MANUFACTURING PROCESSES II
TA-201N

Laboratory Manual

Department of Materials & Metallurgical Engineering
Indian Institute of Technology, Kanpur
(2009-2010 IInd Semester)

TA201N: Introduction of Manufacturing Processes (2009-10 Sem II)

TA201N (MME) Laboratory Schedule

Turn→ / Section ↓	Demonstration & Practice Session					Lab Exam	Project Session							REMARK
	1st Exer1	2nd Exer2	3rd Exer3	4th Exer4	5th Exer5	6th Drawing Submission + Lab Exam	7th Pro1	8th Pro2	9th Pro3	10th Pro4	11th Pro5	12th Pro6	13th Pro7	
Monday	4/1	11/1	18/1	25/1	1/2	8/2	15/2	22/2	8/3	22/3	29/3	5/4	12/4	
Tuesday	5/1	12/1	19/1	2/2	9/2	16/2	23/2	9/3	23/3	30/3	6/4	13/4	20/4	Required one makeup
Wednesday	6/1	13/1	20/1	27/1	3/2	10/2	17/2	24/2	10/3	31/3	7/4	14/4	21/4	Required one makeup
Thursday	31/12	7/1	14/1	21/1	28/1	11/2	18/2	25/2	11/3	18/3	25/3	1/4	8/4	
Friday	1/1	8/1	15/1	22/1	29/1	12/2	19/2	26/2	12/3	19/3	26/3	9/4	16/4	Required one makeup

1st to 5th : ***Demonstration & Exercise turns***
6th Turn : ***Lab Examination + Drawing Submission***
7th to 13th : ***Project Turns***

First Class : **December 31, 2009**
Republic Day : **January 26, 2010**
Ist Mid Semester Examination : **February 4th to February 6th, 2010**
Mid Semester Races : **February 27th to March 7th, 2010**
IInd Mid Semester Examination : **March 15th to March 17th , 2010**
Ram Navami : **March 24, 2010**
Good Friday : **April 02, 2010**
Last Class : **April 23, 2010**

Important Reminder:

2nd Turn	**Project group formation**
3rd Turn	**Discussion with rough sketch (5-6 PM)**
4th Turn	**Discussion with final drawing (5-6 PM)**
6th Turn	**Lab examination and final drawing submission**

Mr. G P Bajpai
Lab Incharge
gpbajpai@, 7978(O)

Dr. Krishanu Biswas
Instructor In-Charge
kbiswas@, 6140(O)

GENERAL INSTRUCTIONS

1. Every student should obtain a copy of Manufacturing Processes Laboratory Manual

2. Dress Code: Students must come to the laboratory wearing (i) Trousers, (ii) half-sleeve tops and (iii) Leather shoes. Half pants, loosely hanging garments and slippers are not allowed.

3. To avoid injury, the student must take the permission of the laboratory staff before handling any machine.

4. Students must ensure that their work areas are clean and dry to avoid slipping.

5. A leather apron will be issued to each student during Welding Exercise. Students not wearing the apron will not be permitted to work in the laboratory. Students are required to clear off all tools and materials from machine/work place.

6. At the end of each experiment, students must clear off all tools and materials from the work area.

7. Laboratory report must be submitted in standard sheet, available at the shopping center, in the subsequent lab turn. Reports on ordinary sheet and computer papers will not be accepted.

8. Each group submits one lab report if the experiment was performed in a group. For individual experiments separate lab reports should be submitted.

9. The Lab report should only contain: (1) Title of the experiment, (ii) Three to four lines stating the objectives, (iii) Name of all equipments/tools used along with a one line description of its use, and (iv) Answer to questions specifically asked in the section "Report the following." The report should be short and sweet.

10. Laboratory report will not be returned. However student can check their graded report by contacting their respective tutors.

11. Careless handling of machines may result in serious injury.

RECOMMENDED READING:

1. Materials Science & Engineering, G.S. Upadhyaya and A. Upadhyaya
2. Fundamentals of Modern Manufacturing, M.P. Groover
3. Fundamentals of Manufacturing Processes, G.K. Lal and S.K. Choudhury
4. Materials & Processes in Manufacturing, E. P. DeGarmo, J.T. Black and R. Kohser
5. Manufacturing Engineering and Technology, S. Kalpakjian
6. E.P. DeGarmo: Materials and Processes in Manufacturing, Macmillan.
7. J.S. Campbell: Principles of Manufacturing Materials and Process, McGraw Hill.
8. J.S. Schey: Introduction of Manufacturing Processes, McGraw Hill International.
9. M.L. Begeman & B.H. Amstead: Manufacturing Process, John Wiley.
10. H.W. Pollack: Manufacturing and Machine Tool Operations, Prentice-Hall.
11. R.A. Lindberg: Process and Materials for Manufacturing, Prentice-Hall.
12. L.E. Doyle: Manufacturing Processes & Materials for Engineers, Prentice-Hall.

GENERAL INFORMATION

In this laboratory you will be exposed to the common manufacturing processes such as casting, metal forming, and welding processing. Laboratory experiments will consist of hands expression and demonstration of the above mentioned processes.

This laboratory divided into three parts:

(1)	Hand-on-experience and demonstration of the above-mentioned processes	(5 turns)
(2)	Lab Examination & Drawing Submission	(1 turn)
(3)	Project	(7 turns)

You are required to submit a report on each laboratory session in the following that session. You will be provided with a question bank and quiz will be based on the questions contained in the bank. <u>You have to refer to the textbooks for appropriate answers to the questions in the question bank.</u>

Laboratory Session

Exercise	**No. of turn**
GMA & MMAWelding Practice and Demonstration + TIG Welding Demonstration & Polymer Joining	1
Brazing and Gas Welding Practice and Demonstration	1
Sheet Metal Practice and Demonstration + Rolling Demonstration	1
Hot Forging Practice and Demonstration + Cold Forging Demonstration	1
Demonstration & Practice of thermocole pattern making, molasses mold making + Demonstration of green sand mold making, and metal pouring in both molds	1
Laboratory examination	1
Project	7

INTRODUCTION TO CASTING PROCESSES

Objective

To study and observe various stages of casting through demonstration of Sand Casting Process.

Background

Casting is one of oldest and one of the most popular processes of converting materials into final useful shapes. Casting process is primarily used for shaping metallic materials; although it can be adopted for shaping other materials such as ceramic, polymeric and glassy materials. In casting, a solid is melted, treated to proper temperature and then poured into a cavity called mold, which contains it in proper shape during solidification. Simple or complex shapes can be made from any metal that can be melted. The resulting product can have virtually any configuration the designer desires.

