SECOND SEMESTER DIPLOMA EXAMINATION IN MECHANICAL ENGINEERING- MARCH, 2011

MANUFACTURING PROCESS

PART-A

1. Mention four thermal properties of materials.

Specific heat, Thermal conductivity, Thermal resistance, Thermal diffusivity

2. Differentiate between soldering and brazing.

Soldering is the process of joining metals by the use of filler metal (solder) below the temperature of 450^0c. **Brazing** is the process of joining metals by the use of filler metal (spelter) above the temperature of 450^0c.

3. What are the functions of electrode coating using flux?

- ✓ To provide gaseous shield for the arc and weld area.
- ✓ To prevent the formation of surface oxides and weld porosity.
- ✓ To provide the alloying element to the weld metal.
- ✓ To stabilize the arc and maintain its consistency throughout the welding operations.

4. What is a hand file?

Hand file used commonly for filing flat surfaces. It has rectangular cross-section with parallel edges throughout, but thickness is tapered towards point.

5. Name two precision instruments used for angular measurements.

Universal bevel protractor, Adjustable bevel

PART-B

1. Distinguish between ductility and malleability, brittleness and toughness

Ductility and Malleability
Ductility is termed as the property of a material enabling it to be drawn into wire with the application of tensile load. A ductile material must be strong and plastic.
Malleability is the ability of the material to be flattened into thin sheets under applications of heavy compressive forces without cracking by hot or cold working means.
Brittleness and Toughness
Brittleness is the property of a material opposite to ductility. It is the property of breaking of a material with little permanent distortion. The materials having less than 5% elongation under loading behavior are said to be brittle materials.
Toughness 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. What are the different types of patterns? Explain the features of gated pattern.

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..

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.

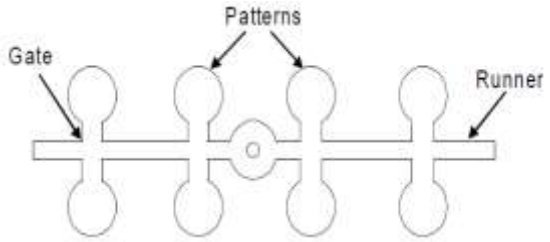
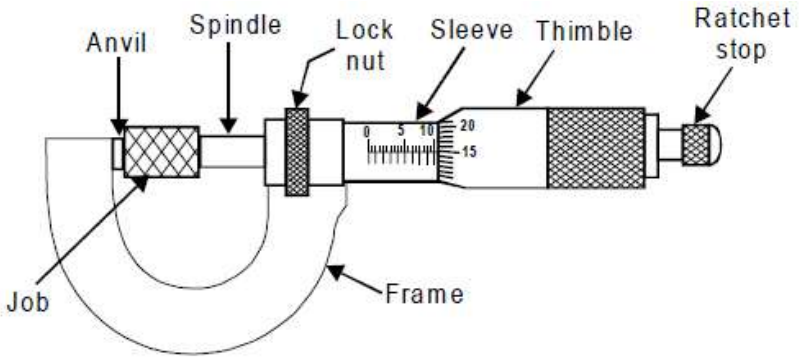


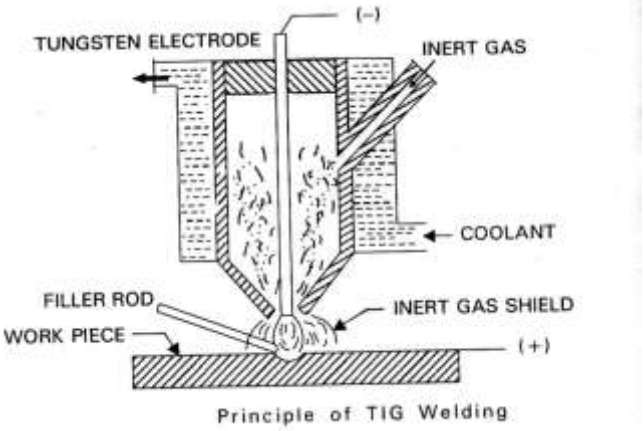
Fig. Gated pattern

3. Draw a neat sketch of a micrometer and mark all parts.



4. What is TIG welding? How it is done?

In this process the heat necessary to melt the metal is provided by a very intense electric arc which is formed between a non-consumable tungsten electrode and metal work piece. Non-consumable tungsten electrode is used with an envelope of inert shielding gas around it. The shielding gas protects the tungsten electrode and the molten metal weld pool from the atmospheric contamination.



