SECOND SEMESTER DIPLOMA EXAMINATION IN MECHANICAL

ENGINEERING- MARCH, 2014

MANUFACTURING PROCESS

PART-A

1. Give any two advantages of X-ray radiography over gamma ray radiography.

- ✓ X-ray radiography provides better results for examining uniform thick objects.
- ✓ X-ray radiography requires only few seconds or minutes

2. List any two linear measuring and angular measuring instruments

Linear measuring instruments: Vernier caliper, micrometer

Angular measuring instruments: Bevel protractor, combination set

3. Give any two limitations of welding.

The process is not suitable for mechanization.

Takes longer time and skilled worker is required.

4. List the different types of patterns used for foundry.

Single piece pattern, split pattern, match plate pattern, Gated pattern, Sweep pattern, Cope and Drag pattern, loose piece pattern

5. Mention any four thermal properties of materials.

Specific heat, Thermal conductivity, Thermal resistance, Thermal diffusivity

PART-B

1. Define the following mechanical properties of materials:

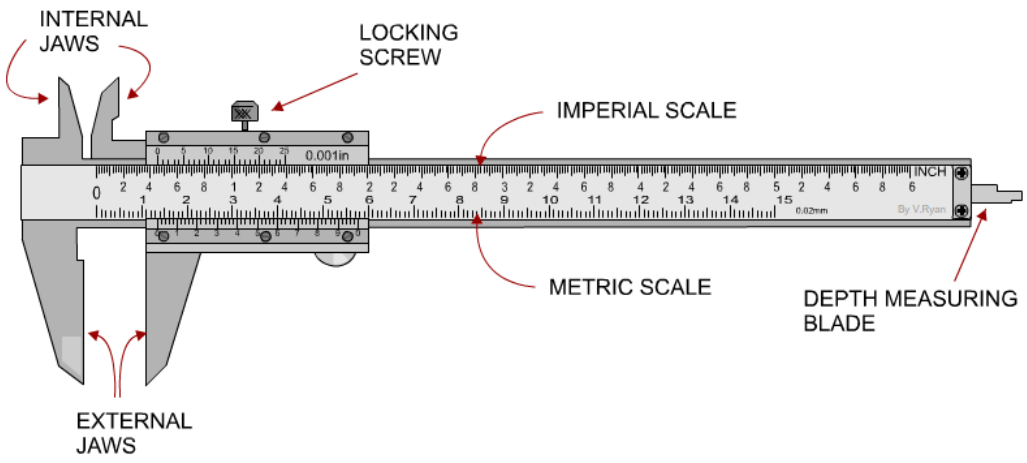
(1) Brittleness (2) Creep (3) Toughness.

Brittleness: It is a property of breaking without much permanent distortion or deformation.

Creep: The slow and continuous deformation of a material under steady load with time.

Toughness: It is the ability of a material to withstand shock or shear load. In other words, it is the ability of a material to withstand both plastic and elastic deformations.

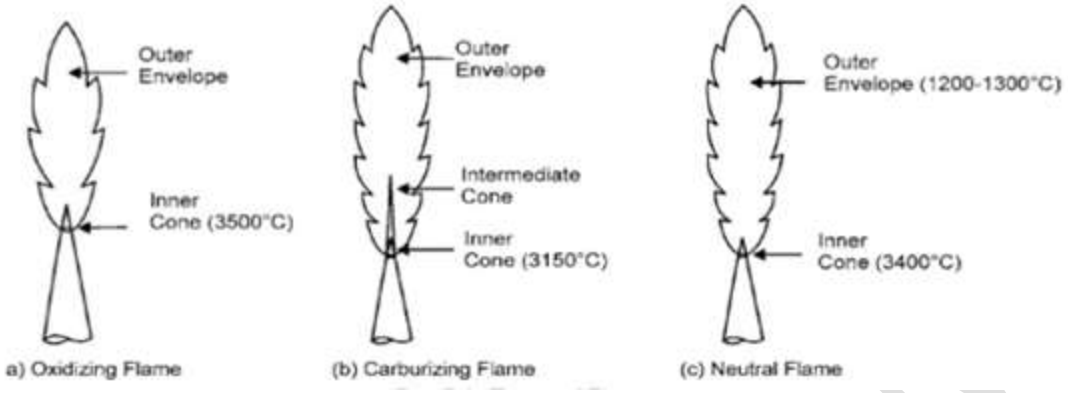
2. Sketch the figure of Vernier caliper and label its parts.