Casting product range in size from a fraction of centimeter and fraction of kilogram to over 10 meters and many tons. Moreover casting has marked advantages in production of complex shapes, of parts having hollow sections or internal cavities, of parts that contain irregular curved surfaces and of parts made from metals which are difficult to machine.

Several casting processes have been developed to suit economic production of cast products with desired mechanical properties, dimensional accuracy, surface finish etc. The various processes differ primarily in mold material (whether sand, metal or other material) and pouring method (gravity, pressure or vacuum). All the processes share the requirement that the material solidify in a manner that would avoid potential defects such as shrinkage voids, gas porosity and trapped inclusions.

Any casting process involves three basic steps, i.e. mold making, melting and pouring of metals into the mold cavity, and removal and finishing of casting after complete solidification.

SAND CASTING PROCESSES

Sand is one of the cheaper, fairly refractory materials and hence commonly used for making mold cavities. Sand basically, contains grains of silica (SiO_2) and some impurities. For mold making purposes sand is mixed with a binder material such as clay, molasses, oil, resin etc.

Green Sand Molding

In green sand molding process, clay (a silicate material) along with water (to activate clay) is used as binder. The mold making essentially consists of preparing a cavity having the same shape as the part to be cast. There are many ways to obtain such a cavity or mold, and in this demonstration you will learn to make it using a wooden ‘pattern’, metal ‘flasks’ and ‘green-sand’ as mold material.

A pattern is a reusable form having approximately the same shape and size as the part to be cast. A pattern can be made out of wood, metal or plastic; wood being the most common material. Green sand refers to an intimate mixture of sand (usually river sand), bentonite clay (3-7 percent by weight of sand, to provide bonding or adhesion between sand grains), and water (3-6 percent by weight of sand, necessary to activate the bonding action of the clay). Mixing the above ingredients in a sand-muller best provides the intimate mixing action. In practice, a major part of this sand mixture consists of ‘return sand’, i.e. the reusable portion of the sand left after the solidified metal casting has been removed from the mold. Molding flasks are rectangular frames with open ends, which serve as containers in which the mold is prepared. Normally a pair of flasks is used; the upper flask is referred to as ‘Cope’ and the lower one as ‘drag’. A riddle is a relatively coarse sieve. Riddling the green sand helps in breaking the lump and aerates the sand.

Sometimes the casting itself must have a hole or cavity in or on it. In that case the liquid metal must be prevented from filling certain portions of the mold. A ‘core’ is used to block-off portions of the mold from being filled by the liquid metal. A core is normally made using sand with a suitable binder like molasses. Core is prepared by filling the core-box with core sand to get the desired shape and the baking this sand core in an oven at suitable temperature.

During mold making a suitable ‘gating system’ and a riser’ is also provided. The gating system is the network of channels used to deliver the molten metal from outside the mold into the mold cavity. The various components of the gating system are pouring cup, sprue, runners and gates. Riser or feeder head is a small cavity attached to the casting cavity and the liquid metal of the riser serves to compensate the shrinkage in the casting during solidification.

Fig. 1.1 shows the various parts of a typical sand mold. Several hand tools, such as rammer, trowel, sprue pin, draw spike, slick, vent wire, gate cutter, strike off bar etc. are used as aids in making a mold.

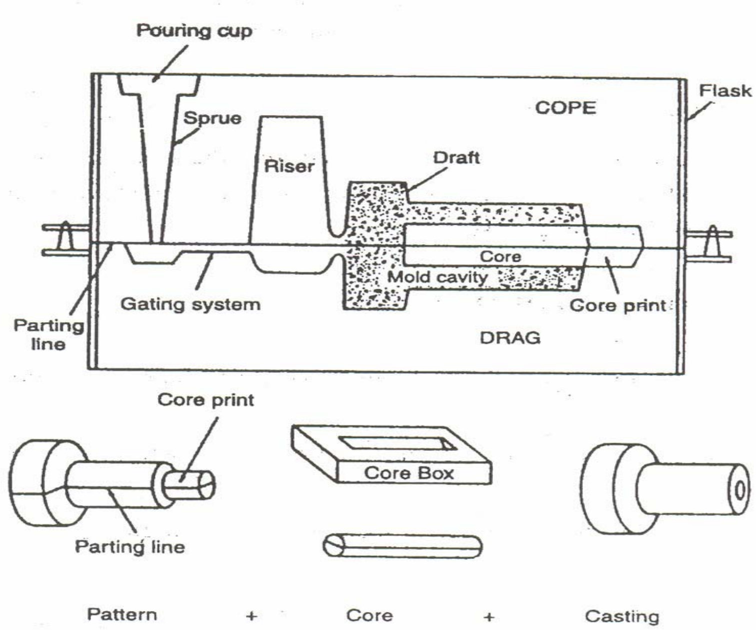


Fig: 1.1: Cross Section of a typical two-part sand mold, indicating various mold comoponents and terminology

The various steps involved in making mold from green sand (see Fig. 1.2) would be shown during the demonstration.

