SECOND SEMESTER DIPLOMA EXAMINATION IN MECHANICAL ENGINEERING- OCTOBER, 2011

MANUFACTURING PROCESS

PART-A

1. Mention four mechanical properties of materials.

Ductility, Malleability, Brittleness, Toughness

2. How will you distinguish between precision and non-precision measuring instruments?

Precision instruments posses high degree of accuracy and reliable in measurements. They have the ability to measure parts with accuracy of 0.01 mm or better. e.g.: Vernier caliper

Non-precision measuring instruments do not posses high degree of accuracy and exactness, and not reliable in measurements of parts. E.g.: steel rule

3. Differentiate between upsetting and drawing down.

Upsetting is the process of increasing cross-sectional area at the expense of its length.

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

4. What is the purpose of seasoning of wood?

Purpose of seasoning of wood is to reducing the moisture content of the timber so that it is suitable for the environment and intended use.

5. What is reaming?

Reaming is the process of finishing a drilled hole to an accurate size with a smooth finish.

PART-B

1. Briefly explain the following mechanical properties of materials

(1) Strength (2) Elasticity (3) Fatigue (4) Plasticity

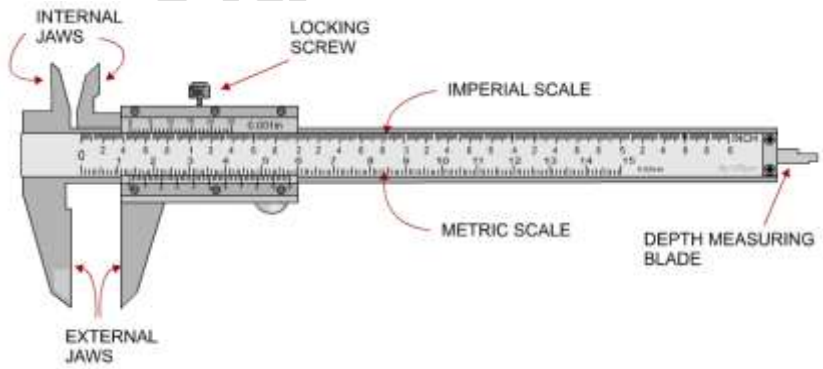
(1) Strength: It is the ability of a material to withstand external load.

(2) Elasticity: It is the ability of a material to regain its original shape and size after the removal of external load.

(3) Fatigue: It is the ability of a material to withstand repeated or cyclic load without rupture.

(4) Plasticity: It is the ability of a material to undergo some permanent deformation without failure.

2. Draw a neat sketch of a Vernier caliper and mark the parts.



3. Explain the use of fullers and flatters

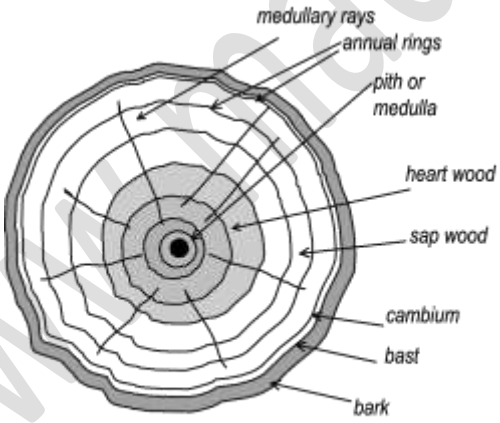
Fullers are used in pairs for necking or grooving operations. The bottom fuller has a square shank to fit in the hardie hole and top one is provided with handle. Fullers are generally used to spread metals in one direction only.

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.