3. Explain different type of flames used in gas welding.

Oxidizing flame: It has an excess of oxygen over the acetylene. Its inner cone is shorter. It is used for welding brass and bronze and brazing of ferrous metals. It assures complete combustion and highest temperature, but has a tendency to oxidize metals being welded.

Neutral flame: It has equal quantities of oxygen and acetylene. It is most common flame used in welding processes. It has no tendency to react with material being welded.



Reducing flame: It has an excess of acetylene over the oxygen. It has a longer inner cone, an intermediate feather and bluish outer flame. It is used for welding high carbon steel. The flame has carburizing effect on steel, causing hard, brittle and weak weld.

4. List the advantages and applications of welding.

Advantages:

- ✓ Welding equipment is not very costly and is portable.
- ✓ Welding permits considerable freedom in design.
- ✓ A welded joint is strong as base metal.
- ✓ Welding joints are easier to inspect.
- ✓ Welding products are lighter and stronger.

Applications:

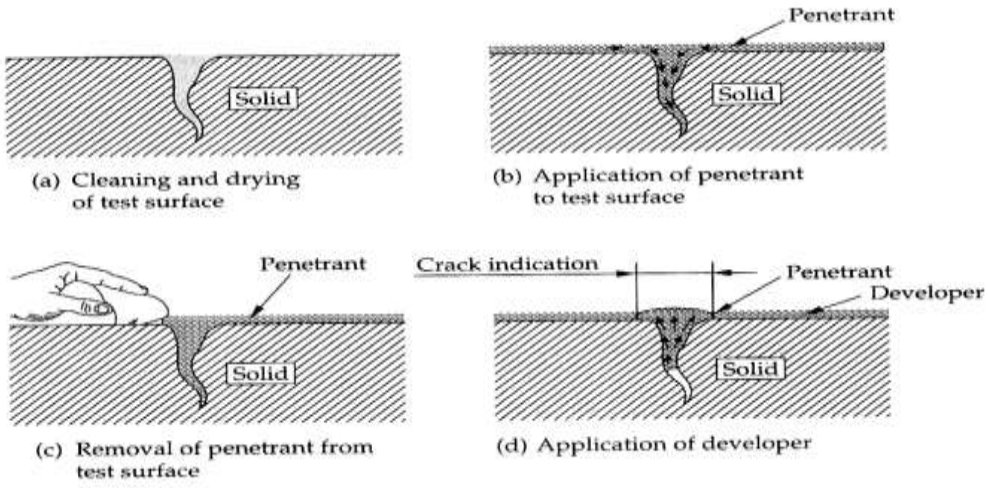
Fabrication of pressure vessels, ships, structural steel work, joint in pipe work, construction and repair of machine parts, hard facing and repair of broken parts.

5. Explain the liquid penetrant test.

Used to examine an object or material without damage or breaking. It is often required to verify the quality of a product. The product or specimen can use after the test.

Procedure of performing liquid penetrant test:

- A liquid with high surface wetting characteristics is applied to the surface of the part.
- Allowed time to seep into surface breaking defects.
- The excess liquid is removed from the surface of the part.
- A developer (powder) is applied to pull the trapped penetrant out the defect and spread it on the surface where it can be seen.
- Visual inspection is the final step in the process. The penetrant used is often loaded with a fluorescent dye and the inspection is done under UV light to increase test sensitivity.



6. Briefly explain shrinkage allowances and machining allowances.

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 allowances.

Machining or finishing allowance:

The excess in the dimension of the casting (i,e. in the dimension of pattern) over the finished casting is called machining or finishing allowance.

