QUESTIONS AND SOLUTION

MODULE 1

1. Differentiate between renewable and non-renewable sources of energy.

(Dec 2014) (July 2015) (July 2016)

Soln: Renewable Energy sources: Defined as the energy resources which are produced continuously in nature and are essentially inexhaustible at least in the time frame of human societies.

1. Ex: Direct solar energy
2. Wind energy
3. Tidal energy
4. Hydel energy
5. Ocean thermal energy

Non-Renewable Energy sources: defined as the energy resources which have been accumulated over the ages and not quickly replenish able when they are exhausted.

1. Ex: Fossil fuels
2. Nuclear fuels

2. List out any five boiler mountain and boiler accessories (Dec 2014) (July 2015)

Soln: Boiler mountings:

The boiler mountings are necessary for the proper function & safety of a boiler.

- Safety valve
- Water level indicator
- Pressure gauge
- Blow off valve
- Steam stop valve
- Feed check valve

Boiler accessories:

Boiler accessories are auxiliary parts used in steam boilers for their proper functioning and to improve the efficiency of the power plant.

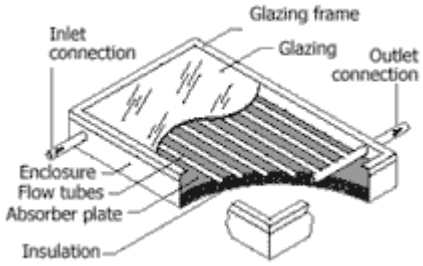
- Super heater
- Economizer
- Air pre-heater
- Steam separator

3. Define solar constant and explain liquid flat plate collector with a neat sketch.
(Jan 2016)

Solution:

It is the rate at which energy reaches the earth's surface from the sun, usually taken to be 1,388 watts per square metre.

Liquid Heat Plate collector:



A typical flat-plate collector is a metal box with a glass or plastic cover (called glazing) on top and a dark-colored absorber plate on the bottom. The sides and bottom of the collector are usually insulated to minimize heat loss.

Sunlight passes through the glazing and strikes the absorber plate, which heats up, changing solar energy into heat energy. The heat is transferred to liquid passing through pipes attached to the absorber plate. Absorber plates are commonly painted with "selective coatings," which absorb and retain heat better than ordinary black paint. Absorber plates are usually made of metal—typically copper or aluminum—because the metal is a good heat conductor. Copper is more expensive, but is a better conductor and less prone to corrosion than aluminum. In locations with average available solar energy, flat plate collectors are sized approximately one-half- to one-square foot per gallon of one-day's hot water use.

Applications: The main use of this technology is in residential buildings where the demand for hot water has a large impact on energy bills. This generally means a situation with a large

family, or a situation in which the hot water demand is excessive due to frequent laundry washing.

Commercial applications include laundromats, car washes, military laundry facilities and eating establishments. The technology can also be used for space heating if the building is located off-grid or if utility power is subject to frequent outages. Solar water heating systems are most likely to be cost effective for facilities with water heating systems that are expensive to operate, or with operations such as laundries or kitchens that require large quantities of hot water.Unglazed liquid collectors are commonly used to heat water for swimming pools. Because these collectors need not withstand high temperatures, they can use less expensive materials such as plastic or rubber. They also do not require freeze-proofing because swimming pools are generally used only in warm weather or can be drained easily during cold weather.While solar collectors are most cost-effective in sunny, temperate areas, they can be cost effective virtually anywhere in the country so should be considered.

4. Explain principle of nuclear power plant with a neat sketch. (Jan 2016) (July 2015)

Solution:

NUCLEAR REACTOR

- A nuclear reactor is a device which controls the nuclear fission chain reaction to hardness nuclear energy for peaceful purposes.
- A nuclear reactor which is used t generate electricity, is called a nuclear power plant.
- Fuel in the form of pellets is enclosed in several tubular claddings of steel or aluminum. This is called fuel assembly. Enriched U-235 or Pu-239 is the fuel material.
- A coolant is circulated through the reactor to remove the heat generated. Ordinary water is most commonly used coolant.
- Rods made of boron or cadmium which are neutron absorbers are used as control rods. The neutrons available for fission are controlled by moving the control rods in and out of the nuclear core. The rods can be used to shut down the reactor.