4. Distinguish between green sand moulding and dry sand moulding.

	Green sand moulding	**Dry sand moulding.**
Principle	Its principal use is in making molds for metal casting. Green sand is an aggregate of sand, bentonite clay, pulverized coal and water. Green sand is not green in color, but "green" in the sense that it is used in a wet state (akin to green wood).	Dry sand mould is prepared in the same manner as that of green sand moulding, except that the mould is baked in oven to remove the moisture present in the sand and also the harden the moulds.
Advantages	✓ Less expensive Method. ✓ Sand can be reused many times after reconditioning with clay and moisture. ✓ Preferred for simple, small and medium size castings. ✓ Suitable for mass production	✓ Strength and stability of dry sand moulds is high when compared to green sand moulds. ✓ Baking removes moisture and hence, defects related to moisture are eliminated. ✓ Dry sand moulds give better surface finish and dimensional tolerance of castings.
Disadvantages	• Moulds prepared by this process lack in permeability, strength and stability. • They give rise to many defects like porosity, blow holes etc. because of low permeability and lot of steam formation due to their moisture content. • Not suitable for very large size casting. • Surface finish and dimensional accuracy of castings are not satisfactory. • Mould erosion is common in Green sand mould casting. • Difficult to cast thin and intricate shapes	• Consumes more time, labour and cost due to baking process. Hence, not suitable for mass production. • Not suitable for large and heavy size castings, as they are difficult to bake. • High capital cost of bake ovens. • Under baked or over baked moulds is another disadvantage.

5. Draw the cross section of hard wood and indicate the main features.

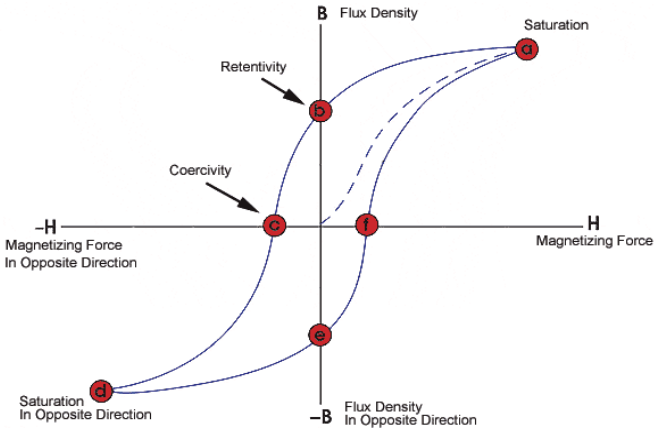


The tree trunk showing growth rings

6. Explain the term magnetic hysteresis with a neat sketch.

Magnetic Hysteresis

Hysteresis is defined as the lagging of magnetization or induction flux density behind the magnetizing force or it is that quality of a magnetic substance due to energy is dissipated in it on reversal of its magnetism.



Below Curie temperature, magnetic hysteresis is the rising temperature at which the given material ceases to be ferromagnetic, or the falling temperature at which it becomes magnetic. Almost all magnetic materials exhibit the phenomenon called hysteresis.

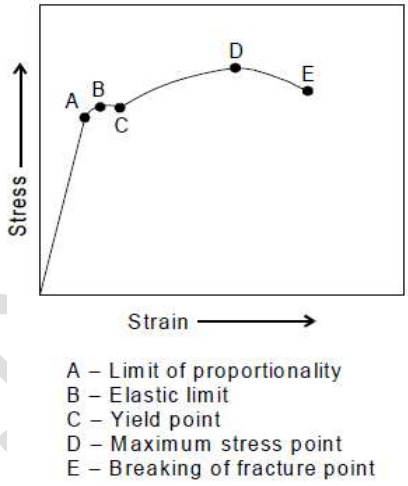
7. What are the different smith forging operations?

Upsetting, Drawing down, Setting down, Fullering, Swaging, Punching, Drifting, Bending, Cutting, Welding

PART-C

UNIT-I

(a) Draw a typical stress-strain diagram for ductile material and explain the salient points.



Proportional limit: It is the stress at which the stress-strain curve deviates from linearity. Upto this point, stress is proportional to strain.

Elastic limit: It is the greatest stress that the metal can withstand without experiencing a permanent strain when load is removed.

