B.E.

Fourth Semester Examination, Dec-2009

Manufacturing Technology (ME-202-E)

Note : Attempt any ***five*** questions. All questions carry equal marks.

Q. 1. (a) What are the master patterns? How does their size differ from other patterns? Explain.

Ans. Master Patterns : Master pattern is the term for any hard copy model or design which is used by a foundry to make a metal cast. Before starting upon the construction of a sand master pattern for the 1st time, artists are advised to check with their foundry that the proposed construction method and material's content of their studies work is suited to a sand moulding process.

Q. 1. (b) What are the main characteristics which a good moulding sand should possess? How these characteristics influence the performance of moulding sand and casting?

Ans. Main Characteristic of Sand Moulding : The characteristic of the moulding sand are :

(i) Permeability : Permeability or porosity of the moulding sand is the measure of its ability to permit air to flow through it.

(ii) Strength or Cohesiveness : It is the property of holding together of sand grains.

(iii) Refractoriness : It is the ability of the moulding sand mixture to withstand the heat of melt without showing any signs of softening or fusion.

(iv) Plasticity or Flowability : It is measure of the moulding sand to flow around and over a pattern during ramming and to uniformly fill the flask.

(v) Collapsibility : This is ability to moulding sand to decrease in volume to some extent under the compressive forces developed by the shrinkage of metal during freezing and subsequent cooling.

(vi) Adhesiveness : This is the property of sand mixture to adhere to another body.

(vii) Coefficient of Expansion : The sand should have low co-efficient of expansion.

Q. 2. (a) What is investing casting? What are the main materials used for making the investing pattern? What are the principal ways of applying the investment material to the pattern?

Ans. Investing Casting : Casts can be made of the wxy model itself, the direct method or of a wax copy of a model that need not be of wax, the indirect method.

*** The Main Material Used for Making the Investing Pattern :**

The main material used by artist or mould-maker creates an original pattern from wax, day, wood, plastic, steel or another material.

*** The Principal Ways of Applying the Investment Material to the Pattern :**

(i) Produce a Material Pattern : An artist or mold-maker creates on original pattern from wax, clay, wood, plastic, steel.

(ii) Mold Making : A mold, known as the master die is made of the master pattern. The master pattern may be made from a low-melting point metal, steel or wood.

(iii) Produce the Wax Pattern : Wax patterns may be produced in one of two ways. In one process the wax is poured into the mold and switched around until an even coating, cover the inner surface of mould.

(iv) Assemble the Wax Pattern : Multiple different wax patterns may be created and then assembled into one complex pattern.

5. Investment : The ceramic mould, known as the investment, is produced by three repeating steps : coating stuccoing and hardening.

Q. 2. (b) What are the advantages & disadvantages of true centrifugal casting?

Ans. The Advantages of Centrifugal Casting :

(i) Improved Physical Properties : Formed under pressures many times that of gravity combined with directional solidification, two unique characteristics of the centrifugal casting process the products exhibit a denser, closer grained structure with absolutely no porosity.

(ii) Longer Life : Parts made from centrifugal process with the casting closer grained structure provide more reliable service life and withstand greater stress and impact without fracturing.

(iii) Competitive product pricing and lower life time cost.

(iv) Faster Delivery : Due to the short mold set up and preparation time required for centrifugal castings, delivery can be scheduled to meet the customer needs.

(v) Reduced Rejects : The trapped oxides and impurities are easily removed in the machining process.

(vi) Production Flexibility : In this allows economical production of a diversified range of sizes, shapes and quantities.