7. List the essential characteristics of a good comparator.

- ✓ It should be compact.
- ✓ It should be simple to handle.
- ✓ It should give quick results and must be reliable in operation.
- ✓ It should not affect environmental conditions while working.
- ✓ It should be robust in construction and must be cheaper.
- ✓ It must be light in weight.
- ✓ It should be sensitive as per requirement.
- ✓ It should be free from wear and back lash.
- ✓ It must have long life.

PART-C

UNIT-I

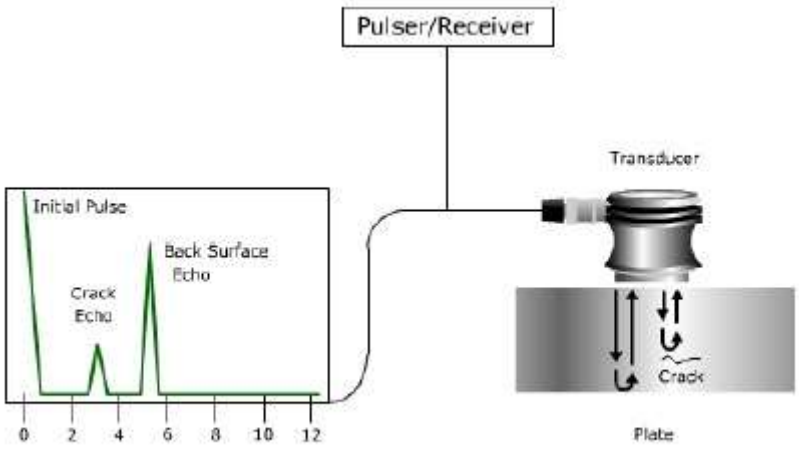
(a) Explain ultrasonic inspection and give its advantages, disadvantages and applications.

Ultrasonic Testing (UT) uses high frequency sound waves (typically in the range between 0.5 and 15 MHz) to conduct examinations and make measurements. Besides its wide use in engineering applications (such as flaw detection/evaluation, dimensional measurements, material characterization), etc.

UT inspection system consists of several functional units, such as the pulser/receiver, transducer, and a display device. A pulser/receiver is an electronic device that can produce high voltage electrical pulses. Driven by the pulser, the transducer generates high frequency ultrasonic energy.

The sound energy is introduced and propagates through the materials in the form of waves. When there is a discontinuity(such as a crack) in the wave path, part of the energy will be reflected back from the flaw surface. The reflected wave signal is transformed into an electrical

signal by the transducer and is displayed on a screen. Knowing the velocity of the waves, travel time can be directly related to the distance that the signal traveled. From the signal, information about the reflector location, size, orientation and other features can sometimes be gained.



Ultrasonic inspection test

Advantages:

It is sensitive to both surface and subsurface discontinuities.

- ✓ The depth of penetration for flaw detection or measurement is superior to other NDT methods.
- ✓ Only single-sided access is needed when the pulse-echo technique is used.
- ✓ It is highly accurate in determining reflector position and estimating size and shape.
- ✓ Minimal part preparation is required.
- ✓ It provides instantaneous results.
- ✓ Detailed images can be produced with automated systems.
- ✓ It is nonhazardous to operators or nearby personnel and does not affect the material being tested.
- ✓ It has other uses, such as thickness measurement, in addition to flaw detection.
- ✓ Its equipment can be highly portable or highly automated.

Disadvantages:

Surface must be accessible to transmit ultrasound.

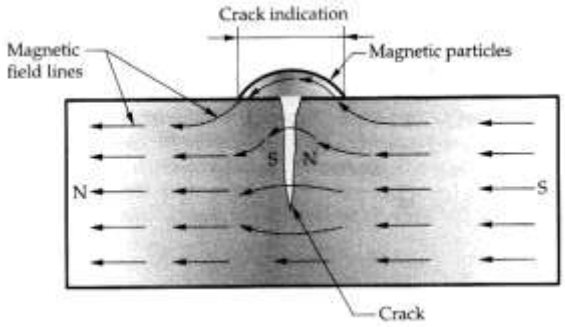
- ➢ Skill and training is more extensive than with some other methods.
- ➢ It normally requires a coupling medium to promote the transfer of sound energy into the test specimen.
- ➢ Materials that are rough, irregular in shape, very small, exceptionally thin or not homogeneous are difficult to inspect.
- ➢ Cast iron and other coarse grained materials are difficult to inspect due to low sound transmission and high signal noise.
- ➢ Linear defects oriented parallel to the sound beam may go undetected.
- ➢ Reference standards are required for both equipment calibration and the characterization of flaws.

