# B. TECH. EME101

# FIRST SEMESTER EXAMINATION, 2009-10

## MANUFACTURING PROCESSES

*Time : 2 Hours* *Total Marks : 50*

**Note : Be precise and scientific in writing**

### SECTION–A

**Attempt all the questions.**

**This section contains 10 questions. All questions carry equal marks.**

**1. Energy required to rupture the material is known as ———.**

**Ans.** Toughness

**2. List the alloying elements of duralumin.**

**Ans.** Alloying elements of duralumin are the following

Cu = 4% Mg = 0.5%

Si = 0.7% Rest is aluminium.

**3. Misrun is a metal forming defect. (True/false)**

**Ans.** Misrun is casting defect not a forming defect. So this statement is FALSE.

**4. Write the two welding defects.**

**Ans.** Welding defects are the following

(a) cracking (b) porosity (c) slag inclusion

(d) oxide inclusion etc.

**5. Brittle failure occurs when a part is subjected to**

**(i) compressive stress**
**(ii) tensile stress**
**(iii) fluctuating stress**
**(iv) uniform stress**

**Ans.** (ii) Brittle failure occurs when part is subjected to tensile stress.

**6. Finishing is**

**(i) Machining Process**
**(ii) Welding Process**
**(lii) Joining Process**
**(iv) Metal Forming Process**

**Ans.** (i) Finishing is machining process

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

**Ans.** Hole is produced in casting with the helps of CORE.

**8. Molding sand is called green sand because it contains**

**(i) bakelite**
**(ii) moisture**
**(iii) no moisture**
**(iv) dry sand**

**Ans.** (ii) Molding sand is called green sand because it contains moisture.

**9. In compound rest method of taper turning, compound rest is swilled by the angle**

(*i*) $\tan \alpha = \frac{d_1 - d_2}{l}$

(*ii*) $\tan \alpha = \frac{d_1 - d_2}{2l}$

(*iii*) $\tan \alpha = L \times \frac{d_1 - d_2}{l}$

(*iv*) $\tan \alpha = \frac{d_1 - d_2}{4l}$

**Ans.** Compound rest is swilled by the angle

$$\tan \alpha = \left( \frac{d_1 - d_2}{2l} \right)$$

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

**Ans.** Major advantages of powder metallurgy process are the following :

(*a*) It is cost effective in Producing certain parts as compared to other manufac-turing process.
(*b*) Certain types of parts can be made only by powder metallurgy by mixing different metals and non-metals, metals and ceramics etc.
(*c*) Complex shapes can be produced
(*d*) High production rates can be 500 to 1000 pieces per hour

## SECTION–B

**Attempt any three questions. All questions carry equal marks.**

**1. Explain the following terms with suitable example:**

**(i) Ductility**
**(ii) Toughness**
**(iii) Creep**

**Ans.** (i) **Ductility:** Ductility is exposed by the percentage elongation, *i.e.* percentage strains at a fracture point. Property of a material that enables it to be elongated is known as ductility. It is associated with tensile loading.

**(ii) Toughness:** Please See Q. 2(b), Ist Sem of 2008-2009.

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

**2. Explain the properties and applications of**

**(*i*) Wrought Iron**

**(*ii*) Tool Steel**

**(*iii*) Cast Iron**

**Ans. (*i*) Wrought Iron:** Please see Q. 9 of Unit-I, page-6

**(*ii*) Tool St** Manufacturing techniques make use of tools an essential need. Depending on the requirements of production, a tool may the just an ordinary one, or shock-resisting or a cutting tool. Amongst wide categories of tools; cutting tools are most important. They are used in machining operations such as turning, drilling, milling, broaching etc.

**Different types of commonly employed tool steels are**

**Water-hardening tool steels**: These contain 0.7 to 1.3% carbon. They are used for drills, files, chiesels, hammeers and forging dies etc.

**Hot worked tool steels**. These are suitable for use in dies for casting, forming, blanking and extrusion etc.

**Shock resisting tool steels.** These are Cr-W, Si-Mo, or Si-Mn alloys. Due to their outstanding toughness, they are used in making dies.

**Cutting tool steels.** These are either W-based or Mo-based, each having addition of Co in them. Important types of cutting tool materials are illustrated in Table.

