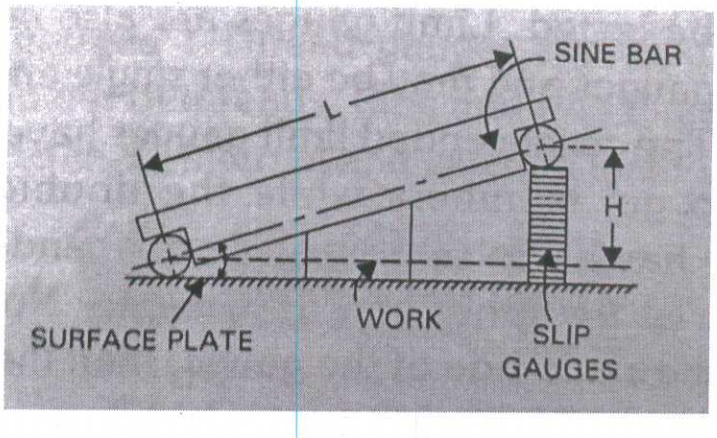
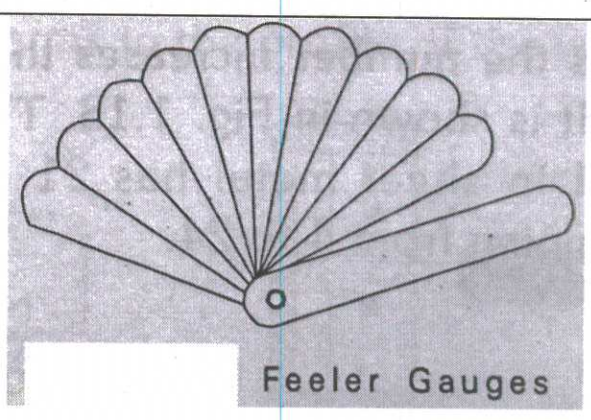
Scoring Indicators

Code :3023 **Version:**

Qn. No.	Scoring Indicators	Split score	Total score
	Part A		
I .1	Chaplets are metal forms placed between mould and surfaces. They are used to overcome displacement of the core due to buoyant force exerted on it by the molten metal.	2	2
I .2	They are chemical compounds used to prevent the oxidation and other unwanted chemical reactions during welding.	2	2
1.3	The measuring instrument which does not give a direct indication of size of the part can be termed as comparator. It gives only dimension differences in relation to a basic dimension.	2	2
1.4	Mechanical working of metals above recrystallization temperature is hot working.	2	2
1.5	the type of metal to be welded the position in which the weld is to be done the power source polarity, in case of D.C. thickness of the base metal expected properties of welded joint	2	2
	Part B		
II.1	A perfect crystal, with every at the correct position, does not exist. All crystals have some *defects.* Defects contribute to the mechanical properties of metals. Point defects, which are places where an atom is missing or irregularly placed in the lattice structure.Point defects include lattice vacancies, self-interstitial atoms, substitution impurity atoms and interstitial impurity atoms Linear defects, which are groups of atoms in irregular positions. Linear detects are commonly called dislocations. Planar defects, which are interfaces between homogeneous regions of the material. Planar defects include grain boundaries, stacking faults and external surfaces.	2	
	Point defects are where an atom is missing or is in an irregular place in the lattice structure. Point defects include self interstitial atoms, interstitial impurity atoms, substitutional atoms and vacancies. A self interstitial atom is an extra atom that has crowded its way into an interstitial void in the crystal structure. Self interstitial atoms occur only in low concentrations in metals because they distort and highly stress the tightly packed lattice structure A substitutional impurity atom is an atom of a different type than the bulk atoms, which has replaced one of the bulk atoms in the lattice. Substitutional impurity atoms are usually close in size (within approximately 15%) to the bulk atom. An example of substitutional impurity atoms is the zinc atoms in brass. In brass, zinc atoms with a radius of 0.133 nm have replaced some of the copper atoms, which have a radius of 0.128 nm.	2	

	Interstitial impurity atoms are much smaller than the atoms in the bulk matrix. Interstitial to impurity atoms fit into the lattice structure An example of interstitial impurity atoms is the carbon atoms that are added to iron to make steel. Carbon atoms with a radius 0.071nm fit ff nicely in the open spaces between the larger (0.124 nm) iron atoms	2	6
II.2	important constituents of moulding sand are (a) Silica sand (b) Binders (c) Additives (d) Water (a) Silica Sand : Silica sand is the granular particles resulting from the break down of quartz and other silica rocks. A moulding sand contains50 to 95 percentage of silica sand in it. Pure silica sand lacks binding quality. (b) Binders: A material present in the moulding sand, which imparts cohesiveness to it is called a binder. The binder holds the sand grains together, imparts strength, resistance to erosion and breakage. The common bindersused in foundry can be grouped as follows. (1) Organic binders (2) In organic binders. (c) Sand Additives: Additives are those materials other than binders,	4* 11/2	6
II.3.a	A sine bar is used for measuring and setting of angles. It is made of tool steel, hardened, ground and lapped to an extreme accuracy. It has two hardened steel rollers of equal diameter fastened near the ends. The axes of rollers are mutually parallel and the centres of these cylinders are on a line exactly parallel with the working face of the bar. It is used one surface plate in conjunction with a set of slip gauges as in the Figure.	1	
		2	
II.3.b	Feeler gauges: Feeler gauges are thin steel blades hardened and ground to various sizes. These are used for checking the clearance between two mating parts. The blades are pivoted in a holder as in Figure. Each blade is marked with its thickness which varies from 0.03 mm to 1 mm and the length of the blades is about 100 mm	1	