Yield point: It is the minimum stress at which the specimen is deformed without an increase in load**.**

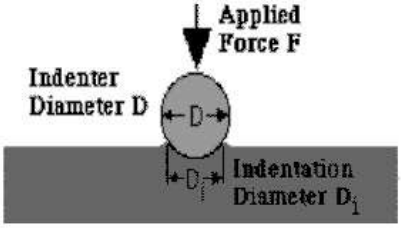
Maximum stress point: It is the maximum stress, a material can withstand without fracture.

Breaking stress: It is the stress at which the specimen will fracture or failure.

(b) What is meant by hardness of a material? Explain the procedure of finding the hardness of materials by Brinell hardness test.

Hardness is the property of a material that enables it to resist plastic deformation, usually by penetration. However, the term hardness may also refer to resistance to bending, scratching, abrasion or cutting.
The Brinell Hardness Test

1. The Brinell hardness test method consists of indenting the test material with a 10 mm diameter hardened steel or carbide ball subjected to a load of 3000 kg. For softer materials the load can be reduced to 1500 kg or 500 kg to avoid excessive indentation.
2. The full load is normally applied for 10 to 15 seconds in the case of iron and steel and for at least 30 seconds in the case of other metals.
3. The diameter of the indentation left in the test material is measured with a low powered microscope.
4. The Brinell harness number is calculated by dividing the load applied by the surface area of the indentation.



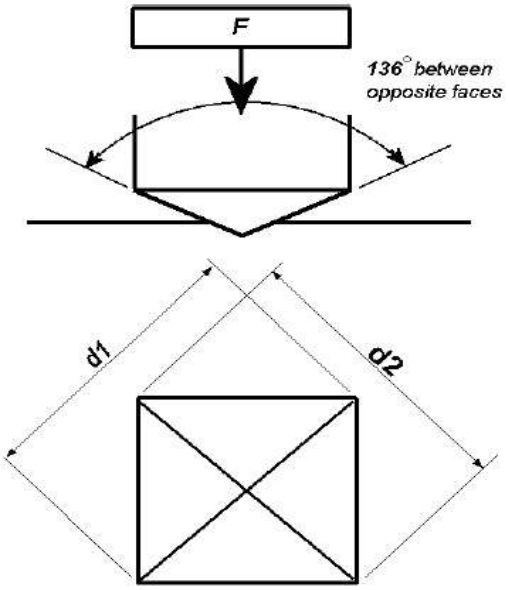
$$BHN = \frac{F}{\frac{\pi}{2} D \cdot (D - \sqrt{D^2 - D_1^2})}$$

5. The diameter of the impression is the average of two readings at right angles and the use of a Brinell hardness number table can simplify the determination of the Brinell hardness.

(a) Explain the procedure of finding the hardness of materials by Vickers hardness test.

Vickers Hardness Test

1. The Vickers hardness test method consists of indenting the test material with a diamond indenter, in the form of a right pyramid with a square base and an angle of 136 degrees between opposite faces subjected to a load of 1 to 100 kgf.
2. The full load is normally applied for 10 to 15 seconds.
3. The two diagonals of the indentation left in the surface of the material after removal of the load are measured using a microscope and their average calculated.
4. The area of the sloping surface of the indentation is calculated.
5. The Vickers hardness is the quotient obtained by dividing the kgf load by the square mm area of indentation.



F= Load in kgf
d = Arithmetic mean of the two diagonals, *d1* and *d2* in mm
HV = Vickers hardness

$$HV = \frac{2F\sin\frac{136^\circ}{2}}{d^2} \qquad HV = 1.854\frac{F}{d^2} \text{ approximately}$$

When the mean diagonal of the indentation has been determined the Vickers hardness may be calculated from the formula, but is more convenient to use conversion tables.