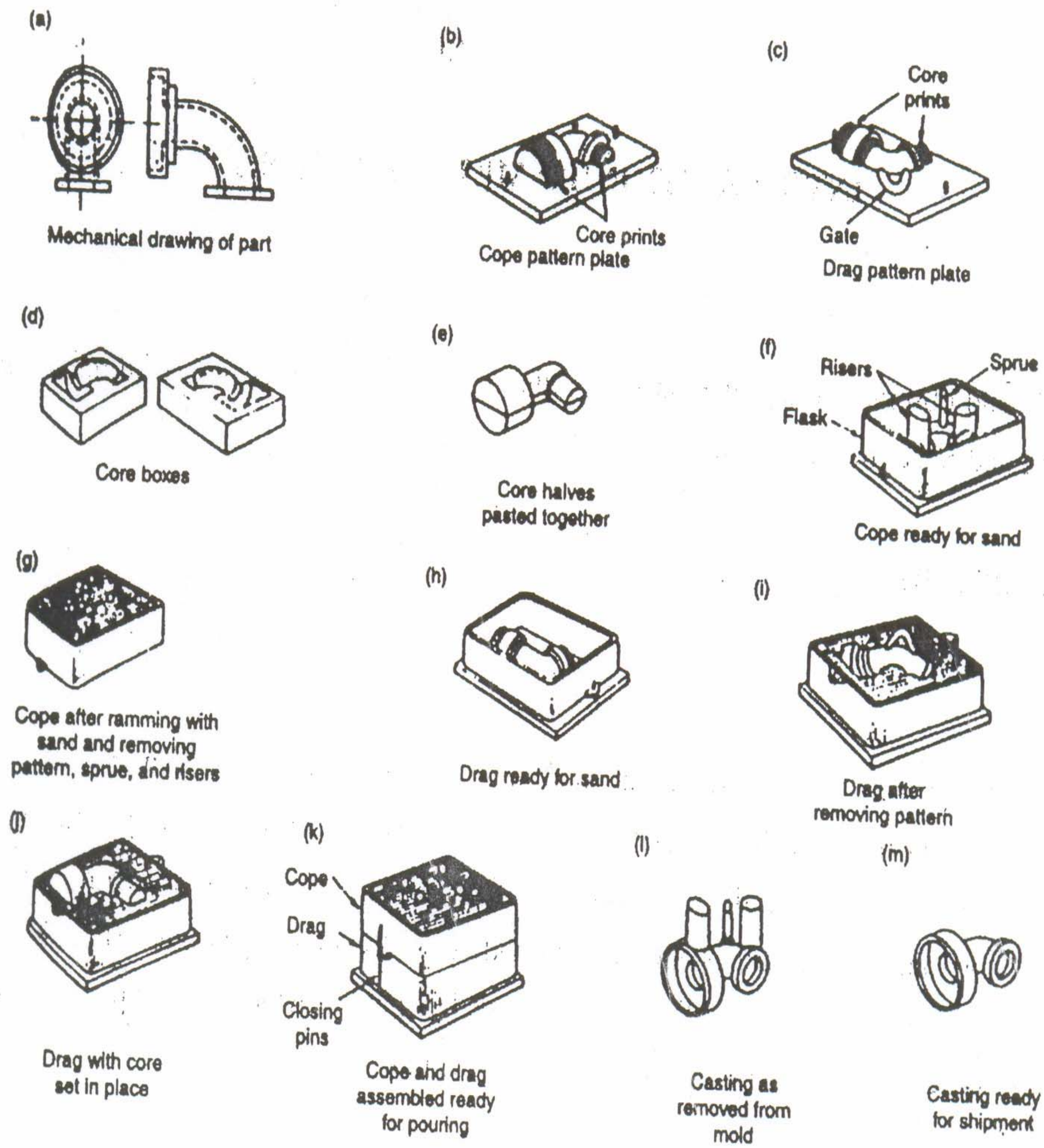


Fig 1.2: Schematic illustration of the sequence of operations for sand casting
Source: Steel founders society of America

Melting and Pouring of Metals

The next important step in the making of casting is the melting of metal. A melting process must be capable of providing molten metal not only at the proper temperature but also in the desired quantity, with an acceptable quality, and within a reasonable cost.

In order to transfer the metal from the furnace into the molds, some type of pouring device, or ladle, must be used. The primary considerations are to maintain the metal at the proper temperature for pouring and to ensure that only quality metal will get into the molds.

The operations involved in melting of metal in oil fired furnace/induction furnace and pouring of liquid metal into the mold cavity will be shown during the demonstration.

Removal and Finishing of Castings

After complete solidification, the castings are removed from the mold. Most castings require some cleaning and finishing operations, such as removal of cores, removal of gates and risers, removal of fins and flash, cleaning of surfaces, etc.

LABORATORY EXERCISE I
MOLD MAKING & CASTING

Objective

1. To prepare a pattern for given object for lost form casting.
2. To prepare a molasses sand mold from the prepared pattern.
3. To melt and pour iron metal into the mold.

Equipment and Materials

Pattern, core box, molding flasks, molding tools, sand muller, riddle, sand, molasses, bentonite, core baking oven, thermocole, melting furnace, fluxes, pouring ladle, pyrometer, hacksaw, file.

Procedure

Core making

(i) Prepare the core sand
(ii) Assemble (clamp) the core-box after applying some parting sand
(iii) Fill the core box cavity with core sand and ram it
(iv) Make vent holes or insert reinforcing wire as desired
(v) Tap the mold box on all sides to loosen the core from the box, unclamp the core box and carefully transfer the core on to a baking plate or stand.
(vi) Keep the core in the baking oven and bake it for desired length of the time at a predetermined temperature. After baking take the core out of the oven and allow it to cool at room temperature.

Mold Making

(i) Place the drag part of the pattern with parting surface down on ground or molding board at the center of the drag (flask).
(ii) Riddle molding sand to a depth of about 2 cm in the drag and pack this sand carefully around the pattern with fingers.
(iii) Heap more molding sand in the drag and ram with rammer carefully.
(iv) Strike off the excess sand using strike bar.
(v) Make vent holes to within 1 cm of the pattern surface in the drag.
(vi) Turn this complete drag and place the cope portion (flask) over it.
(vii) Place the cope half of the pattern over the drag pattern matching the guide pins and apply parting sand over the parting surface. Also place the sprue pin and riser pin in proper positions.
(viii) Complete the cope half by repeating steps (ii) to (v).
(ix) Remove the sprue and riser pins and make a pouring basin. Separate the cope and drag halves, and place them with their parting faces up.
(x) Moisten sand at the copes of the pattern and remove pattern halves carefully using draw spikes.
(xi) Cut gate and runner in the drag. Repair and clean the cavities in the two mold halves.

(xii) Place the core in position, assembled the two mold halves assemble and clamp them together.

Melting and Pouring

(i) Melt the metal in the furnace. Use appropriate fluxes at proper stages and measure metal temperature from time to time.

(ii) Pour the molten metal into the pouring ladle at a higher temperature (say 100^{o}C higher) than the pouring temperature. As soon as the desired pouring temperature is reached, pour the liquid metal into the mold in a steady stream with ladle close to the pouring basin of the mold. Do not allow any dross or slag to go in.

(iii) Allow sufficient time for the metal to solidify in the mold. Break the mold carefully and remove the casting.

(iv) Cut-off the riser and gating system from the casting and clean it for any sand etc.

(v) Inspect the casting visually and record any surface and dimensional defects observed.

Report The Following

1. Sketches of the product made, pattern and core.
2. Composition of molding sand and core sand used.
3. Melting and pouring temperature of the used metal.
4. List the allowances that are generally provided on a pattern.
5. Type, amount and manner of addition of fluxes, if any used.
6. Defects produced in your casting.