**Table. Important Cutting Tool Materials**

| *Material* | *Composition* | *Application* |
|---|---|---|
| High carbon tool steel | C 0.8 to 1.3%, Si o.1 to 0.4%, Mo 005 to 0.4 %, rest Fe | Milling cutters, twist drills and turning tools for soft metals |
| Low alloy carbon tool steel | C 1.2%, Mu 0.3% to 0.7%, W 1.5% to 4%, Mo 0.3% to 0.5%, S 0.3%, rest Fe | High speed milling, drilling and turning tools |
| High speed steels (HSS) | | All kinds of cutting tools |
| 18-4-1 steel | W 18%, Cu 4%, V 1% C 0.7%, Co, rest Fe | Useful at high temperature operations |
| High Mo steel | Mo 8.5%, Cr 4%, W 1.5% V 1%, C 0.8%, rest Fe | Useful for high temperature cutting |
| W-Mo steel | W 6%, Mo 5%, Cr 4%, V 2% C 0.8%, rest Fe | For machining highly abrasive materials |
| Stellites | Co 40 to 5%, Cr 25 to 30%, W 15 to 30%, C 2 to 43% | Rapid machining of hard metals |
| Cemented carbide | TaC 10%, TiC 15%, Co | |
| UCON | Nb 50%, Ti 30%, W 20% | As throw-away tool inserts |
| BORAZON (CBN) (Cubic boron nitiride) | | As grinding wheel on HSS and stellites |
| Diamond | | All kinds of cutting tools |

(*iii*) **Cast Iron:** Ferrous metals containing 2% to 4.5% carbon is called Cast Iron (CI). There are many kinds of Cast Iron; each having some specific properties. These are:

(1) Grey C.I.

(2) White C.I.

(3) Mottled C.I.

(4) Malleable C.I.

(5) Spheroidal C.I.

(6) Spongy C.I.

(7) Chilled C.I.

(8) Inoculated C.I.

**Grey C.I.:** It is also known as Graphics C.I. and finds maximum use amongst all other kinds of cast Iron. It contains flake form of graphite whose tips are sharp. Slow rate of cooling and additions of Si (silicon) promotes graphitization in C.I. It is used for structural parts such as columns, bed plates, pipes etc.

**White C.I :** It comprises of cementire phase. It is used to produce malleable Cast Iron. Due to presence of cementite, it is extremely hard besides being strong and brittle.

**Mottled C.I:** It contains a mixture of grey and white C.I.

**Malleable C.I :** It is produced from white C.I (on prolonged heating at 900°C following by slow cooling. Due to this process, cementite decomposes to ferrite. Content of Si is kept less than 1% so as to avoid graphitization. It is used as parts of agricultural machinery and implements, pipe fittings, parts of railway rolling stock.

**Spheroidal C.I:** It contains graphite in the form of spherical nodule. Since there are no sharp tips there is no stress concentrations hence brittleness is unnoticed. It is produced by adding Mg or Ce to molten Iron.

**Innoculated C.I:** It is produced by innoculating molten pig Iron by solution of silicon compounds such as calcium silicide. Addition of silicon produces better effects.

**Note:** Also can be seen from sample paper I, Q. no 1(c) page 5

**3. Explain with neat sketch, the basic working principle of Rolling. Describe its application in industry.**

**Ans.** Please see Q. 2nd (II), IInd sem. exam of year 2008-09

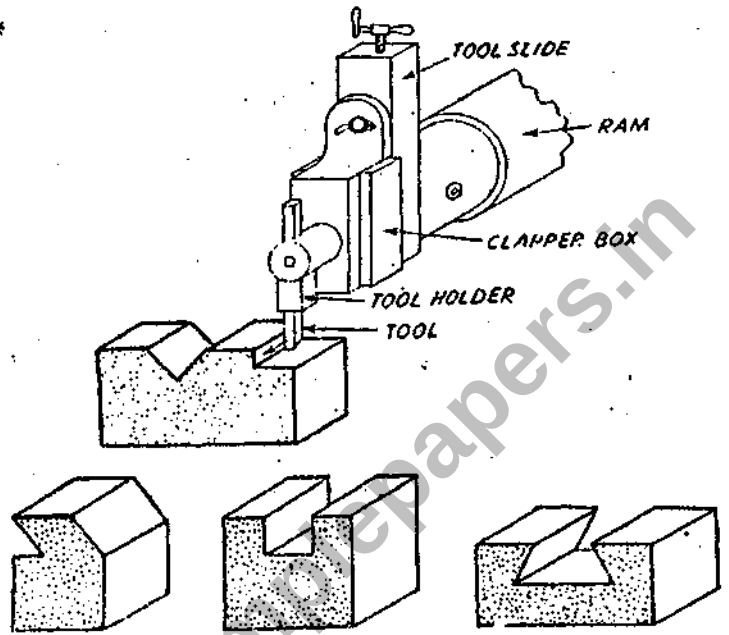
**4. Differentiate between shaper and planner. With the help of neat sketch, explain the basic components of lathe machine.**