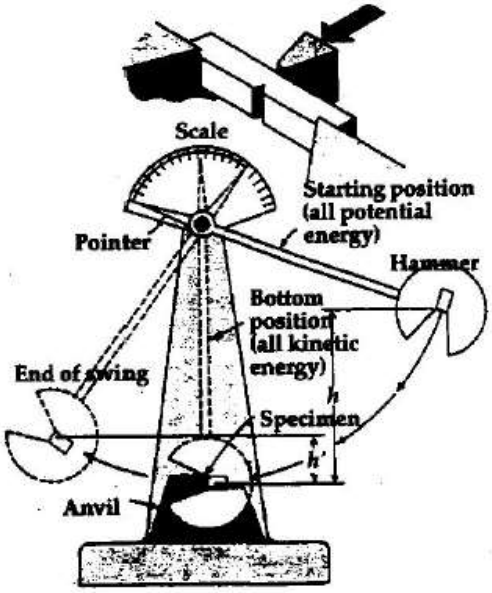
(b) Define impact strength of a material. Explain the procedure of finding out the impact strength by Charpy pendulum test.

The capacity of a material to withstand suddenly applied loads without fracture is known as impact strength.

The test consists of breaking by one blow from a swinging pendulum, under conditions defined by standards, a test piece notched in the middle and supported at each end. The energy absorbed is determined in joules. This absorbed energy is a measure of the impact strength of a material.

- The test bar, notched in the center, is located on two supports. The beams may be simply loaded.
- The blow in Charpy test is delivered at a point directly behind the notch
- The hammer will fracture the test bar and the absorbed energy (in Joule) is an indication for the resistance of the material to shock loads.
- The function of the V notch in metal is to ensure that the specimen will break as a result of the impact load to which it is subjected.
- The energy input in this case is a function of the height of fall and the weight of the pendulum used in the test setup.

The energy remaining after fracture is determined from the height of rise of the pendulum due to inertia and its weight. The difference between the energy input and the energy remaining represents the energy absorbed by the standard metal specimen. Advance testing setups of carrying out such experiments are generally equipped with scales and pendulum actuated pointers, which provide direct readings of energy absorption.



IMPACT TESTER

UNIT-II

(a) A micrometer is used for taking the accurate measurement of a steel specimen. The pitch scale reading is 6 mm; the 30th division of the thimble coincides with the fiducial line. The pitch of the micrometer screw is 0.5mm and the thimble consists of 50 divisions. Find the actual measurement of the specimen.

Given

pitch of the micrometer screw = 0.5mm

thimble division =50

Therefore, least count =0.5/50 = 0.01 mm

Pitch scale reading = 6 mm

Thimble reading = 36 x 0.01 = 0.36

So that, actual measurement = 6 + 0.36 = 6.36 mm

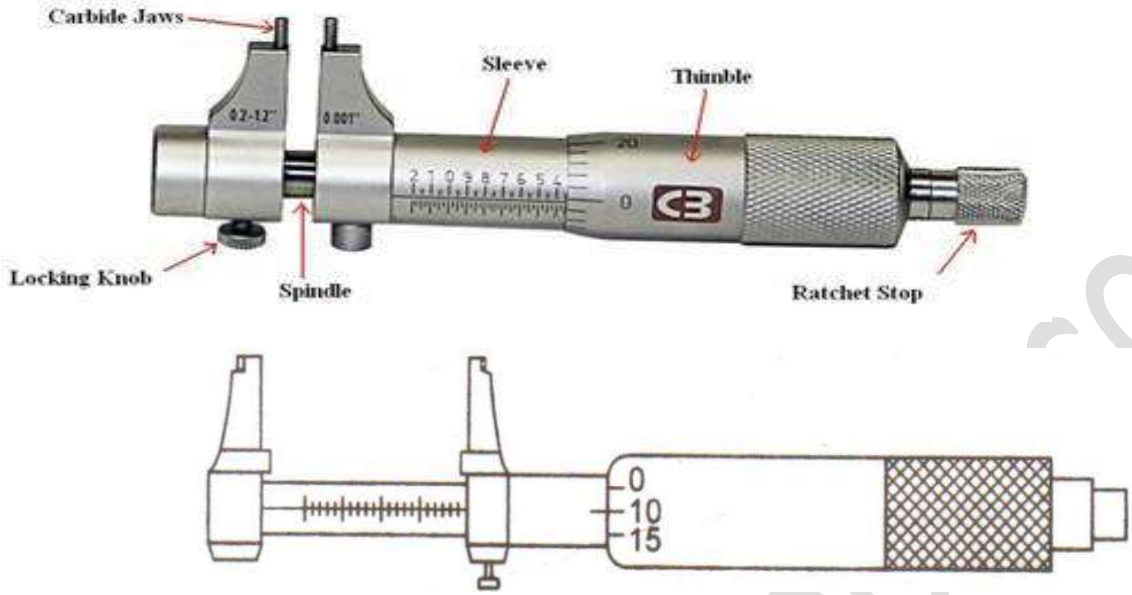
(b)What is a comparator? Explain the working of a mechanical comparator.

