SUMMER-18 EXAMINATION

Model Answer Subject Code 17456

Subject: Fabrication Processes.

SUMMER – 18 EXAMINATIONS

Model Answer

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. NO.	MODEL ANSWER	MARKS	TOTAL
1.	Attempt any **FIVE** of the following	5*4	20
a)	**Accuracy:-** It is the closeness with which an instrument reading approaches the true value of the quantity being measured. It is the degree of closeness to the true value. **Precision:-** It is a measure of reproducibility of measurement. The difference between two successive or consecutive readings measured by instrument is known as precision.	2m 2M	**04**
b)	(see table below)	4m (ANY 4 POINTS)	**04**

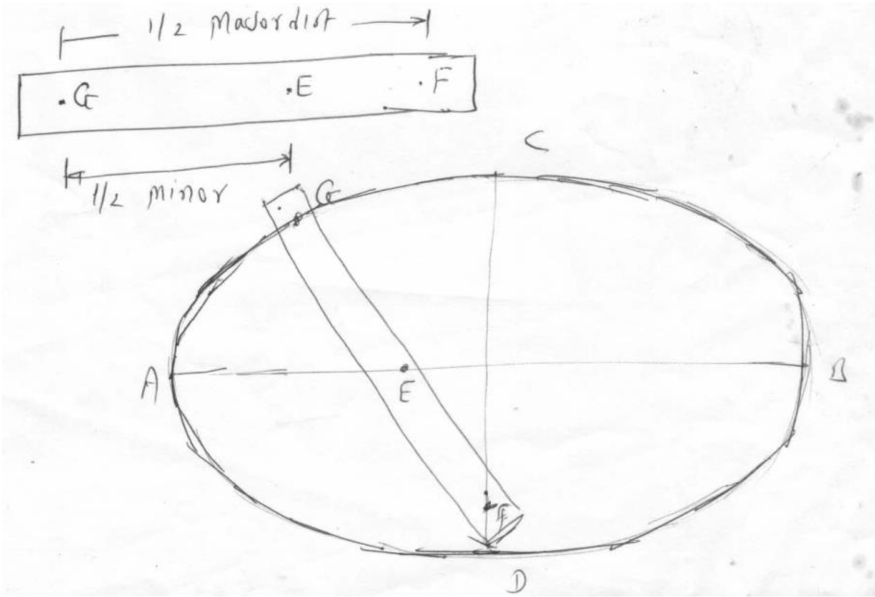
Characteristics	Line standards	End standards
Accuracy of measurement	Limited to + 0.2mm. For high accuracy, scales have to be used along with microscopes.	Highly accurate for measurement of close tolerances, up to + 0.001mm.
Time of measurement	Quick and easy.	Time consuming.
Effect of use	Scale markings are not subjected to wear but	Measuring faces get worn out. To take care

		end of scale is worn. Thus, it may be difficult to assume zero of scale as datum.	of this, end pieces can be hardened. Built in datum is provided.		
	Other errors	Parallax errors can occur.	Improper wringing of slip gauge may introduce error. Change in laboratory temperature may lead to some errors.		
	Manufacture and cost of equipment	Simple and low.	Complex and high.		
	Examples	Yard, metre	Slip gauges, ends of of micrometer anvils.		

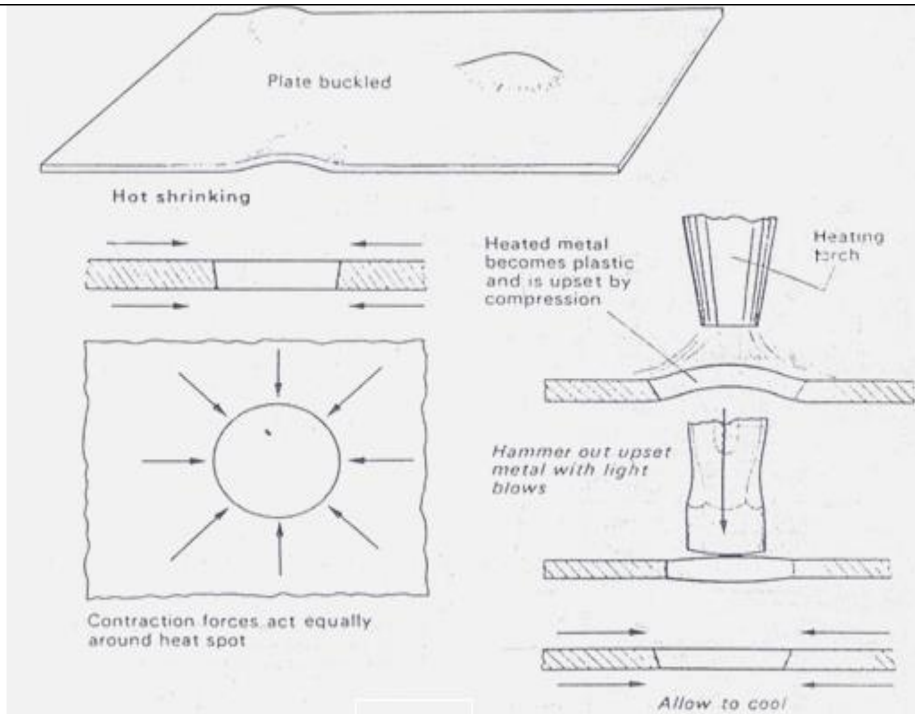
c)	Tools used in marking: -	4m 1M EACH FOR ANY 4	**4M**

Tools used in marking: -

1. Surface Plate: - It provides perfectly flat i.e. true surface.
2. Angle Plate: - It assists in holding the work piece perpendicular to the table.
3. Scriber: - It is equivalent to pen or pencil. It literally scratches the metal surface living behind fine bright line.
4. Height Gauge: - Allow line to be scribed at a pre-set distance from the datum surface.
5. Tri Square: - To transfer 90^{0} angle to the work piece.
6. Steel Tape: - It is used for linear measurement.
7. Protractor: - It is used for measuring angle.
8. Punch: - Used to create permanent mark.
9. Ball Peen hammer: - It is used in conjunction with the punch to provide the striking blow required.
10. Divider or Compass: - It is used for drawing out circles or arc of

	any desired radius		
d)	1) By using an Elliptical trammel:-  ➢ The trammel method of ellipse construction involves plotting a series of pointer by using a strip of paper, cardboard, plastic and rotating the strip up and down and around horizontal and vertical axes. ➢ The stripes of length of paper or cardstock are a trammel. ➢ The trammel has 3marks, two representing the foci and one representing for ellipse circumference. ➢ Lay out horizontal (AB) and vertical (CD) axes that intersect at right angle. ➢ Determine the minor and major axes and the foci of the intended ellipse. ➢ On a strips or cardstock, lay off distance GE representing half the length of the minor axis and GF represents half the length of major axis. ➢ Set the trammel on the drawing so that E is always traversing AB an F is moving along CD ➢ AB we move the trammel plot points at G which will always indicate the circumference of the ellipse.	2m dia & 2m explanation	04

e)



2m dia & 2m explanation — 04

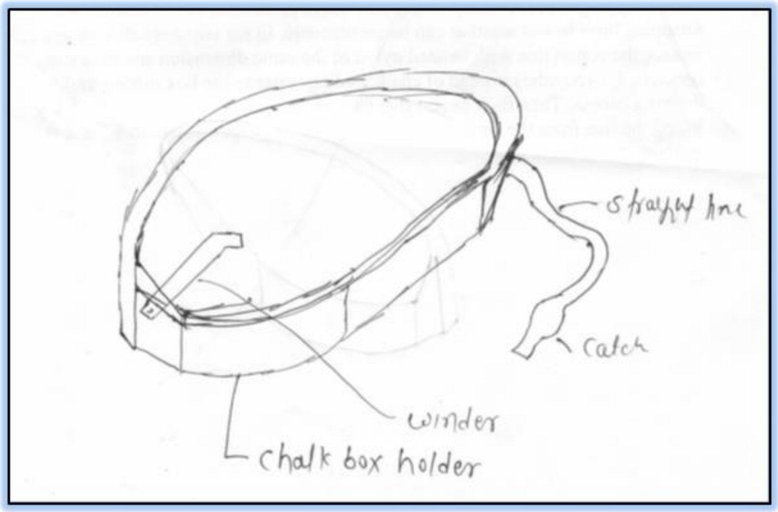
Description:-

It has been known that the application of heat can produce distortion. Heat can be used to advantage, for those same forces of expansion and contraction can be harnessed to remove distortion in plates or to straighten sections.

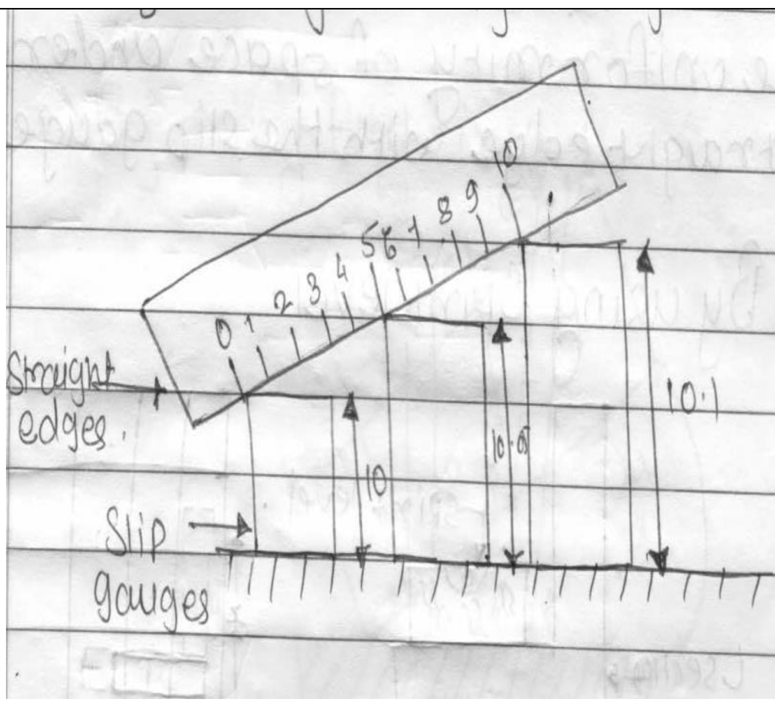
The figures below illustrate the principle of shrinking a thin plate at the places that are stretched.

A buckled or deformed plate may be straightened by the relatively simple process of 'hot shrinking'. A number of spots in the area of stretched (buckled) metal are heated to a cherry-red (approximately 750°C) and allowed to cool in turn. The metal which is locally heated becomes plastic, but the surrounding cold metal plate prevents thermal expansion. The plastic area becomes upset by compressive forces. When a heated spot is allowed to cool, the metal will tend to contract, and it is during this shrinkage that contractional stresses will occur.