Applications: inspections for voids, cracks, and laminations, inspections of welds and thickness measurements

(b) Explain the magnetic particle test.

Magnetic Particle Test is a non destructive testing, used to examine an object or material without damage or breaking. It is often required to verify the quality of a product. The product or specimen can use after the test. But test is conducted only for the component being magnetized.

The part to be tested is magnetized initially. Finely milled iron particles coated with a dye pigment are then applied to the specimen. These particles are attracted to magnetic flux leakage fields and will cluster to form an indication directly over the discontinuity. This indication can be visually detected under proper lighting conditions.



(a) Explain the test used for finding the fatigue strength of materials.

The fatigue test determines the stresses which a sample of material of standard dimensions can safely endure for a given number of cycles. It is performed on a test specimen of standard metal having a round cross-section, loaded at two points as a rotating simple beam, and supported at its ends.

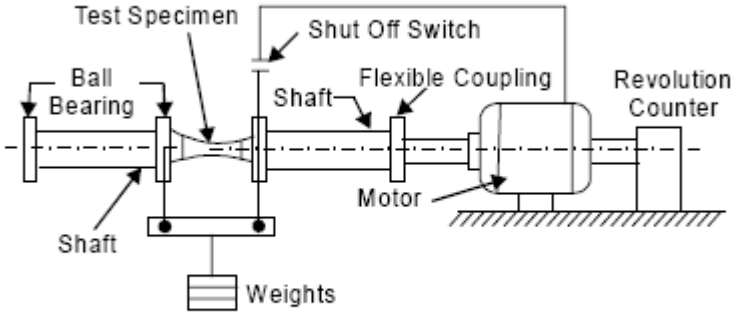
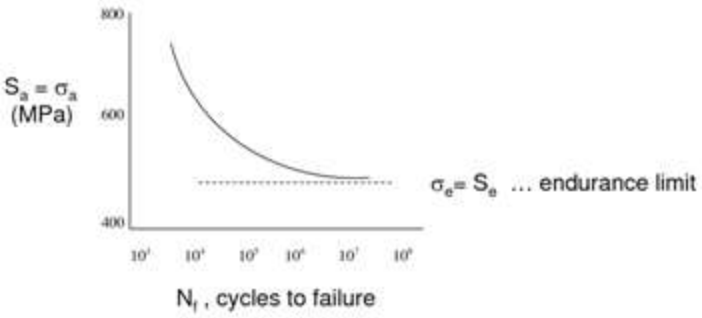


Fig. Schematic fatigue test setup

The upper surface of such a standard test specimen is always in compression and the lower surface is always in tension. The maximum stress in metal always occurs at the surface, halfway along the length of the standard test specimen, where the cross section is minimum. For every full rotation of the specimen, a point in the surface originally at the top centre goes alternately from a maximum in compression to a maximum in tension and then back to the same maximum in compression. Standard test specimens are tested to failure using different loads, and the number of cycles before failure is noted for each load. The results of such tests are recorded on graphs of applied stress against the logarithm of the number of cycles to failure. The curve is known as S-N curve.



(b) Define the following properties:

(1) Thermal conductivity **(2) hardness** **(3) stiffness**

Thermal conductivity: It is the ability of a material to conduct heat. In other terms, it is the quantity of heat transmitted through a unit thickness in a direction normal to a surface of unit area, due to a unit temperature gradient under steady state conditions.

Hardness: It is the ability of a material to resist indentation or surface abrasion.

Stiffness: It is the ability of a material to resist elastic deformation or deflection. Higher the value of young's modulus, higher the stiffness.