Principle of TIG Welding

The shielding gases generally used are argon, helium or their mixtures. A separate filler rod is used to add filler metal. TIG welding is specially used for aluminums and its alloys.

5. Propose and explain a method for the welding of rails in railway.

Thermit welding

It may be of forge or fusion kind of welding. Fusion welding requires no pressure.

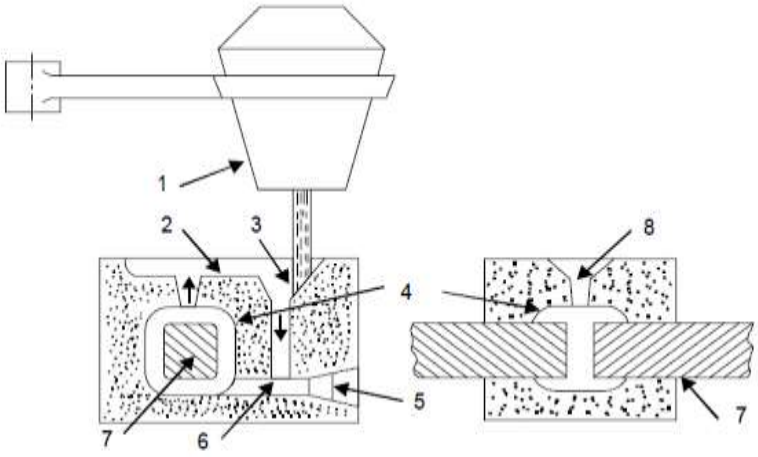
It is a process which uses a mixture of iron oxide and granular aluminium. This mixture in superheat liquid state is poured around the parts to be joined.

The joint is equipped with the refractory mold structure all around. In case of thermit pressure welding, only the heat of thermit reaction is utilized to bring the surface of metal to be welded in plastic state and pressure is the applied to complete the weld.

The temperature produced in the thermit reaction is of the order of 3000°C.

Thermit welding is used for welding pipes, cables, conductors, shafts, and broken machinery frames, rails and repair of large gear tooth. The reaction takes place in the crucible is

$$8Al + 3Fe_3O_4 = 4Al_2O_3 + 9Fe$$



1. Crucible,
2. Slag basin,
3. Runner,
4. Wax pattern,
5. Sand plug,
6. Preheating,
7. Workpiece,
8. Riser.

6. Which are the common materials used for pattern making? What are the factors to be considered for the selection of pattern materials?

The common materials used for pattern making are Wood, Metals and alloys, Plastic and rubbers, Plasters, Waxes.

Factors effecting selection of pattern material:
The following factors must be taken into consideration while selecting pattern materials.

- ✓ Number of castings to be produced. Metal pattern are preferred when castings are required large in number.
- ✓ Type of mould material used.
- ✓ Kind of molding process.
- ✓ Method of molding (hand or machine).
- ✓ Degree of dimensional accuracy and surface finish required.
- ✓ Minimum thickness required.
- ✓ Shape, complexity and size of casting.
- ✓ Cost of pattern and chances of repeat orders of the pattern

7. Write short notes on combination set and bevel protractor.

Combination Set:
Combination set is an important instrument which has the combination of instruments namely square head, a centre head, and a bevel protractor and sprit level. The three portions of the combination set are used separately being held in at any desired position by nuts. The beam of the instrument acts as a rule, for measuring the length and height as and when required. The square head possesses one edge square to the rule, giving a right angle, where as the other edge form an angle of 45°. It is provided with a spirit level. It is also fitted with a spirit level to help in leveling the work of setting it at an angle.
Bevel Protractor:

The bevel protector is an instrument used for testing and measuring angles within the limits of five minutes accuracy. Vernier scale is also provided on the disc to take reading for accurate measurement. Dial is graduated in degrees over an arc.