**Ans. Parts of Shaper :**

1. Power transmission
2. Ram
3. Shaper head
4. Column

5. Base
6. Cross-rail
7. Saddle and table
8. Shaper gibs

**Shaper :**




**Shaper Operation Vs Planer Operation :** Major difference between two is that in shaping, the primary (cutting) motion is provided to the tool and the feed is given to the work piece. "Whereas 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:** Components of Lathe Machines :

**Operations Performed on Lathe Machine :**

1. Facing
2. Turning
3. Taper Turning
4. Reaming
5. Chamfering
6. Trepanning
7. Boring
8. Parting
9. Knurling
10. Threading

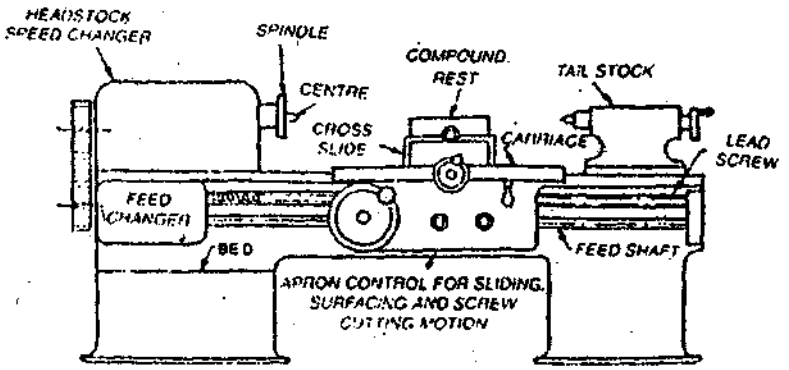



Fig. Schematic Sketch of Lathe

**5. Describe with suitable examples, plant layout and its different types and applications.**

**Ans.** Please see Q. 5 of Unit-IV at page 49.

## SECTION–C

**Attempt any four questions. Each question carries equal marks.**

**1. Write short notes on Annealing and Normalizing of carbon steels.**

**Ans.** Please see Q. 15 of Unit-I, at page 9.

**2. Differentiate between hot and cold working of metals. Bring out the advantages and disadvantages of each of these techniques.**

**Ans.** Please see Q.no 4(a), Ist sem. exam of 2008-09

**3. With the help of neat diagram, explain the working principle of cupola. Also write its limitations.**

**Ans. Cupola Furnace :** Cupola furnace is used exclusively for melting cast iron (gray cast iron, nodular cast iron and white cast iron). The furnance is simple and economical, has high melting rate, and is available in a wide range of capacities. It is economical to operate and can be operated continuously for long hours with a minimum of maintenance.

The cupola consists of a hollow vertical cylindrical shell made of strong mild steel plates riveted or welded at the seams. Welded joints are more common in modern practice. It is lined with fire bricks and rests on a square bed plate which is supported on four cast iron pillars, above the ground. With the help of tuyeres, air is introduced inside the furnace. The furnace is provided with a side door near the top of the furnace for charging and spouts at different levels for tapping off the slag and the molten iron.

**Charging and Combustion Zone in Cupola**

The charge consists of alternate layers of coke, pig iron mixed with scrap castings and a fluxing material, usually limestone ($CaCO_3$), a fluorspar ($CaF_2$) or soda ash ($Na_2CO_3$) added to protect the iron from oxidation, is fed through the charging door. In operation, a coke bed is ignited and alternate charges of coke and pig iron are made in the ratio of 1 part coke to 8 or 10 parts iron, measured by weight. The amount of air required to melt one ton of iron depends upon the quality of coke and coke-iron ratio. Theroretically, 3.19 $m^3$ of air at 100 kPa and 15.5°C is required to melt 0.5 kg of carbon. The highest temperature produced in the combustion zone (consisting of melting zone and superheating zone) of the cupola is 1650°C.