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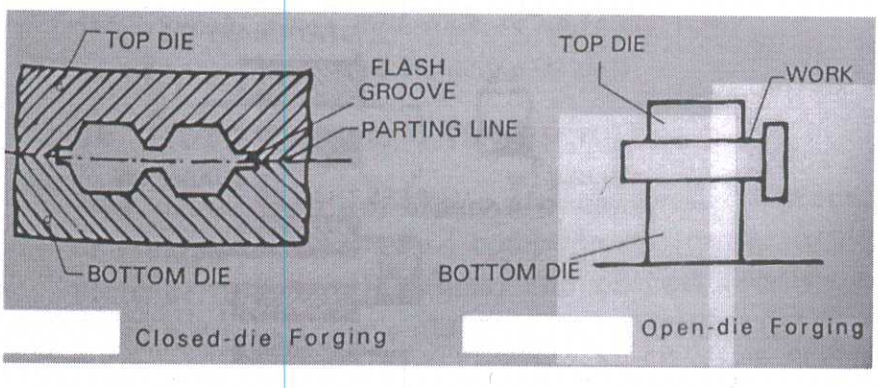
II.4 In open die forging the hot metal is shaped between two flat dies or dies with a groove of simple shape. Because at least one of the work piece surfaces deforms freely. Open die forging have lesser accuracy than closed or impression die forging, however, tooling cost is low and allows the production of the large variety of the shapes.This method is used to produce large forgings such as propeller shafts for ships. Open die forging performed by hand is called smithing or hand forging. | 3



Closed (impression)-die drop forging is a very suitable process for mass production and can be employed to produce parts ranging in weight from few grams to several hundred kilograms. In drop forging the upper half of the die is attached to ram and bottom half of the die to the anvil. The ram is raised and allowed to fall on the work piece, placed over the bottom half of the die.The process consists of kneeding and shaping the hot metal in closed impression dies. These dies impart proper shape and size to the work piece. | 3 | 6

II.5 The materials selected for a pattern should be easily workable, durable and should maintain dimensional accuracy.

1. Wood :
2. Metal a.Steel, b.Cast iron, c.Aluminium, d.Brass,
3. Plastics

6* 1 | 6

Wood advantages :

Easily available and possess low weight.

Inexpensive and easy to work.

Can be preserved its surface by shellac coating.

Metal advantages :

3

Durable, and produce castings of improved surface finish.

High strength, and donot deform in storage.

Wear resistance and maintains dimensional stability.

Greater resistance to abrasion in mould.

Greater stability under changing atmosphere.

(a) Steel: It possess excellent wear resistance and strength. However, it has poor resistance to corrosion. These patterns can be easily repaired, and are best suited for mass production.

(b) Cast iron : Cast iron is used for large size castings and requires dry storage area to protect from rust. The advantages of cast iron are :

Strong and gives a good smooth mould surface.

Cheap and easy to repair.

Good resistance to abrasion.

(c) Aluminium: Aluminium is the most commonly used metal for patterns. It offers the following advantages.

Low melting point.

Soft and easy to shape.

Resist corrosion.

Patterns are light with good strength and wear resistance.

(d) Brass : Advantages :

Stronger than aluminium and can withstand rough usage in moulding.

Takes better surface finish.

Repairs can readily be made with soft solders.

Patterns are able to withstand the wear of the moulding sand.

Plastics : advantages

High strength and light weight.

Good dimensional stability.

Resistance to corrosion.

Ease of repair and modification.

II.6 PRINCIPLE OF ARC WELDING :

The source of heat in this process is an electric arc. The electric arc develops when current flows across the air gap between the end of metal electrode and the work surface.The temperature of this arc is about 3600°C which can melt and fuse the metal very quickly to produce joint. The temperature of the arc at the centre is

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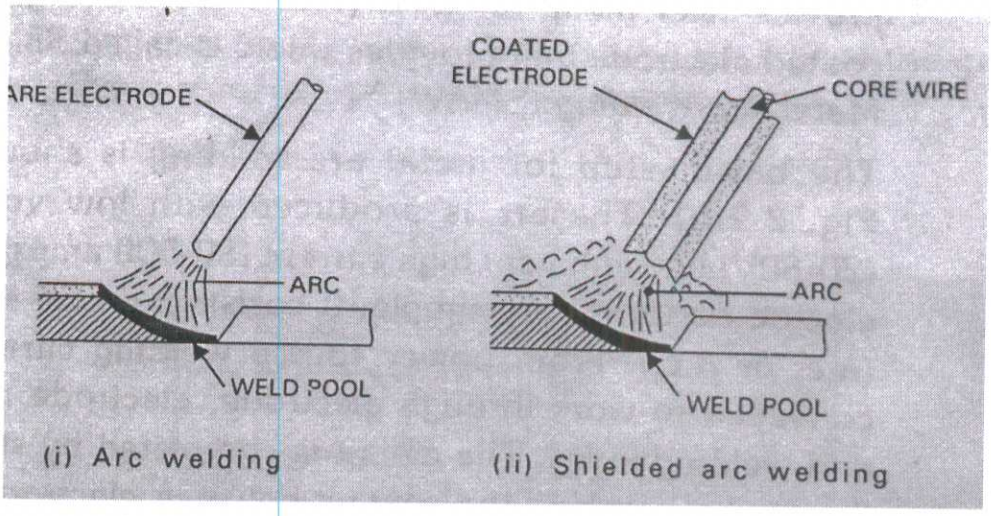
around 6500°C.