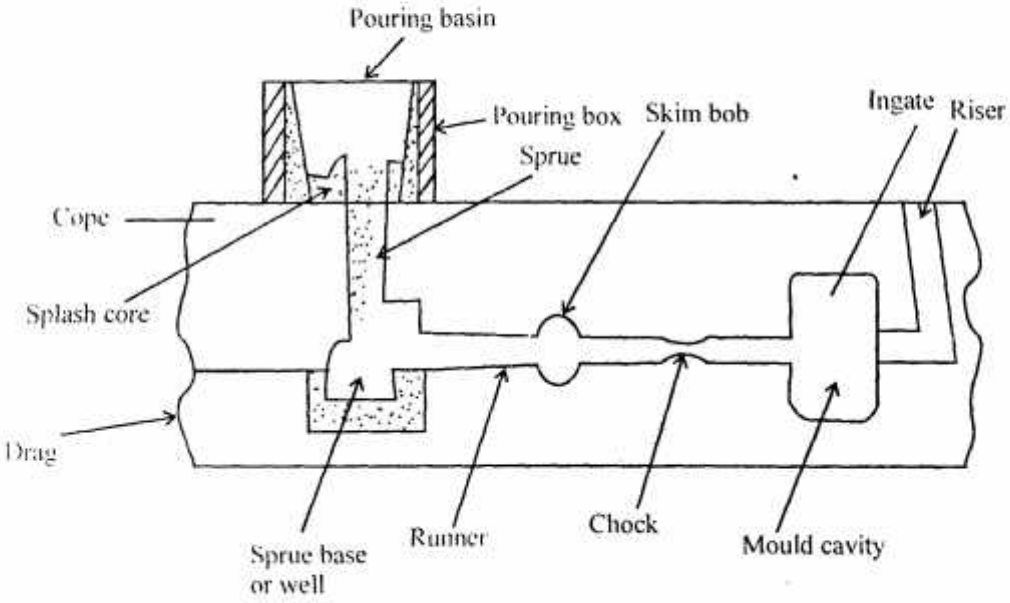
Disadvantages :

(i) Limitations on shape of casting.

(ii) Normally restricted to the production of cylindrical geometric shapes.

Q. 3. What do you understand from the term Gating System? What are the main requirements expected of an ideal gating system?

Ans. Gating System :



The molten metal from the ladle is not introduced directly into the mould cavity, because it will strike the bottom of the mould cavity with a great velocity and can cause considerable erosion of the bottom of the mould cavity. Due to this, the molten metal introduced into the mould cavity from the ladle, through the gating system.

The gating system for a casting is a series of channels which lead molten metal from the ladle into the mould cavity. It may include any or all of the following :

(i) Pouring basin
(ii) Sprue
(iii) Sprue base or well
(iv) Runner
(v) Choke
(vi) Skin bob
(vii) Gate
(viii) Riser.

Gating System Design :

The liquid metal that runs through the various channels in the mould obeys the Bernoulli's theorem :

$$h + \frac{P}{\omega} + \frac{v^2}{2g} = \text{constt.}$$

h = Potential head, m

P = Pressure, ρ_a

V = Liquid velocity, m/s

ω = Specific weight of liquid, N / m^3

g = Gravitational constt.

As the metal enters the pouring basis, it has highest potential energy with no kinetic or pressure energy.

But as the metal moves through the gating system a loss of energy occurs because of the friction between the molten metal and the mould walls.

The gating system behaviour is the low of continuity :

i.e., $$Q = A_1V_1 = A_2V_2$$

Q = Rate of flow, m^3 / s

A = Area of cross section, m^2

V = Velocity of metal flow, m/s

Q. 3. (b) How will you calculate the metal charge of a cupola in order that the produced casting can have a desired composition? Explain.

Ans. Charge Calculation of a Cupola in Order that Produced Casting :

* It is very important in the foundry to know the final composition of the metal being obtained so as to control it properly.
* The elements in the final analysis are essentially the sum total of what contained in each charge ingredients, with some losses or pick up in the cupola. Out of the various elements, the ones that are relevant are carbon, silicon, maganese and sulphur.
* As the charge comes through coke bed, some amount of carbon picked up by the metal depending on the temperature and the time when the metal is contact with the coke.
* Silicon is likely to get oxidised in cupola and therefore, a loss of 10% of total silicon contained in charge is normal. Under the worst condition, it go as high as 30%.
* Maganese is also likely to be lost in melting process. The loss could be of the order 15 to 20%.
* Similar to carbon, sulphur is also likely to be picked up from coke during melting. A reasonable estimate could be 0.03 to 0.05%.

Q. 4. (a) How many types of rolling mills are in commercial use? Describe their arrangements of rolls, specific uses and other details?