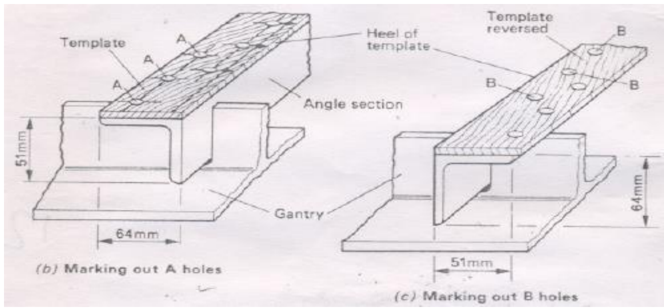
The process is repeated until the stretched areas of metal are compressed and the plate is restored to a straight and flat condition. This process is widely used in Light Vehicle Crash Repair And Panel-Beating Workshops.

f)	<u>Use of Chalk line to mark a straight line:-</u>  A chalk line is used to mark a straight line over a longer distance. It consists of a holder with chalk and a long string wound up inside the holder. The holder is filled with chalk usually red oxide or marking chalk. Following are the steps used for marking:- 1) Coat the string with chalk by shaking the holder. 2) Then work with assistant & stretch the string across the wall, floor, piece of wood or surface you are marking. 3) If we don’t have partner one can hook up the string on the surface using the catch. 4) The line is now hooked tightly from starting position over the length to be marked. 4) Pull the line up from the surface release it; the chalk line will mark the straight line on the surface. 5) It is important to pull the line vertically to avoid the line being released at an offset angle.	2m dia & 2m explanation	**04**
g)	Applications:- 1)AEROSPACE APPLICATIONS:- One of the primary requirements of aerospace structural materials is that they should have low density and, at the same time, should be very stiff and strong.	1m each point Any 4	**04**

	2) Automotive Engineering Feasibility studies were carried out, since early seventies, to explore the possibilities of using composites in the exterior body panels, frameworks/chassis, bumpers, drive shafts, suspension systems, wheels, steering wheel columns and instrument panels of automotive vehicles. 1) Civil Engineering:- Composite materials are most popularly used in civil engineering applications for construction like RCC. 2) Marine Applications:- Strong, stiff and light composites are also very attractive materials for marine applications. GFRPs are being used for the last 3-4 decades to build canoes, yachts, speed boats and other workboats. 3) Composites also have extensive uses in electrical and electronic systems. 4) Composites are, now-a-days, preferred to other materials in fabrication of several important sports accessories		
h)	**Need for surface coating:** Some of the properties of engineering components sharply depend on the surface quality of the components. The properties largely affected by surface quality and type of surface are: Corrosion resistance, wear resistance, abrasion resistance, reflectivity, hardness, conductivity, etc. To achieve these properties, many times the surface of a component is coated or covered with another material, which changes the physical, mechanical and electrical properties of the component. The material at the surface provides a physical barrier between the environment and the surface of the component. **Need for surface cleaning:** The need to provide the above mentioned physical barrier for a long period of time, such materials should have inherently certain desired properties, be continuous and uniform in thickness. These requirements are fulfilled only if there exist an excellent adhesion between the surface and the coated layer. Pre-treatment is therefore the preparation of the substrate surface, by chemical and / or physical means, so that it becomes optimized to accept the powder coating finish. To do so, it is essential to ensure that the substrate is free of dirt, grease, oil and metal oxides, such as rust and mill scale.	02m 02m	**04**

2.	Attempt any **FOUR** of the following	4*4	16
a)	Materials used for templates: - 1) Template paper: - It is used for outline for small bend shape such as brackets, small pipe bends, etc. It is also used for developing patterns for sheet metal template. 2) Hard Board: - Template for gusset plate is used to produce in small quantity by using hard board template. 3) Timber- It is used in considerable quantity for steel work template. Easy to drill & cut. 4) Sheet Metal: - It is used for making repetition of sheet metal components. 5) Steel Plate: - Light steel plate fitted with drilling bush is used a template for batch drilling of large gusset plate.	04 m (any 4 each 1 mark)	**04**
b)		2m dia & 2m explanation	**04**

	A straight edge is a measuring tool which consists of a length of steel of narrow and deep section so as to avoid bending of that rod. For(Changing the)checking the straightness edge is taken on the slip gauges and two are vivid again the light which clarify indicates the straightness. If this two surfaces are perfectly straight the there is a negligible gap. If the detraction of light is red in colour a gap of 0.0012 to 0.0017mm and if the detraction if light is blur in colour the gap is approximately 0.0075mm. More accurate method is support the straight edges on equal slip gauges at the correct points for minimum deflection sand measurement the uniformity of space under the straight edge with slip gauge. In the above figure the staright edge is supported on the slip gauges at several points and with the help of that we can conclude the surface is perfectly flat or not.		
c)	Essentials of plant layout: An efficient factory layout is one that can be instrumental in achieving the following objectives; a) Proper and efficient utilization of available floor space b) To ensure that work proceeds from one point to another point without any delay c) Provide enough production capacity d) Reduce material handling cost e) Reduce hazards to personnel f) Utilize labor efficiently g) Increase employee morale h) Reduce accidents i) Provide for volume and product flexibility j) Provide ease of supervision and control k) Provide for employee safety and health l) Allow ease of maintenance m) Allow high machine or equipment utilization n) Improve productivity	1m each for each point any 4	**4m**

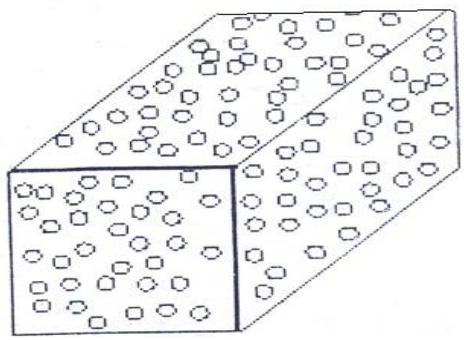
d)	Marking off holes in angle sections:  • One bottom template is generally used to mark off hole position on both flange and web. • Before applying template center line representing half the thickness of stock is marked with French chalk on both ends of L-section. • The template with the instruction uppermost is laid on the surface of flange with the center line aligned with center line marked on L-section. • The holes are ben marked with the help of a nipple punch. • Once the hole are been marked the L-section will be tilted the web will be on uppermost position with the help of template mark of holes on web position.	2m dia & 2m explanations	**4m**
e)	Based on matrix material 1)Metal Matrix Composites (MMC): Metal Matrix Composites are composed of a metallic matrix (aluminum, magnesium, iron, cobalt, copper) and a dispersed ceramic (oxides, carbides) or metallic (lead, tungsten, molybdenum) phase. 2) Ceramic Matrix Composites (CMC): Ceramic Matrix Composites are composed of a ceramic matrix and embedded fibers of other ceramic material (dispersed phase). 3) Polymer Matrix Composites (PMC): Polymer Matrix Composites are composed of a matrix from thermoset (Unsaturated Polyester (UP), Epoxy (EP)) or thermoplastic (Polycarbonate (PC), Polyvinylchloride, Nylon, Polystyrene) and embedded glass, carbon, steel or Kevlar fibers (dispersed phase). **OR**	4m any 1 ans	**04**

Based on reinforcing material structure

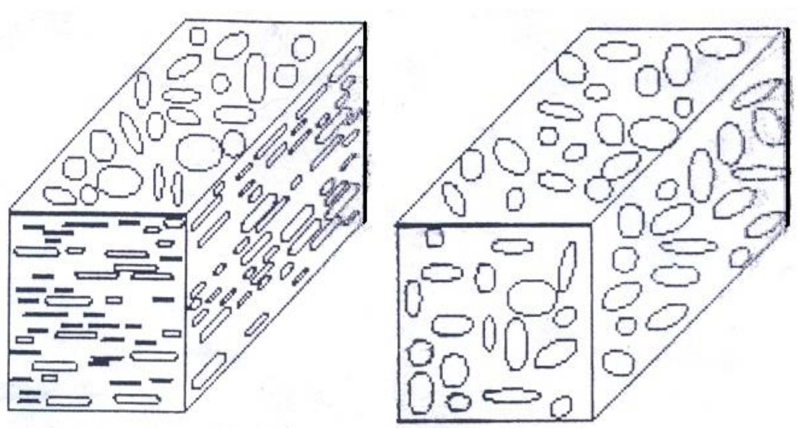
1)Particulate Composites

Particulate Composites consist of a matrix reinforced by a dispersed phase in form of particles.

1. Composites with random orientation of particles.

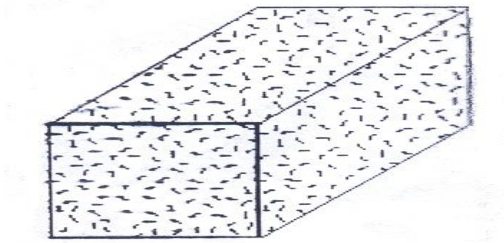
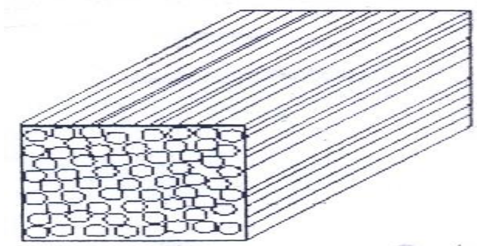
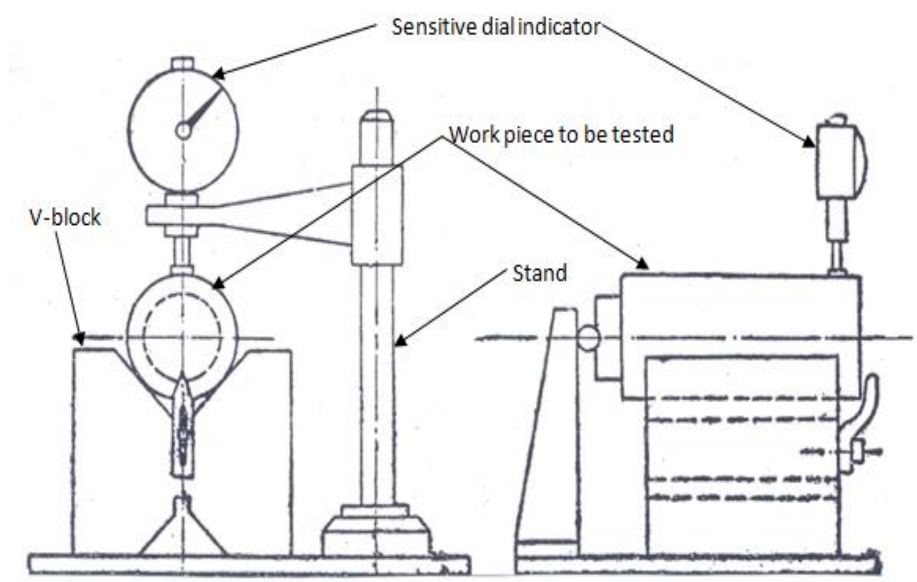


2. Composites with preferred orientation of particles. Dispersed phase of these materials consists of two-dimensional flat platelets (flakes), laid parallel to each other.