The principle of arc welding is based upon the formation of an electric arc between a consumable electrode (bare or coated) and the base metal. The heat of the arc is concentrated at the point of welding; as a result, it melts the electrode and base metal. When the weld metal solidifies, the slag gets deposited on its surface as it is lighter than metal and weld metal is allowed to cool gradually and slowly. After cooling (solidification) a sound joint is formed. The slag is removed by chipping hammer.

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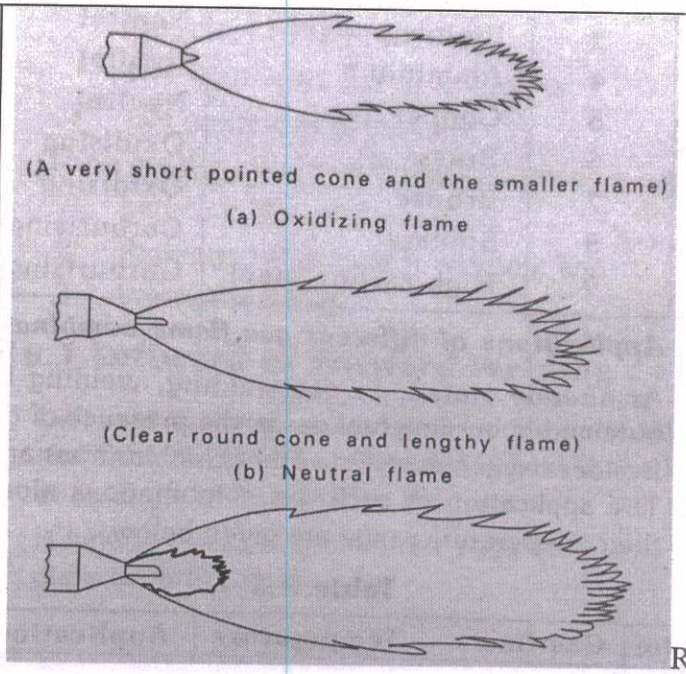
II.7 Depending on the relative amount of oxygen acetylene, the gas flame classified into three types

Oxidising flame : The oxidising flame has an excess of oxygen over the acetylene. Its inner cone is shorter and less luminous and outer flame acquires light bluish colour.It is used for welding brass, bronze and brazing of ferrous metals. A slightly oxidising is helpful In welding manganese steel and cast iron.

Neutral flame: The neutral flame has equal quantities of oxygen and acetylene, it Is most common flame used in welding processes. It has an inner luminous cone and outer flame with bluish colour .It is used for welding low-carbon steel, stainless steel, cast iron, aluminium, magnesium, copper and bronze.

Reducing (carburising) flame : The carburising flame has an excess of acetylene over the oxygen. It has a longer inner cone, an intermediate cone of whitish colour (intermediate feather) and bluish outer flame.It is used for welding high carbon steel and hard facing of HSS with satellites and cemented carbides.



Reducing (carburising) flame

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Part C

III.a

Inside Micro meter: It is used for measuring the diameter of holes and other internal dimensions to an accuracy of 0.01 mm. It consists of measuring unit, a number of interchangeable extension rods, and a handle. The measuring unit has a barrel and thimble graduated in the same manner as outside micrometer, but its total adjustment is limited to 13 mm i.e., when a screw is turned in the barrel, the distance between measuring faces can vary from 50 to 63 mm. But a basic internal micrometer covers a measuring range of 50 mm to 200 mm by using extension rods.

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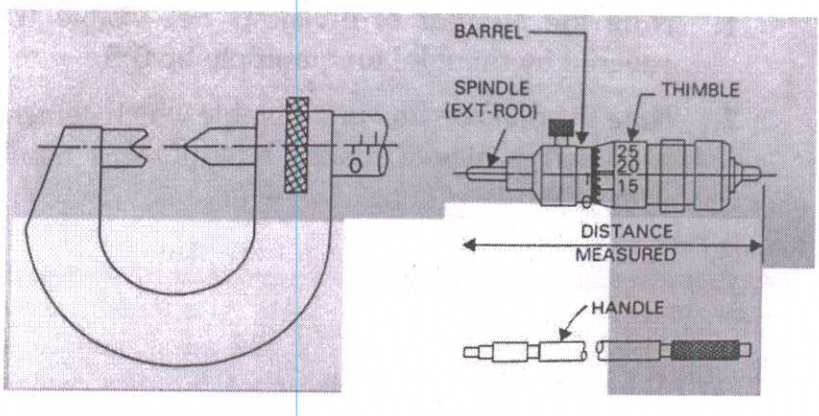

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III.b

Electrical Comparators The principle of these comparators is to convert the linear displacement of the measuring stylus into an electric output. Wheatstone bridge circuit is used for this comparator. When the circuit is balance no current is detected and the following condition will exist. $\frac{R_1}{R_2} = \frac{R_3}{R_4}$

If one of these resistors is varied then imbalance in the circuit will result in a current flow through the galvanometer. By arranging the variable resistor to form the part of the measuring head mechanism, the galvanometer may be calibrated to