Comparators are measuring instruments which give only dimensional difference in relation to a basic dimension. Used to check components in mass production, to set working or inspection gauge, etc.

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.

(a) Draw a neat sketch of inside micrometer and mark different parts.



(b) Describe the following:

(1) Feeler gauge (2) thread pitch gauge (3) Plate and wire gauge (4) form gauge.

(1) 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.

(2) Thread pitch gauge: This gauge is used for checking pitch diameter of threads. Plug and ring thread gauges are available to check internal and external threads respectively.

(3) Plate and wire gauge: Wire gauge is used to check the diameter of wires from 0.1 mm to 10 mm. Plate gauge is used to measure the thickness of sheets.

(4) Form gauge: Form gauges are used to check the profile of objects; two of the most common types are radius gauges, which are packs of blades with both concave and convex circular profiles that are used to check the radii of grooves and corners, and screw-thread pitch gauges, which are blades with triangular serrations spaced to correspond with various pitches, or numbers of threads per inch or per centimeter.

UNIT-III

(a) Explain the brazing process with an application.

Brazing is a process of joining metals without melting the base metal. Filler material used for brazing has liquidus temperature above 450°C and below the solidus temperature of the base metal. The filler metal is drawn into the joint by means of capillary action (entering of fluid into tightly fitted surfaces).
The copper-zinc alloy is most widely used for filler material and is called spelter. Brazing is a much widely used joining process in various industries because of its many advantages. Due to the higher melting point of the filler material, the joint strength is more than in soldering.
Almost all metals can be joined by brazing except aluminum and magnesium which cannot easily be joined by brazing. Because of the lower temperatures used there is less distortion in brazed joints.
Also, in many cases the original heat treatment of the plates being joined is not affected by the brazing heat. The joint can be quickly finished without much skill. Because of the simplicity of the process it is often an economical joining method with reasonable joint strength. The brazed joints are reasonably stronger, depending on the strength of the filler metal used.

Applications: Dissimilar metals, such as stainless steel to cast iron can be joined by brazing. The process is used for cycle and motorcycle frames, heat exchangers.

(b) Classify the hearths used in smithy shops. Mention the details of an open hearth furnaces.

(a) Explain the working of a rotary hearth furnace.

It is a continuous furnace concept that allows processing of small to very large product. The material is conveyed directly on the furnace hearth which consists of an externally driven turntable located inside the furnace heating chamber. Furnaces can be provided in electric, direct fired and indirect gas fired configurations to meet specific processing requirements.

Rotary hearth furnace has a circular hearth which rotates within the furnace with the metal work pieces are placed over it. The speed of rotation of the hearth is such that the metal is heated to the required temperature in one revolution. It is heated with the help of burners. The temperature is controlled by means of burners positioned along the wall and on the roof of the furnace.

(b) Write the difference between hand forgings and die forging.