PART-C

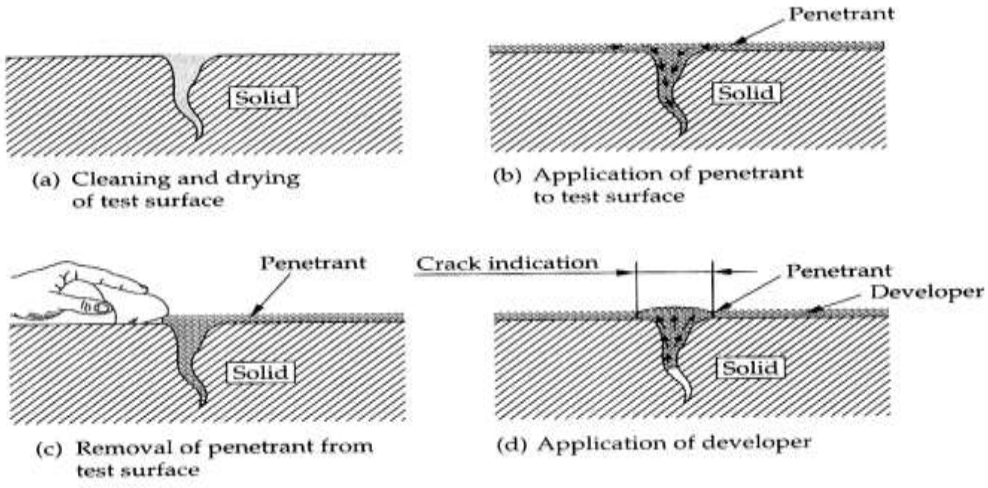
UNIT-I

(a) What is meant by non-destructive test? Explain the procedure of performing liquid penetrant test.

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. e.g.: magnetic particle test, ultrasonic test

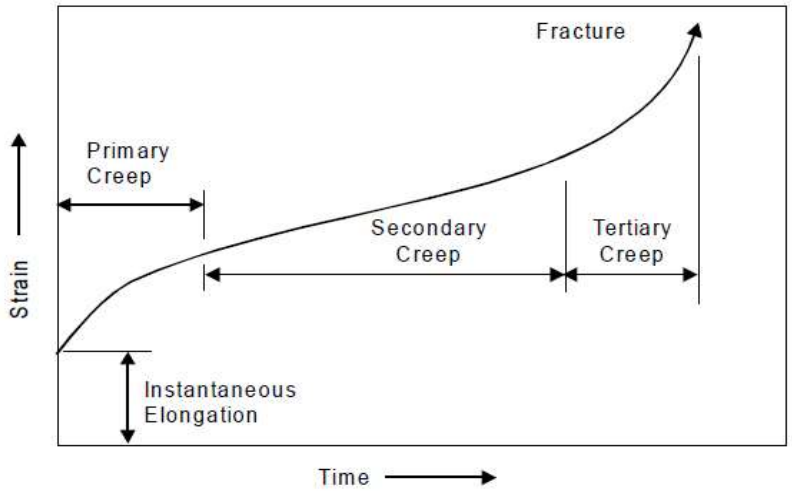
Procedure of performing liquid penetrant test:

- 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.



(b) What is creep resistance of materials? Explain the test for finding out the creep strength of materials.