Ans. Classification of Rolling Mills are in Commercial Use :

(i) Blooming and Slabbing Mills : These are heavy mills with rolls from 800 to 1400 mm in diameter. They are designed to roll ingot into blooms and slab.

(ii) Billet Mills : These mills have rolls from 450 to 850 mm in diameter and are designed to further reduce bloom into billets.

(iii) Rail and Structural Mills : These mills have rolls from 750 to 800mm in diameter and are used mainly to produce rail road rails, beams, channels and other heavy structural shape.

(iv) Section Mills : Have rolls from 250 to 750mm in diameter, depending upon shape and section to be rolled.

(v) Rod Mills : Have rolls about 250mm in diameter and are used to produce wire rod.

(vi) Sheet and Plate Mills : Have barrel length ranging from 800 to 5000 mm for hot rolling and from 300 to 2800mm for cold rolling.

(vii) Seamless Tube Mills : Produce seamless tube.

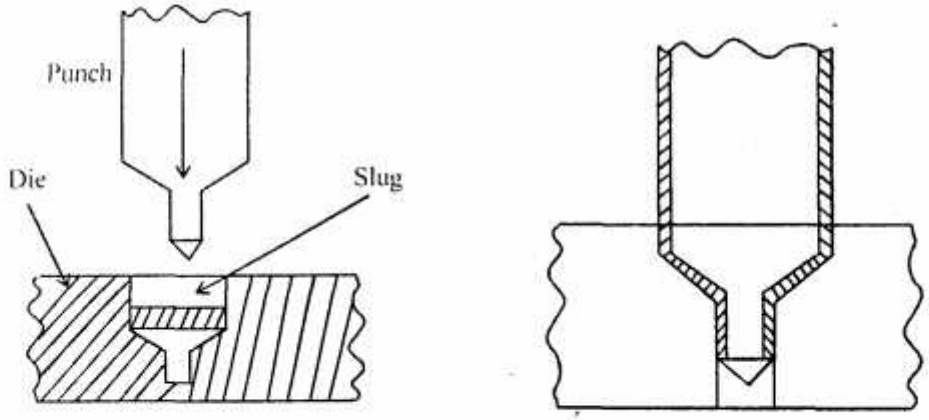
(viii) Tyre and Wheel Mills are used to manufacturing rail-road wheel and tyres.

Q. 4. (b) What fuels are generally used in forging furnaces? What specific characteristics a fuel used in forging work should possess?

Ans. Fuel Used in Forging Furnace : Charcoal is the original forge fuel. By a process of distillation in which wood is heated hot enough to burn, but starved to oxygen, most of the compounds in the wood are driven off in form of vapours leaving carbon behind. After the burn most of the wood was recovered in form of charcoal. In 15 to 18th centuries, coal as the primary source of forge fuel.

Q. 5. (a) What is impact extrusion? Explain this process and state its specific applications.

Ans. Impact Extrusion : In backward cold extrusion is called impact extrusion, the set up consists of a die and a punch as shown in fig.



Impact Exptrusion

The slug for making the component in kept on the die and punch strike the slug against the die.

The metal is then extruded through the gap between the punch and die. Opposite to the punch movement as shown in fig. Because of the impact force, the side walls go straight along the punch though they are not confined.

* This process is more commonly used for making the collapsible tube for housing paste, liquids and similar articles.

Q. 5. (b) How direct extrusion differs from indirect extrusion? Discuss their relative merits and demerits.

Ans. Comparison of Direct and Indirect Extrusion :

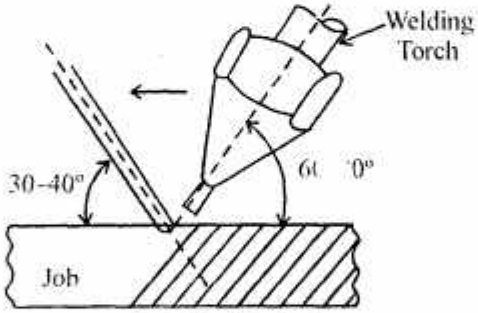
* The direct extrusion, is the simplest, but it is limited by the fact that as ram moves, the billet must slide or shear at the interface between billet and container. These large friction forces must be overcome by very high ram forces, which produce very high residual stresses on the container.