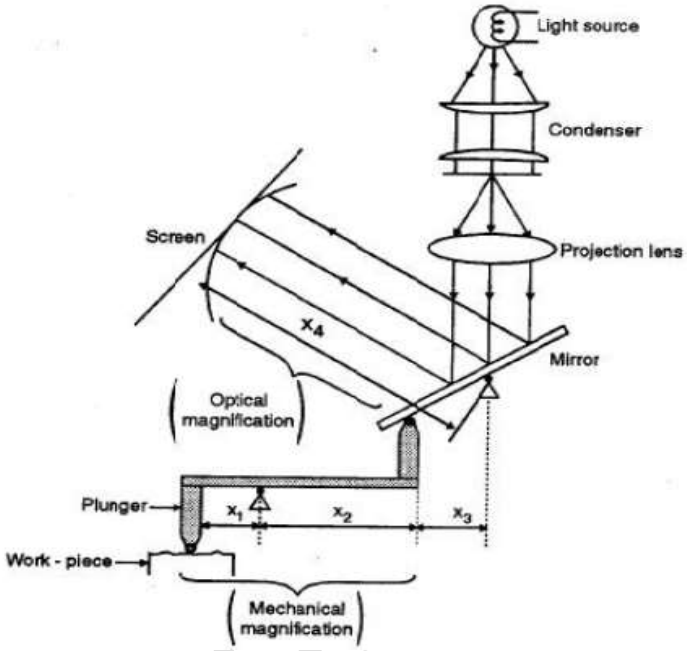
UNIT-II

(a) Explain the working of an optical comparator. List its advantages and disadvantages.

Optical comparator: It works on the principle of optical lever. It involves the movement of a mirror on which a beam of light is directed. The reflected beam deflect twice the angle of rotation of the mirror, thus giving an automatic magnification.

The movement of the plunger is magnified by the mechanical system using a pivoted lever. From the Figure the mechanical magnification = x2 / x1.

High optical magnification is possible with a small movement of the mirror. The important factor is that the mirror used is of front reflection type only.



Advantages

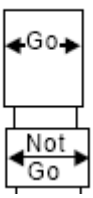
- ✓ The wear of measuring heads is avoided due to absence of direct contact.
- ✓ Friction is less due to less number of moving parts.
- ✓ Work piece is cleaned by supplying of all during the measurement.
- ✓ Unaffected by temperature change.

Disadvantages:

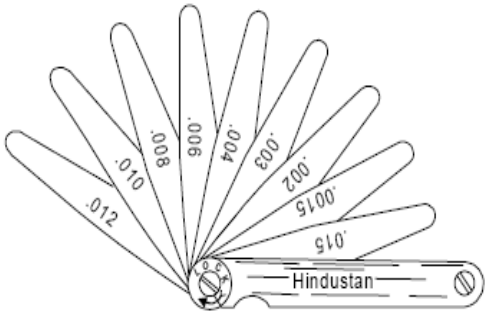
- Very low magnification is possible.
- Operation is difficult.
- It require electric supply
- Operation system is complex.

(b) Briefly explain the uses of plug gauge and feeler gauge.

Plug gauge: Used for checking inside diameter of an object. Standard type plug gauge is used to check one size only. GO-NO GO type is used to test limits of size of a hole.