2)Fibrous Composites

1. Short-fiber reinforced composites. Short-fiber reinforced composites consist of a matrix reinforced by a dispersed phase in form of discontinuous fibers (length < 100*diameter).
    1. Composites with random orientation of fibers.
    2. Composites with preferred orientation of fibers.

	 2. Long-fiber reinforced composites. Long-fiber reinforced composites consist of a matrix reinforced by a dispersed phase in form of continuous fibers. 1. Unidirectional orientation of fibers. 2. Bidirectional orientation of fibers (woven).  3)Laminate Composites When a fiber reinforced composite consists of several layers with different fiber orientations, it is called multilayer (angle-ply) composite.		
f)	V-Block Method:- Dia:-  	2m dia & 2m explanation	**04**

	Assessment using a V-block --- The set up employed for assessing the circularity error (lobbing) by using a V-block is shown in the figure below. i.e. the V-block is placed on a surface plate and the work to be checked is placed upon it. A sensitive dial indicator is firmly fixed in a stand and its feeler is made to rest against the surface of the work. The work is rotated to measure the rise and fall of the work piece. For determining the number of lobes on the work piece, the work piece is first tested in a 60° V-block and then in a 90° V-block. The number of lobes is then equal to the number of times the indicator pointer deflects during rotation of the work piece through 360°.		
3.	Attempt any **FOUR** of the following	4X4	16
a) i)	Classification of methods of measurement: Depending upon the accuracy required and the amount of permissible error, the following methods of measurement are followed. • Direct method of measurement. In this method the value of a quantity is obtained directly by comparing the unknown with the standard. It involves, no mathematical calculations to arrive at the results. For example, measurement of length by a graduated scale. The method is not very accurate because it depends on human insensitiveness in making judgement. • Indirect method of measurement. In this method several parameters (to which the quantity to be measured is linked with) are measured directly and then the value is determined by mathematical relationship. For example, measurement of density by measuring mass and geometrical dimensions. • Fundamental method of measurement. Also known as the absolute method of measurement, it is based on the measurement of the base quantities used to define the quantity. For example, measuring a quantity directly in accordance with the definition of that quantity, or measuring a quantity indirectly by direct measurement of the quantities linked with the definition of the quantity to be measured. • Comparison method of measurement. This method involves comparison with either a known value of the same quantity or another quantity which is function of the quantity to be measured. • Substitution method of measurement. In this method, the quantity to be measured is measured by direct comparison on an indicating device by replacing the measuring quantity with some other known quantity which produces same effect on the indicating device. For example, determination of mass by Borda method. • Transposition method of measurement.	Any 4 classification 1 m each	**04**

This is a method of measurement by direct comparison in which the value of the quantity to be measured is first balanced by an initial known value A of the same quantity; next the value of the quantity to be measured is put in the place of that known value and is balanced again by a second known value B.

When the balance indicating device gives the same indication in both cases, the value of the quantity to be measured is VAB. For example, determination of a mass by means of a balance and known weights, using the Gauss double weighing method.

• Differential or comparison method of measurement.

This method involves measuring the difference between the given quantity and a known master of near about the same value. For example, determination of diameter with master cylinder on a comparator.

• Coincidence method of measurement.

In this differential method of measurement, the very small difference between the given quantity and the reference is determined by the observation of the coincidence of scale marks. For example, measurement on Vernier calipers.

• Null method of measurement.

In this method the quantity to be measured is compared with a known source and the difference between these two is made zero.

• Deflection method of measurement.

In this method, the value of the quantity is directly indicated by deflection of a pointer on a calibrated scale.

• Interpolation method of measurement.

In this method, the given quantity is compared with two or more known value of near about same value ensuring at least one smaller and one bigger than the quantity to be measured and the readings interpolated.

• Extrapolation method of measurement.

In this method, the given quantity is compared with two or more known smaller values and extrapolating the reading.

• Complimentary method of measurement.

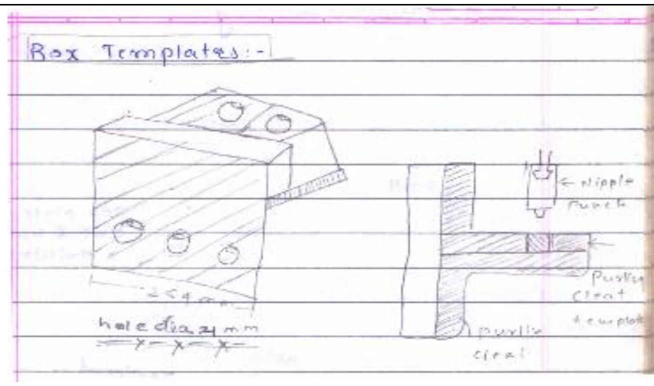
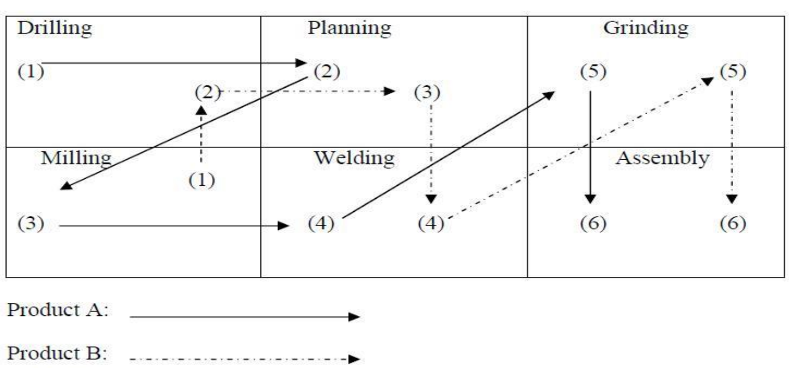
This is the method of measurement by comparison in which the value of the quantity to be measured is combined with a known value of the same quantity so adjusted that the sum of these two values is equal to predetermined comparison value.

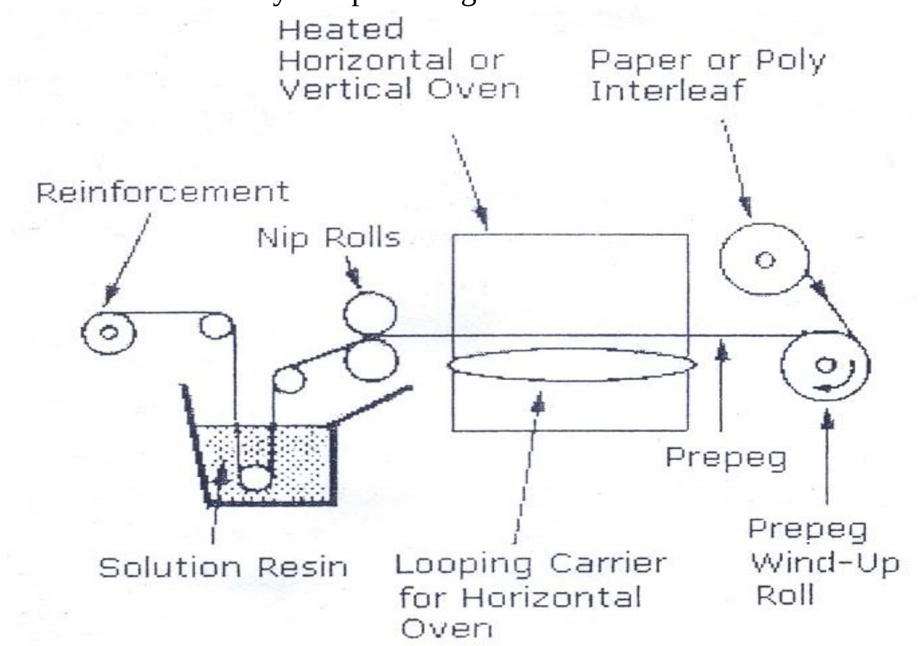
For example, determination of the volume of a solid by liquid displacement.

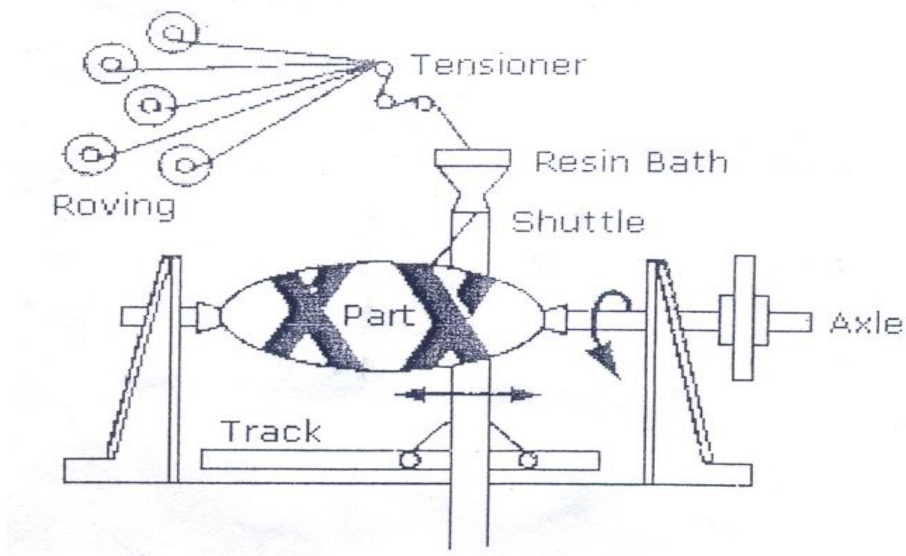
• Composite method of measurement.

