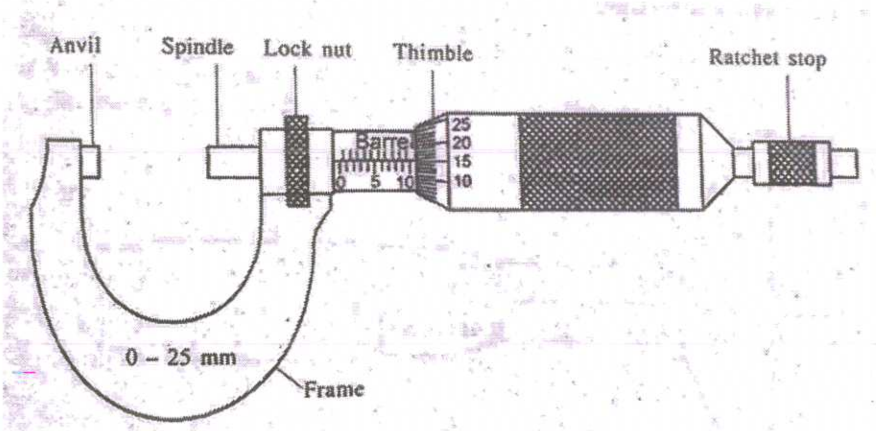
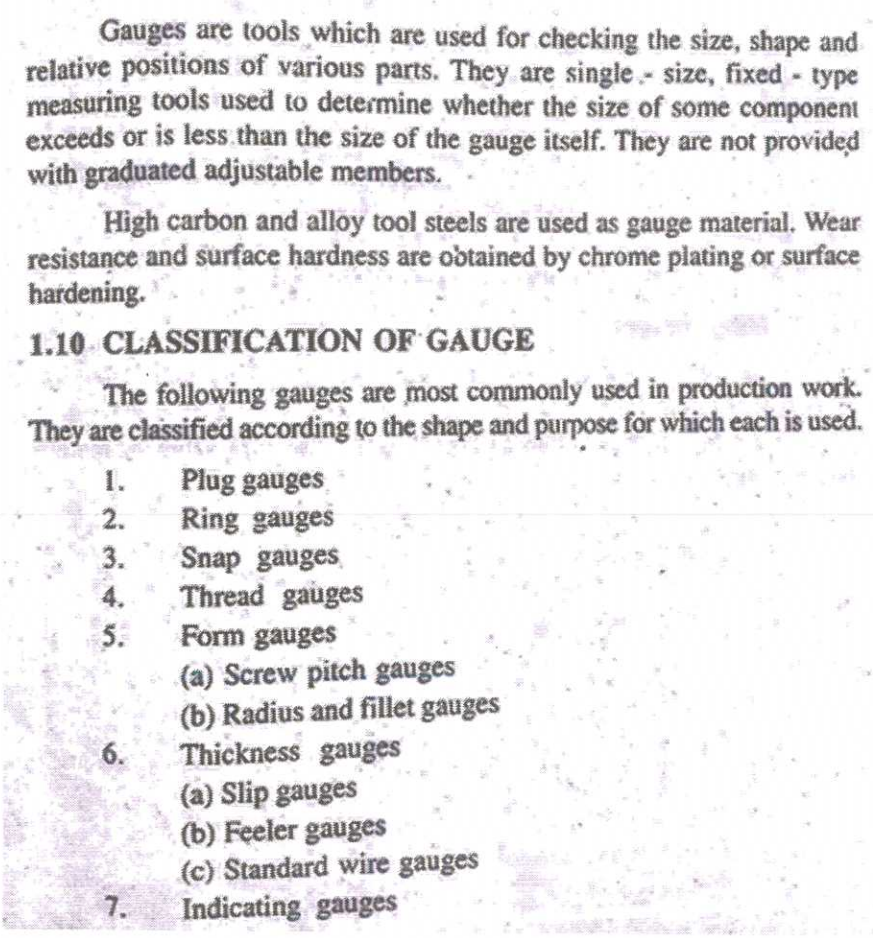
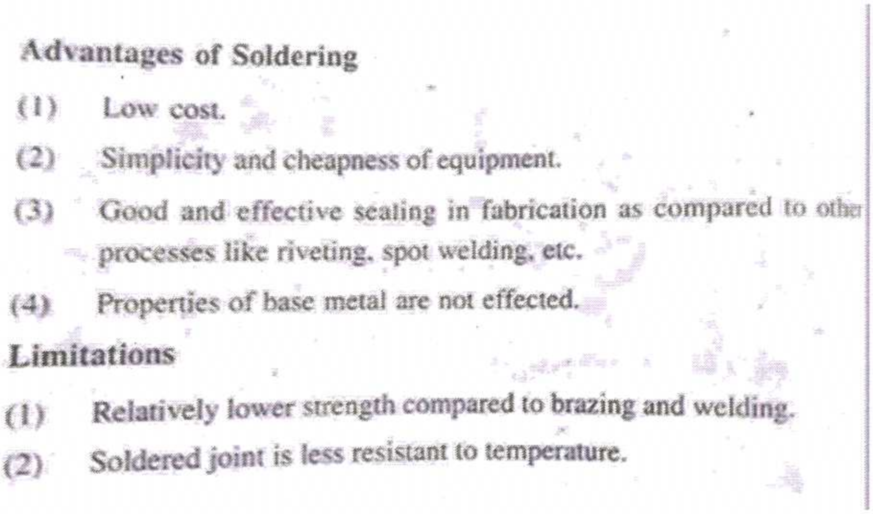
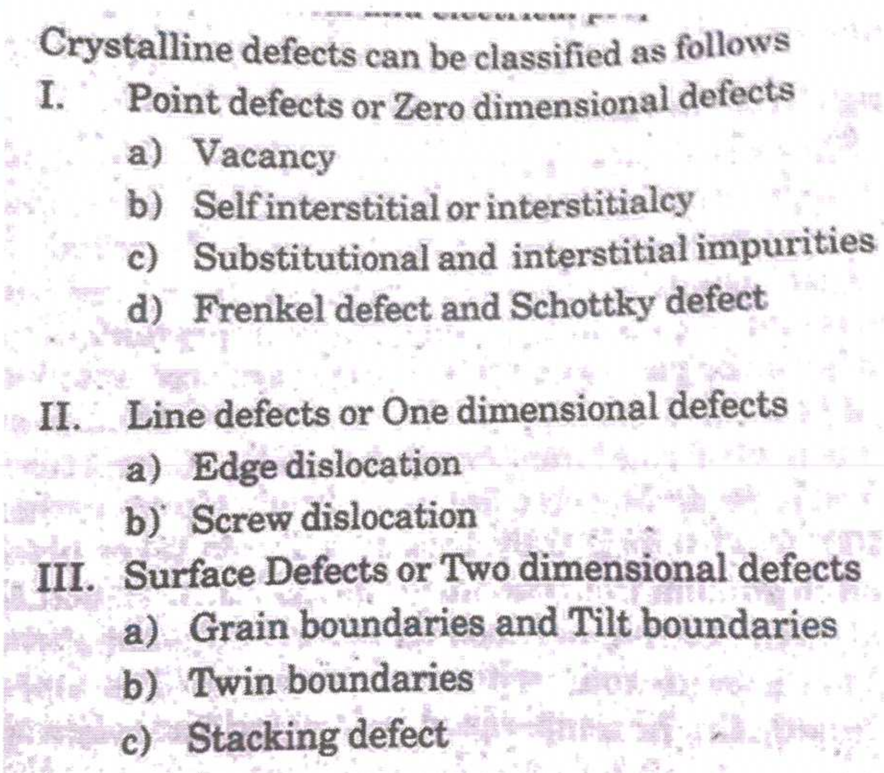
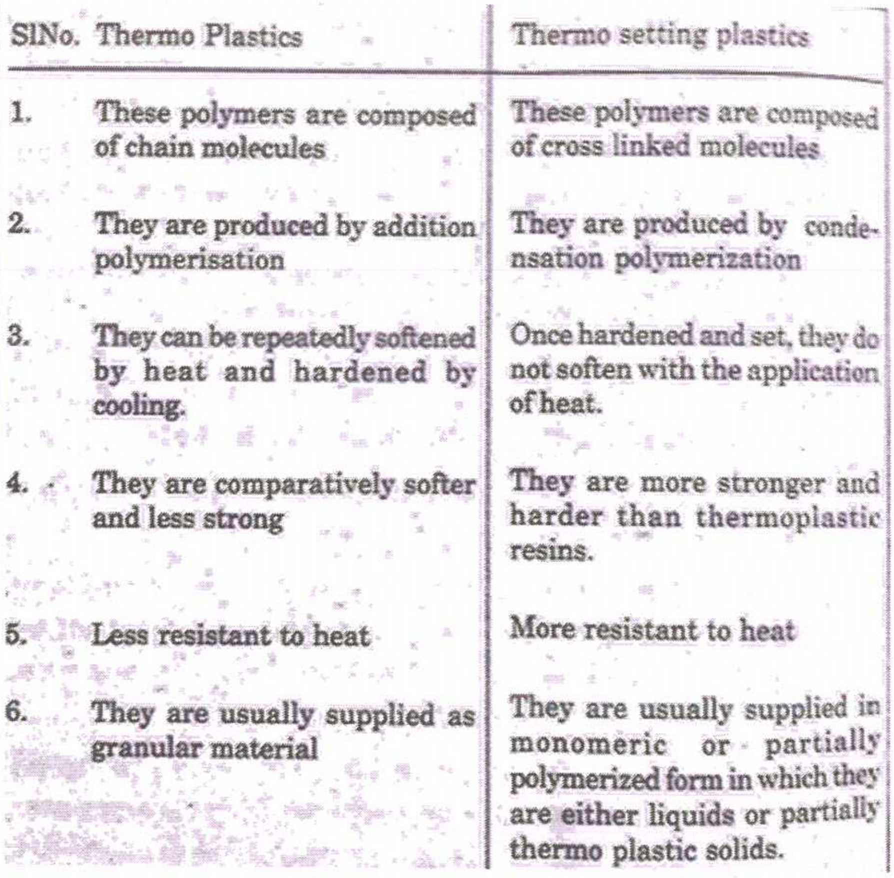
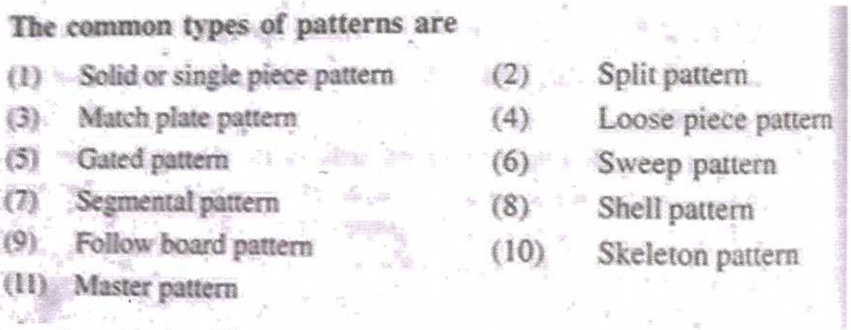