  In indirect method, the billet proper does not move relative to the container, instead the die moves. The friction involves between the die and container and that is indepencent to the billet length.
* The friction forces are lower and power required for extrusion is less than for direct extrusion.
* Extruding force is 25 to 30% less than in direct extrusion.
* Complex design of tools, the indirect extrusion finds only limited application.

Q. 6. (a) What do you understand by : Leftward welding, Right Ward, Vertical welding, Forge welding?

Ans. Leftward Welding :

* The welder hold welding torch in his right hand and filler rod in the left hand.
* The welding flame is directed away from the finished weld. i.e., toward the unwelded part of the joint leftward technique is usually used on relatively thin metals i.e., having thickness less than 5mm.

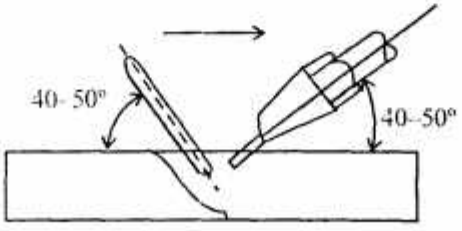


Left Ward Technique

* **Right Ward Welding :**

Here again the welding torch is held in the right hand of the welder and the filler wire in the left.

Welding begins at the left-hand end of the joint and proceeds toward right hence the name rightward technique.

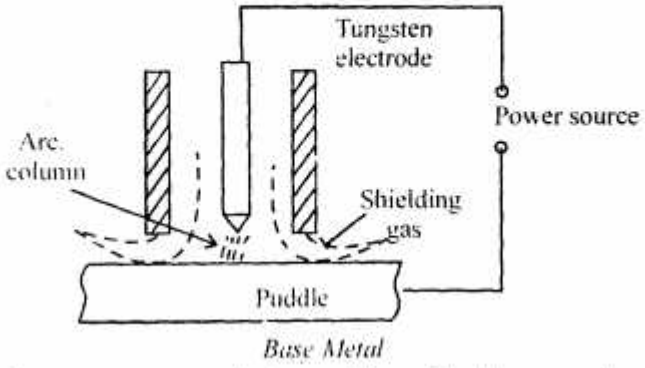


Right Ward Technique

Forge Welding : In this method of welding the surfaces to be joined are heated in on open hearth until they reach the welding temperature of metal, which is below its melting point.

Q. 6. (b) Describe the following welding methods and their specific application : TIG welding, MIG welding.

Ans. TIG Welding (Tungsten Inert Gas) :



In this process the heat necessary to melt the metal is provided by a very intense electric arc which is struck between a virtually non-consumable tungsten electrode and metal workpiece.

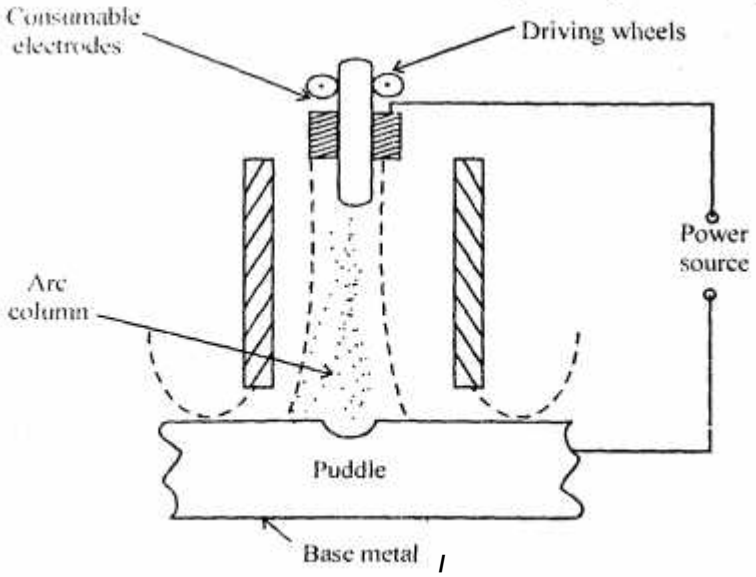
- The electrode does not melt and become a part of the weld.
- The weld zone is shielded from the atmosphere by on inert gas (argon and helium).