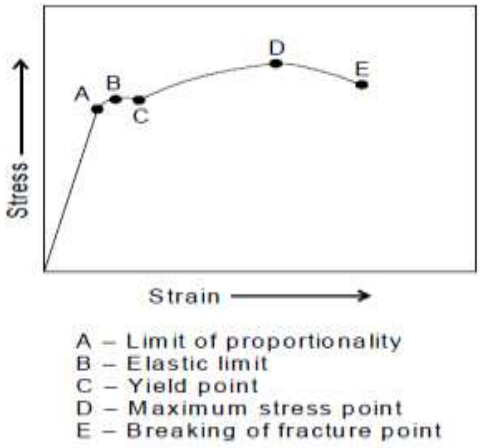
Metal part when is subjected to a high constant stress at high temperature for a longer period of time, it will undergo a slow and permanent deformation (in form of a crack which may further propagate further towards creep failure) called creep. Creep is time dependent phenomena of metal failure at high constant stress and at high temperature. Test is carried out up to the failure of the test specimen. A creep curve for high temperature and long time creep is shown in Fig. The curve shows different portions of the primary secondary and tertiary creep which ends at fracture in metals.



Creep curve for high temperature and long time creep

(b) Explain the procedure of conducting a tensile test on universal testing machine. Draw a sample stress-strain obtained.

A tensile test is carried out on standard tensile test specimen in universal testing machine. Gauge length is marked on the test specimen. The test specimen griped between two cross heads. Tensile load is applied gradually on the end grips. Load is applied till the specimen fracture. Load on each time can be taken from dial of UTM. The elongations are measured with help of extensometer. Fig. shows the stress strain curve for ductile material.



(a) Write short notes on the following mechanical properties:

(1) Hardness (2) Impact strength (3) Resilience (4) Toughness

(1) Hardness: Hardness is defined as the ability of a material to resistance to wear, scratching, deformation and machinability etc. It is the ability of a metal to cut another metal.

(2) Impact strength: It is the resistance of the material to fracture under quickly applied dynamic load. It is the ability of a material to withstand impact or shear load.

(3) Resilience: It is the capacity of material to absorb energy elastically. The quantity gives capacity of the material to bear shocks and vibrations.

(4) 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.

UNIT-II

(a) Write short notes on the following gauges:

(1) Snap gauge (2) Plug gauge (3) Thread gauge (4) Taper gauge

(1) Snap gauge: It is a limit gauge and used for checking external dimensions such as diameter and thickness of part.

(2) 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.

(3) Thread 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.

(4) Taper gauge: It is a limit gauge and used for check the size of a hole and accuracy of taper.

(b) What is a comparator? Name different type of comparators. Briefly explain the uses of a dial gauge.

Comparator is an instrument used for comparing the dimensions of a component with a standard. It gives only dimensional differences in relation to a basic dimension.

1. Mechanical comparators
2. Electrical comparators
3. Pneumatic comparators
4. Optical comparators.

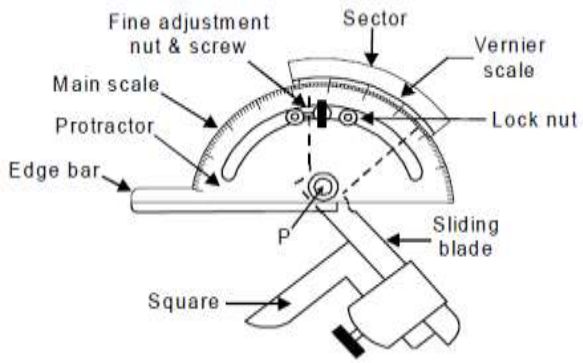
The **dial gauges** are also known as dial indicators.. They are generally used for testing flatness of surfaces and parallelism of bars and rods. They are also used for testing the machine tools. They are available in both metric as well as in inches units. Inches dial indicator

of 0.001" measuring accuracy is in commonly used. The commonly used metric dial indicator has an accuracy of 0.01 mm. Those having 0.001 mm accuracy are also available; however they are used in highly precision measurement work.

(a) Explain the method of measuring angles of an object by using Vernier bevel protractor with suitable sketch.