It involves the comparison of the actual contour of a component to be checked with its contours in maximum and minimum tolerable limits. This method provides for the checking of the cumulative errors of the interconnected elements of the component which are controlled through a

	combined tolerance. This method is most reliable to ensure inter-changeability and is usually effected through the use of composite "Go" gauges, for example, checking of the thread of a nut with a screw plug "GO" gauge. • Element method. In this method, the several related dimensions are gauged individually, i.e. each component element is checked separately. For example, in the case of thread, the pitch diameter, pitch, and flank angle are checked separately and then the virtual pitch diameter is calculated. It may be noted that value of virtual pitch diameter depends on the deviations of the above thread elements. The functioning of thread depends on virtual pitch diameter lying within the specified tolerable limits. In case of composite method, all the three elements need not be checked separately and is thus useful for checking the product parts. Element method is used for checking tools and for detecting the causes of rejects in the product. • Contact and contactless methods of measurements. In contact methods of measurements, the measuring tip of the instrument actually touches the surface to be measured. In such cases, arrangements for constant contact pressure should be provided in order to prevent errors due to excess contact pressure. In contactless method of measurements, no contact is required. Such instruments include tool-maker's microscope and projection comparator, etc.		
b)	Chemical Cleaning (Removal of Oxide Scales and Surface Defects): Chemical cleaning is divided into two distinct groups: • Organic solvent based • Alkaline and acid aqueous method Emulsifiable Solvent and Emulsion Cleaning The component is either sprayed or immersed in an organic solvent which contains emulsifying agents. After comprehensive coverage, the component is rinsed with water to emulsify the solvent together with contaminating oil or grease. Another advantage is that treatment is usually at ambient temperature, although cleaning efficiency is directly related to physical agitation over the component surface during the water rinsing stage. **OR** Alkaline and Acid Cleaners Alkaline cleaners are the most extensively used chemical cleaners for substrate pre-treatment, primarily on grounds of economics, safety, and resistance of steels to attack. They are also commonly used before metal	4 m any 1 method	**4m**

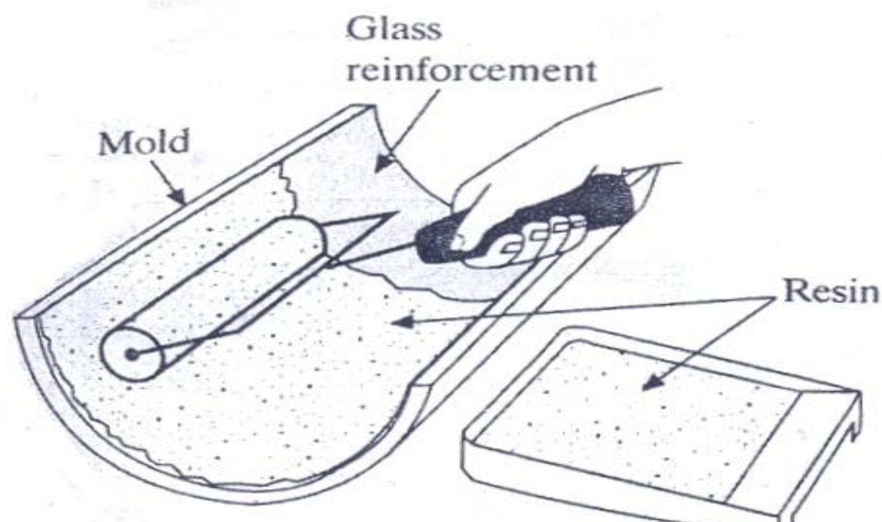
	undergoes conversion coating. The degree of alkalinity is known to effect phosphate conversion coatings (particularly zinc), with higher the pH, coarser the resulting crystal structure. In general, a finer structure is preferred for improved mechanical strength of the phosphating and gloss of the applied powder coating. Acid cleaners have a relatively restricted application, limited to mainly light rust removal. They are generally inefficient for oil and grease removal, and if the component is soiled as well as rusty, then acid cleaning is usually a follow-on to solvent or alkaline.		
c)	 These are made from wood & simply two flanged template fastened together. They are used for marking up longitudinally structural member used in constructional steel work. The hole positions are marked on the box template to standard dimensions as per the drawing usually supplied by the drawing office & drilled. When marking OFF holes from a box template the nipple punch is used. Fig shows a box template these are made from wooden strips cut to required length and nailed as shown.	2m dia & 2m explanation	**04**
d)	1) PROCESS LAYOUT: - 	2m dia & 2m explanation	**04**

	In this type of layout machines of similar type are arranged together at one place. e.g. Machines performing drilling operations are arranged in the drilling department, etc. The job/s move from one department to another without creating bottlenecks. Other machines tools or other items of equipments in each department must have periodic maintenance. The distance between departments should be as short as possible for avoiding long distance movement of materials The arrangement should be convenient for inspection and supervision.		
e)	Description of processes: A brief description of each process with neat sketches is as follows; • Prepegging --- It involves the application of formulated resin products, in solution or molten form, to a reinforcement such as carbon, fibreglass or aramid fibre or cloth. The reinforcement is saturated by dipping through the liquid resin. In an alternative method called a Hot Melt Process the resin is impregnated through heat and pressure. The Hot Melt System uses resins with a very low percentage of solvents.  **OR** • Wet filament winding --- In this process, continuous fibre reinforcement materials are drawn through a container of resin mixture and formed onto a rotating mandrel to achieve the desired shape. After winding, the part is cured in an oven. This process can also be used as preimpregnated fibre tows called towpregs.	2m dia & 2m explanation Any 1 method	**04**



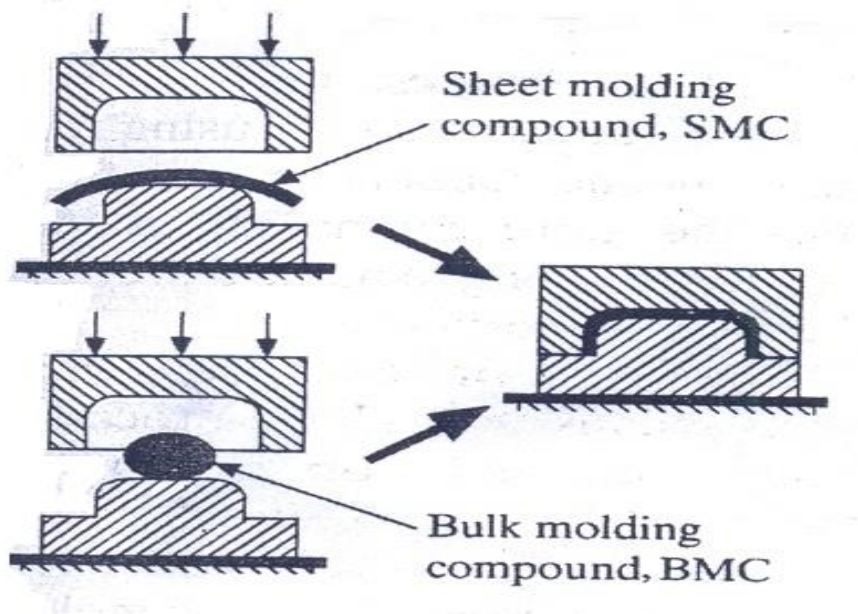
OR

- Hand lay-up or contact moulding --- This involves coating a mould or form with a layer of resin; a layer of glass reinforcement is applied, and the reinforcement is thoroughly saturated with resin. The process is repeated until the desired composite thickness is achieved (the maximum thickness is usually 9mm). The polymer matrix is usually a polyester or epoxide.

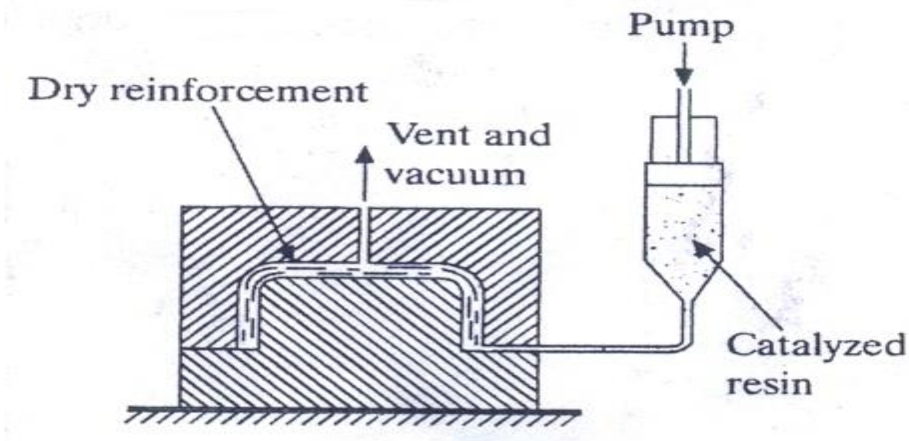


Hand lay-up

OR

	• Compression moulding --- It is similar to the process described for unreinforced thermosets, except that special techniques are required to introduce the glass reinforcement into resins that have to be catalysed and have a limited pot life after actualization. In the sheet moulding process, catalyzed polyester or epoxy resin is kneaded into the glass reinforcement by rollers. Special fillers are added to keep the resin from being tacky and inhibitors are added to increase the pot life of the catalyzed resin. The finished sheet, called sheet moulding compound (SMC), consists of resin and reinforcement and this sheet can be cut to an appropriate size and pressed in a matched mould to make the finished part. The moulds are heated to complete the cross-linking of the resin. A similar product, called bulk moulding compound (BMC), is produced by adding thickeners to the resin; it is kneaded like dough with chopped fibres to make a compression moulding charge that resembles a glob of dough. The heating and pressing are the same as in sheet moulding. Both processes can be used for large mouldings such as automobile fenders.  Compression molding **OR** • Resin transfer moulding --- This process has evolved as a way to speed up contact and to improve the part by having two finished surfaces instead of one. This process requires a close fitting mould. Glass reinforcement is cut and shaped to the desired thickness in the open		

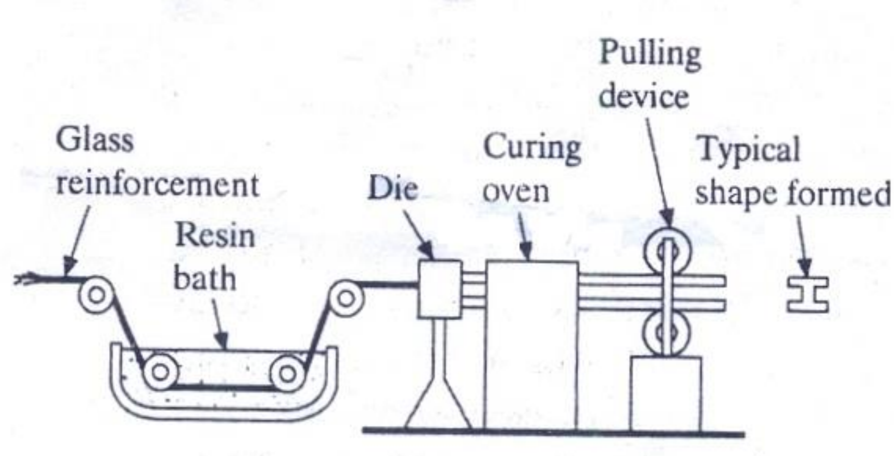
mould. The mould is then closed and evacuated and catalyzed resin is pumped into the bottom of the mould. When the mould is filled, the pump is shut off, the resin line is stopped off and the part is allowed to cure. This is becoming an important process for the production of large RTP boats. It is replacing hand lay-up.



Resin transfer molding

OR

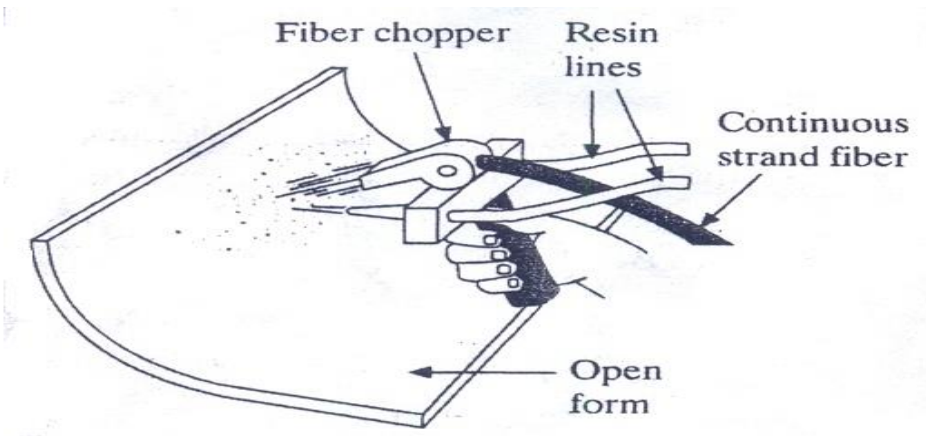
- Continuous pultrusion --- It is a process for making glass-reinforced shapes that can be generated by pulling resin-impregnated glass strands through a die. The glass is pulled through a resin bath; it is shaped as it goes through a heated bath and the resin cross-links in the heated die and combined curing section. Pipes, channels, I-beams and similar shapes can be generated. Pultrusion structural shapes are frequently used for decking and structural members around corrosive chemical tanks.