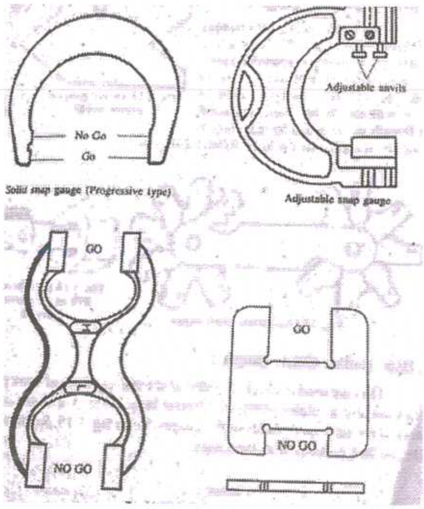
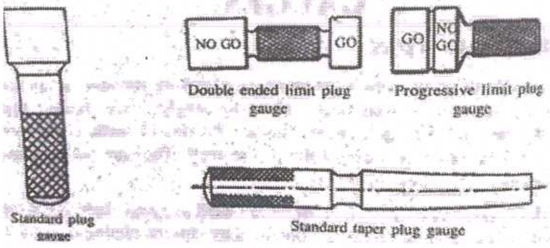
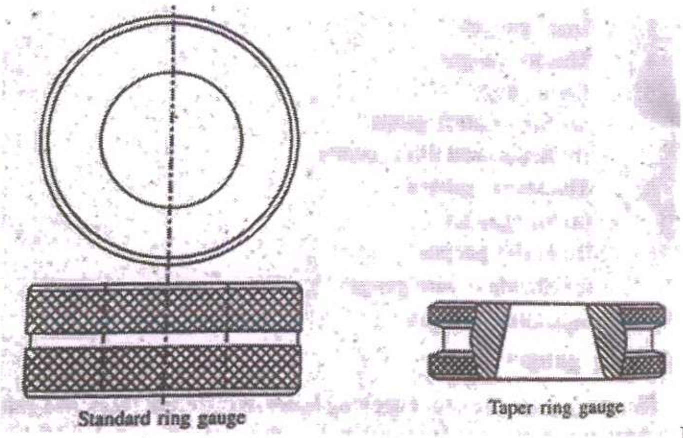
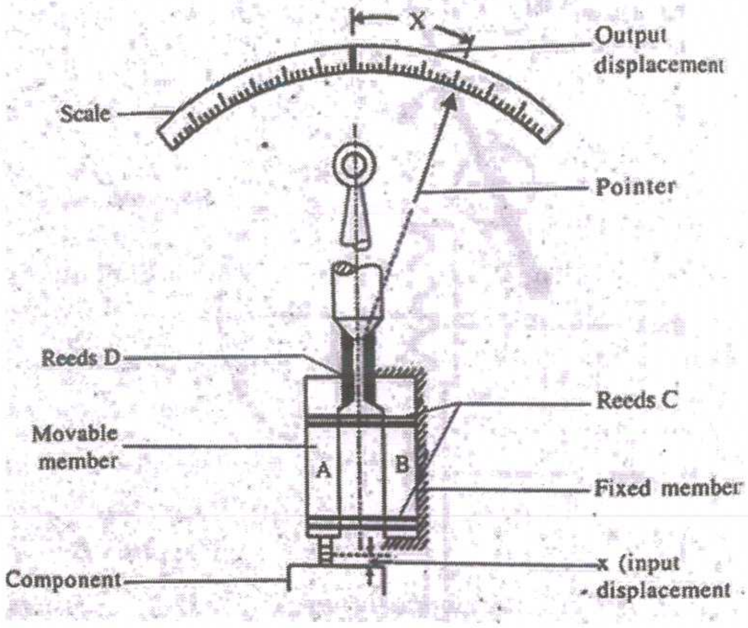
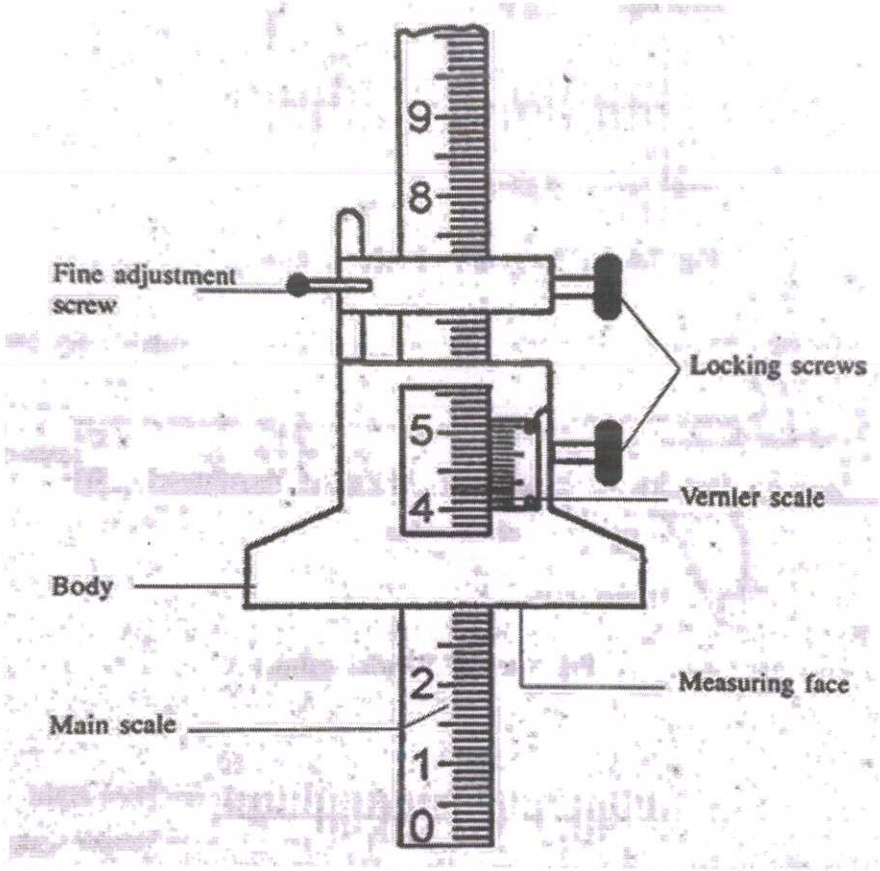
Course Title: Manufacturing Process **Course Code: 3023** **Revision: 2015**