INTRODUCTION TO METAL FORMING

Objective

To study and observe through demonstration the metal forming processes (Rolling, Forging and Sheet metal forming).

Background

ROLLING

Rolling is the process of plastic deformation of metals by squeezing action as it passes between a pair of rotating rolls, either plane or grooved. The process may be carried out hot or cold. The most common rolling mill is the 2-high rolling mill, which consists of two rolls usually mounted horizontally in bearings at their ends and vertically above each other (Fig. 2.1). The rolls may be driven through couplings at their ends by spindles, which are coupled, to pinions (or gears), which transmit the power from the electric motor.

To control the relative positioning of rolls, a roll positioning system is employed on the mill stand. In small mills, such as the one in the laboratory, the roll positioning system called the 'mill screw' is hand driven, while in commercial mills they are motor driven.

The 2-high mills could be either reversing or non-reversing type. In the reversing type, which is the most common one, the direction of motion of the rolls can be reversed, and therefore the work can be fed into the mill from both sides by reversing the direction of rotation of rolls.

For rolling to take place the roll separation or roll gap must be less than the in going size of the stock. After rolling, the height of the stock is reduced and length is increased. The difference in height of ingoing and outgoing is called 'draught'. Fig. 2.1 shows a flat piece of metal of thickness h_1, through a pair of rolls of radius R. The AC is called the 'arc of contact'. The angle θ subtended at the roll center by the arc of contact is called the 'angle of contact' and can be evaluated from

$$\cos \theta = [1 - (h_o - h_1) / 2R]$$

If there is no elastic deflection of rolls during rolling, the final thickness of metal h_1 is same as the roll gap. If elastic deflection of rolls occur, the final thickness of metal after rolling h_1, is greater than the roll gap fixed before rolling.

Depending upon the condition under which the metal is introduced into the roll gap, two situations can occur:

- The metal is gripped by the rolls and pulled along into the roll gap.
- The metal slips over the roll surface.

The process of rolling depends upon the frictional forces acting between the surfaces of the roll and the metal. The condition of biting or gripping of metals into rolls is $\mu \geq \tan \theta$, where μ is the coefficient of friction between the roll and metal surfaces. The maximum value of θ ($\theta_{max} = \tan^{-1}\lambda$)

is often called the angle of bite. The average coefficient of friction can now be estimated as $\mu = \tan \theta_{max}$.

Rolling of a metal plate on a two high rolling mill will be demonstrated. The demonstration of the situations when (a) metal slips on the roll surface, and (b) metal is gripped by the rolls, would also be shown to you.

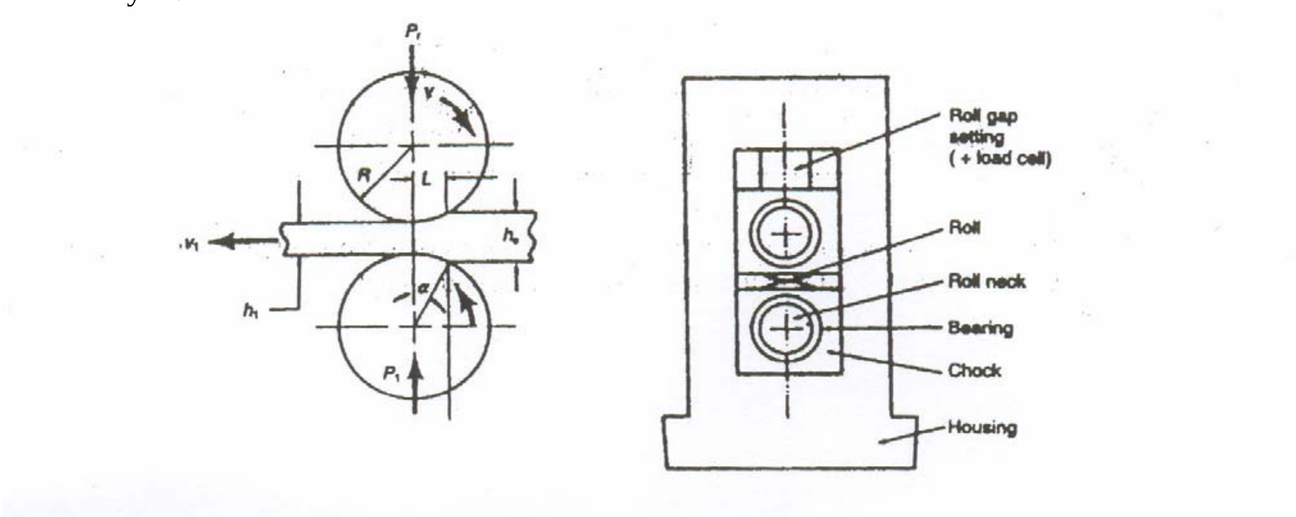


Fig.2.1: Rolling is steady state process that (a) reduces the thickness of the work piece (b) in rolling mills of considerable stiffness

Observations

(1) Report the various parameters in a tabular form for the various passes during the rolling of the given metal piece as shown in rolling demonstration.

Metal used:
Roll diameter:
Roll speed:

Pass	Initial Dim.			Passive	Final Dim.			Draught	% Inc.			Spring	Bite	Coefficient
No.	L	W	T	Roll Gap	L	W	T		L	W	T	back	Angle	of Friction
1.														

(L: Length, W: Width, T: Thickness, Inc: Increase, Red: Reduction, Dim: Dimension)

FORGING

Forging primarily consists of a work piece material and dies, which is of a predetermined shape by applying compressive load. Forging may be done in open or closed dies. Open die forgings are nominally struck between two flat surfaces, while closed die forgings are formed in die cavities. All forging processes require skill, but more skill is required in the open than closed dies forging.

Either a hammer or press can apply the compressive load. There are several types of each of these machines. You would be shown a power hammer, and a hydraulic press. On power hammer, the ram is accelerated on the down stroke by steam or air pressure in addition to gravity. Steam or air is also used to raise the ram on the upstroke. Hydraulic presses are load-restricted machines in which hydraulic pressure moves a piston, in a cylinder.

The ram velocity can be controlled and even varied during the stroke. The hydraulic press is a relatively slow speed machine. This results in longer contact time, which may lead to problems of heat loss from the workpiece and deterioration of the die. You would be shown the demonstration of the press forging of cylindrical shape metal specimens between top and bottom platens of the press.