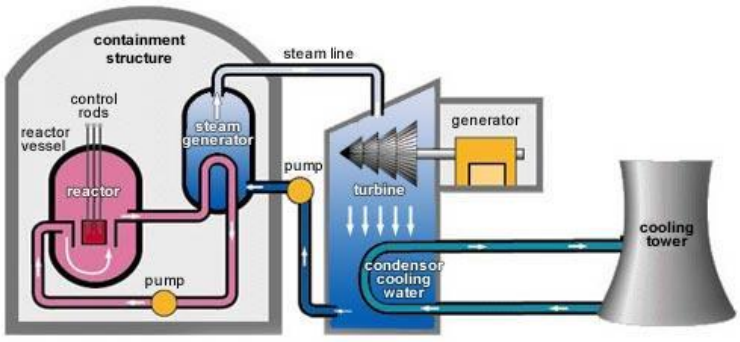


Figure 2: Nuclear reactor

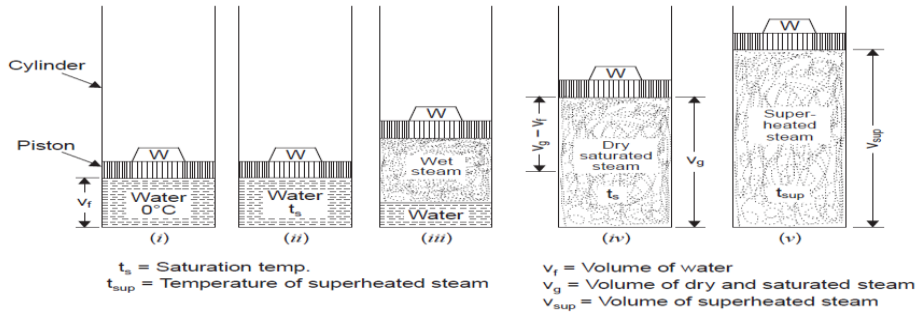
- Heat produced during fission process is absorbed by the coolant and is used to convert water in to steam in the heat exchanger. The steam is used to rotate the steam turbine.The steam turbine is connected to a generator which generates electricity.
- The entire reactor is enclosed in a concrete building with lead sheets covered inside to prevent radioactive radiations being released in to the environment.

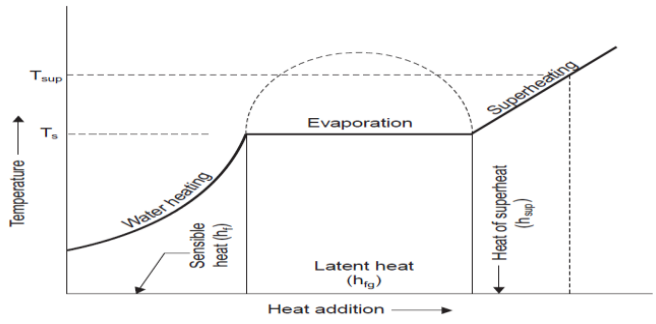
5. Define enthalpy and explain formation of steam with a T-S diagram. (Jan2016)

Solution:

Enthalpy is defined as a thermodynamic state function, designated by the letter "H", that consists of the internal energy of the system (U) plus the product of pressure (p) and volume (V) of the system: Since U, p and V are all functions of the state of the thermodynamic system, enthalpy is a state function.

Formation of Steam





Graphical representation of formation of steam

Sensible heat of water (hf): It is defined as the quantity of heat absorbed by 1 kg of water when it is heated from 0°C (freezing point) to boiling point. It is also called total heat (or enthalpy) of water or liquid heat invariably.