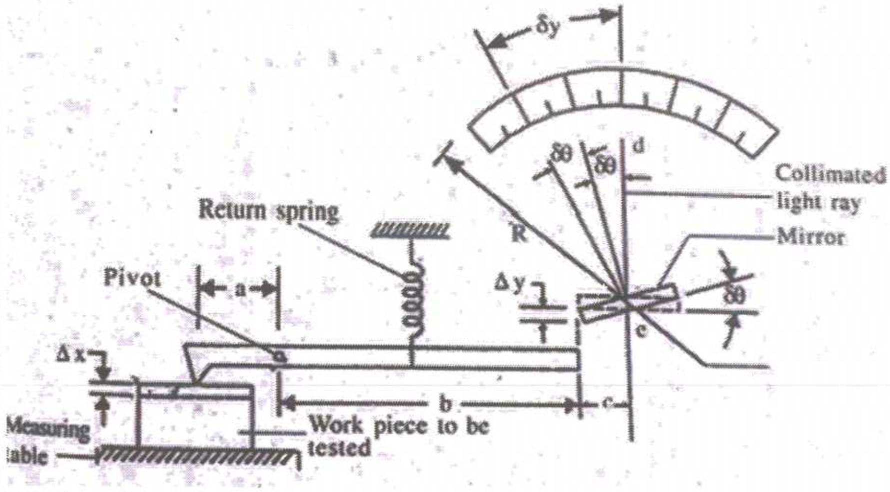
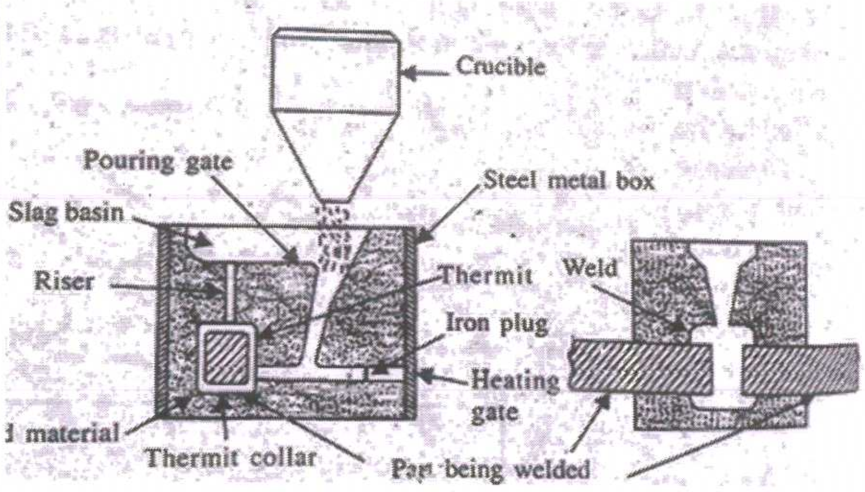
Qst. No.	Scoring Indicator	Split up score	Sub Total	Total
I				
1	SWG is Standard wire gauge,It is used for measuring the thickness of sheet or diameter of wires	2	2	
2	Inorganic(ZnCl,NH4Cl,Phophoric acid) & Organic (Resin,Tallow)	2	2	
3	Pressure and Non pressure welding	2	2	10
4	The grouping of atoms whose repetition will produce the crystal is called Unit cell	2	2	
5	Porosity,Refractiveness,adhesiveness,Plasticity	2	2	
II				
1	 **Fig. 1.1 Outside micrometer** Drawing Labelling	4 2	6	