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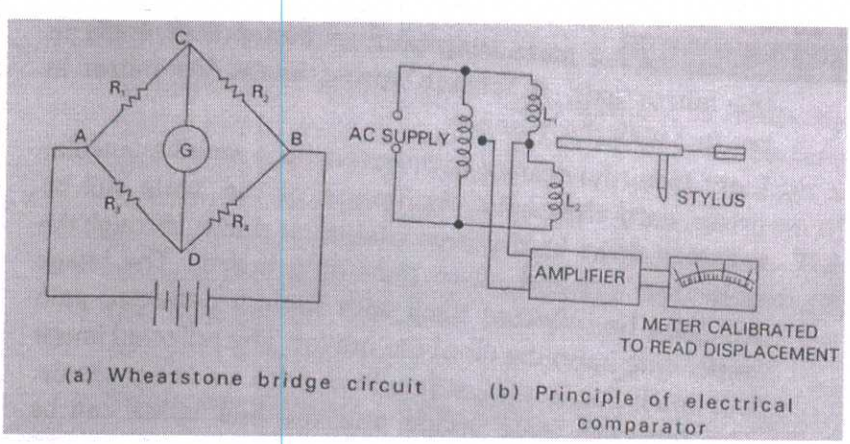
read linear displacement. The wheat stone bridge circuit is suitable only for D.C. supplies.



(a) Wheatstone bridge circuit (b) Principle of electrical comparator

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IV.a Reed type mechanical comparator: It is a mechanical comparator with frictionless device for magnifying small displacement of the work contact spindle.. Fixed block A is rigidly connected to the gauge head case and floating block B. Floating block carries the spindle and is connected horizontally to the fixed block by reeds C. The vertical reeds D attached to each block with upper end joined together, and beyond this joint a pointer is provided as shown in Figure. A linear displacement of the spindle moves free block vertical causing the vertical reed on the floating block to slide past the vertical reed on the fixed block. This movement causes both the reeds swing through an arc as they are joined at upper end, and pointer which is an extension of reeds, swings through much wider arc. The amount of pointer swing is proportional to the distance the floating block has moved. The mechanical amplification is usually less than 100,.

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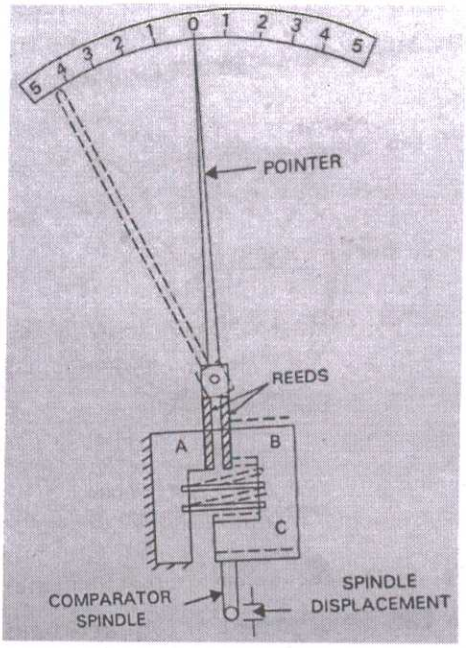

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IV.b Vernier Height Gauge :The vernier height gauge is used to measure the height of a component to an accuracy of 0.02 mm. The main parts of vernier height gauge is shown in Figure. It consists of an upright steel beam attached to the steel base. A movable jaw with vernier scale is attached to this beam. The movable jaw can be positioned and firmly fixed to the beam with the help of clamping screws. Before using vernier height gauge, it should be adjusted for the zero reading. Zero line of vernier should coincide with that of the scale. Now move the slide to required

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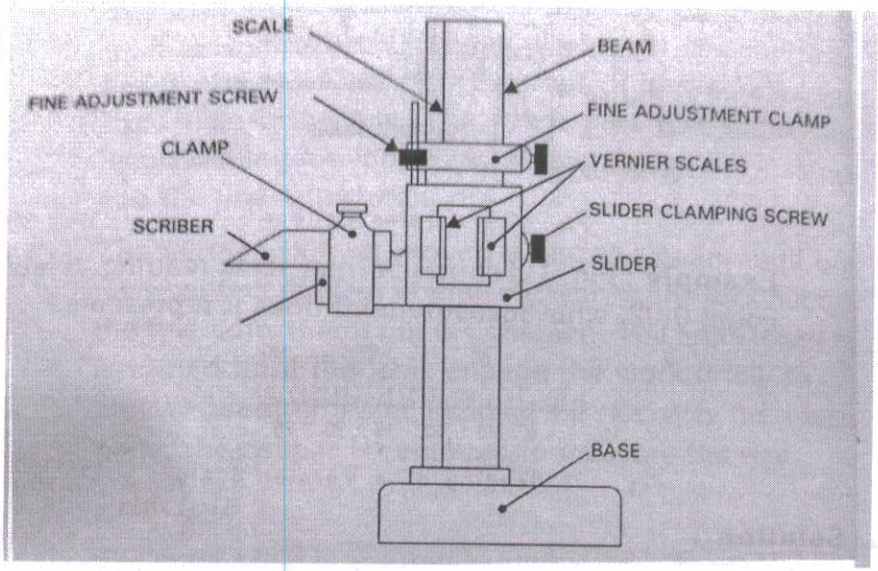
position. It can also be used to mark at specified height by inserting scriber in the lower face of the jaw