Continuous pultrusion

OR

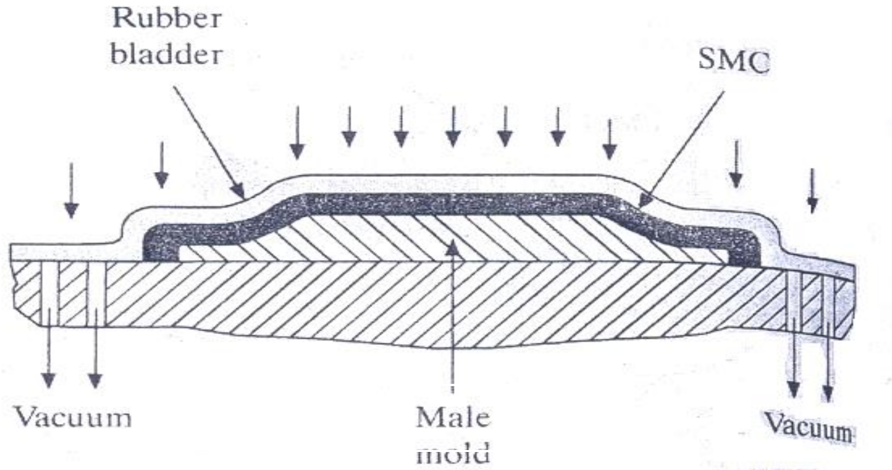
- Chopped fibre spraying --- It performs the same job as hand lay-up, but it is much faster. Two component resins are mixed in a hand-held gun and sprayed at a mould surface. A chopper is incorporated in the gun. It chops continuous strands of glass into short lengths to act as reinforcement in the composites. This process can be used to make large reinforced composites such as boats, shower stalls and bathtubs. Chopped fibre reinforcements, however are not as strong as hand lay-ups that are reinforced with mat or woven roving.



Chopped fiber sprayer

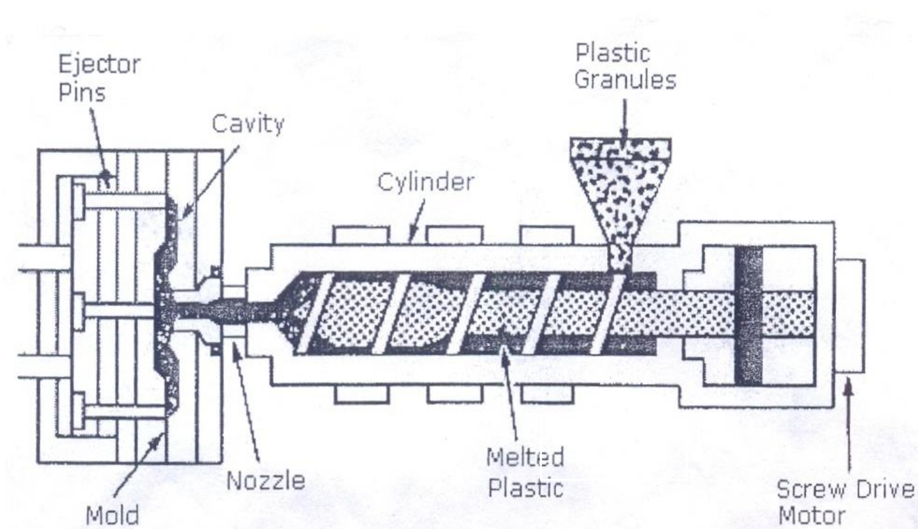
OR

- Vacuum bag forming --- It is used to shape sheet moulding compounds to complex shapes. This process uses atmospheric pressure to do the forming, thus eliminating the high cost of matched metal moulds. It is possible to cure the SMC in the vacuum bag rig using temperature-resistant silicone rubbers for the forming bladder, but the more common practice is to use vacuum-bag forming to make a preform and cure the preform in another mould.



OR

- Injection moulding --- Chopped fibres and particulate reinforcements are blended into the moulding pellets/granules. However this method is not normally used in PMC processes due to fibre damage in the plasticating barrel. Thermoplastic granules are fed via a hopper into a screw-like plasticating barrel where melting occurs. The melted plastic is injected into a heated mould where the part is formed. This process is often fully automated.



OR

Joining Composites:

Introduction: In any product, there are generally several parts or components joined together to make the complete assembly. These parts are interconnected with each other to make the final product. The purpose of the joint is to transfer loads from one member to another, or to create relative motion between two members.

Joints are but usually avoided in a structure as a good design policy. In any structure, a joint is the weaker area and most failures emanate from joints. Because of this, joints are eliminated by integrating the structure.

In an ideal product, there is only one part. Fibre-reinforced composites provide the opportunity to create large, complicated parts in one shot and reduce the number of parts in a structure.

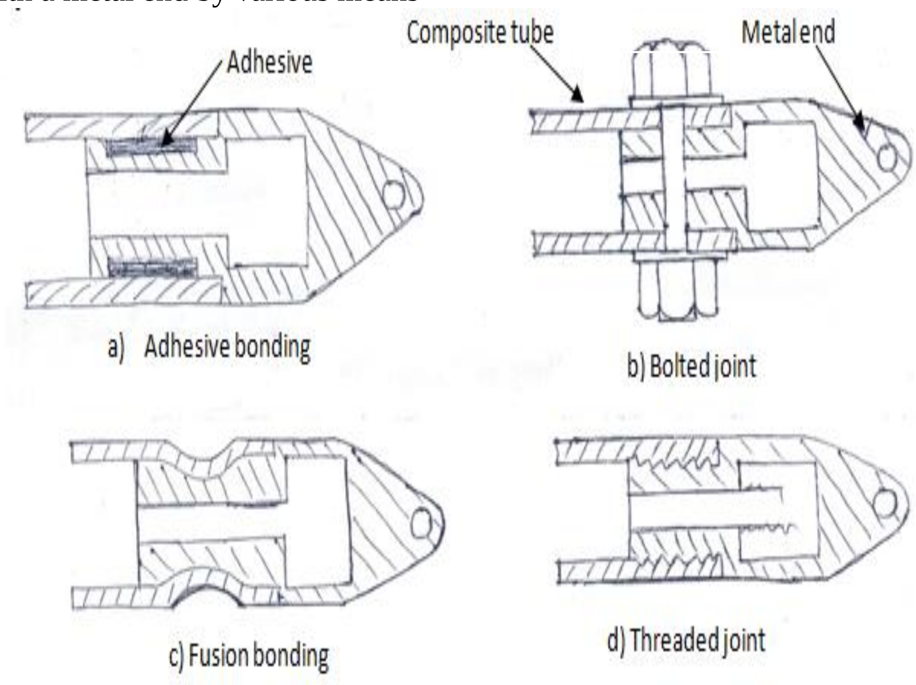
There are two types of joints used in the fabrication of composite products:

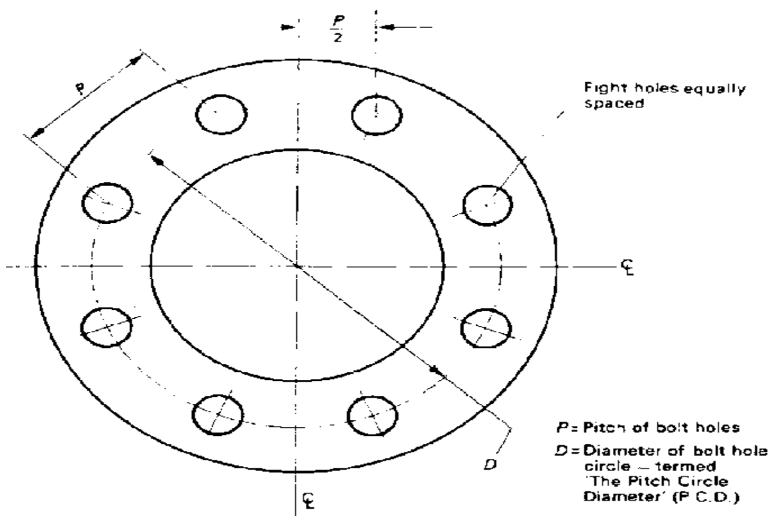
- Adhesive bonding
- Mechanical joints

Adhesive bonding is the more common type of joint used in composites manufacturing.

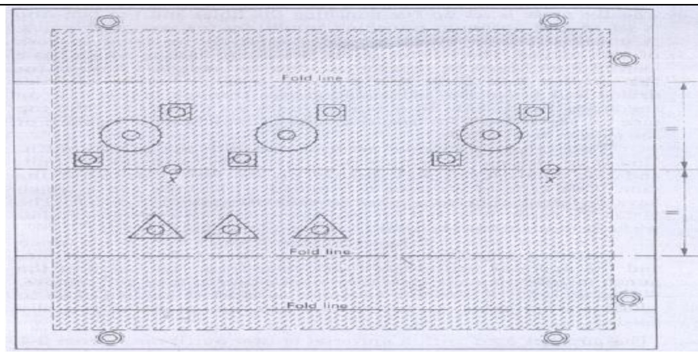
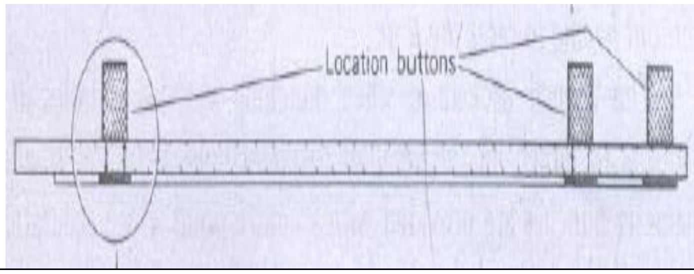
In adhesive bonding, two substrate materials are joined by an adhesive. Mechanical joints for composites are similar to the mechanical joints of metals. In mechanical joints: rivets, bolts and / or screws are used to form the joints. Fusion bonding is also used for joining purposes. It is used to join thermoplastic parts by means of heat.