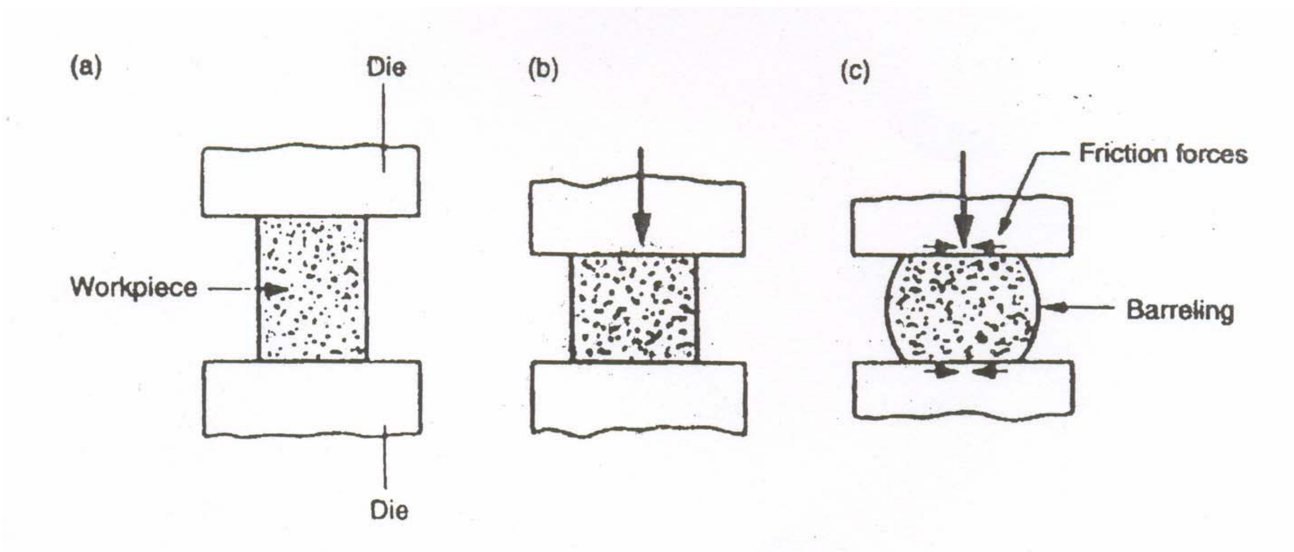


Fig: 2.2: a) Solid cylindrical billet upset between two flat dies (b) Uniform deformation pf the billet without friction (c) Deformation with friction

Observations

1) Report the percent reduction in height, and percent increase in diameter, and your observation on the shape of the blocks after forging as shown in the forging demonstration.
2) Draw schematically the shape of the blocks after forging.

Lubrication Condition	Initial Dimension		Pressure/Load	Final Dimension		Remarks
	Length	Diameter		Length	Diameter	

LABORATORY EXERCISE II
FORGING

Objective

To manufacture a small object using hot forging technique.
Report the observations during the cold forging of given metal pieces.

Equipment & materials
Forge hearth, tongs, anvil, sledge, flatter hammer, steel rod.

Procedure

- Take a steel rod of about 25 mm dia and about 75 mm long.
- Take piece weight before the heating.
- Place it in the hearth and heat it upto 1150^{o}C (yellow hot).
- Remove it from the hearth and hammer it to square shape
- Grind the head and sharpen the edge
- Weigh the final object.

Report The Following

(i) Sketches depicting each major step in processing.
(ii) Give the weight loss during the hot forging in your object.
(iii) Problems associated with heating of steel prior to forging.
(iv) Applications of the open die cold forging.
(v) Precautions to be taken.

SHEET METAL FORMING

Many products are manufactured from sheet metal involving combination of processes such as shearing, bending, deep drawing, spinning etc. In all these operations, some plastic deformation of the metal is involved. They are essentially cold working operations.

LABORATORY EXERCISE III
SHEET METAL FORMING

Objective

(i) To prepare a sheet metal product (square container).
(ii) Report the various parameters for the various passes during the rolling of the given metal piece.

Equipment & material
Mallet, hand shear, bench shear, grooving and riveting tool, metal sheet, soldering equipment.

Demonstration

Self secured sheet metal joints

(a) Internal grooved joint

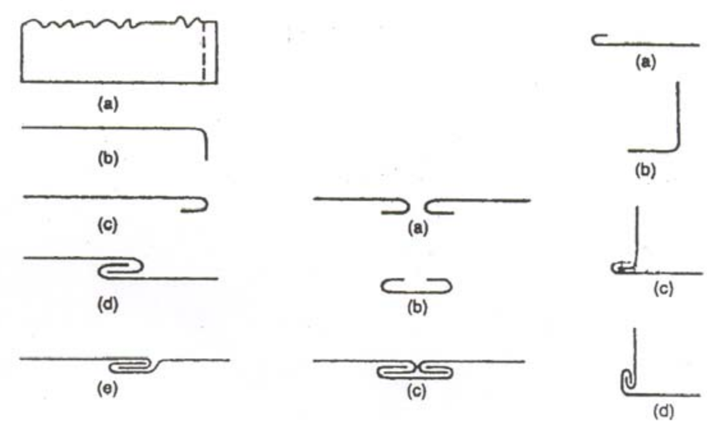
- Mark out portions of given sheets near edges to be joined with a marker (Fig. 3.1a)
- Fold the sheets at edges in the portion marked, first at right angles to the plane of the sheet (Fig. 8.1b) and then at 180^o to the plane (Fig.3.1c)
- Insert one folded sheet into the other (Fig. 3.1d)
- Groove the seam using grooving die (Fig. 3.1e)

(b) Double grooved joint

- Fold sheets after making them as per the instructions given (Fig. 3.2a)
- Cut a piece of sheet (called strap) of required width
- Strap width = (4x size of marked edges) + (4 x thickness of sheet)
- Close the edges of the strap slightly as shown in Fig. 3.2(b)
- Slip the strap on the bent edges of the sheets after bringing them together (Fig. 3.2c)

(c) Knocked-up joint

- Fold one sheet and close edges slightly (Fig. 3.3a)
- Bend one sheet to form a right angles band (Fig. 3.3b)
- Slip the second sheet in the folded one (Fig. 3.3c)
- Close the right angled sheet using a mallet (Fig. 3.3d)



3.1 3.2 3.3

Fig: Sheet Metal Joints

Procedure for Square Container:

- Cut a sheet of 120 mm x 120 mm, and mark a center of 60 mm x 60 mm to indicate bend lines.
- Mark bending lines of 4 mm and 6 mm on outer edge of square sheet as shown in figure
- Join the diagonals and mark 15^0 from corners of inner square (60 x 60 mm) …i.e. 7.5^0 on the either side of the diagonals
- Mark the intersection of 15^0 line with 10mm outside bending line, mark a 60^0 to the bending line (for all four corners, or eight times).