Latent heat or hidden heat (hfg): It is the amount of heat required to convert water at a given temperature and pressure into steam at the same temperature and pressure. It is expressed by the symbol hfg.

Total heat or enthalpy of wet steam (h): It is defined as the quantity of heat required to convert 1 kg of water at 0°C into wet steam at constant pressure. It is the sum of total heat of water and the latent heat and this sum is also called enthalpy.

In other words, $h = h_f + xh_{fg}$

If steam is dry and saturated, then $x = 1$ and $h_g = h_f + h_{fg}$.

Superheated steam: When steam is heated after it has become dry and saturated, it is called superheated steam and the process of heating is called superheating. Superheating is always carried out at constant pressure. The additional amount of heat supplied to the steam during superheating is called as 'Heat of superheat'

The total heat of superheated steam is given by

$$h_{sup} = h_f + h_{fg} + c_{ps}\,(T_{sup} - T_s)$$

Where Cps is the specific heat of superheated steam at constant pressure.

6. Explain Babcock and Wilcox boiler with a neat sketch. (Jan2016)

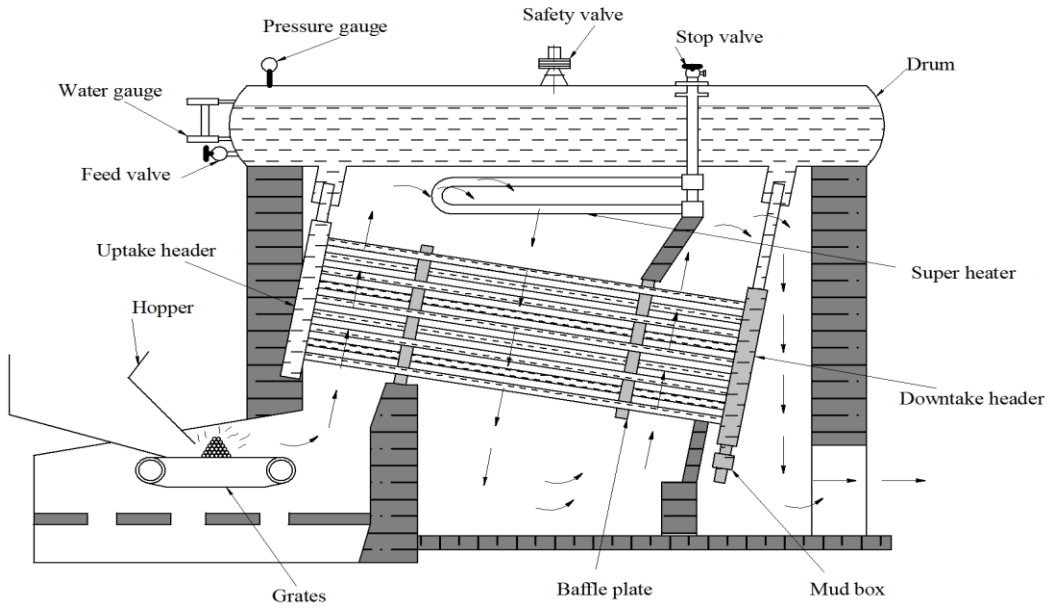


Figure :Babcock & Wilcox Boiler

Boiler mountings:

The boiler mountings are necessary for the proper function&safetyof a boiler.

- Safety valve
- Water level indicator
- Pressure gauge
- Blow off valve
- Steam stop valve
- Feed check valve

Boiler accessories:

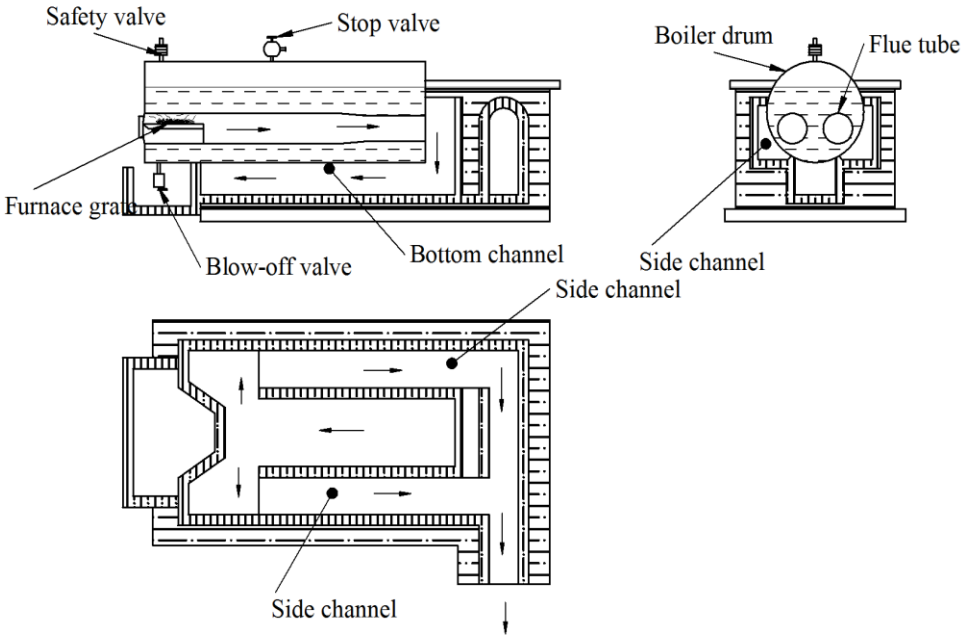
Boiler accessories are auxiliary parts used in steam boilersfor their proper functioning and to improve the efficiency of the power plant.

- Super heater
- Economizer
- Air pre-heater
- Steam separator
- Steam trap

7. With a neat sketch, explain the working of a water tube boiler.

(July 2015) (July 2016)

Soln: Lancashire Boiler:



Module 2:

1. Compare closed cycle gas turbine with open cycle gas turbine Dec (2014)

Soln: Open cycle gas turbine:

It consists of a compressor, a combustion chamber and a turbine. Both turbine and the compressor are mounted on the same shaft.

- The compressor draws air from the atmosphere and compresses it o a high pressure
- The compressed air flows into the combustion chamber where the fuel is burnt at constant pressure
- The high pressure-high temperature hot gases are then made to flow through the turbine blades where heat energy gets converted into mechanical work
- The shaft of the turbine in turn will be connected to a generator for producing electricity
- The gases coming out from the turbine are discharged to the atmosphere, hence called as open cycle gas turbine

Closed cycle gas turbine:

It consists of a compressor, a heater, a turbine and a cooler. The compressor and turbine are mounted on the same shaft. Gases like argon, helium, nitrogen, carbon dioxide are used as working fluid for turbines.

- The working fluid is compressed in a compressor and passed on to a heater where it gets heated and the heat is transferred using an heat exchanger
- The high pressure and temperature fluid is made to flow through the turbine
- After expansion of hot gases, heat energy will get converted to mechanical work
- The fluid is then made to pass through a cooler and the low temperature and pressure fluid is made to pass to a compressor for the next cycle
- Since the working fluid is circulated again and again, hence it is called as closed cycle gas turbine

2. Explain with block diagrams principle of open cycle and closed cycle gas Turbine. (Dec 2014)

Soln: Closed cycle gas turbine:

It consists of a compressor, a heater, a turbine and a cooler. The compressor and turbine are mounted on the same shaft. Gases like argon, helium, nitrogen, carbon dioxide are used as working fluid for turbines.