The figures below show an application in which a composite tube is joined with a metal end by various means



f)	Methods of Marking Out Holes for flanges: -  • Many fabrications such as boilers, chemical plant, pressure vessels incorporate the use of flanged inlet & outlet, pipes of various diameters are connected by means of flange. • The flanges are welded and connections are made by bolting. • Fig shows a flange with 8 holes lies on circle which is known as pitch circle. • Note that bolt holes never lie on the vertical centre line because there is more chance of failure of the lowest bolt. • The distance between adjacent holes is referred as pitch. If 8 holes are to be drilled on a pitch circle of 406 mm then pitch of adjacent holes may be calculated as follows: - • The pitch distance of adjacent holes= PCD X constant for 8 holes • To obtain the position of first hole divide pitch by 2 set the divider to these dimension and mark off from intersection of vertical centre line and bolt circle. The reminder of the bolt hole center may now be located with the divider et as correct pitch.	2m dia & 2m explanation	**04**
4.	Attempt any **TWO** of the following	2*8	16
a)	Plant layout:- It is the arrangement of physical facilities such as machinery, equipment, furniture etc. within the factory building in such a manner so as to have quickest flow of material at the lower cost and lower material handling.	2m definition	**08**

	Factors: - 1) Factory building: - The nature & size of the building determines the floor space available for layout. 2) Nature of product: - Product layout is suitable for uniform products whereas process layout is suitable for custom made products. 3) Production processes: - In assembly line industries product layout is better. In job order process layout is desirable. 4) Type of machinery: - Special purpose machineries are used in product layout and general purpose machines are used in process layout. 5) Repair and maintenance: -machines should be so arranged so that there will be an adequate space available for repair and maintenance work. 6) Human needs: - Adequate arrangements should be made for clock rooms, washrooms, lockers, drinking waters, canteen etc. 7) Plant environment: - Heat, light, noise, ventilation and other aspects should be duly considered. 8) Safety arrangements:- adequate safety arrangements should be made.	Any 6points 1 m each	
b)	**Marking of an Instrumental Panel: -** The sequence of operations for marking of holes may be as follows: A template is used to mark the positions of all the holes. Such a template is usually marked out on mild steel plate on a surface table using a Vernier height gauge and an angle plate. Small pilot holes are drilled, and once the template has been passed by inspection these are opened out with the correct size drill to suit the diameter of a nipple punch. The template is provided with location buttons to give an accurate location for the blanks. Figure below shows the template positioned over the blank ready for transferring the hole positions with a nipple punch. The use of such a template is a fool proof system which not only provides identical hole positions on each blank, but dispenses with the use of guides and locations having to be set up on the press.	(4m Dia & 4m description	**08**

	 		
c)	Templates for Hopper Plates Large steel hoppers are usually of riveted or welded construction made up off our tapered steel plates. The templates for these hopper plates may be made from wooden battens, sheet metal or template paper. The template is laid on the plate and the outline marked with French chalk and 'witness marks' are centre-punched at suitable positions. Rivet holes (where applicable) are marked through the template with a nipple punch. When paper templates are used, the holes are not provided in the template, as is the case with wooden and metal templates. The centres of the hole positions are marked on a paper template and may be transferred on to the plate by centre-punching through the template.	(4m Dia & 4m description	**08**

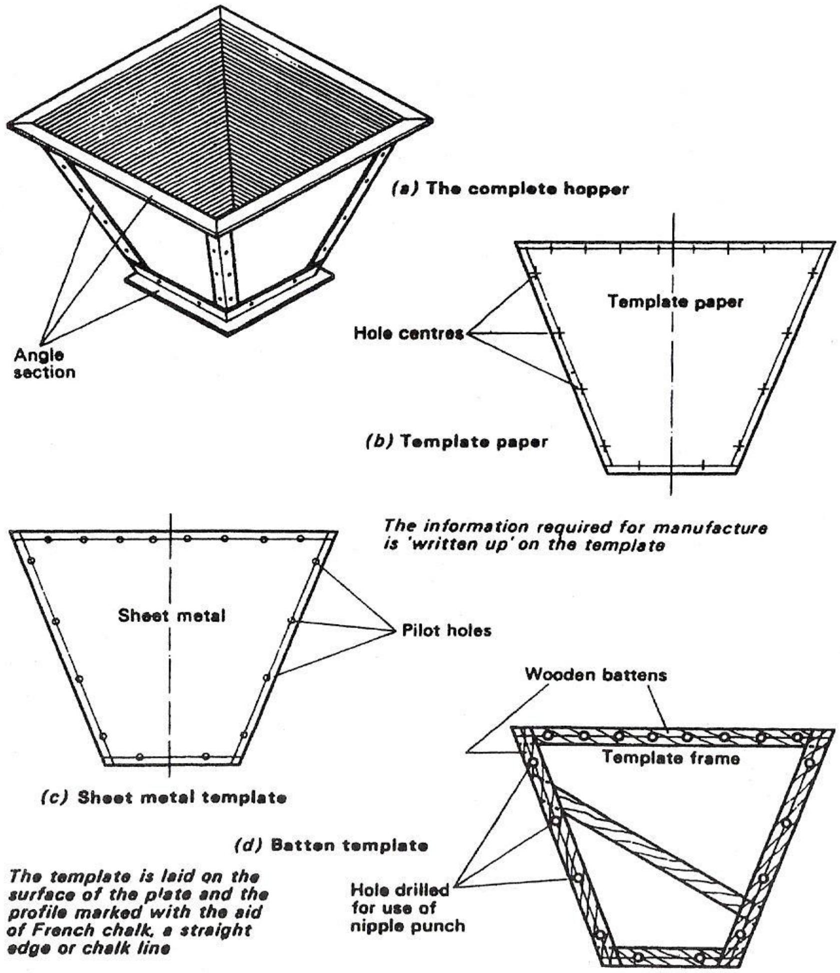
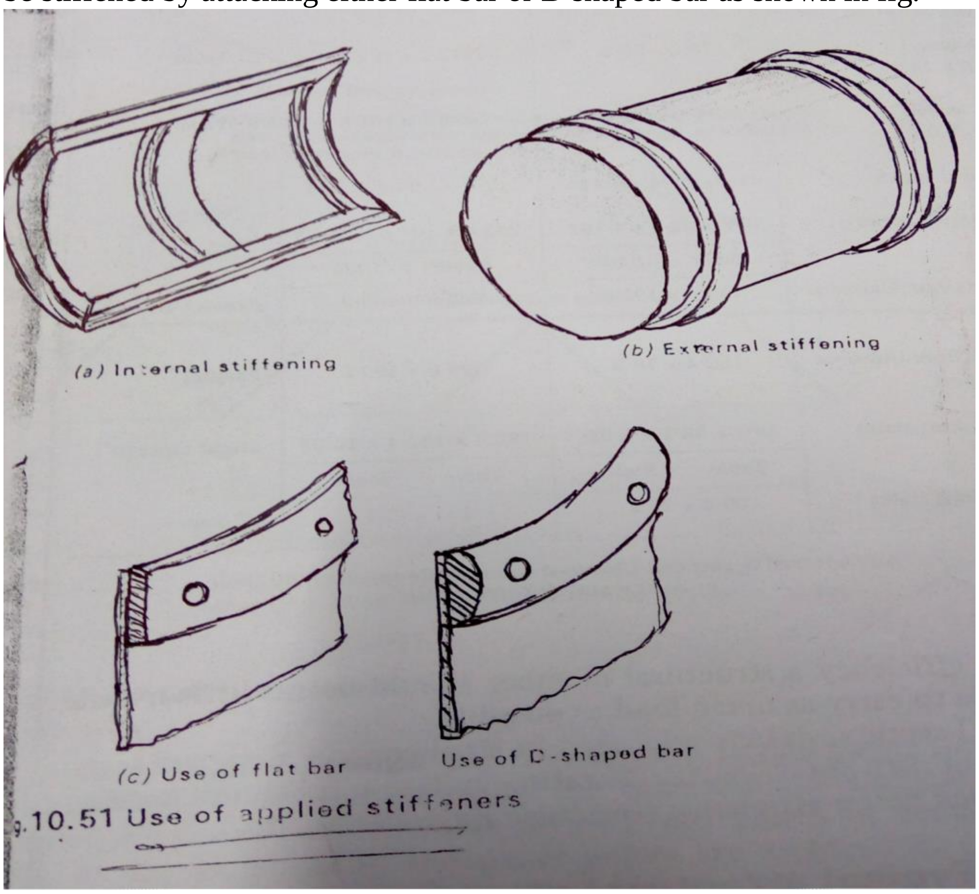


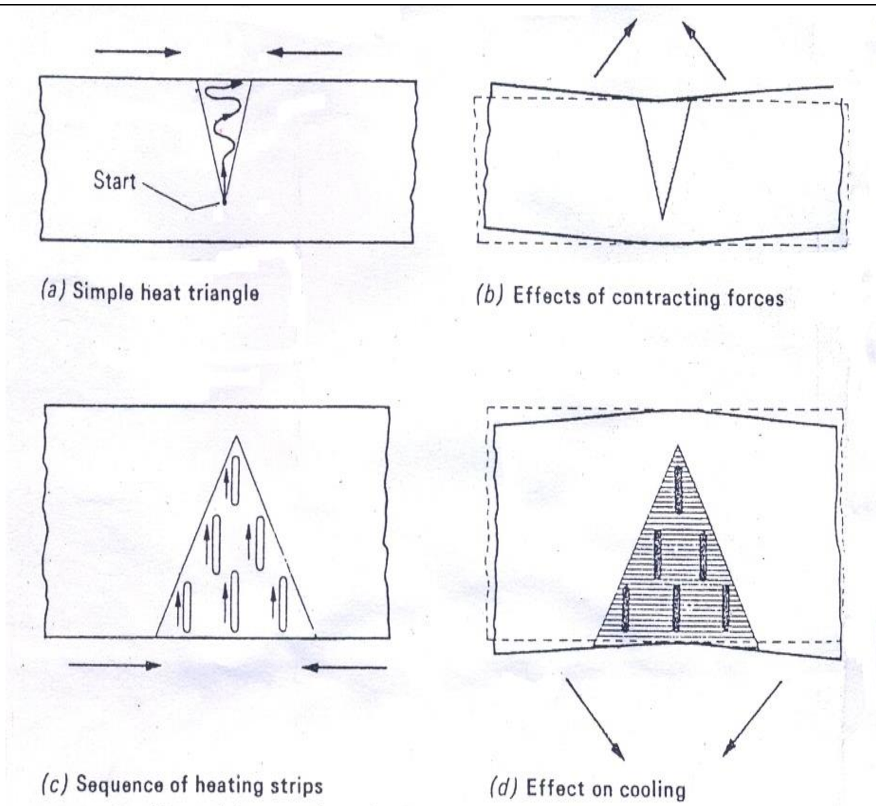
Figure 1 - The Use of Templates for Hopper Plates