Bevel Protractor

The bevel protractor is an instrument used for testing and measuring angles within the limits of five minutes accuracy. The common components of this instrument are base, disc which is fitted with a pivot at the centre and carries a datum line. On this pivot of the protector, the dial is allowed to rotate when the clamping nut is released. The other unit clamps the blade rigidly to the dial. The blade can be moved lengthwise. Vernier scale is also provided on the disc to take reading for accurate measurement. Dial is graduated in degrees over an arc.



(b) What is least count of a measuring instrument? How the least count of micrometer is determined? Find the least count of a metric micrometer having 0.5mm pitch and 50 thimble divisions.

Given,

The least value that can be measured by using any measuring instrument known as least count.

The least count of micrometer is determined that, one complete revolution of the thimble causes the spindle movement divided by the thimble division.

Or least count = pitch/ thimble division.

Pitch = 0.5 mm

Thimble division = 50

So that, least count of micrometer = 0.5/50 = 0.01mm

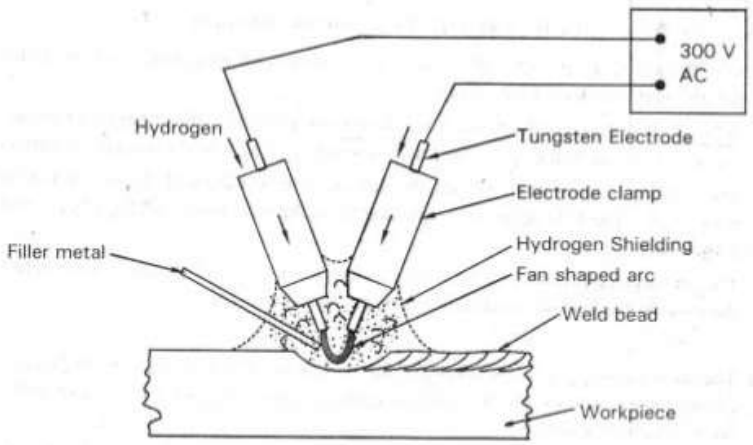
UNIT-III

(a)What are the precautions to be taken while performing overhead welding?

i. Do not permit unauthorized persons to use welding equipment.
ii. Do not weld in a building with wooden floors, unless the floors are protected from hot metal by means of fire resistant fabric, sand, or other fireproof material. Be sure that hot sparks or hot metal will not fall on the operator or on any welding equipment components.
iii. Remove all flammable material, such as cotton, oil, gasoline, etc., from the vicinity of welding.
iv. Before welding or cutting, warm those in close proximity who are not protected to wear proper clothing or goggles.
v. Remove any assembled parts from the component being welded that may become warped or otherwise damaged by the welding process.
vi. Keep a suitable fire extinguisher nearby at all times. Ensure the fire extinguisher is in operable condition.
vii. Mark all hot metal after welding operations are completed. Soapstone is commonly used for this purpose.
viii. Use proper cloths, safety equipments etc.

(b) Explain the procedure of performing atomic hydrogen welding.

Atomic hydrogen welding is a thermo - chemical welding process in which the work pieces are joined by the heat obtained on passing a stream of hydrogen through an electric arc struck between tow tungsten electrodes. The arc supplies the energy for a chemical reaction to take place, thereafter heat is obtained for welding. Filler rod may or may not be used during the process.