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V.a

Metal Inert gas (MIG) welding is an arc welding process In which metal electrode in the form of continuous wire is fed into the arc at the same rate at which it to being melted and deposited in the weld. The arc and welding zone to shielded by inert gas to prevent atmospheric contamination

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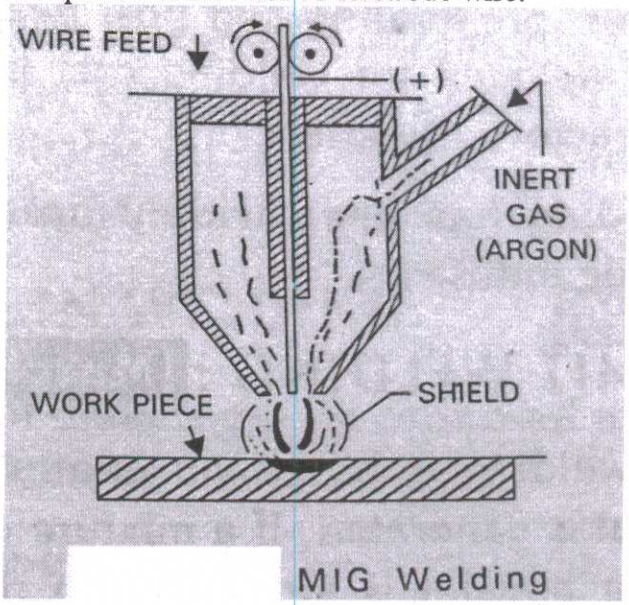
Direct current reverse polarity (DCRP) to generally used in MIG welding, DC straight polarity (DCSP) to sometimes used, but AC is to not used in MIG due to unequal burn off rates of electrode wire.



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V.b

Soft soldering (soldering) is the process of joining metals by the use of filler metal of low melting point (450°C).The filler metal is an alloy of lead and tin and is called solder. The melting point of solder is less than the base metals. Depending upon the proportions of each constituent, its melting point vary from 150 to 350°C The percentage of lead increases the melting point of solder.

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Advantages of Soldering :

Operation is simple and faster than other methods.

Strong enough for most sheet-metal works and electrical components.

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Disadvantages of Soldering :

Joints are weak and cannot with stand high temperature.

Brazing is similar to soldering but it gives much stronger joint. It is accomplished at temperature above 450°C using a number of Non-ferrous alloys (brazing alloys), The copper zinc (brass), is most widely used for filler material and is called spelter. Depending upon the composition, a melting point about 875^0C to 895^0C | 4 | 7

In brazing two metal surfaces to be joined must be cleaned and are properly fitted together with appropriate clearance for the filler materials. The flux such as borax is applied on the joint and is heated to a temperature just above the melting point of the spelter, the liquid spelter is distributed between the surfaces by capillary action. After solidification it adheres to surfaces and forms strong joint.

Advantages of brazing :

The strength of brazed joint is superior to that of soldered joint.

Brazed joint can withstand high temperature.

Mechanical interlocking of parts is not necessary

Disadvantages of brazing :

Requires costly equipment for heating.

The colour of brazing alloy may not match with the base metal.

VI.a Submerged arc welding is used for the production of long continuous weldings. In this case, a bare electrode (1.5 -10 mm) in the form of continuous wire is used; and the arc is struck between electrode wire and work piece under the flux, consisting of lime, silica, magnesium oxide, calcium fluoride and other elements, The flux is fed as a powder In front of the electrode The flux near the arc melts and forms a protective coating of slag, which Is easily detached from finished weld The rate of cooling of the weld metal is slow, and it is also protected from atmosphere while cooling. | 4