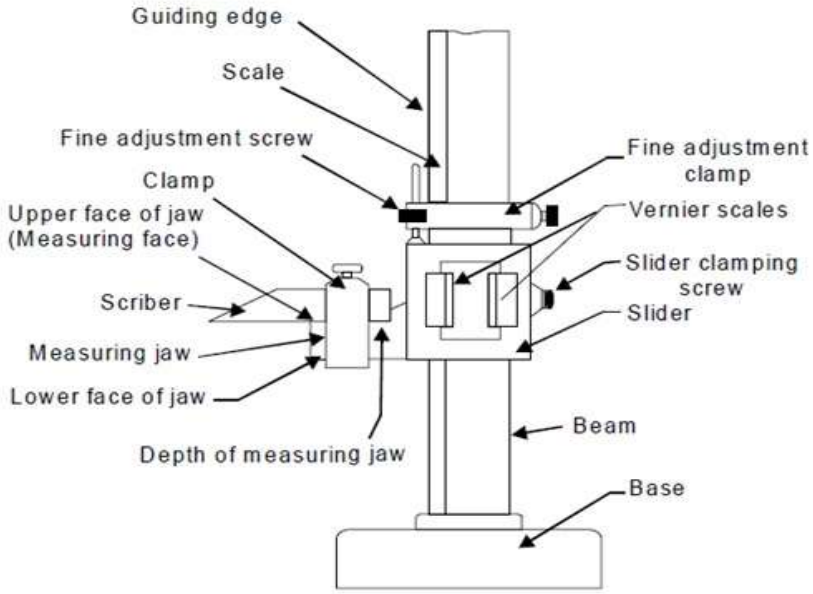


Feeler gauge: These are thin steel blades used for checking the clearance between two mating parts. The blades are pivoted in a holder. Each blade is marked with its thickness ranging from 0.03 mm to 1 mm.



(a) Draw a neat sketch of Vernier height gauge and mark its parts. Mention its important features.

Vernier height gauge , which is employed for measuring the height of parts and in precision marking work. It consists of a heavy base, an accurately finished bottom, a vertical bar mounted square to the base, carrying the main scale, a sliding head with Vernier, an auxiliary head with fine adjustment screw and nut and a bracket attached to the sliding head. This bracket is provided with a clamp by means of which interchangeable jaws can be fixed over there. The jaws can be fixed for measuring height or replaced by scribing jaws according to requirement or need.

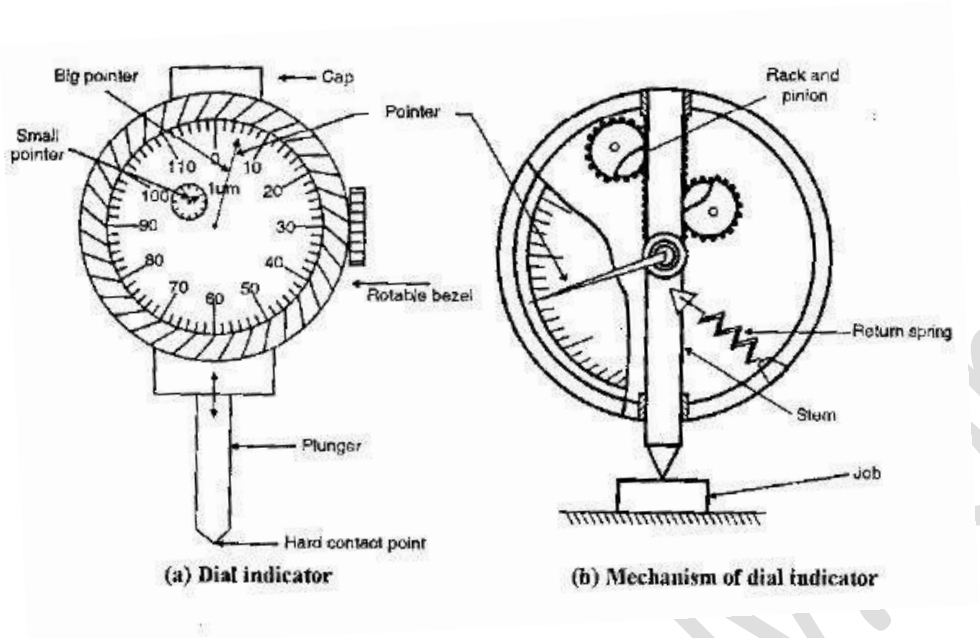


A vernier height gauge

(b) Explain the principle of a mechanical comparator. Explain any one type of mechanical comparator.

Mechanical Comparator:
It is self controlled and no power or any other form of energy is required. It employs mechanical means for magnifying the small movement of the measuring stylus. The movement is due to the difference between the standard and the actual dimension being checked.
The method for magnifying the small stylus movement in all the mechanical comparators is by means of levers, gear trains or combination of these. They are available of different make and each has its own characteristic. The various types of mechanical comparators are dial indicator, reed type comparator, sigma comparator.