2	 Gauges are tools which are used for checking the size, shape and relative positions of various parts. They are single - size, fixed - type measuring tools used to determine whether the size of some component exceeds or is less than the size of the gauge itself. They are not provided with graduated adjustable members. High carbon and alloy tool steels are used as gauge material. Wear resistance and surface hardness are obtained by chrome plating or surface hardening. **1.10 CLASSIFICATION OF GAUGE** The following gauges are most commonly used in production work. They are classified according to the shape and purpose for which each is used.	2	6	
	1. Plug gauges 2. Ring gauges 3. Snap gauges 4. Thread gauges 5. Form gauges (a) Screw pitch gauges (b) Radius and fillet gauges 6. Thickness gauges (a) Slip gauges (b) Feeler gauges (c) Standard wire gauges 7. Indicating gauges	4		
3	 **Advantages of Soldering** (1) Low cost. (2) Simplicity and cheapness of equipment. (3) Good and effective sealing in fabrication as compared to other processes like riveting, spot welding, etc. (4) Properties of base metal are not effected.	4	6	
	Limitations (1) Relatively lower strength compared to brazing and welding. (2) Soldered joint is less resistant to temperature.	2		
4	Butt Joint,Lap,Corner,T joint,Edge (With explanation)	4*1.5	6	

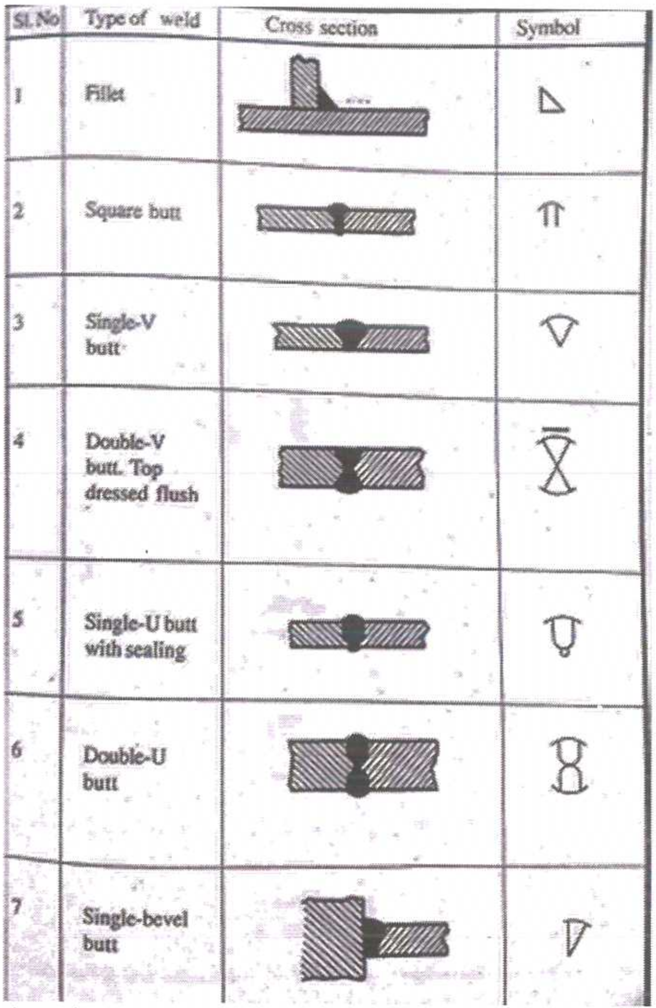
<table>
<tr><td>5</td><td>Defenition
Crystalline defects can be classified as follows
I. Point defects or Zero dimensional defects
a) Vacancy
b) Self interstitial or interstitialcy
c) Substitutional and interstitial impurities
d) Frenkel defect and Schottky defect
II. Line defects or One dimensional defects
a) Edge dislocation
b) Screw dislocation
III. Surface Defects or Two dimensional defects
a) Grain boundaries and Tilt boundaries
b) Twin boundaries
c) Stacking defect</td><td>2
4</td><td>6</td><td>30</td></tr>
<tr><td>6</td><td>
<table>
<tr><th>SlNo.</th><th>Thermo Plastics</th><th>Thermo setting plastics</th></tr>
<tr><td>1.</td><td>These polymers are composed of chain molecules</td><td>These polymers are composed of cross linked molecules</td></tr>
<tr><td>2.</td><td>They are produced by addition polymerisation</td><td>They are produced by condensation polymerization</td></tr>
<tr><td>3.</td><td>They can be repeatedly softened by heat and hardened by cooling.</td><td>Once hardened and set, they do not soften with the application of heat.</td></tr>
<tr><td>4.</td><td>They are comparatively softer and less strong</td><td>They are more stronger and harder than thermoplastic resins.</td></tr>
<tr><td>5.</td><td>Less resistant to heat</td><td>More resistant to heat</td></tr>
<tr><td>6.</td><td>They are usually supplied as granular material</td><td>They are usually supplied in monomeric or partially polymerized form in which they are either liquids or partially thermo plastic solids.</td></tr>
</table>
Any 3 comparison</td><td>3*2</td><td>6</td><td></td></tr>
</table>

