B.TECH.

[EME-201]

SECOND SEMESTER EXAMINATION 2010-11

MANUFACTURING PROCESSES

Time : 2 Hours *Total Marks : 50*

Note: Be precise and scientific in writing.

Section-A

Attempt all questions. **(10×1=10)**

This Section contains 10 questions (objective/ fill in the blanks types). Choose/Fill the correct answer.

1. **The castability of Al is very poor.**

   (True/False)

   Ans. False

2. **The machinability of Nickel and Steel is good.** **(True/False)**

   Ans. False

3. **Energy required to rupture the material is known as .....**

   Ans. Toughness

4. **Brittle failure occurs when a part is subjected to:**

   (*i*) Compressive stress

   (*ii*) Tensile stress

   (*iii*) Fluctuating stress

   (*iv*) Uniform stress

   Ans. (*ii*) Tensile stress

5. **Stainless steel comes uader the category of:**

   (*i*) Non-ferrous metal and alloy

   (ii) Ferrous metal and alloy

   (*iii*) Polymer

   (*iv*) Composite

   Ans. (*ii*) Ferrous metal and alloy

6. **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

7. **Hole is produced in casting with the help of .....**

   Ans. CORE

8. **Forging of metal is a:**

   (*i*) Machining Process

   (*ii*) Welding Process

   (*iii*) Joining Process

   (*iv*) Metal Forming Process

   Ans. (*iv*) Metal Forming Process

9. **Metal forming is the process in which:**

   (i) Removal of metal takes place

   (*ii*) Shaping of metal by compressive forces applied through various dies and tools

   (*iii*) Some additional material are joined to the raw material

(*iv*) Neither material removal nor addition.

Ans. (*ii*) Shaping of metal by compressive forces applied through various dies and tools.

10. Name the two major advantages in favour of powder metallurgy process.

Ans. (*i*) Complex shapes can be produced.

(*ii*) Very high production rate i.e. 500 to 1000 pieces per hour.

SECTION - B

Attempt any three questions. All questions carry equal marks. (5×3=15)

Q.1. Classify the carbon steel based on the percentage of carbon as low, mild, medium, and high carbon steel. Write their properties and applications.

Ans. Carbon steel, on the basis of percentage of carbon can be classified as following:

1. **Low Carbon Steel :** Steel containing carbon percentage less than 0.3% is called low carbon steel. It is ductile and soft in nature. Rivetes, wires, ship plates, boiler tubes, camshafts, axles are made from such steel.
2. **Medium Carbon Steel :** Carbon steel containing carbon percent from 0.3% to 0.6% is called medium carbon steel. Its strength is high than low carbon steel. These have good machinability and depth hardening properties. These are used to make crank pins, set screws, value springs, lock washers, clips, etc
3. **High Carbon Steel :** In such type of carbon steel, the carbon percentage likes between 0.6 to 0.9%. It is hard in nature. These are used to make agriculture tools, chisels, wrenches, jaws for vices, shear blades, hack show pneumatic drill bits, railway wheels etc.

Q.2. Explain with neat sketch the stress-strain diagram of a (i) ductile material, and (ii) brittle material.

Ans. Please See Q.No. 2(b), Ist Semester 2008-09.

Q.3. Explain (i) mould and (ii) pattern. Describe the four important pattern allowances.

Ans. Mould: A mould is an assembly of two or more metal blocks or bonded refractory particles (sand) consisting of a primary cavity. The mould cavity holds the liquid material and essentially acts as a negative of the desired product.

Pattern: A pattern is a replica of the part to be cast and is used to prepare the mould cavities. Pattern are made of either wood or metal.

Pattern Allowances : The size of the pattern is different than the actual size of the casting to be produced and is always made larger to take care of several factors. The excess in dimensions over the size of the casting is known as allowance. These allowances are shrinkage, draft, finish, distortion and shake.

1. **Shriakage Allowance :** Metals and alloys have tendency to shrink on cooling. There are three principal stages of shrinkage : (1) Shrinkage of the liquid, (2) Solidification shrinkage as the liquid turns to solid, and (3) Solid metal contraction as the solidified metal cools down to room temperature. Following solidification, a casting continues to contract as it cools, the amount of this contraction being as much as 2% or 2.6 mm/metre. To produce the designed final dimensions, the pattern must be made slightly larger than the casting.The exact amount of this compensation depends on the metal that is being cast. Typical allowances for some metals/alloys are given below:

Metal (%)	*Shrinkage Allowance (mm/metre)*	
Cast Iron	0.8 - 1.0	8.2-10.5
Steel	1.5 - 2.0	15.7 - 20.6
Aluminium	1.0 - 1.3	10.5 - 13.1
Magnesium	1.0 - 1.3	10.5 - 13.1
Brass	1.5	15.7

If shrinkage is not provided, cracks are bound to occur in the casting. Figure shows a wheel with spokes. If the spokes are curved, the tensile stress in them resulting from contraction during solidification and hence the tendency for cracking is reduced.