- The working fluid is compressed in a compressor and passed on to a heater where it gets heated and the heat is transferred using an heat exchanger
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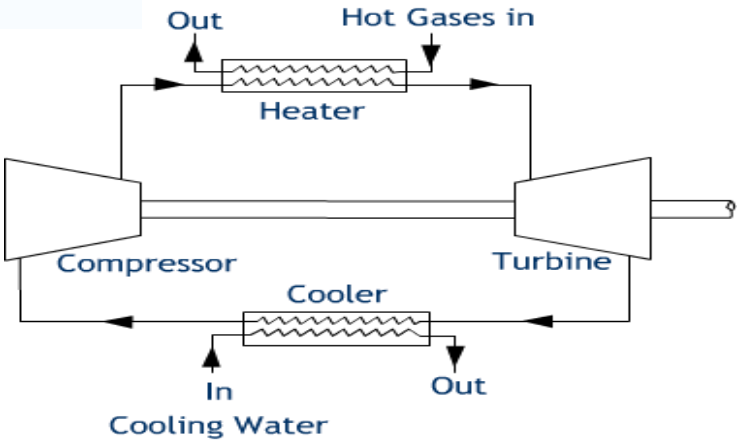


3.Explain with neat sketch, impulse And reaction turbines. (Dec 2014)

Soln: Impulse Steam turbine:

- The turbine consists of a series of curved blades fixed on the circumference of a single wheel called rotor which in turn is connected to a shaft
- The high pressure and low velocity steam generated in the boiler is used as a working fluid. The working fluid contains potential energy and kinetic energy
- Before reaching the turbine the fluid's potential energy gets changed to kinetic energy by accelerating the fluid through a nozzle

- The high velocity steam leaving the nozzle is directed towards the moving blades of the turbine
- The steam flowing over the blades undergoes a change in its velocity and direction thereby resulting in change of momentum
- This resulting impulse force pushes the blade in the same direction

Example: Delaval's Turbine

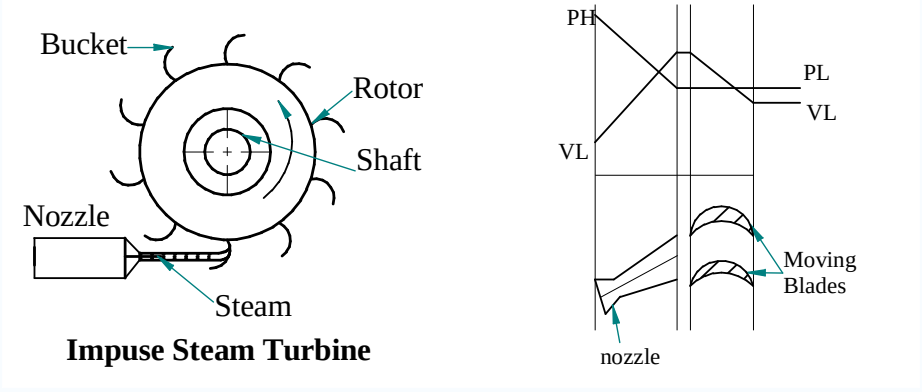


Figure 2.1 Impluse steam turbine

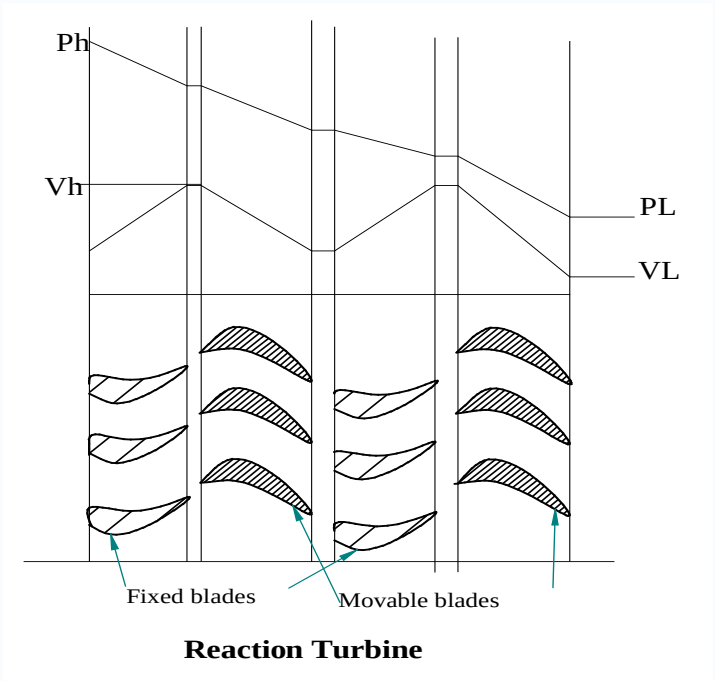
Reaction turbine (Impulse-Reaction Turbine):