7	 **The common types of patterns are** (1) Solid or single piece pattern (2) Split pattern (3) Match plate pattern (4) Loose piece pattern (5) Gated pattern (6) Sweep pattern (7) Segmental pattern (8) Shell pattern (9) Follow board pattern (10) Skeleton pattern (11) Master pattern Any six with detailing	6*1	6	
III a	 Snap Gauge	3		
	 Plug Gauge	3		
	 Ring	2	8	15

b		4	7	
	Explanation	3		
IV a				15
		4	8	
	Explanation	4		

b	 Explanation	4 3	7	
V a	 Explanation	4 4	8	15
b	Undercut,Overlap,Excessive penetration,Slag inclusion,Blow holes, Spatters,cracks,craterpipe (With explanation)	7*1	7	

VI a

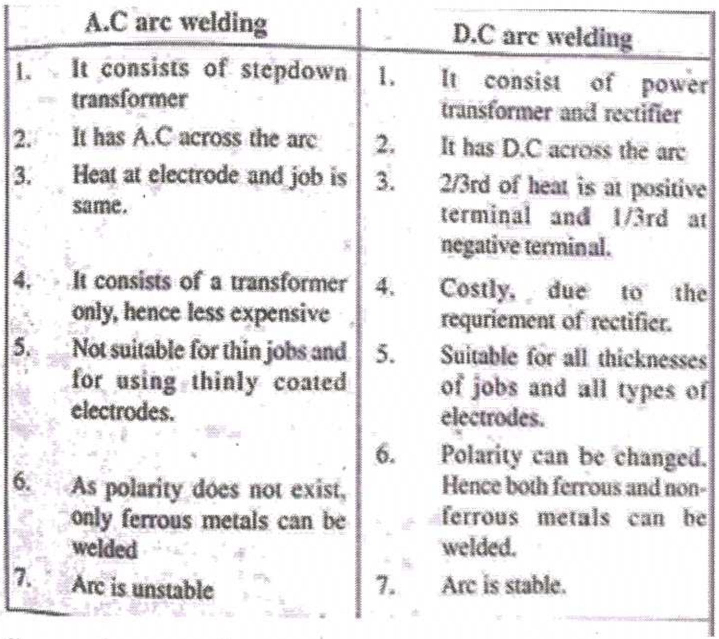


Sl. No	Type of weld	Cross section	Symbol
1	Fillet		◺
2	Square butt		‖
3	Single-V butt		▽
4	Double-V butt. Top dressed flush		X
5	Single-U butt with sealing		U
6	Double-U butt		8
7	Single-bevel butt		▷

Any 4

4*2 8

B

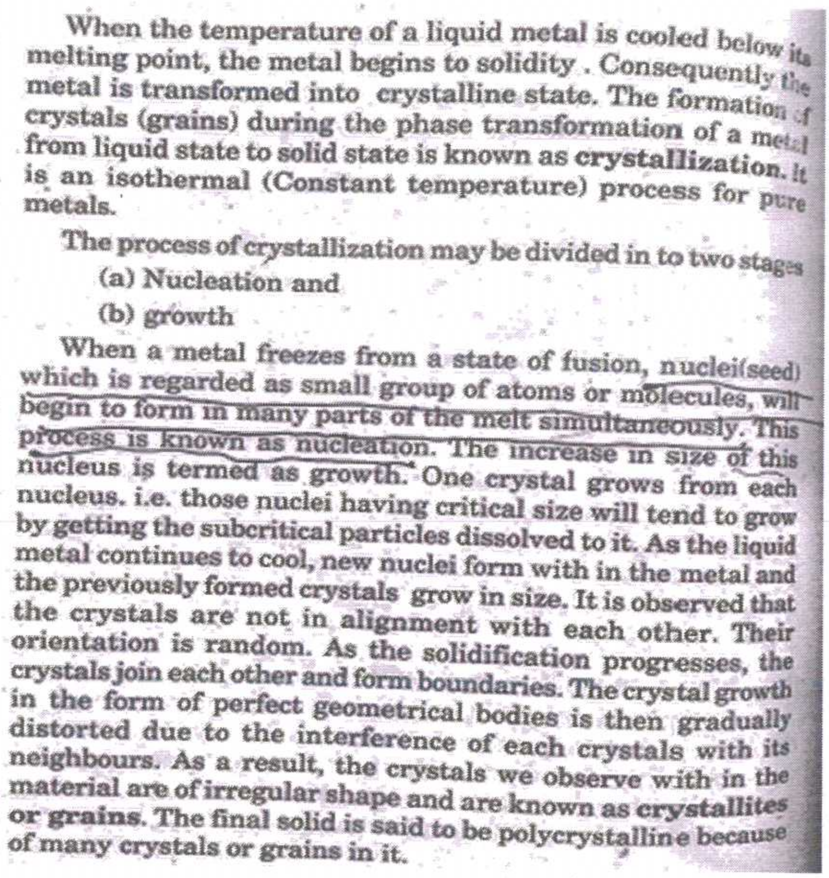
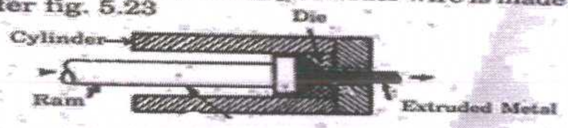
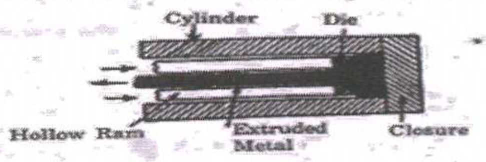