Application of TIG :

1. Welding aluminium, magnesium, copper, nickel and their alloys.
2. Welding sheet metal and thinner section.
3. Rocket motor chamber fabrication in launch vehicles.

MIG Welding (Metal Insert Gas) :

- In this an arc welding process where in coalescence is produced by heating the job within an electric arc established between the continuous fed metal electrode and the job.
- No flux is used but the arc and molten metal are shielded by an inert gas which may be argon, helium.



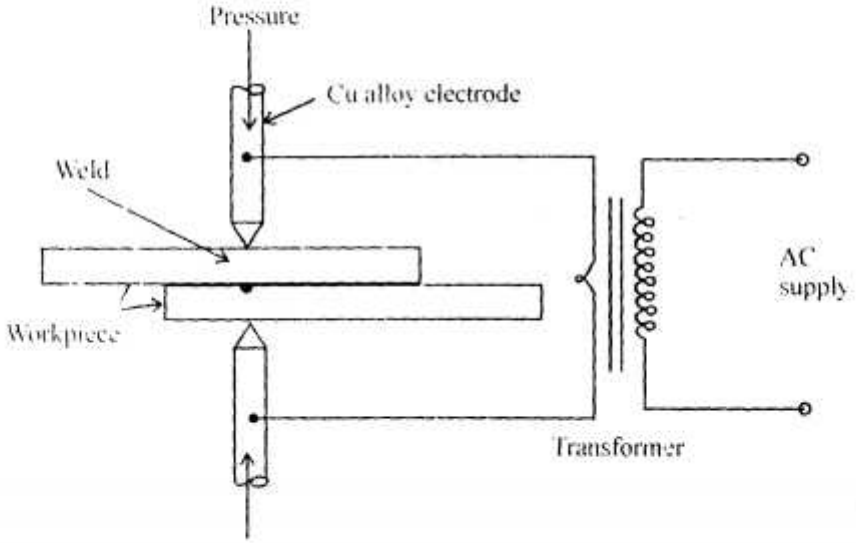
Q. 7. What are the principles or operation of resistance welding? Describe UPSET-Butt, Flash-Butt, Spot, Projection, Percussion welding giving their merits and limitations.

Ans. Resistance Welding : Resistance welding is a group of welding processes wherein coalescence is produced by the heat obtained from resistance of the work to the flow of electric current in a circuit of which the work is a part and by the application of pressure. No filler metal is needed.

The heat H for electric resistance welding is generated by passing a large electric current.

$$H = I^2RT$$

Spot Resistance Welding :



Spot welding is a resistance welding process is which overlapping sheets are joined by local fusion at one or more spots by the heat generated by resistance to the flow of electric current through workpieces that are held together under force by two electrodes, one above and other below the two overlapping sheet.

UPSET-Butt Welding :

Definition : Upset-butt welding is a resistance welding process wherein coalescence is produced simultaneously over the entire area of abutting surfaces by the heat obtained from the resistance to electric current through the area of contact of those surface.

Flash Butt : Flash welding is a resistance process, wherein coalescence is produced, simultaneously over the entire area of abutting surfaces by the heat obtained from the resistance to electric current between the two surfaces and by the application of pressure after heating is substantially completed.

Advantage of Flash Welding :

(i) Many dissimilar metals with different melting temperature can be flash welded.

(ii) Flash welding offers strength factors upto 10%.

Disadvantage :

(i) Metal is lost during flashing and upsetting.

(ii) Shape of the workpiece to be flash welded should be similar.

Application :

Flash welding finds application in automotive and aircraft products, house-hold appliances, refrigerators.

Percussion Welding : It is a resistance welding process where in coalescence in produced simultaneously over the entire area of abutting surface by heat obtained from an arc produced by rapid discharge of electric energy with pressure rapidly applied during following the electric discharge :

Merit :

(i) Because of the extreme brevity of the arc fusion is confined to the surface of part being welded and there is almost completely absence of flash or upset.

(ii) Heat treated or cold worked metals can be welded without annealing or destroying the heat treatment.

Limitation :

(i) The process is limited to butt welded joints only.