The reactions taking place inside the combustion zone are exothermic in nature evolving heat in the completion of reactions. The representative chemical reactions are :

$$C + O_2 \rightarrow CO_2 + \text{Heat}$$

$$Si + O_2 \rightarrow SiO_2 + \text{Heat}$$

$$2\,Mn + O_2 \rightarrow 2\,MnO + \text{Heat}$$

$$4\,Fe + 3\,O_2 \rightarrow 2\,Fe_2O_3 + \text{Heat}$$

Combustion is improved by preheating the air as in regenerative type melting furnaces. Such a furnace is called a *hot-blast furnace*. In this furnace, the stack gases are put through a heat exchanger,

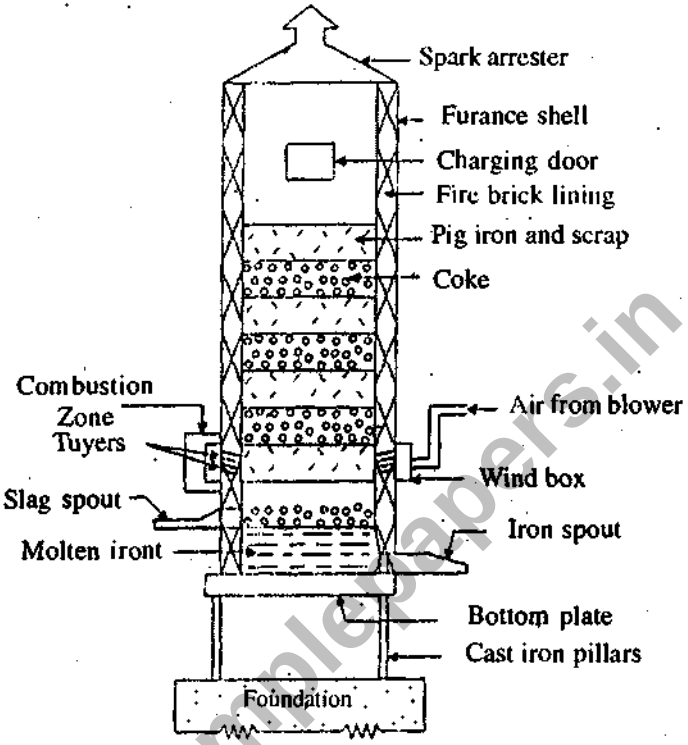



Fig. Cross section of a cupola furnace

enabling the incoming air to be preheated to temperatures as high as 650°C thereby accelerating the rate of melting.

Environmental conditions suggesting minium pollution require the use of modern cupola of rotary type (*rotary cupola*) which uses oil-firing for making gray iron. Rotary cupola uses compressed air which increases the melting rate of iron. The unit has dust collectors, quencher etc. for an environment-friendly condition.

**Limitations:** Following are some limitations of curpola.

(1) Since molten iron and coke come in contact with each other, certain element (like Si, Mn) are lost while others (like sulpur) are picked up. This changes the final analysis of molten iron.

(2) Close temperature control is difficult to maintain.

(3) More maintenance is required.

**4. Distinguish between welding, brazing and soldering processes. Write about the importance of fluxes being used in welding.**

**Ans. Welding brazing and soldering:** Soldering and Brazing process differ from welding in the sense that there is no direct melting of the base metals being joined. Soldering and brazing are carried out by allowing a molten filler material to flow in the gap between the parent bodies. When the filler material is a copper alloy (copper-zinc and copper-silver. The process is called brazing. A similar process with the Lead-Tin alloy as the filler material is called soldering. Filler metal used in soldering

has a melting point above 427°C whereas in brazing has a melting point above 427°C. Brazing produces joints stronger than those made by soldering and they can be used in service at higher temperature,

**Importance of Flux:** Flux is important in welding because of its many functions :

(*a*) It acts as deoxidizers or scavengers to help purify the weld metal and produce a sound deposit :

(*b*) To form slag to float on he molten weld metal and protect if from the atmosphere during solidification

(*c*) To provide shielding gas.

(*d*) To act as are stabilizers to produce a smooth welding are and reduce weld spatter.

**5. With the help of schematic sketch, describe the basic working principle of grinding process.**

**Ans.** Please see Q. 17 of Unit-III at page 40.

**6. Write short notes on:**

**(*i*) Ceramics and its applications**

**(*ii*) Composite materials and their applications.**

**Ans. I. Ceramics and its applications:** Please see Q. 3 of Unit-IV at page 48.

**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.

**Properties 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. Characteris-tically, composites possess high strength-to-weight and stiffness-to-weight ratios, and offer new design flexibilities and improved corrosion and wear resistance.

**Applications :** Composite materials have wide applications in aircrafts, space vehicles, off. share structure, electronics, automobile industries etc..