- From 60^0 intersecting line at 4mm from outer edge, now mark 172.5^0 to bending line (for all four corners, or eight times).
- Now remove the corner portions
    a. i.e. 60^0 till 6 mm (from inner corner edge towards outside edge),and then
    b. 172.5^0 for last 4 mm till outer edge.
- Fold the sides of container (try avoiding waviness)
- Seam the edges at all corners and make sure it is leak proof

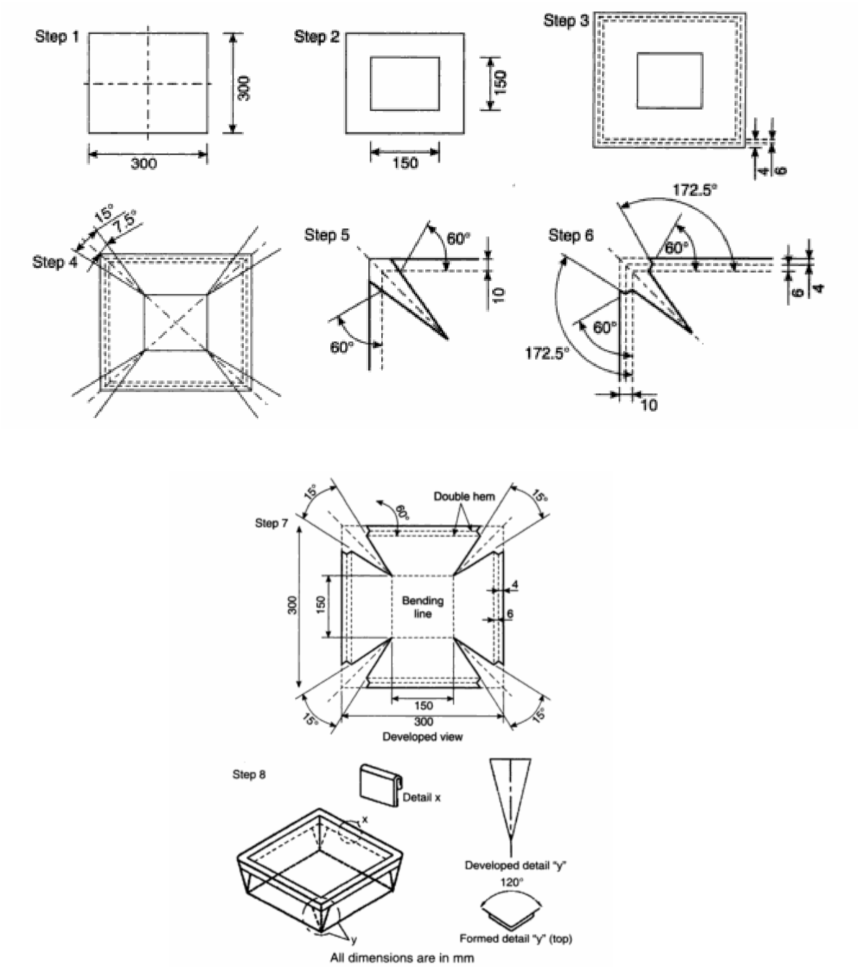


Fig. 2: Sheet metal forming of square container

Report the following

1. Precautions to be taken during sheet metal working
2. Name the processes used in soldering with description.
3. Composition of Solder alloy.
4. Draw the sketches showing the principle of the development of the job as shown in the sheet metal forming demonstration.
5. What are the machines used in the shearing and bending operation.

INTRODUCTION TO WELDING PROCESSES

Objective

To study and observe the welding and brazing techniques through demonstration and practice (Gas, MIG, TIG, Plastic, Brazing)

Background

Solid materials need to be joined together in order that they may be fabricated into useful shapes for various applications such as industrial, commercial, domestic, art ware and other uses. Depending on the material and the application, different joining processes are adopted such as, mechanical (bolts, rivets etc.), chemical (adhesive) or thermal (welding, brazing or soldering). Thermal processes are extensively used for joining of most common engineering materials, namely, metals. This exercise is designed to demonstrate specifically: gas welding, arc welding, resistance welding, brazing.

WELDING PROCESSES

Welding is a process in which two materials, usually metals, and is permanently joined together by coalescence, resulting from temperature, pressure, and metallurgical conditions. The particular combination of temperature and pressure can range from high temperature with no pressure to high pressure with any increase in temperature. Thus, welding can be achieved under a wide variety of conditions and numerous welding processes have been developed and are routinely used in manufacturing.

To obtain coalescence between two metals following requirements need to be met: (1) perfectly smooth, flat or matching surfaces, (2) clean surfaces, free from oxides, absorbed gases, grease and other contaminants, (3e) metals with no internal impurities. These are difficult conditions to obtain. Surface roughness is overcome by pressure or by melting two surfaces so that fusion occurs. Contaminants are removed by mechanical or chemical cleaning prior to welding or by causing sufficient metal flow along the interface so that they are removed away from the weld zone friction welding is a solid state welding technique. In many processes the contaminants are removed by fluxing agents.

The production of quality welds requires (1) a satisfactory heat and/or pressure source, (2) a means of protecting or cleaning the metal, and (3) caution to avoid, or compensate for, harmful metallurgical effects.

ARC WELDING

In this process a joint is established by fusing the material near the region of joint by means of an electric arc struck between the material to be joined and an electrode. A high current low voltage electric power supply generates an arc of intense heat reaching a temperature of approximately 3800^{o}C. The electrode held externally may act as a filler rod or it is fed independently of the electrode. Due to higher levels of heat input, joints in thicker materials can be obtained by the arc welding process. It is extensively used in a variety of structural applications.