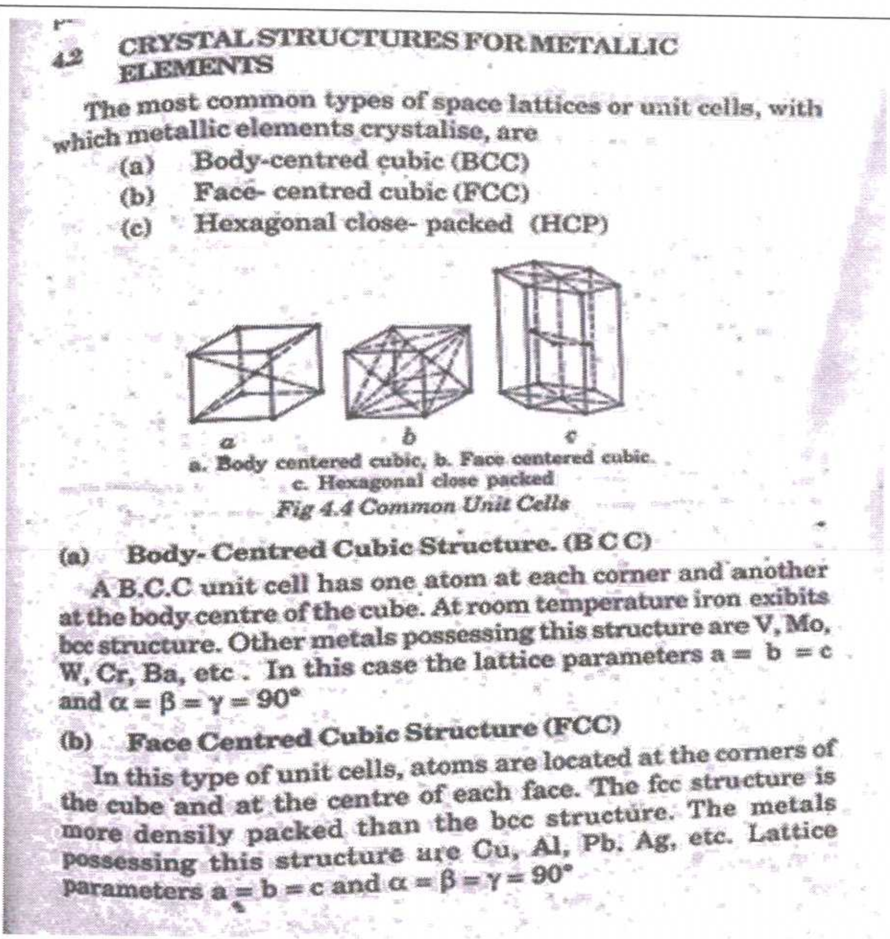
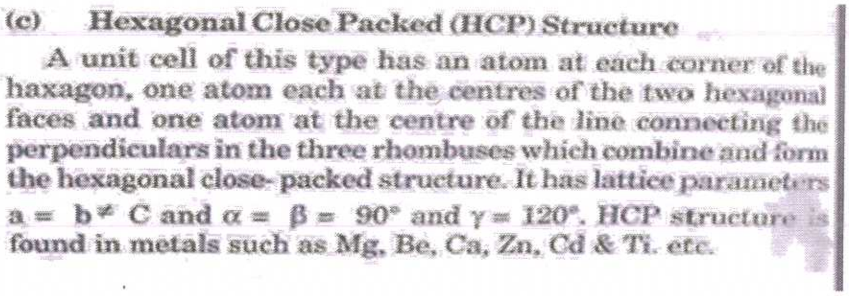
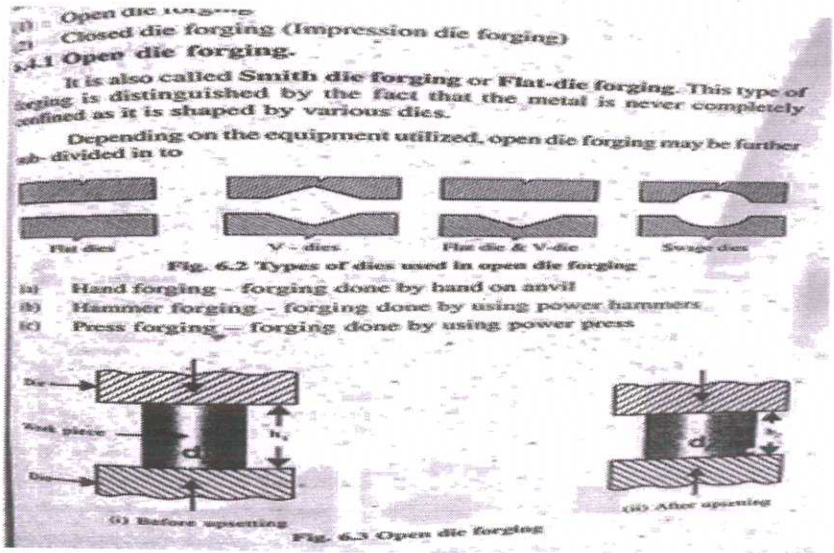
A.C arc welding		D.C arc welding	
1.	It consists of stepdown transformer	1.	It consist of power transformer and rectifier
2.	It has A.C across the arc	2.	It has D.C across the arc
3.	Heat at electrode and job is same.	3.	2/3rd of heat is at positive terminal and 1/3rd at negative terminal.
4.	It consists of a transformer only, hence less expensive	4.	Costly, due to the requriement of rectifier.
5.	Not suitable for thin jobs and for using thinly coated electrodes.	5.	Suitable for all thicknesses of jobs and all types of electrodes.
6.	As polarity does not exist, only ferrous metals can be welded	6.	Polarity can be changed. Hence both ferrous and non-ferrous metals can be welded.
7.	Arc is unstable	7.	Arc is stable.