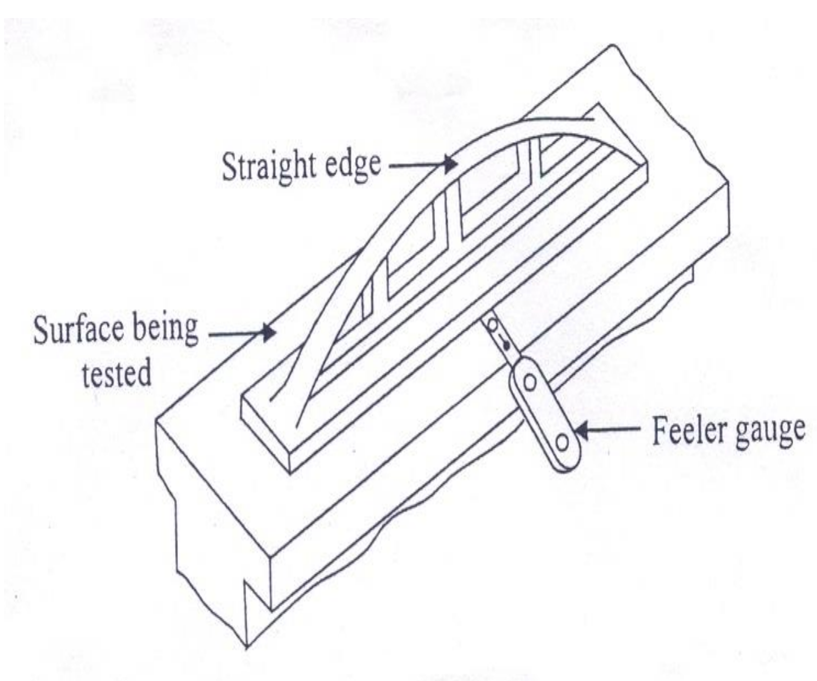
This simple type of hopper is made up off our identical steel plates for which only one template is required. The choice of template material is as follows:

When only one or two off are required, template paper may be used, Light-gauge sheet metal is ideal material for the template where a quantity of identical hoppers is required

Small pilot holes are either punched or drilled in the template in the correct positions. The hole positions are then transferred to the hopper plate with the aid of a centre punch.

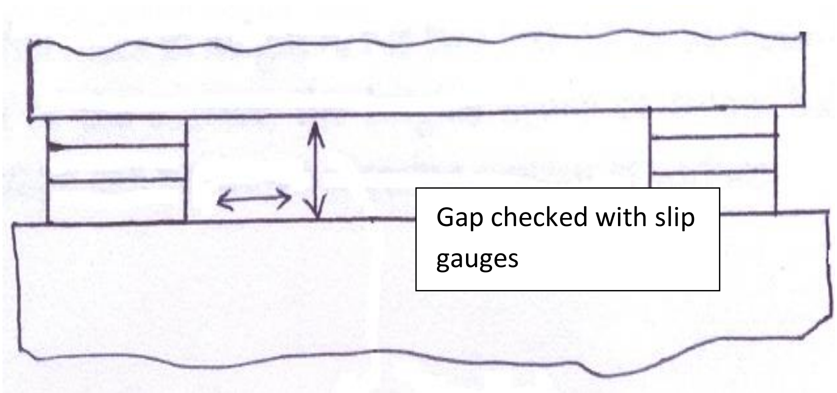
5.	Attempt any **FOUR** of the following	4*4	16
a)	Description: Fig illustrates an application of internal stiffening of a panel of circular shapes. The stiffening sections in this case rolled to correct contour and attached externally. When a sheet metal is too thick to allow the edge to be wired the edges may be stiffened by attaching either flat bar or D shaped bar as shown in fig.  	(2m Dia & 2m description	**04**

b)	Use of heat triangles Use of heat triangles: The use of heat triangles for straightening thin angle and flat sections, and the use of 'triangles' of heat strips for the bending and straightening of plate and wide sections are as shown in the figures below. Simple heat triangles may be used as shown in figure a) below by starting with the heating torch at the apex of the triangle and working towards the base with a gradually widening zigzag movement. When allowed to cool, the base of the heat triangle will start to contract the most, and the contracting forces tend to cause the plate to bend, as shown in figure b) below. The resultant effects of using triangles of heat strips are exactly the same as for the simple heat triangles. Simple heat triangles are used for straightening of thin plate and light sections. Triangles of heat strips are preferred when bending or straightening thick plate and heavy sections. The order, in which the heat strips are applied, in the triangle, is shown below in figure c). Heating with the torch is commenced a short distance in from the edge of the plate, progressively heating from the outside inwards.	(4m Dia & 4m description	**04**

c)	<u>Straightness Testing: -</u> At many places it is required that the surfaces must be perfectly straight, e.g., in a lathe it is desired that tool must move in a straight path. A line is said to be straight over a given length, if the variation of the distance of its points from two planes perpendicular to each other and parallel to the general direction of the line remains within the specified tolerance limits. Following are the methods which are used for straightness testing: - 1) By using a Straight Edge: - A straight edge is a measuring tool which consists of rod of steel of narrow and deep cross sections so as to avoid bending of that rod. A ruler is marked on straight edge. For checking straightness, the straight edge is placed on surface to be check. If these two surfaces match perfectly because of negligible gap, then we will say that the surface is perfectly straight. For determining the straightness of engineering components in workshop by straight edge, it is placed against the work as shown in the figure below. feeler gauges are then used to find any possible error.  	(2m Dia & 2m description any 1 method)	04

Use of straight edge with feeler gauge

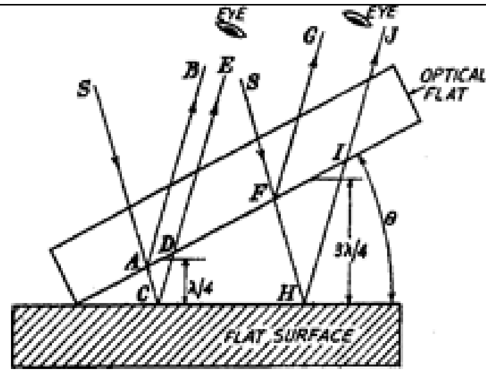
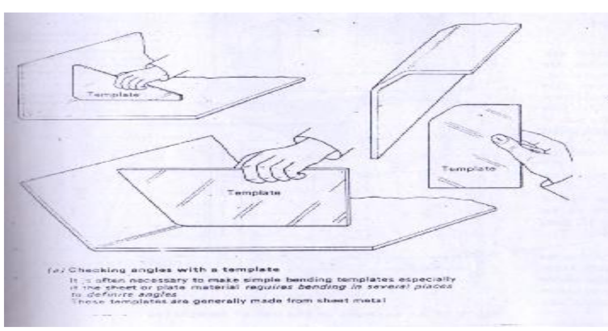
A more accurate method is to support the straight edge on equal slip gauges at the correct points for minimum deflection and measure the uniformity of the space under the straight edge with slip gauges as shown in the Figure below.

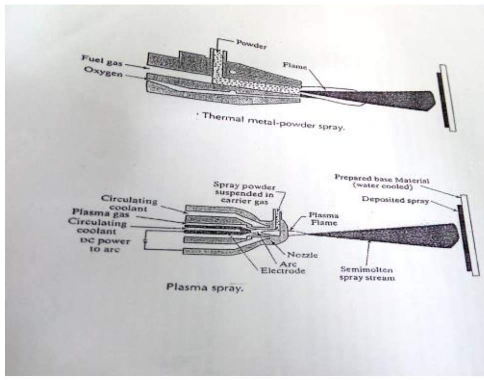


Use of straight edge with sleep gauges

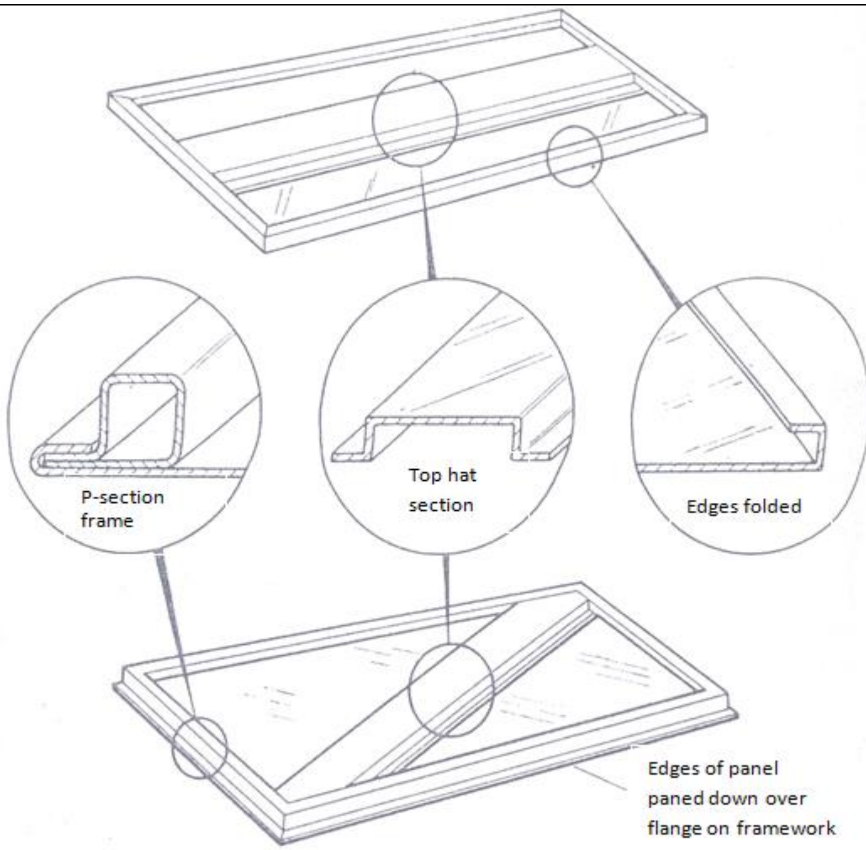
2) By using Spirit level: -
The flatness or straightness of any object can be tested with the help of spirit level as shown in fig.
Tests for straightness can be carried out by using spirit level. The straightness of any surface could be determined by either of this instrument by measuring the relative angular positions of number of adjacent sections of the surface to be tested.
So first a straight line is drawn on the surface whose straightness is to be tested. Then it is divided into a number of sections, the length of each section being equal to the length of spirit level base.
The spirit level is kept on the top of that surface and straightness is checked with spirit level at intermittent positions.