The turbine runs by the reactive force of the jet of steam rather than the direct push or impulse as in case of impulse turbine. It consists of several alternate rows of fixed and moving blades. The fixed blades are fastened to a stationary casing, while the moving blades are mounted on the periphery of a rotating wheel called rotor which in turn is connected to a shaft. In reaction turbine the shape and the cross-section of moving and fixed blades are designed such that it acts as a nozzle.

Working

- The high pressure, low velocity steam generated in a boiler first passes over the fixed blade
- The fixed blade acts as a nozzle where the steam gets expanded to a low pressure and high velocity and it also guides the steam onto the moving blades where it undergoes a change in its velocity and direction thereby resulting in impulse force

- The kinetic energy of the steam is converted into mechanical energy by the rotation of the rotor and when the steam leaves the moving blade, a reactive force is set up



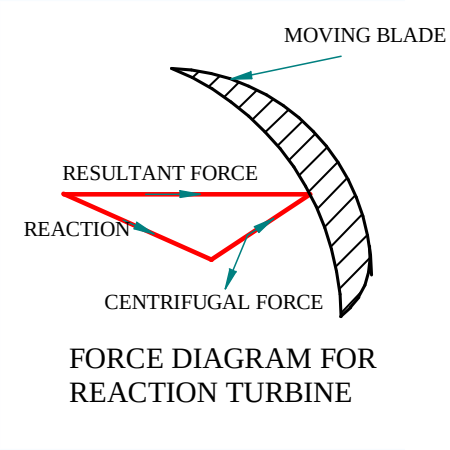


Figure 2.2 Reaction steam turbine

4.Define Turbine & explain De Laval turbines with a neat sketch and P-V diagram. (Jan2016)

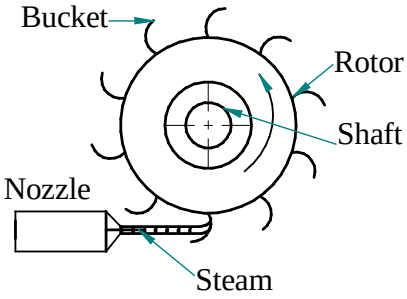
Solution:

A turbine is a rotary engine that extracts energy from a fluid flow. The simplest turbine will have one moving part, a rotor assembly with blades attached to it, moving fluid acts on the blades or the blades react to the flow so that they rotate and impart energy to the rotor.

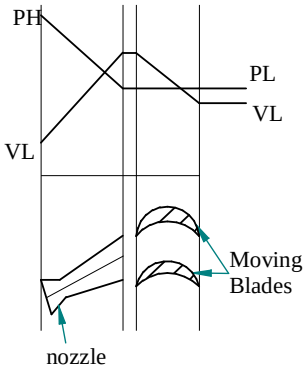
Delaval's Turbine or impulse steam turbine

- The turbine consists of a series of curved blades fixed on the circumference of a single wheel called rotor which in turn is connected to a shaft
- The high pressure and low velocity steam generated in the boiler is used as a working fluid. The working fluid contains potential energy and kinetic energy

- Before reaching the turbine the fluid's potential energy gets changed to kinetic energy by accelerating the fluid through a nozzle
- The high velocity steam leaving the nozzle is directed towards the moving blades of the turbine
- The steam flowing over the blades undergoes a change in its velocity and direction thereby resulting in change of momentum
- This resulting impulse force pushes the blade in the same direction