Dial Indicator:
It operates on the principle, that a very slight upward pressure on the spindle at the contact point is multiplied through a system of gears and levers. It is indicated on the face of the dial by a dial finger. Dial indicators basically consists of a body with a round graduated dial and a contact point connected with a spiral or gear train so that hand on the dial face indicates the amount of movement of the contact point.



The movement mechanism of the instrument is housed in a metal case for its protection. The large dial scale is graduated into 100 divisions. The indicator is set to zero by the use of slip gauges representing the basic size of part.

UNIT-III

(a) Define soldering and brazing. Compare their characteristics with welding.

Soldering is defined as the process of joining metals by the use of filler metal (solder) below the temperature of 450^0c.

Brazing is defined as the process of joining metals by the use of filler metal (spelter) above the temperature of 450^0c.

Welding	Soldering	Brazing
Parts being joined by direct application of heat	Parts being joined by inserting low melting point metal between the surfaces being joined (solder).	Parts being joined by inserting low melting point metal between the surfaces being joined (spelter).
Welding gives much stronger joint	Weak joint	Joint is stronger than soldering.
It requires very high temperature (above melting points)	It requires only temperature below 450^0c.	It requires temperature above 450^0c but below melting point of metals.
Two metals are fused together	Solder melts and forms a bond between two surfaces.	Spelter melts and forms a bond between two surfaces.

(b) Explain any four principal operations in smith forging.

(1) Upsetting: It is the process of increasing cross-sectional area at the expense of its length. It is achieved by heating the bar and striking the end with bar. Upsetting also known as 'jumping up'.

(2) Drawing down: It is the process of decreasing the cross-sectional area with a corresponding increase in length of object. It is opposite to upsetting.

(3) Setting down: It is the process of decreasing the thickness rather than a general reduction in area. Setting down is initiated with fullers and finished with flatters.

(4) Cutting: It is the process of removing excess metal from the stock with chisel. The operation is often carried to separate required length from bar stock.

(a) List and explain the main hand forging tools.

Anvil, Swage block, Tongs, Hammers, Chisel, Fullers, Flatters, Punches, Drifts,etc..

Anvil: Used for supporting the work while hammering. The anvil is specified by its weight.

Swage block: It has grooves on faces and holes in the body. It is used for holding bar while bending and knocking up heads.

Tongs: Used for holding the job in hand forging operations.

Hammers: Hammers are striking tools used to deform the work piece into required shape.

Chisel: The chisels are used for cutting the metals.

Fullers: Fullers are used in pairs for necking or grooving operations. Fullers are generally used to spread metals in one direction only.

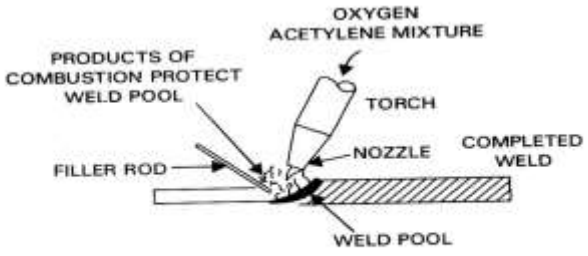
Flatters are used to obtain smooth and finished flat surfaces. These are made of tool steel with flat faces of about 75 mm square or round.

Punch: Used for making holes in a hot metal.

Drifts: It is used for enlarging the hole made by punch. They shape and finish the hole as well as enlarging it.

(b) What is the principle of gas welding? List the types of gas welding. Briefly explain the two types of gas welding techniques.

A fusion welding process which joins metals, using the heat of combustion of an oxygen and fuel gas (i.e. acetylene, hydrogen propane or butane) mixture is usually referred as 'gas welding'. The intense heat (flame) thus produced melts and fuses together the edges of the parts to be welded, generally with the addition of a filler metal. The fuel gas generally employed is acetylene; however gases other than acetylene can also be used though with lower flame temperature.



Principle of Gas Welding

Oxy-acetylene flame is the most versatile and hottest of all the flames produced by the combination of oxygen and other fuel gases. Other gases such as Hydrogen, Propane, Butane, Natural gas etc., may be used for some welding and brazing applications.