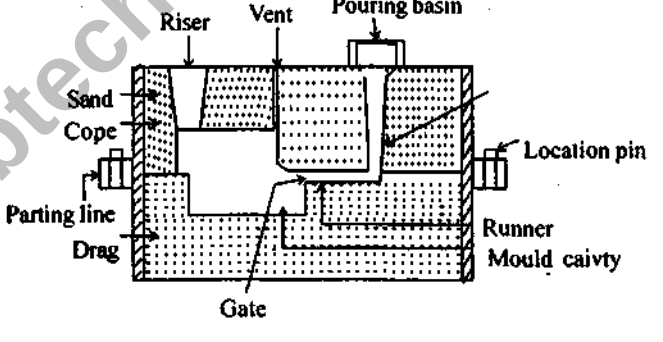


Fig. *Shrinkage allowance*

In order to produce a sound casting, a riser, or liquid metal reservoir, is attached to the casting to provide a source of liquid metal.

2. Draft Allowance/Draft : When a removable pattern is drawn from a mould, the tendency to tear away the edges of the mould in contact with the pattern is decreased if the surfaces of the pattern, parallel to the direction of its withdrawal, are slightly tapered. This tapering of the sides of the pattern is known as draft or draft allowance. It provides a slight clearance for the pattern as it is lifted.

The amount of draft to be provided depends upon the shape and size of the pattern, the depth of the cavity, the pattern material, the mould material, and the moulding procedure. Draft angles usually range from 0.5° to 2°. Inner surfaces have twice draft as compared to outer surfaces because the casting shrinks inward towards the core. Draft tends to increase the size of a pattern and thus the size and weight of a casting, therefore, is recommended to keep it to the minimum that permits satisfactory pattern removal.

3. Machining Allowance/Finish Allowance : The dimensional accuracy and the surface finish of the casting produced by sand casting processes are not very good. Before their applications, they may need machining on one or all over their surfaces. This excess in dimensions of the casting and pattern over their final dimensions to take care of machining is called machining allowance. Machining allowance, which is to be added to the pattern, depends on the type of casting and increases with the size and section thickness of the castings. This allowance usually ranges from about 2 mm to 5 mm for small castings, to more than 25 mm for large castings. Die castings are sufficiently smooth, so very little or no metal is required to be removed. Investment castings do not require machining.

4. Distortion Allowance : Distortion allowance applies to the castings of irregular shape that are distorted in the process of cooling because of metal shrinkage. Distortion occurs due to thermal stresses developed during solidification. *U*-shaped sections have tendency to distort due to differential rate of cooling of its arms and base. To eliminate this defect, an opposite distortion of equal amount is provided in the pattern. Distortion depends greatly on the particular configuration of the casting, and the designer must use experience and judgement to provide distortion allowance.

5. Shake Allowance/Rapping Allowance : The removable pattern is initially in firm contact with the sand mould. To make its withdrawal from the mould easier, its vertical surfaces are rapped so that they are detached from the mould. But during the process, the cavity in the mould increases slightly. In large castings, or in ones that must fit together without machining, a shake allowance is occasionally considered by making the pattern slightly smaller.

Q.4. Differentiate between shaper and planner. With the help of neat sketch, explain the basic components of lathe machine.

Ans. Differentiate between Shaper and Planer: In shaping, the primary (cutting) motion is provided to the tool and the feed is given to work piece. Where as in Planning, it is just the opposite. The cutting operation is intermittent in nature and takes place during the forward stroke.

Basic Components of lathe machine: Please See Q.No. 2(d), Ist Sem. 2008-09.

Q.5. With the help of neat sketch, define the following operations:

(*i*) Forging

(*ii*) Rolling

(iii) Drawing

(iv) Extrusion

Ans. Please See Q.No. 2(e), Ist Sem. 2008-09.

SECTION - C

Attempt any five questions. Each question carries equal marks. **(5×5=25)**

Q.1. What are the major uses of copper? What are the alloying elements in brass and bronze, respectively? List various types of brass, also give their npplication.

Ans. Uses of Copper: Copper is mainly used in various electrical industries. Though it is next to the silver in terms of conductivity but in terms of relative cost it is much lower than that of silver. It is used for making copper wires. To make alloy such as brass, heat exchanger tubes etc.

Brass: Brass is an alloy of copper in which zinc is used as substitutional impurity. Hence Brass are Cu-Zn alloy containing upto 45% zinc. It is used in stampings and extruded parts, bullet shorts, heat exchangers condensers.

Bronze: It is an alloy of copper and Tin (Sn). This alloy has superior mechanical properties and corrosion resistance than Brasses. It is used in pipe fittings, low pressure valves, diaphragms castings of bells etc.

Q.2. Differentiate between hot and cold working of metals. Bring out the advantages and disadvantages of each of these techniques. Explain with neat sketch the forging of ingots.

Ans. Cold Working:

It is plastic deformation of metal and alloys under conditions of temperature and strain rate such that the work hardening or strain hardening is not relieved. Working temperature for cold working is below the recrystallization temperature of the metal/alloy. Mostly is is carried out in room temeprature.