(ii) The joint used is limited to about 1. 5 to 3 sq. cm

Q. 8. Write short note on :

(i) Braze welding

(ii) Thermit welding

(iii) Embossing

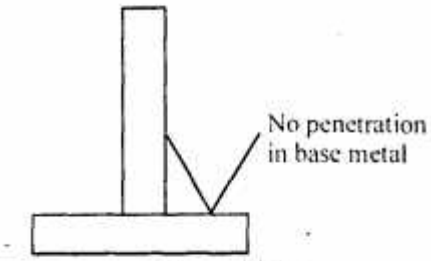
(iv) Submerged arc welding.

Ans. (i) Braze Welding :

Definition : Brazing is defined as a group of joining process wherein coalescence is produced by heating to a suitable temperature and by using a filler metal having a liquidus above 800°F and below the solids of the base metal.

In braze welding, metallic parts are jointed by a non-ferrous filler metal or alloy.

The filler metal is distributed between the closely fitted surfaces of the joint by capillary attraction.



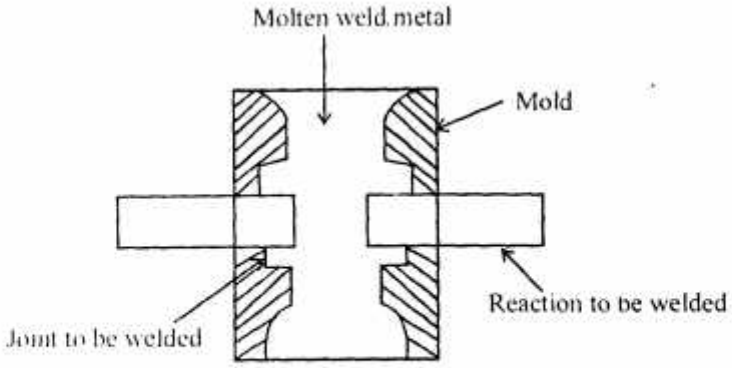
Brazed Joint

(ii) Thermit Welding :

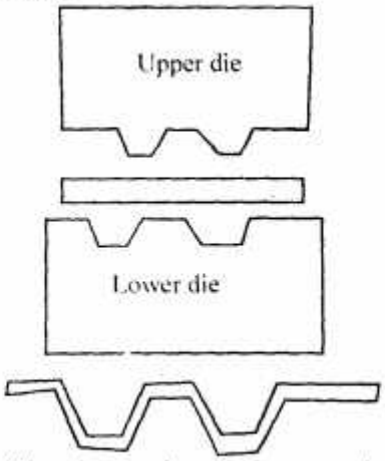
Definition : Thermit welding comprises a group of welding processes where in coalescence is produced by heating with superheated liquid metal and slag resulting from chemical reaction between a metal oxide and aluminium with or without the application of pressure.

Principle of Operation :

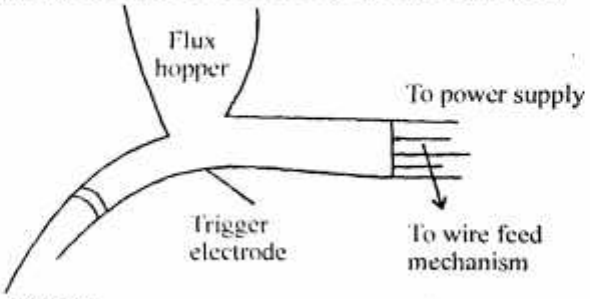
Thermit welding is based on casting and foundary practice and consist essentially of providing, by means of a chemical reaction, a volume of molten weld metal which is poured into the joint to be welded.



(iii) Embossing : Embossing is a forming or drawing operation for producing a raised or projected design in relief on the surface of the workpiece. The operation uses matching punch and die with the impression machined into both surface is shown in fig.



(iv) Submerged Arc Welding : The submerged arc process created on arc column between a base metallic electrode and workpiece. The arc, the end of the electrode and molten weld pool are submerged in a finely divided granulated powder that contains appropriate deoxidizers, cleaners and other fluxing elements. The fluxing powder is fed from a hopper that is carried on the welding head. The tube from the hopper spreads the powder in continuous mount in front of the electrode along the line of the weld.



Apparatus Used in Manual Submerged Arc Welding