There are so many types of the basic arc welding process such as shielded metal arc welding (SMAW), gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), submerged arc welding

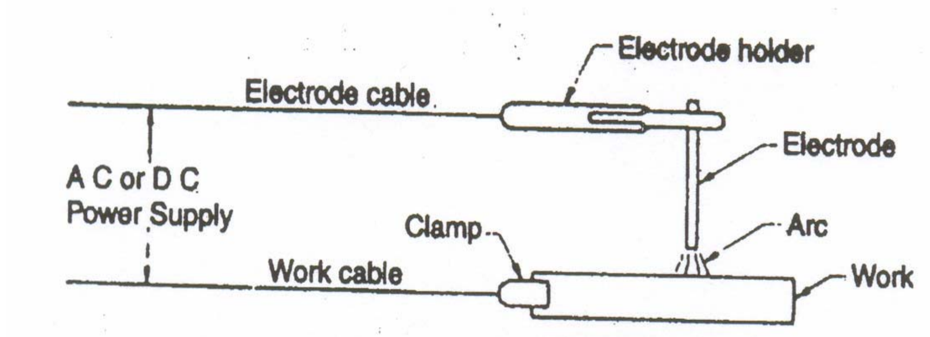


Fig 4.1: The Basic circuit for arc welding

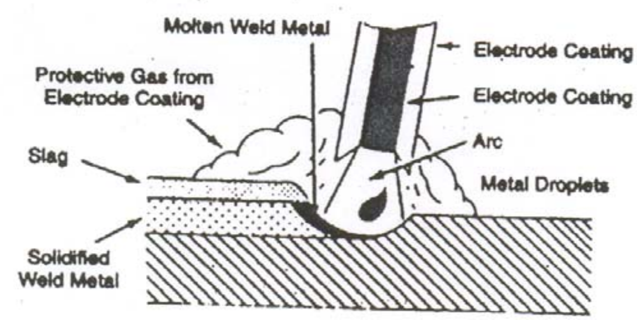
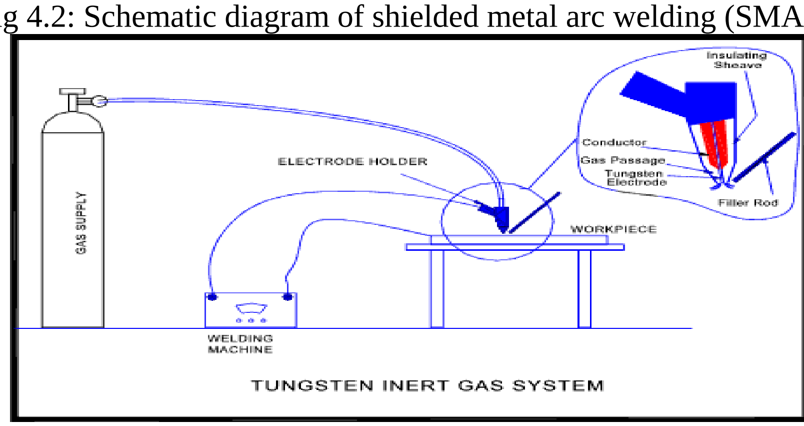


Fig 4.2: Schematic diagram of shielded metal arc welding (SMAW)



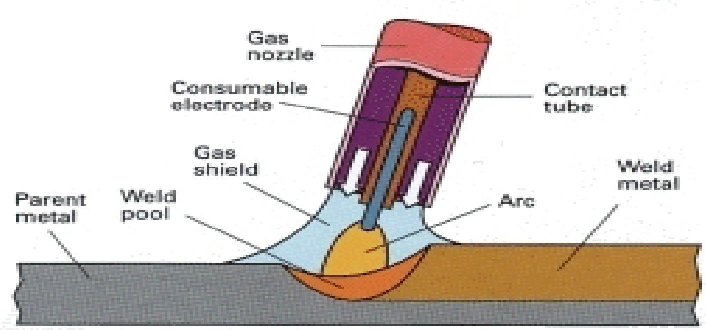


Fig 4.3: Schematic diagram of gas metal arc welding (GMAW)

LABORATORY EXERCISE IV
ARC WELDING

Objective

To prepare a butt joint with mild steel strip using GMAW & MMAW technique.

Equipment and materials

Welding unit, consumable mild steel wire, mild steel flats (140 x 25 x 5 mm), protecting gas, Wire Brush, Tongs etc.

Procedure

- Clean the mild steel flats to be joined by wire brush
- Arrange the flat pieces properly providing the gap for full penetration for butt joint (gap ½ thicknesses of flats).
- Practice striking of arc, speed and arc length control
- Set the welding current, voltage according to the type of metal to be joined.
- Strike the arc and make tacks at the both ends to hold the metal pieces together during the welding process
- Lay beads along the joint maintaining proper speed and arc length (Speed 100-150 mm/min).
- Clean the welded zone and submit.

Report the following

1. Precautions to be taken during various arc welding processes.
2. Advantages of GMAW over MMAW.
3. Difference between consumable and non-consumable arc welding.
4. Limitations of arc welding.
5. What is the procedure of ultrasonic welding?
6. Is there any difference between resistance and ultrasonic welding?

GAS WELDING

In this process, a joint is established by fusing the material near the region of joint by means of a gas flame. The common gas used is mixture of oxygen and acetylene which on burning gives a flame temperature of 3300^{o}C. A filler rod is used to feed molten material in the gap at the joint region and establish a firm weld. The flame temperature can be controlled by changing the gas composition i.e. ratio of oxygen to acetylene. The color of flame changes from oxidizing to neutral to reducing flame.

BRAZING

In this process metal parts to be joined are heated to a temperature below the melting point of the parts but sufficient to melt the lower fusion point filler material which is used to fill the gap at the joint and establish a bond between the edges through the filler material (Fig.3.3). This process can establish a joint between two dissimilar metals also though a proper choice of filler material. Unlike in welding the filler rod differs widely in composition from the parent material(s). Gas (oxy-acetylene mixture) is used for heating.

LABORATORY EXERCISE V
GAS WELDING & BRAZING

Objective

To prepare a butt joint with mild steel strips using brazing technique.

Equipment & materials

Gas welding set, brazing wire, gas-welding wire, fluxes, mild steel strips(140 x 25 x 3 mm), wire brush, tongs etc.