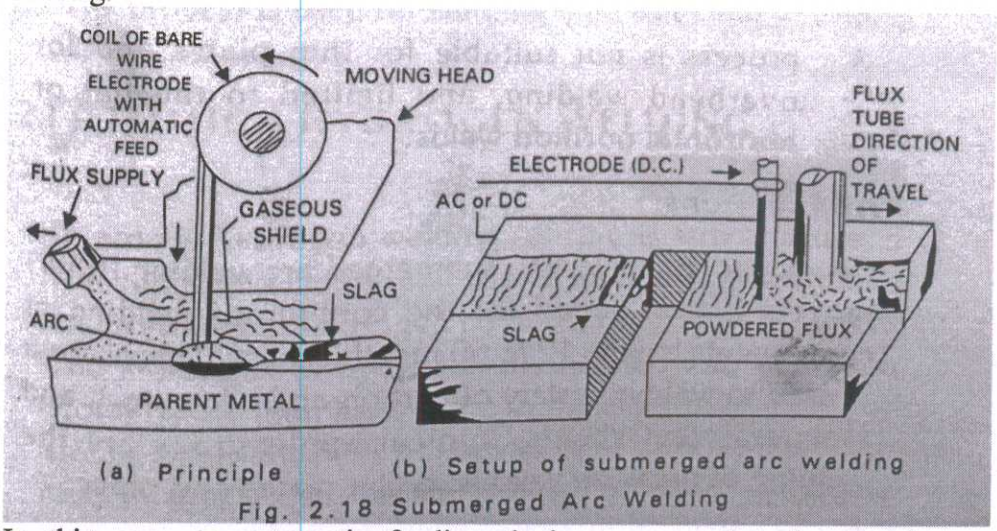
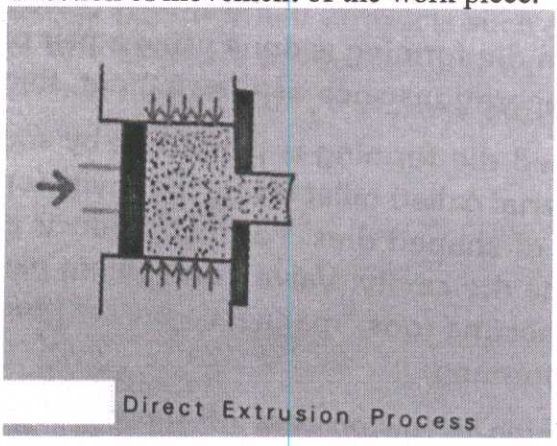
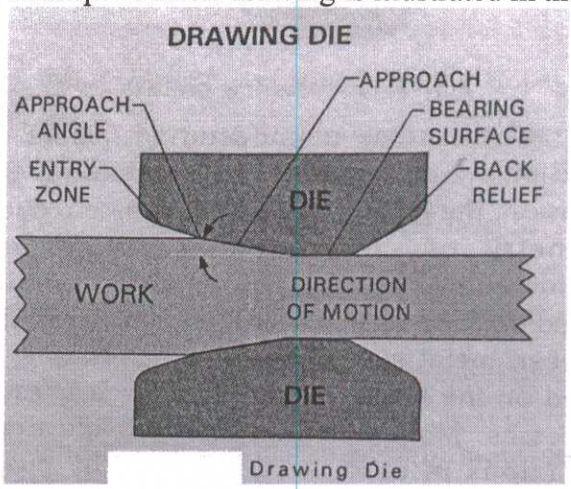
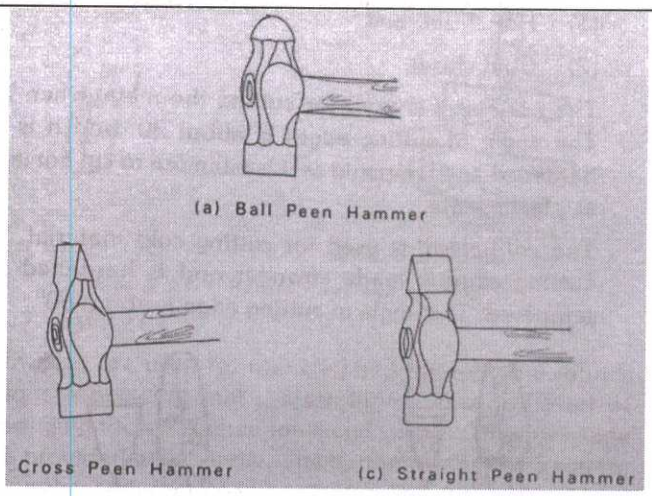


Fig. 2.18 Submerged Arc Welding

In this case, an automatic feeding device ensures that the gap between the electrode and the base metal is constant. Electric current usually range between 300A and 2000A. The power supply is from a standard single or three phase power lines with a primary rating upto 440V. | 4 | 8

VI.b	lack of Penetration : Lack of weld metal actually entering parent metal Caused by loo long an arc length Undercut: Groove formed along the edges of welding bead, thereby reducing the thickness of base metal Slag Inclusion: An entrapment of slag or other foreign matter actually Inside the weld metal. Porosity Holes in the weld metal caused by entrapment of gas. Spatter : Globules of metal expelled from an electrode and deposited on the surface of the parent metal. Poor Fusion: Lack of thorough and complete mixing between filler metal and base metal. Wrapping and Distortion : Deviation of weldments from straightness or flatness	7*1	7
VII.a	Extrusion involves forcing the raw material through a narrow opening of constant cross- section or varying cross-section in order to reduce the diameter and increase the length. Extrusion can be done hot or cold. Extruded products include shafts, tubes, cans, cups, gears.Basically there are two methods of extrusion, forward and backward extrusions. In forward extrusion the work and the extrusion punch move along the same direction. In backward extrusion the punch moves opposite to the direction of movement of the work piece.  Direct Extrusion Process	4	
	Metal drawing is a manufacturing process that forms metal work stock by reducing its cross section. This is accomplished by forcing the work through a mold, (die),of smaller cross sectional area than the work. This process is very similar to metal extrusion, the difference being in the application of force. In extrusion the work is pushed through the die opening, where in drawing it is pulled through. The basic concept of metal drawing is illustrated in the following figure.  Drawing Die	4	8