Advantages:

1. Thin gauge sheets can be made be cold working.

2. Since cold working is done at room temperature or low temperature, no oxidation and scaling of the work-material occurs. This results in reduced material loss.

Disadvantages:

1. Since higher forces are required, high capacity and costly machines are needed for cold working.

2. Severe stresses are set up in the material during cold working. This requires stress releiving or annnealing treatment.

Hot Working:

It is plastic deformation of metals and allows under conditions of temperature and strain rate, such that recovery and recrystallization takes place simultaneously with the deformation.

Hot working is carried out above the recrystallization temperature of the material and after hot working, a fine grained recrystallized structure is obtained.

Advantages:

1. Blow holes and proposities in work material are eliminated.
2. Stress annealing is not required after hot working.
3. Machines are not heavy.

Disadvnntages:

1. Poor surface finish.
2. This guage sheets cannot be obtained.

Q.3. Define the foilowing terms with neat sketch as used in sand casting:

(*i*) Core

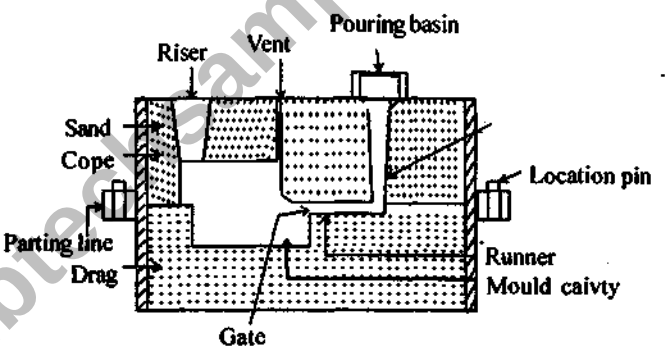
(*ii*) Core prints

(*iii*) Sprue

(*iv*) Runner

(*v*) Riser

Ans.



(i) Core : Core is sand mass which is inserted into mould to produce identical shaped region such as holes or passages for water cooling or otherwise define the interior surface of the casting, Cores are also used on the outside of the casting to form features such as lettering on the side of a casting or deep external pockets. They are placed in the mould cavity before casting to form the interior surfaces of the casting and are removed from the finished part during shakeout and further processing. Like moulds, cores must strength, permeability, ability to withstand heat, and collapsibility, Therefore cores are made of sand aggregates.

(ii) Core Prints : Core Prints are the projected parts added to the pattern. core or mould and are used to locate and support the core within the mould.

(iii) Sprue : Sprue is the vertical passage connected to the pouring basin through which the molten metai flows downward, hence also called downsprue.

(iv) Runner : Runner is the horizontal channel in the parting line to carry the molten metal from the sprue to the mould cavity.

(v) **Riser** : Riser is a reservoir of molten metal which supplies additional metal to the casting so that hot molten metal can flow back into the mould cavity when there is a reduction in the volume of metal due to solidification.

Q.4. With the help nf schematic sketch, describe the basic working principle and important parts of shaper machine. Also describe the difference in operation between shaper nnd planer.

Ans. Please See Q.No. 5(a) Ist Sem. 2008-09.

Q.5. Explain fusion as it relates to welding operations. How will you classify the welding processes? Explain the features of nentral, reducing, and oxidizing flames. Also draw labeled diagrams nf these flames.

Ans. Please See Q.No. 5(b), Ist Sem. 2008-09.

Q.6. Discuss the role and importance of materials and manufaeturing for the growth of any nation. Explain production and productivity.

Ans. Production: It ma· be defined as a transformation process in which a set of inputs like men, machines, money d materials get converted into a specific set of output elements like finished products or serv..es of required quality.

We can define production as "organised activity of converting raw materials into finlshed products."

Productlvlty: Productivity of a production system may be defined as ratio between output and inut.

$$\text{Quantitative Productivity} = \frac{\text{Outupt}}{\text{Input}}$$

Production can be increased by increasing the input but productivity may not increase.

Q.7. Explain the following with suitable examples:

***(i)* Electroplating**

***(ii)* Galvanizing**

***(iii)* Plant layout**

***(iv)* Ceramics.**

Ans. *(i)* Electroplatlng: It is an electrodeposition process of metal. The coating material is deposited on the base metai by passing D.C. current through an electrolytic solution. Quality f the coating depends on the composition of electroplating solution, current density, agitation, temperature of solution etc. It is done for .

1. Corrosion protection and
2. Decoration purposes.

***(ii)* Galvanizing:** In this process coating of zinc is done on iron. Galvanished iron is used for making buckets, rooting articles and Gi. pipes etc.

***(iii)* Plant layouts:** Plant layout is the most effective physical arrangement, either existing or in plans of industrial facilities i.e. arrangement of machines, processing equipment and service departments to achieve greatest co-ordination and efficiencies of 4 M's (men, material, machine and methods) in aplant.

***(iv)* Ceramics:** 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 non-crystalline. Ceramics can sustain very high temperature.