Hand forging is also known as *smith forging*. In hand forging, a hammer strikes and deforms the workpiece, which is placed on a stationary anvil. Therefore the operator, or a robot, needs to orient and position the workpiece to get the desired shape. Open die forgings can be worked into shapes which include discs, hubs, blocks, shafts (including step shafts or with flanges), sleeves, cylinders, flats, hexes, rounds, plate, and some custom shapes. Open-die forging lends itself to short runs and is appropriate for art smithing and custom work. In some cases, open-die forging may be employed to rough-shape ingots to prepare them for subsequent operations. Open-die forging may also orient the grain to increase strength in the required direction.

Die forging

Die forging is also called impression-die forging, the metal is placed in a die resembling a mold, which is attached to the anvil. Usually, the hammer die is shaped as well. The hammer is then dropped on the workpiece, causing the metal to flow and fill the die cavities. The hammer is generally in contact with the workpiece on the scale of milliseconds. Depending on the size and complexity of the part, the hammer may be dropped multiple times in quick succession. Excess metal is squeezed out of the die cavities, forming what are referred to as *flash*. The flash cools more rapidly than the rest of the material; this cool metal is stronger than the metal in the die, so it helps prevent more flash from forming. This also forces the metal to completely fill the die cavity. After forging, the flash is removed.

UNIT-IV

(a) Explain the details of the following work holding tools:

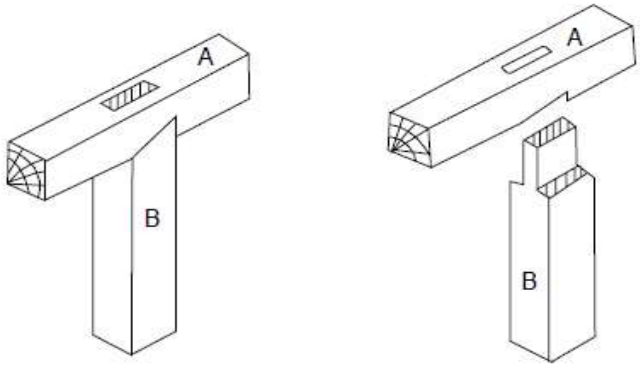
(1) Carpentry vice (2) 'C' clamp.

(1) Carpentry vice:
Carpenter vice is very important tool in wood working shops for holding wooden jobs. There are several varieties of vices, each possessing its own particular merit. One jaw of the vice is tightened to the table and is kept moveable for holding the articles Work benches are built solidly with good heavy tops for providing a good working surface for cutting, as well.
(2) 'C' clamp:

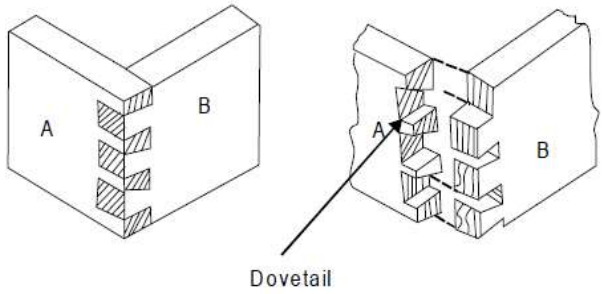
Clamps are commonly used in pairs in gluing up operations at the final assembly of wood joinery work. These clamps can provide pressure required to hold joints together until they are secured due to the setting of glues. It consists of a frame with a jaw at one end, and movable jaw which is operated by a screw and a thumb nut at the other end.

(b) With the aid of neat sketch, explain any three carpentry joints.

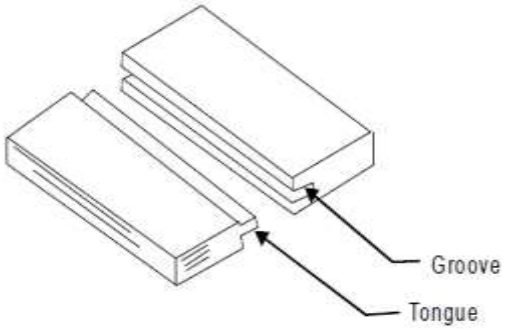
Mortise and tenon joint: It is the strongest joint, and is used for doors, windows and frames. The tenon (tongue) fit into a mortise (mouth).