Impuse Steam Turbine



3 b. Explain closed cycle gas turbine with a neat sketch. (Jan2016)

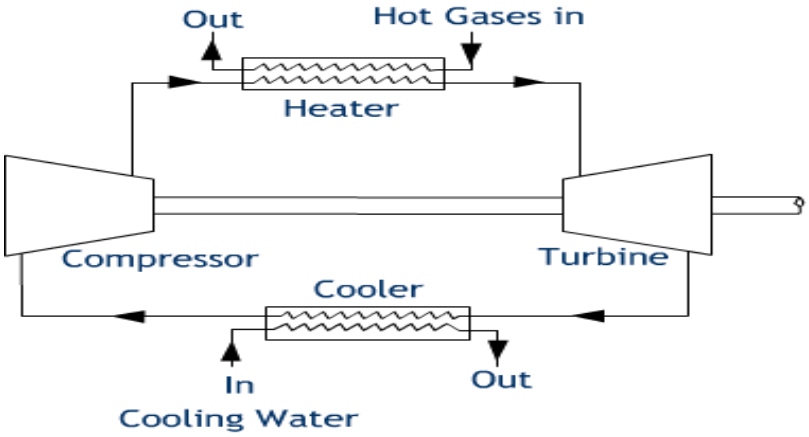
Solution:

Closed cycle gas turbine:

It consists of a compressor, a heater, a turbine and a cooler. The compressor and turbine are mounted on the same shaft. Gases like argon, helium, nitrogen, carbon dioxide are used as working fluid for turbines.

- The working fluid is compressed in a compressor and passed on to a heater where it gets heated and the heat is transferred using an heat exchanger
- The high pressure and temperature fluid is made to flow through the turbine
- After expansion of hot gases, heat energy will get converted to mechanical work
- The fluid is then made to pass through a cooler and the low temperature and pressure fluid is made to pass to a compressor for the next cycle

- Since the working fluid is circulated again and again, hence it is called as closed cycle gas turbine.



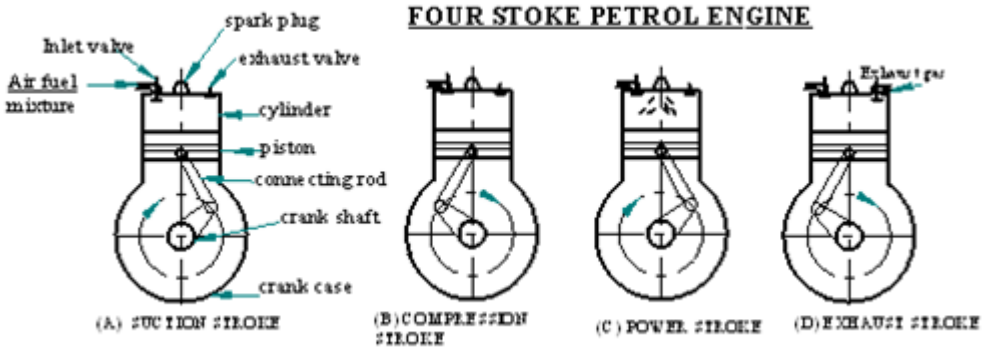
5. Explain 4-stroke IC engine with a neat sketch and PV diagram.

(Jan2016) (July 2015) (july2016)

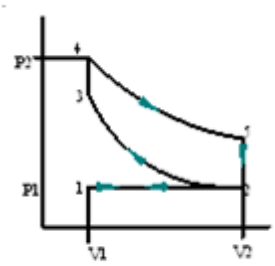
Solution:

The following are the working strokes

(A) Suction (B) Compression (C) Power (D) Exhaust stroke.