Comparison any 4

7 7

15

VII a	When the temperature of a liquid metal is cooled below its melting point, the metal begins to solidity . Consequently the metal is transformed into crystalline state. The formation of crystals (grains) during the phase transformation of a metal from liquid state to solid state is known as **crystallization.** It is an isothermal (Constant temperature) process for pure metals. The process of crystallization may be divided in to two stages (a) Nucleation and (b) growth When a metal freezes from a state of fusion, nuclei(seed) which is regarded as small group of atoms or molecules, will begin to form in many parts of the melt simultaneously. This process is known as nucleation. The increase in size of this nucleus is termed as growth. One crystal grows from each nucleus. i.e. those nuclei having critical size will tend to grow by getting the subcritical particles dissolved to it. As the liquid metal continues to cool, new nuclei form with in the metal and the previously formed crystals grow in size. It is observed that the crystals are not in alignment with each other. Their orientation is random. As the solidification progresses, the crystals join each other and form boundaries. The crystal growth in the form of perfect geometrical bodies is then gradually distorted due to the interference of each crystals with its neighbours. As a result, the crystals we observe with in the material are of irregular shape and are known as **crystallites or grains.** The final solid is said to be polycrystalline because of many crystals or grains in it.	8	8	
b	**(1) *Direct* or forward extrusion** In this case the raw material used is a billet. The heated billet is pushed by the press by operating a ram in the cylinder (container) through a small restricted opening of the die. The length of the extruded part will depend upon the size of the metal billet and cross- section of the die. The direct extrusion method is the most popular method, the extrusion press being mechanically simpler. For example solder wire is made by this method. Refer fig. 5.23  *Fig 5.23 Direct (forward) extrusion* **(2) Indirect or backward extrusion** It is similar to forward extrusion with the difference that the extruded metal is forced through the hollow ram as shown in fig. 5.24. In this case the force required to compress the metal is less but the equipment used is more complicated. The limitations of this method are weakening of the ram and impossibility of providing adequate support for the extruded part. This process provides a better quality product.  *Fig. 5.24. Indirect or Backward extrusion.* **(3)Tube extrusion**- This is a form of direct extrusion, but uses a mandrel to shape the inside of the tube. First the mandrel	2 2 3	7	

VIII a	 **4.2 CRYSTAL STRUCTURES FOR METALLIC ELEMENTS** The most common types of space lattices or unit cells, with which metallic elements crystalise, are (a) Body-centred cubic (BCC) (b) Face- centred cubic (FCC) (c) Hexagonal close- packed (HCP) a. Body centered cubic, b. Face centered cubic. c. Hexagonal close packed *Fig 4.4 Common Unit Cells* **(a) Body- Centred Cubic Structure. (B C C)** A B.C.C unit cell has one atom at each corner 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 . In this case the lattice parameters a = b = c and α = β = γ = 90° **(b) 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 fcc 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 α = β = γ = 90°	2 2 2	8		
	 **(c) 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. It has lattice parameters a = b ≠ C and α = β = 90° and γ = 120°. HCP structure is found in metals such as Mg, Be, Ca, Zn, Cd & Ti. etc.	2			
b	 Open die forging (2) Closed die forging (Impression die forging) **6.4.1 Open die forging.** It is also called **Smith die forging** or **Flat-die forging**. This type of forging is distinguished by the fact that the metal is never completely confined as it is shaped by various dies. Depending on the equipment utilized, open die forging may be further sub- divided in to Flat dies V - dies Flat die & V-die Swage dies Fig. 6.2 Types of dies used in open die forging (a) Hand forging - forging done by hand on anvil (b) Hammer forging - forging done by using power hammers (c) Press forging — forging done by using power press Die Work piece h_1 d (i) Before upsetting (ii) After upsetting Fig. 6.3 Open die forging				

In power forging (hammer forging and press forging) the top die attached to the ram of the machine and the bottom die is attached to the hammer anvil or press bed. Most open die forgings are produced on fla flat-V or Swaging dies. (Ref. fig. 6.2).

The shapes most commonly used by open die-forging are: bars slabs or billets with rectangular, circular, hexagonal or octagonal cros sections. fig. 6.3 shows one of the simplest form of open die forging which involves placing a solid cylindrical work piece between two flat dies (platens) and reducing its height by compressing it.

7

Advantages of open die forging

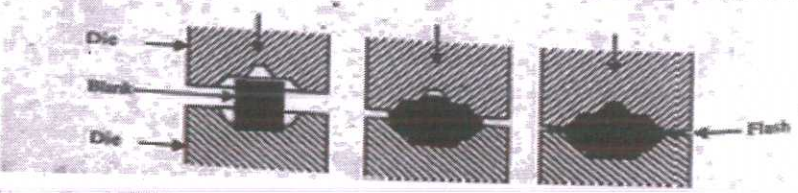
1. Simple to operate.
2. Suitable for low production volume.
3. Inexpensive tooling & equipment.
4. Wide range of workpiece sizes can be used.

Disadvantages

1. Suitable for simple shapes and low production volume only.
2. Difficult to maintain close tolerances.
3. Materials utilization is poor.
4. Less control in determining grain flow, mechanical properties and dimensions.

6.4.2 Closed die forging

More complex shapes of great accuracy cannot be made by open die forging. In closed die forging, cavities or impressions are cut in the die block, in which the metal is forced to take its final shape and dimensions. This method is used to produce forged shapes in large quantities, the finished forging being duplicates of each other. A simplest example of closed dies forging is shown in fig. 6.4. Two dies are brought together and the work piece undergoes plastic deformation until its enlarged sides touch the side walls of the die.