Procedure of Atomic Hydrogen Welding:

1. The equipment consists of a welding torch with two tungsten electrodes inclined and adjusted to maintain a stable arc.
2. Annular nozzles around the tungsten electrodes carry the hydrogen gas supplied from the gas cylinders.
3. A transformer with an open circuit voltage of 300 volts is required to strike and maintain the arc.
4. The work pieces are cleaned to remove dirt, oxides and other impurities to obtain a sound weld. Hydrogen gas supply and welding current are switched ON.
5. An arc is suck by bringing the two tungsten electrodes in contact with each other and instantaneously separated by a small distance, say 1.5 mm, such that the arc still remains between the two electrodes.
6. As the jet of hydrogen gas passes through the electric arc, it disassociates into atomic hydrogen by absorbing large amounts of heat supplied by the electric arc. (Endothermic Reaction)
7. The heat thus absorbed can be released by recombination of the hydrogen atoms into hydrogen molecule (H2)
8. Recombination takes place as the atomic hydrogen touches the cold work piece liberating a large amount of heat. (Exothermic reaction)

(a) What is DC welding? What are the equipments used for DC welding? When polarity is changed in DC welding?

DC welding is the manual metal arc welding in which welding current is provided by a DC equipment.

The equipments used for DC welding are generator and rectifier

Generator : It is driven by a motor or an engine. It generates and supply DC for electric arc welding.

Rectifier : Its purpose is to change the output A.C of a transformer into DC which is required for arc welding. The output of stepdown transformer is connected to the rectifier unit which converts AC to DC.

Polarity indicates the direction of current flow in the welding circuit.

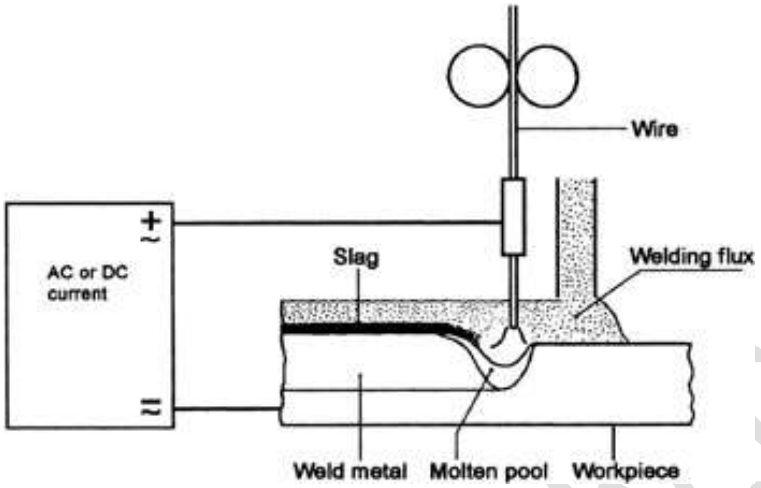
In D.C. welding 2/3 rd of the hit is liberated from the positive end and 1/3 rd from the negative end. To have this advantage of unequal heat distribution in electrode and base metal, the polarity is an important factor for successful welding.

In the latest machines a polarity switch is used to change the polarity. Polarity is changed for the purpose of welding of thick and thin sheets. For thicker sections, straight polarity (electrode connected to negative and work is positive) is used. For sheet metal weldings, reverse polarity is preferred.

(b) With the aid of neat sketch, explain the procedure of performing submerged arc welding

Submerged Arc Welding

In this welding process, a consumable bare electrode is used in combination with a flux feeder tube. The arc, end of the bare electrode and molten pool remain completely submerged under blanket of granular flux. The feed of electrode and tube is automatic and the welding is homogenous in structure. No pressure is applied for welding purposes. This process is used for welding low carbon steel, bronze, nickel and other non-ferrous materials.



UNIT-IV

(a) How the green sand mould is prepared? Explain the procedure.

