at a tempretature above recrystallization temperature. It can therefore, be regarded as a simultaneous process of deformatin and recovery.
2. Hardning due to plastic deformation is completely eliminated by recovery and recrystallization. This is true, however, only if the rate of crystallization is higher than that of deformation.
3. Mechanical properties such as elongation, reduction of area, and impact values are imporved. Ultimate tensile strength, yield point, fatigue strength, hardness and resistance corrosion are not affeted by hot-working, if this is properly done.
4. Refinemtent of crystals occurs.
5. Breaks up brittle film of hard constituents, and promotes uniformity of materials by facilitating diffusion of constituent alloys.
6. Cracks and blow holes are welded up.
7. Internal or residual stresses are not development in the metal.

Cold working :

1. Cold-working is done at a temperature below recrystallization temperature. So no appreciable recovery can take place during deformation.
2. Hardening is not eliminated since working is done at a te...perature below recrystallization, and this is always accompanied by work hardening.
3. Cold-working decreases elongation, reduction of area, and impact values, while it increases ultimate tensile strength, yield point, fatigue strength and hardness. But resistance to corrosion is decreased by cold-working. It severely worked yield point can coincide with ultimate tensile strength.
4. Crystallisation does not occur but are only elongated and or distorted. The extent of distortion depends on the degree of cold-working.
5. Uniformity of materials an hardening properties are affected.
6. Possibility of crack formation and its propagation is great.
7. Internal and resided stresses are developed in the metal.

Advantages of Hot Working :

1. Blow holes and porosities in work material are eliminated.
2. Stress annealing is not required after hot working.

Disadvantage of Hot Working :

1. Poor-surface finish.
2. Thin Gauge-sheets cannot be obtained.

Advantages of Cold-working :

1. Thin gauge sheets can be made from cold working.
2. No oxidation and scaling of the work-material occurs. This results in reduced material loss.

Disadvantages of Cold-working :

1. Higher forces are required, hence high capacity and costly machines are needed for cold working.
2. Severe stresses are setup in the material during cold working. This requires stress relieving or annealing treatment.

(c) Why the pattern is different from casting ? Describe with neat sketch, the various steps in casting process. What is the function of core In casting?

Ans. (c) Please see Q. No. 5 IInd Sem. 2008-09.

(d) How will you classify the welding processes ? Explain with suitable applications, the working principle of resistance weiding.

Ans. Please see Q. No. 7 IInd Sem. 2008-09.

(e) Discuss the role and importance of Materials and Manufacturing for the growth of any nation. Explain with suitable examples the types of production.

Ans. Please see Q. No. 8 IInd Sem. 2008-09.

(f) Write short notes on :

(i) Ceramics and their appiications.

(ii) Composite materials and their applications.

Ans. (i) Ceramics and their applications : Ceramics are non-metallic, inorganic, amorphous solids and are mostly metallic oxides. They have poor tensile strength, and are brittle. They can be either crystalline or noncrystalline. Many ceramics are workable in extremely low (cryogenic) temperature range, while many others able to sustain high temperatures.

Besides conventional applications in ovens and furnaces for lining, as insulators, in domestic uses as crockeries; they are employed in more recent applications mentioned below.

1. Medical field such as artificial limbs and teeth etc.
2. As superconducting materials.
3. In explosive forming.
4. As ferrites in microwave gyrators.
5. As miniature capacitors.
6. In memory cores of computers.
7. As garnet in microwave isolators.
8. In sonar devices etc.
9. For bricks and fine clay.
10. Chimney lining.
11. Electric insulations.
12. Heat insulation.
13. Tiles, sewage and drain pipes.
14. Building masonary.
15. Plastering, preparation of different grades of concrete.

Ceramics may broadly be classified under various groups. Main among them are

1. Refractories
2. Silicates
3. Glasses
4. Limes
5. Cements
6. Plain concretes
7. Prestressed concretes
8. Rocks and stones

(ii) Composite materials and their applications: Composite material is a material system composed of two or more dissimilar constituents, differing in forms, insoluble in each other, physically, distinct and chemically inhomogeneous. The resulting product possesses properties much different from the properties of constituent materials. Composite materials, also referred as composites, are broadly classified as :

1. Agglomerated composite materials,
2. Laminated composite materials, and
3. Reinforced composite materials.

Propertles of Composite Materials : Composites offer several outstanding properties as compared to conventional materials. In composite materials, an attempt is made to increase the stiffness, without the disadvantages of brittleness. Characteristically, composites possess high strength-to-weight and stiffness-to-weight ratios, and offer new design flexibility and improved corrosion and wear resistance.

Applications : Composite materials have wide applications in aircraft, space vehicles, off. Share structure, electronics, automobile industries etc.