A small amount of material is forced outside the die impression, ning flash that is gradually thinned. (In true die forging, no flash is rmed, the workpiece is completely surrounded by the die cavity. In this se right amount of material is to be supplied to the die cavity). Depending n the equipment utilized, closed die forging is further subdivided in to) drop hammer forging (b) press forging and (c) upset machine forging.

7

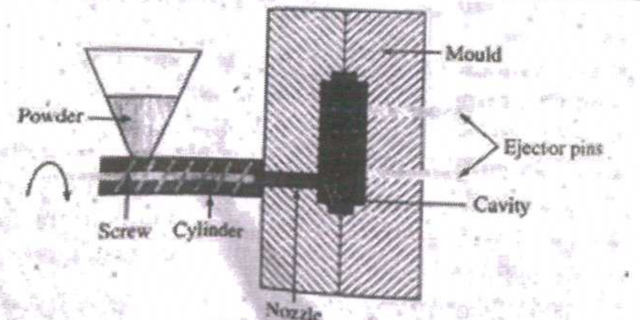
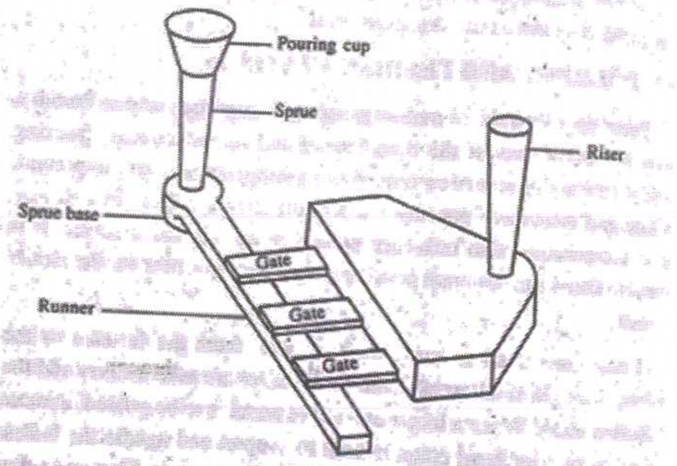
dvantages

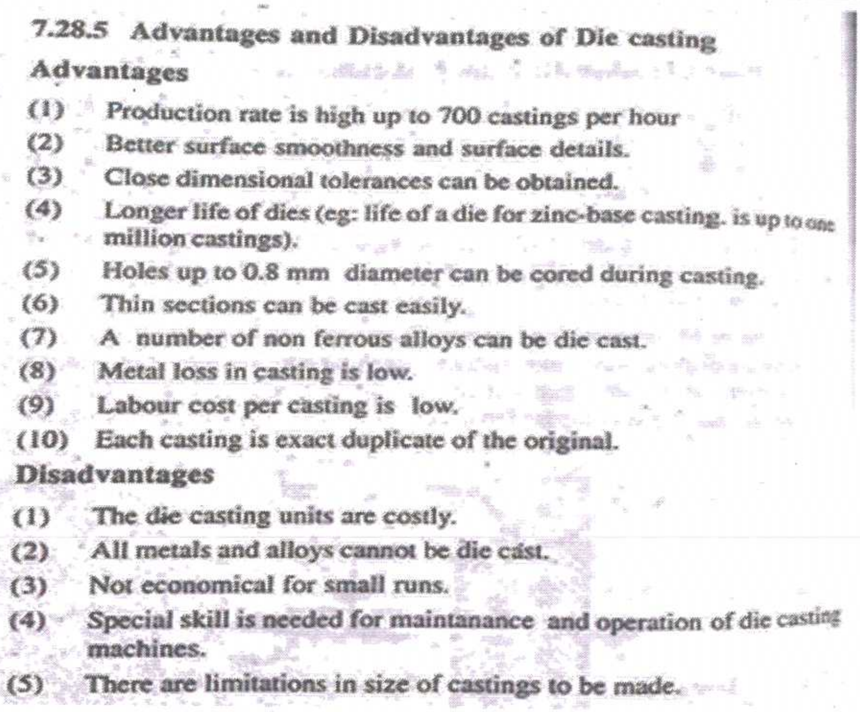
1. Excellent reproducibility with good dimensional accuracy.
2. Makes good utilization of workpiece materials.
3. Can be used for production of complex shapes.
4. The grain flow of the metal can be controlled, ensuring high mechanical properties.
5. Less time consuming, i.e. high production rate - suitable for mass production.
6. Forgings are made with less machining allowance, therefore, reduction in machining time and consumption of metal required for the forging.

Disadvantages

1. More than one step required for each forging.
2. Finishing required for achieving final shape.
3. High equipment and tooling costs.
4. Appropriate die set is required for production of each component.

Note: Both open and closed die forgings can be carried out in hot or cold state.

IX a	 fig. 8.3 Injection moulding	4	8	
	Explanation	4		
b	Bench Moulding,Floor moulding,Pit moulding,Machine moulding With explanation(2 marks each)	7	7	
X A	**7.23.4 ELEMENTS OF A GATING SYSTEM**  Fig. 7.25. A gating system	4	8	
	A gating system is composed of the following elements (parts) (a) Pouring cup (b) Sprue (c) Sprue well (Sprue base) (d) Runner (e) Gates (f) Riser etc. With explanation	4		

B	 **7.28.5 Advantages and Disadvantages of Die casting** **Advantages** (1) Production rate is high up to 700 castings per hour (2) Better surface smoothness and surface details. (3) Close dimensional tolerances can be obtained. (4) Longer life of dies (eg: life of a die for zinc-base casting. is up to one million castings). (5) Holes up to 0.8 mm diameter can be cored during casting. (6) Thin sections can be cast easily. (7) A number of non ferrous alloys can be die cast. (8) Metal loss in casting is low. (9) Labour cost per casting is low. (10) Each casting is exact duplicate of the original. **Disadvantages** (1) The die casting units are costly. (2) All metals and alloys cannot be die cast. (3) Not economical for small runs. (4) Special skill is needed for maintanance and operation of die casting machines. (5) There are limitations in size of castings to be made. 4 advantages & 3 disadvantages	7*1	7	