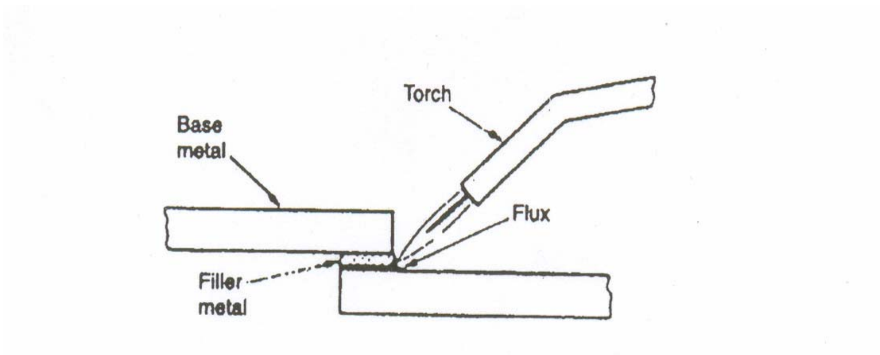


Fig: Brazing

Procedure

Brazing

- Clean the mild steel strip removing the oxide layer and flatten it.
- Keep the metal strip in lap position.
- Tack at the two ends.
- Lay brazing metal at the joint maintaining proper speed and feed.
- Clean the joint and submit

Gas Welding

- Clean the mild steel strip removing the oxide layer and flatten it.
- Keep the metal strip in butt position.
- Tack at the two ends.
- Deposit filler metal at the joint maintaining proper speed and feed.
- Clean the joint and submit

Report the following

1. Nature of flame used in brazing and gas welding.
2. Composition of the filler rod used in brazing and gas welding.
3. Composition of flux used in brazing and its role.
4. Precautions to be taken during brazing and gas welding.
5. Limitation of gas welding and Brazing

ABOUT PROJECT

1) The project groups will be formed by the end of the **Second lab turn**. Maximum number of student in each group will be FOUR. Only in exceptional cases, some of the groups can go up to 5 with prior permission from the section tutors.

2) You should come with all necessary information such as drawing; manufacturing process for each part on the discussion turns **(III and IV).** The drawing should be engineering drawing and properly labeled.

3) The copy of final project drawing with material list must be submitted to the lab on the **Sixth turn**. You should select materials from the list only. (The list is displayed on lab notice board).

4) Plan your project carefully. Do not make it unnecessarily complicated. The project has to be entirely your work. Laboratory staff (technical guide) will provide you only the guidelines. They will not make any part of your project.

5) The total weight of all casting components should not exceed 5 **Kgs**.

6) Your tutor and the technical staff will advise you on the design of your project and also the overall size/weight of the project.

7) There will be no extra lab turn.

8) The exact responsibilities of each group member should be specified.

9) Your project should be a mix of the different processes that you will practice in the both labs.

10) Before the final evaluation of the project a report has to be submitted. The report should contain general description of the project, detailed drawing, procedure, and process involved with description, costing and suggestion for improvements etc.

In case of any doubt regarding the above, please contact Mr. G.P. Bajpai.

TA-201 MANUFACTURING PROCESSES
QUESTION BANK (MME LAB)

Note: Answers to all questions should be to the point. Make use of line sketches whenever applicable.

EXERCISE I: INTRODUCTION TO CASTING PROCESSES

1. What are the advantages sand disadvantages of green sand molds?
2. What are the basic requirements of molding sand?
3. What is a Muller and what function does it perform?
4. What type of allowances is generally incorporated into a casting pattern?
5. Why is it important to make vent holes in the mold?
6. What is a parting line or parting surface?
7. What is the benefit of a split pattern over a one piece or solid pattern?
8. What are cores? How does core sand differ in composition from molding sand?
9. What type of defects is encountered in the casting if the moisture content in the green sand mold is too high?
10. What should be the shape and size of a riser for obtaining a sound casting?
11. What are chills? State their functions?
12. What is dross or slag? How can it be prevented from becoming a part of the finished casting?
13. Why are metals generally subjected to some treatment before being poured into the molds?
14. What is the best way of making a casting having very thin sections from a difficult to machine material? Why?
15. What advantages would you envisage if the melting and pouring of casting were done in vacuum?
16. What is a core-print and what is its purpose?
17. List the pouring temperatures (in C) and suitable melting furnaces for: Cast Irons, Steels, and Aluminum Alloys?
18. What defects are likely to be caused due to (I) Undersized core, (ii) Oversized core?
19. What are the advantages of machine molding?
20. What is a sand rammer and what is its function?

EXERCISE II: INTRODUCTION TO METAL FORMING

1. What do you mean by hot and cold working of metals?
2. What are the advantages and disadvantages of hot working of metals?
3. What are the advantages and disadvantages of cold working of metals?
4. What would be the consequence of having different speeds of the two rolls during rolling?
5. When cold rolling hard strips requiring large rolling leads on a 2-high rolling mill, a common problem encountered is the roll deflection which produces non-uniform thickness access the width of the strip. How is this problem overcome in practice?
6. State of least a products, which are manufactured by rolling process.
7. In industry the rolls are cooled with a spray of water during hot rolling of steels. Why?
8. Why are lubricants generally applied on the sheet of metal being rolled during cold rolling operation?
9. Why does barreling occur during forging of cylindrical blocks? How could this be minimized?
10. How could buckling of cylindrical blocks during forming be prevented?
11. Between the forging hammer and forging press, which one has better energy transfer from the machine to the work piece? Why?
12. Is there any type of forging press other hydraulic type? How does it work?
13. Can you use the some shearing machine without adjusting anything for shearing sheets of various metals of different thickness? Why?
14. What do you mean by spring back phenomenon as associated with the bending operation?
15. What do you mean by neutral axis with reference to bending operation?
16. Why are sheared or blanked edges generally not smooth?
17. Does sheet thickness restrict the angle through which it can be bent? Why?
18. What mechanical property is most important for its swaging? What type of stress is experienced by the material being swaged?
19. What is likely to happen if you swage a tube?
20. What are the advantages of forging over casting?

EXERCISE III: INTRODUCTION TO WELDING PROCESSES

1. What are the requirements of ideal bond during welding?
2. What are some of the problems that might occur when high temperatures are used in welding?
3. What are the stages of combustion of oxygen and acetylene?
4. Why is filler metal required during welding?
5. What are the limitations of gas welding?
6. What is the difference between a consumable electrode and a non-consumable? electrode in arc welding?
7. What are the processes variable as that must be specified when setting up an arc welding process?
8. What is the role of electrode coatings in shielded metal arc?
9. Why might gas metal arc welding the preferred over shielded metal arc welding?
10. What type of rays are given off by an electric arc? What precautions need to be taken by the welder?
11. How do porosity and slag inclusions occur in welding?
12. What tests can be used to check the soundness of the weld?
13. What is the significance of torch angle with respect to the job?
14. With the help of simple sketches the difference between forehand and backhand gas welding.
15. Why does heat get confined at the part interfaces during resistance welding?
16. Why do you need to apply pressure during resistance welding?
17. How does brazing differ from welding?
18. What are the advantages of brazing over welding?
19. What are the functions of flux in brazing and soldering?
20. What alloy system accounts for the majority of soldering alloys?