1. Air-acetylene welding
2. Oxy-acetylene welding
3. Oxy-hydrogen welding
4. Pressure gas welding

Gas welding techniques,

Leftward (forward) welding: Used for the materials upto 5 mm thick. In this case, filler rod is held in the left hand at an angle of 30^0 to 40^0 to the base plate, and the torch is held in the right hand at an angle of 60^0 to 70^0 to the plate. Welding started at the right hand end of the joint and proceeds to the left.

Rightward (backward) welding: Used for the materials over 5 mm thick. In this case, filler rod is held in the left hand at an angle of 30^0 to 40^0 to the base plate, and the torch is held in the right hand at an angle of 40^0 to 50^0 to the plate. Welding started at the left hand end of the joint and proceeds to the right.

UNIT-IV

(a) What are the desired properties of moulding sand? Briefly explain any three properties.

The desirable properties of moulding sand are Porosity, Plasticity, Flowability, Refractoriness, Collapsibility, Adhesiveness, and Cohesiveness.

Porosity: Moulding sand must be sufficiently porous to provide a passage for steam or gases that escaping from the molten metal.

Plasticity: Moulding sands ability to acquire shape from the pattern that is moulded and retain it during casting**.**

Refractoriness: Ability of a moulding sand to withstand the heat of molten metal without softening or fusion.

(b) What do you mean by seasoning of timber? Why is it necessary? Compare natural and artificial seasoning.

Seasoning of wood is the reduction of the moisture or sap content of it to the point where, under normal conditions of use, no further drying out will take place. The main objective of seasoning is to reduce the unwanted amount of moisture from the timber
Need for seasoning of timber before its use is necessary in order to achieve the required moisture content, to reduce fungi decay, to minimize attack of insects, to increase strength of wood and for reduction of wood warpage.

Natural seasoning	Artificial seasoning
✓ It is carried out generally in air, or in water or in smoke. It depends entirely upon the free flow of air around the wood to evaporate moisture. ✓ After natural seasoning the wood becomes soft. ✓ Air seasoning, water seasoning. ✓ Consumes more time	✓ Artificial seasoning is controlled by application of both heat and humidity which enables to reduce the moisture content quickly and accurately. ✓ After artificial seasoning the wood becomes harder. ✓ Kiln seasoning ✓ Consumes only lesser time.

(a) Define fitting. List different tools used in fitting and mention their purposes.

Fitting is the assembling of parts together and removing metals to secure the necessary fit, and may or may not be carried out at the bench.

Tools used in fitting shop

Tools used in bench and fitting shop are classified as under.
1. Marking tools: for marking. E.g.: straight edge, steel rule
2. Measuring devices: E.g.: feeler gauge, plug gauge
3. Measuring instruments: E.g.: Vernier caliper
4. Supporting tools: E.g.: V-block, Surface plate
5. Holding tools: E.g.: C-clamp
6. Striking tools: E.g.: hammers
7. Cutting tools: E.g.: Chisels, file
8. Tightening tools: E.g.: Pliers, wrench
9. Miscellaneous tools: Die, Drift,

(b) List different types of patterns commonly used. Explain the features of any three.

Single piece pattern, split pattern, match plate pattern, Gated pattern, Sweep pattern, Cope and Drag pattern, loose piece pattern, Skelton pattern, Segmental pattern, shell pattern, follow board pattern, etc..

Loose piece pattern: Loose piece pattern is used when pattern is difficult for withdrawal from the mould. Loose pieces are provided on the pattern and they are the part of pattern. The main pattern is removed first leaving the loose piece portion of the pattern in the mould. Finally the loose piece is withdrawal separately leaving the intricate mould.

Cope and drag pattern: In this case, cope and drag part of the mould are prepared separately. This is done when the complete mould is too heavy to be handled by one operator. The pattern is made up of two halves, which are mounted on different plates.

Gated pattern: In the mass production of casings, multi cavity moulds are used. Such moulds are formed by joining a number of patterns and gates and providing a common runner for the molten metal. These patterns are made of metals, and metallic pieces to form gates and runners are attached to the pattern.