VII.b	Ionic Bonding: This is the bond when one of the atoms is negative (has an extra electron) and another is positive. Then there is a strong, direct Coulomb attraction. An example is NaCl. in the molecule, there are more electrons around Cl forming Cl- and less around Na, forming Na+. Ionic bonds are the strongest bonds In real solids, ionic bonding is usually combined with covalent bonding Covalent Bonding: In covalent electrons are shared between the molecules, to saturate the valency. The simplest example is the H2 molecule, where the electrons spend more time in between the nuclei than outside, thus producing bonding Metallic Bonding : In metals, the atoms are ionized, losing some electrons from the valence band. Those electrons form a electron sea, which binds the charged nuclei in place, in a similar way that the electrons in between the H atoms in the H_2 molecule bind the protons.	3 2 2	7
VIII.a	Hammers are striking tools used to deform the work piece into required shape. It is also used to strike punches and chisel for punching and chipping operations. The following types of hammers are used in forging. 1. Hand hammers, 2. Sledge hammers Hand hammers: Hand hammers are used by smith himself. It is made of carbon steel and its working faces are hardened and tempered. The striking face is made slightly convex to improve the striking power. These tools have wooden handles of length about 350 mm and are held in the hand while hammering. A metal wedge is inserted into the end of the handle fitted in the eye. This prevents the hammer to came out from the handle during striking. Types of hand hammers : Based on the shape of peen, hand hammers are classified into three types. (a) Ball peen hammer, (b) Cross peen hammer, and (c) Straight peen hammer. Ball peen hammer : The parts of ball peen hammer are shown in Figure. It has a flat striking face and a ball shaped peen. The peen and face are heat treated (hardened and tempered), while the body is relatively soft and tough. The handle is of elliptical cross-section, made of hardwood. It is used for riveting, chipping (i.e. striking the chisel) and other similar hand operations. The size of ball peen hammer varies from 0.11 kg to 0.91 kg (IS : 841 - 1957).	2 2	



Cross peen hammer : The cross-peen hammer is shown in Figure. It has a flat striking face and a wedge shaped peen across the eye. It is generally used for bending. The weight of cross peen hammer varies from 0.22 kg to 0.91 kg (IS ; 841 - 1957). 2

Straight peen hammer : It is similar to cross-peen hammer except that the peen in this case is parallel to the eye. It is used for stretching the work. Its weight varies from 0.11 kg to 0.91 kg. (IS : 841 - 1957).

The sledge hammers: The sledge hammers are heavy hammers used by smith's helper. The various forms of sledge hammers are shown in Figure. It is provided with wooden handle. Striker (smith's helper) uses this hammer as per the instructions of smith.The sledge hammer is specified by its weight. The weight varies from 3 kg to 10 kg. The length of the handle is about 0.75 m. 2

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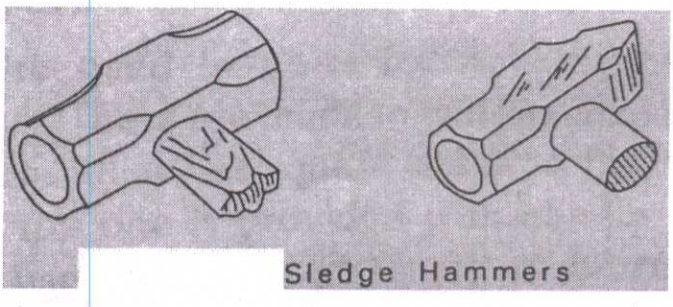

VIII.b

The most common types of space lattices or unit cells, with which metallic elements crystalise, are-

(a) Simple cubic

(b) Body-centred cubic (BCC) 1

(c) Face- centred cubic (FCC)

(d) Hexagonal close- packed (HCP).

a.Simple Cubic Structure :Each atom in the lattice has only six nearest neighbors in an octahedral arrangement. Consequently, the simple cubic lattice is an inefficient way to pack atoms together in space : only 52% of the total space is filled by the atoms. The only element that crystallizes in a simple cubic unit cell is

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polonium. Simple cubic unit cells are, however, common among binary ionic compounds, where each cation is surrounded by six anions and vice versa.

(b) Body- Centred Cubic Structure. (B C C) B.C.C unit cell has one atom at each comer and another at the body centre of the cube. At room temperature iron exibits bcc structure. Other metals possessing this structure are V, Mo, W, Cr, Ba, etc .

(c) Face Centred Cubic Structure (FCC) In this type of unit cells, atoms are located at the corners of the cube and at the centre of each face. The fee structure is more densily packed than the bcc structure. The metals possessing this structure are Cu, Al, Pb, Ag, etc. Lattice parameters $a = b = c$ and $\infty = \beta = \gamma = 90°$

(d) Hexagonal Close Packed (HCP) Structure A unit cell of this type has an atom at each corner of the haxagon, one atom each at the centres of the two hexagonal faces and one atom at the centre of the line connecting the perpendiculars in the three rhombuses which combine and form the hexagonal close- packed structure

4*1 1/2

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IX.a

Permanent mould casting(gravity die casting)

A casting produced by pouring molten metal in a metallic mould is known as permanent mould casting As these moulds last for long periods and can be reused many times; the process is called permanent mould casting. Usually metallic moulds are called dies. Pouring in permanent moulds is done simply due to gravity, (without any external pressure) and hence it is also called as gravity die casting. Permanent moulds are generally made of cast iron and alloy steel, sometimes they are also made of non-ferrous alloys. (Such as bronze, anodized aluminium) graphite or other refractories. For hollow castings, either metal cores or dry sand cores are used. These moulds are generally made in two halves. The sprue, risers, runner, gates and vents are machined in to the parting surface of one or both mould halves. Ejector pin mechanism is also provided to facilitate easy removal of castings from the mould.