Procedure for green sand mould preparation is as follows,

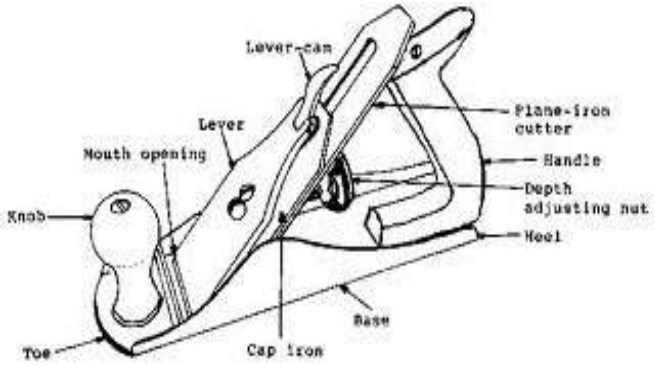
i. Suitable proportions of silica sand (85-92%), bentonite binder (6-12%), water (3-5%) and additives are mixed together to prepare the green sand mixture.
ii. The pattern is placed on a flat surface with the drag box enclosing it. Parting sand is sprinkled on the pattern surface to avoid green sand mixture sticking to the pattern.
iii. The drag box is filled with green sand mixture and rammed manually till its top surface. The drag box is now inverted so that the pattern faces the top. Parting sand is sprinkled over the mould surface of the drag box.
iv. The cope box is placed on top of the drag box and the sprue and riser pin are placed in suitable locations. The green sand mixture is rammed to the level of cope box.
v. The sprue and the riser are removed from the mould. The cope box is lifted and placed aside, and the pattern in the drag box is withdrawn by rapping it carefully so as to avoid damage to the mould. Gates are cut using hand tools to provide passage for the flow of molten metal.
vi. The mould cavity is cleaned and finished. Cores, if any are placed in the mould to obtain a hollow cavity in the casting.
vii. The cope is now placed on the drag box and both are aligned with the help of pins. Vent holes are made to allow the free escape of gases from the mould during pouring. The mould is made ready for pouring

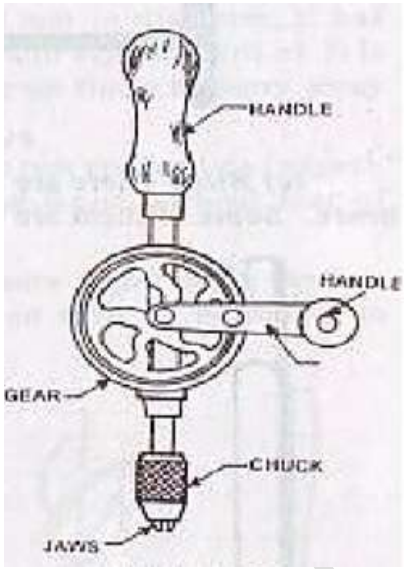
(b) Describe with sketches, the constructions and use of following carpentry tools:

(1)Metal jack plane (2) Wheel brace

(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) Wheel brace: Used for making small holes and drills. It has a chuck with self centering jaws which hold the round and parallel shank drill. Drill bit is rotated by operating the crank.





Metal jack plane **Wheel brace**

(a) Distinguish between surface gauge and surface plate. Write their uses.

Surface gauge:
It consists of a cast iron sliding base fitted with a vertical steel rod. The scriber or marker is positioned or set into an adjustable device using a knurled nut at one end. The scriber can be loosened or tightened by means of the nut. The marker is used to set it at any desired inclination, moved to and fro inside the hole accommodating it or adjust its height along the vertical pillar. It is commonly used in conjunction with either a surface plate or marking table.

Surface plate:
It is a cast iron plate having generally a square top well planed and square with adjacent machined faces. The top surface of the plate is finished true by means of grinding and scrapping. It possesses a cast iron base, which is also machined true to keep the top surface of the plate in a perfect horizontal plane. Its specific use is in testing the trueness of a finished surface, testing a try square, providing adequate bearing surface for V-block and angle plates, etc. in scribing work.

(b) What are the different methods of filing? Explain briefly.

The three methods of filing are: Cross filing, Straight filing, Draw filing

Cross filing: It is the most common method of filing and used to remove large amounts of metal. The file is moved diagonally from left to right, or from right to left.

Straight filing: Used to obtain a flat surface on a short workpiece. It produce smooth surface than cross filing.

Draw filing: It is used to produce a fine finish on a narrow surface. A smooth flat file is placed across the work and is then moved forward and backward.