Flatness Testing: -
Following are the methods for flatness testing.
1) By using Spirit Level: -
The method is same as explained for straightness testing.
2) Flat Circle Method: -

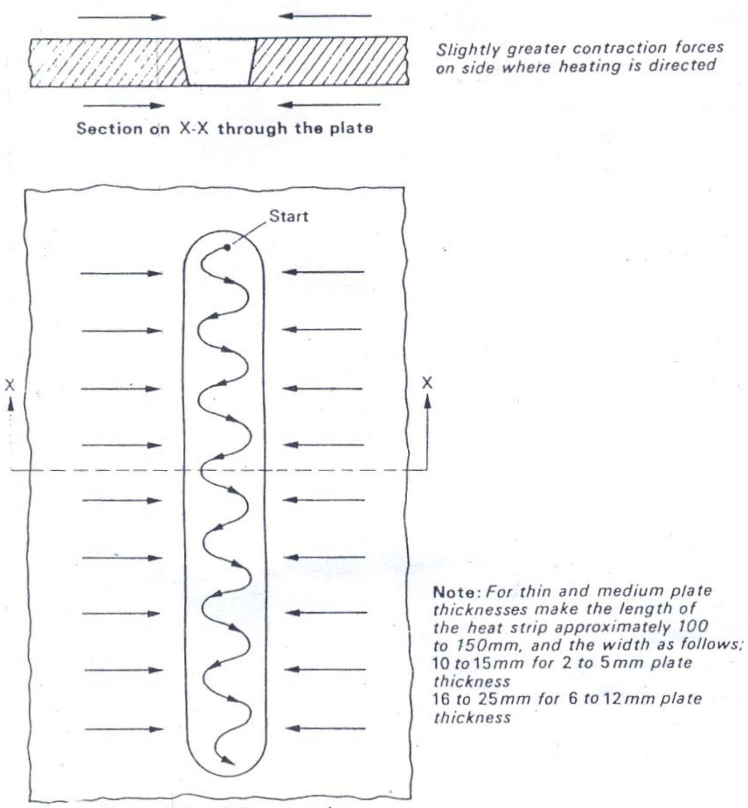
	 The essential equipment for measurement by light wave interference is a monochromatic light source and a set of optical flats. An optical flat is a circular piece of optical glass or fused quartz having its two plane faces flat and parallel and the surfaces are finished to an optical degree of flat ness. If an optical flat is placed upon another flat reflecting surface (without pressure) it will not form an intimate contact, but will lie at some angle making an inclined plane. If the optical flat be now illuminated by monochromatic source of light, the eye if placed in proper position, will observe a number of bands called fringes. As shown in fig. S is a source of monochromatic light which is passed through an optical flat at point A. It will partially have reflected to path B and further transmitted to point C and again at point C it will be reflected back through a path CDE.		
d)	Template As a means of checking: -  • These are usually made up of sheet metal or wood although for some applications template marking paper may be used. • Above fig shows the use of template for checking	(2m Dia & 2m description	**04**

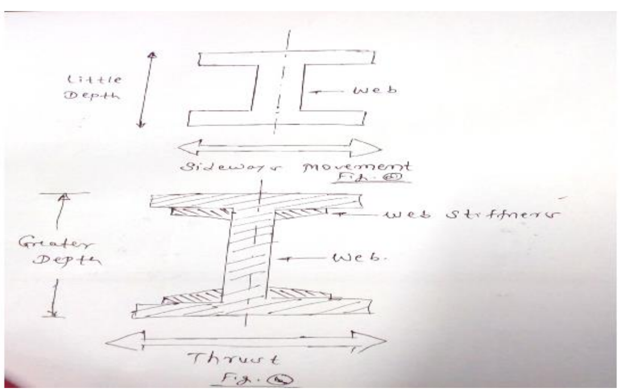
<table>
<tr><td></td><td>• In fig a, b & c template is used for checking the angles.
In fig d checking contour or radius corners template is used.</td><td></td><td></td></tr>
<tr><td>e)</td><td>Thermal Method: -


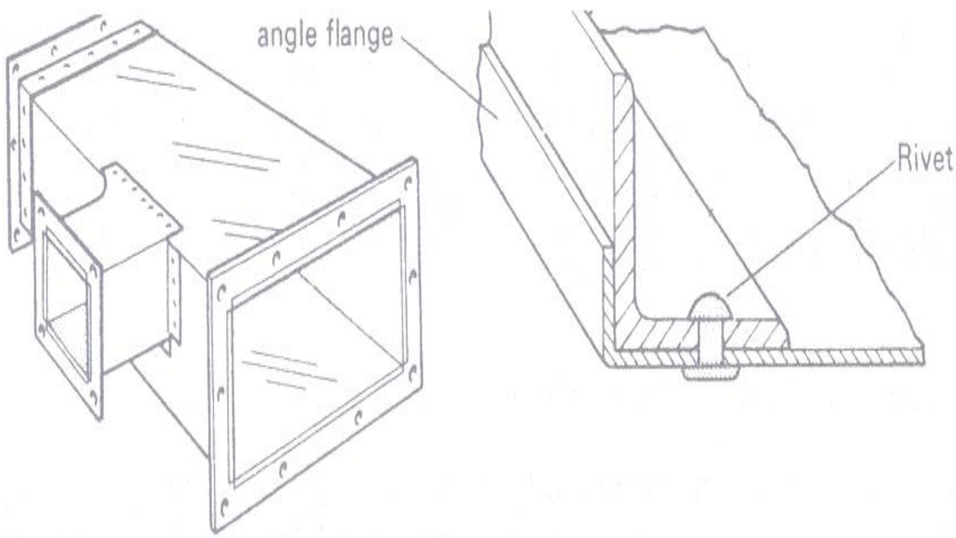
Working: -
In this method a metallic or nonmetallic material in the form of wire or powder is fed into heat source which melts the material and sprays it on to the surface of the work piece.
The work piece does not melt like it does in hard facing.
May be used to improve corrosion resistance, thermal resistance, wear resistance because both metal and ceramic based coatings may be applied.
Generally the work piece needs to be roughened up before spraying to help with adhesion of sprayed material.</td><td>(2m Dia & 2m description</td><td>04</td></tr>
<tr><td>f)</td><td>A large sheet metal panel may be stiffened with all four edges made rigid by folding. ‘Top hat section’ is used to stiffen the center section of the panel and is usually secured in position by spot welding.
Another method of stiffening large sheet metal panels is to attach them to a rigid frame-work. The welded frame is fabricated from lengths of ‘P-section’ which has a very high Strength/weight ratio for a sheet metal section. All four edges of the panel are folded at 90º to a suitable width.
The panel is then placed in position over the frame and the edges ‘paned-down’ over the flange on the ‘P-section’. The centre of the panel is stiffened by means of a diagonal top-hat section.</td><td>(2m Dia & 2m description</td><td>04</td></tr>
</table>

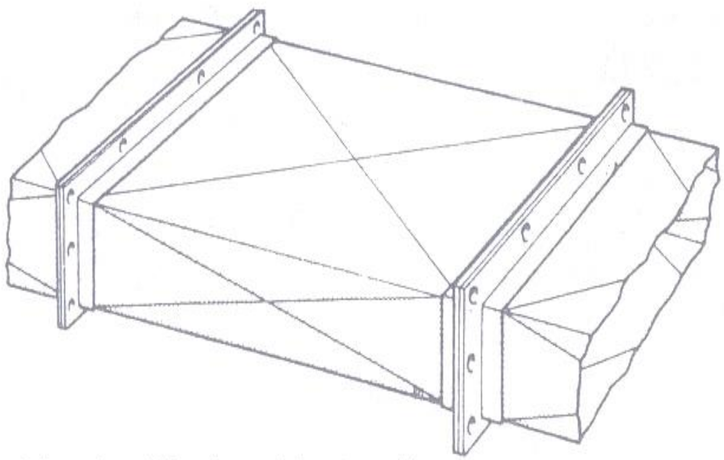


6.	Attempt any **FOUR** of the following	4*4	16
a)	Use of heat strips: The figure below shows the use of heat strips for the 'hot straightening' and 'hot shrinking' of plate and wide sections. The shrinking forces will be approximately equal for both sides of the plate. The figure above shows the application of a heat strip which, upon cooling, causes the metal to become compressed, because the contraction forces come in at right angles to the strip. Heating is commenced at one end of the strip, making sure that the correct heat goes right through the plate (cherry red 750°C). The whole heating operation is a continuous one, employing a zigzag movement of the heating torch towards the opposite end. On cooling the plate will be shorter in length in the locally heated area.	(2m Dia & 2m description	**04**

	 Principle of heat strips		
b)	Dry processes of surface cleaning: i) Thermal degreasing: Work pieces soiled with oil are blow dried with hot air at a temperature of about 250ºC. This degreasing principle is based on the evaporation of oil by correspondingly applying energy. The oil vapors are subsequently condensed and separated from the laden air. Following processing, the oils can be reused in production (recycling rate up to 80%). **OR** ii) Vacuum thermal degreasing: Before heating the work pieces, the system is evacuated to less than 1mbar and the pressure then increased again with N_2. After heating in conjunction with extensive inserting, the oil is evaporated in a vacuum of approximately 10 mbar at a temperature of 150ºC to 200ºC. The oils are condensed and can be reused. **OR** iii) Degreasing with CO_2: Supercritical CO_2 has been used successfully for many years in the food and pharmaceutical industries for the purpose of solvent – free dry extraction. Work pieces are cleaned with super – critical	04M Any 1	**04**

	CO_2 in high pressure systems at approximately 500 bar and an operating temperature of 190ºC		
c)	<u>Care & Storage of template: -</u> 1. To protect template from environmental or mechanical damage we require to take care and also to provide protection against damage. 2. If the template is made up of wood, then there is tendency to absorb moisture and get oversize so as to avoid these we have to carefully store wooden template with the help of some suitable protection clothing. 3. If the template is made up of card board or hard board it should not get folded and preserved carefully to use for longer time. 4. When the metal template is used it has tendency to get corroded or rusted when comes in contact with some gases, moisture etc. so as to prevent some lubricants, oils, grease should be applied regularly on the surface of template. 5. Metal template has the tendency of elongation and contraction when it comes with contact with higher and lower temperature and hence template required to be stored suitable temp range.	4m Any 4 points	**04**
d)	Web Stiffeners: -  **Description: -** Above fig a shows that when the depth of I section is not much there is no chance of bending or twisting so stiffeners are not required. As the depth of I section i.e. the height of web increases the tendency of bending and twisting increases. So as to avoid this the web stiffeners are attached to strengthen the Section as shown in fig b.	(2m Dia & 2m description)	**04**

e)	**Dynamics of plant layout:** Plant layout is a dynamic rather than a static concept meaning thereby if once done if is not permanent in nature rather improvement or revision in the existing plant layout must be made by keeping a track with development of new machines or equipment, improvements in manufacturing process, changes in materials handling devices etc. But any revision in layout must be made only when the savings resulting from revision exceed the costs involved in such revision.	04 marks	**04**
f)	The figures below show the use of angle stiffeners for duct work:  (a) Section of rectangular ductwork Welded angle frames are widely used as a means of stiffening and supporting rectangular ducts for high velocity systems. They also serve as a joining media when assembling sections together by bolting as shown in the figures above.	(2m Dia & 2m description any 2	**04**



(b) Diamond-break stiffening of duct walls
Slight diagonal fold from corner to corner

The large sizes of square or rectangular ducting tend to drum as the air pressure passing through them varies. To overcome this drumming it is necessary to provide adequate stiffening to the walls of the duct. This may be achieved by use of swaging, but often a 'diamond-break' is used as shown in the figure above.

Reasons for stiffening:
The three main reasons for stiffening sheet metal are;

- To give strength and rigidity to the material.
- To produce a safe edge.
- For decorative purposes.