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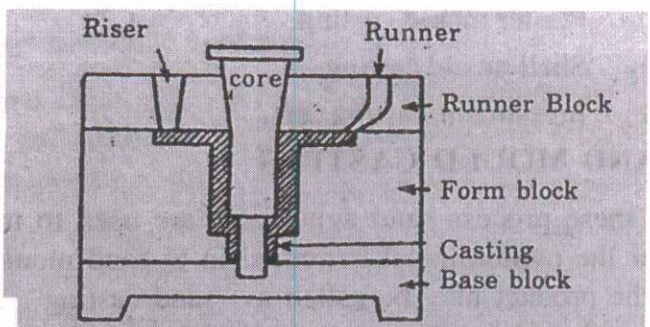

Section showing one half of a permanent mould.

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IX.b

8.2 COMPARISON BETWEEN THERMOPLASTICS AND THE SETTING PLASTICS.

SlNo.	Thermo Plastics	Thermo setting plastics
1.	These polymers are composed of chain molecules	These polymers are composed of cross linked molecules
2.	They are produced by addition polymerisation	They are produced by condensation polymerization
3.	They can be repeatedly softened by heat and hardened by cooling.	Once hardened and set, they do not soften with the application of heat.
4.	They are comparatively softer and less strong	They are more stronger and harder than thermoplastic resins.
5.	Less resistant to heat	More resistant to heat
6.	They are usually supplied as granular material	They are usually supplied in monomeric or partially polymerized form in which they are either liquids or partially thermo plastic solids.

5*1

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X.a

Injection Moulding

It is used for the large scale production of thermoplastic components. The plastic powder is filled in to a hopper connected to a cylinder - screw mechanism. The charge (plastic powder) is fed by gravity to the rotating screw, where it is heated by contact with the heated cylinder and then moves it forward by exerting pressure on it. Under the action of heat and pressure the plastic softens, reaches a highly plastic state, and is then forced through a nozzle in to a water cooled cavity. After the plastic part has cooled and solidified, it is ejected out of cavity.

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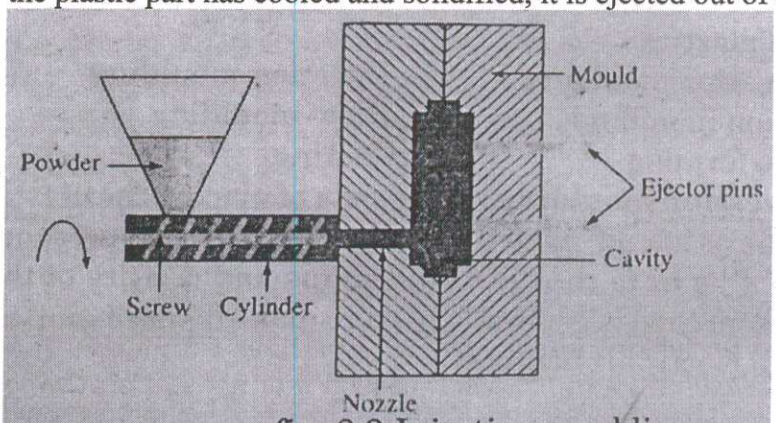

fig. 8.3 Injection moulding

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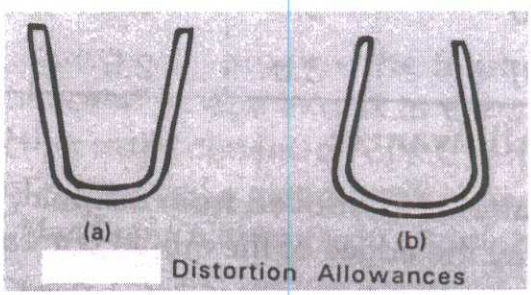
X.b	PATTERN ALLOWANCES :A pattern differs from the casting in certain dimensions. The size of pattern is slightly larger than the finished casting by an amount called allowance. The following allowances are given to the pattern. 1. Shrinkage allowance 2. Machining or finishing allowances 3. Taper or draft allowances 4. Distortion allowances 5. Shake or rapping allowance	1	
	Shrinkage Allowance: The pattern must be made oversize to compensate for contraction of liquid metal on cooling. This addition to the dimension of the pattern is known as shrinkage allowance. Although contraction is volumetrical, the correction for it is usually expressed linearly as a ratio, a percentage or in mm per metre.	2	
	Machining or Finishing Allowance: It is often necessary to produce the finished surface of casting by machining. The excess in the dimensions of the casting (i.e. in the dimension of the pattern) over the finished casting is called machining allowance allowance, Machining allowance in addition to shrinkage allowance is given to the pattern. This allowance depends on casting metal, size and shape of the casting, the process employed, method of machining and the degree of finish required	2	
	Draft Allowance: When a pattern is removed from a mould, the tendency to tear away the edges of the mould is greatly reduced if the vertical surfaces of the pattern are tapered inwards. The provision of taper on vertical faces of the pattern is called draft. The amount of draft recommended on external surfaces varies from 10 to 20 mm per metre, and that on internal surfaces is approximately 60 mm per metre	2	7
	Distortion allowances are applied to the castings of irregular shapes that are distorted in cooling because of metal shrinkage. For example, a 'U' shaped design with parallel legs will certainly spreadout as in figure(a).The pattern maker alters the shape of the U so that the legs slope towards each other as in Figure. (b) to allow for this distortion.  Distortion Allowances		
	Shake or Rapping Allowances : Due to rapping of the pattern in the mould, the size of mould cavity increases slightly. This increase is insignificant for small and medium size castings, but it must be considered for large castings. A shake or rapping allowances shall be given to pattern by making it smaller to compensate for rapping		