Dovetail joint: It is the strongest corner joint, and it is used for construction of boxes and cup boards.



Tongue and grooved joint: It is widening joint used for planks and boards. This joint is prepared by cutting a groove on one edge and a matching tongue on the other by means of a special plane. The tongue is fitted into the groove.



(a)What is a sweep pattern? Explain its applications.

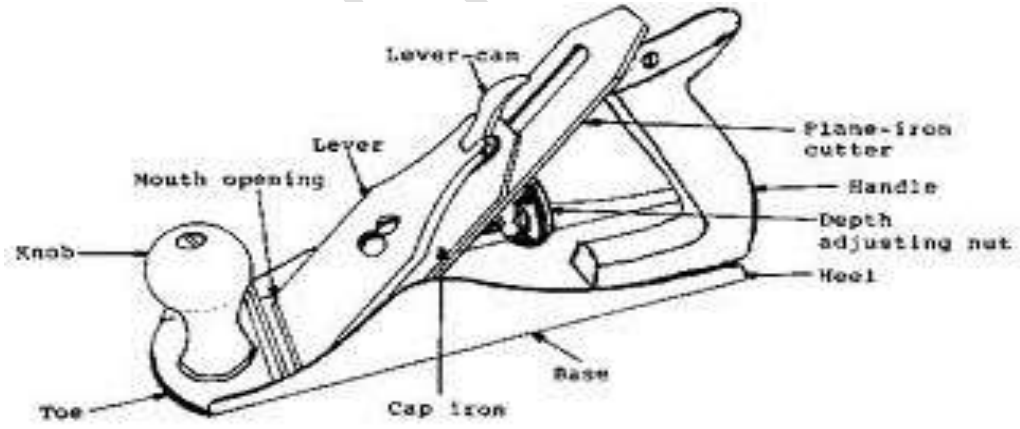
Actually a sweep is a template of wood or metal and is attached to the spindle at one edge and the other edge has a contour depending upon the desired shape of the mould The pivot end is attached to a stake of metal in the center of the mould. In this case, no importance is given to accuracy and smoothness of the casting. . Sweep patterns are used for forming large circular moulds of symmetric kind by revolving a sweep attached to a spindle.

(b) Describe with neat sketches, the construction and use of the following tools:

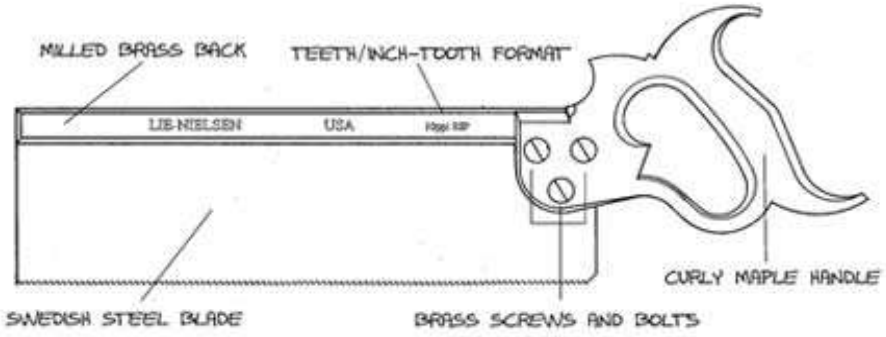
(1) Metal jack plane **(2) Tenon saw**

(1) Metal jack plane:

The body is made with grey cast iron, it is provided with wooden handle at back and wooden knob at front. A fine screw is used for adjusting depth of cut. It is durable and gives better finish. Blade can be adjusted easily.



(2) Tenon saw:



A Tenon Saw is a large backsaw used for making accurate deep cuts in furniture joinery. It should cut straight and fast, and the blade should not bind in the cut. Filed crosscut, this saw can be used for cross grain work like tenon shoulders, housing dadoes and sliding dovetails, or precise cut-off with a small miter box.