PV diagram



SUCTION STROKE:

1. Inlet value opens and exhaust value is closed.
2. Piston moves from top dead centre to bottom dead centre (crank rotates 0-180^{o})
3. Piston sucks the air fuel mixture in to the cylinder (constant pressure and volume increase V1 to V2)

COMPRESSION STROKE:

1. Both inlet and exhaust values closed.
2. Piston moves from bottom dead centre to top dead centre. (180 ^{o} to 360 ^{o} crank rotation).
3. Pressure and temperature of the air fuel mixture increases. (volume decreases)
4. At the end of compression stroke volume remains constant for a small displacement , it is called constant volume cycle (compression ratio is 1:14)

POWER STROKE:

1. Both inlet and exhaust value closed.
2. High pressure and high temperature air fuel mixture catches the fire with spark plug.
3. High amount energy released and pushes piston down word direction.
4. Fly wheel stores the energy. (impact energy)

EXHAUST STROKE:

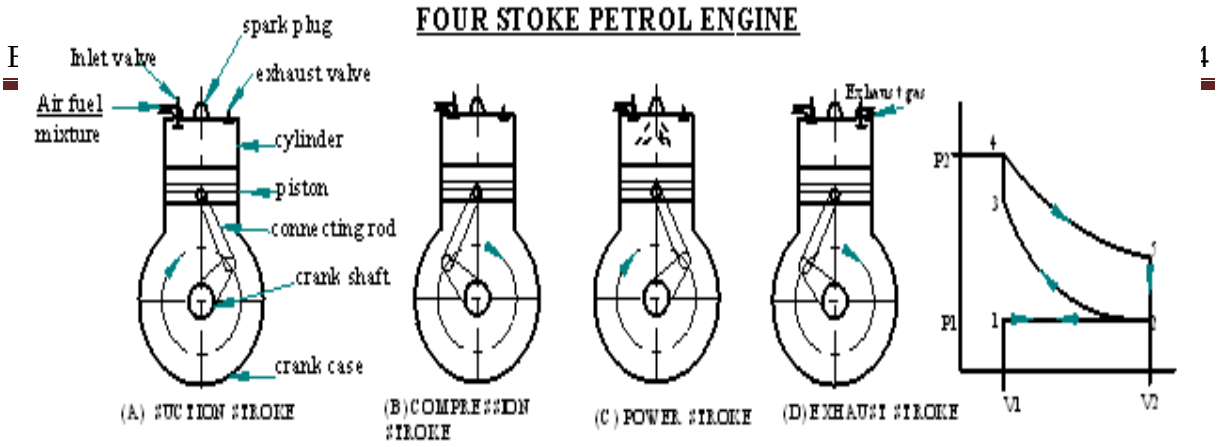
1. Exhaust value opens and inlet value closed
2. Piston moves from bottom dead centre to top dead centre.
3. The burnt gases escape from the cylinder.
4. Crank shaft completes the two revolutions and generates one power stroke.

6.**Explain 4-stroke SI engine with a neat sketch and PV diagram**

(Jan2016) (July 2015) (july2016)

Soln:Four Stroke Petrol Engine (Spark Ignition):

The following are the working strokes
(A)Suction (B) Compression (C) Power (D) Exhaust stroke.



SUCTION STROKE:

1. Inlet value opens and exhaust value is closed.
2. Piston moves from top dead centre to bottom dead centre (crank rotates 0-180^{o})
3. Piston sucks the air fuel mixture in to the cylinder (constant pressure and volume increase V1 to V2)

COMPRESSION STROKE:

5. Both inlet and exhaust values closed.
6. Piston moves from bottom dead centre to top dead centre. (180 ^{o} to 360 ^{o} crank rotation).
7. Pressure and temperature of the air fuel mixture increases. (volume decreases)
8. At the end of compression stroke volume remains constant for a small displacement , it is called constant volume cycle (compression ratio is 1:14)

POWER STROKE:

5. Both inlet and exhaust value closed.
6. High pressure and high temperature air fuel mixture catches the fire with spark plug.
7. High amount energy released and pushes piston down word direction.
8. Fly wheel stores the energy. (impact energy)

EXHAUST STROKE:

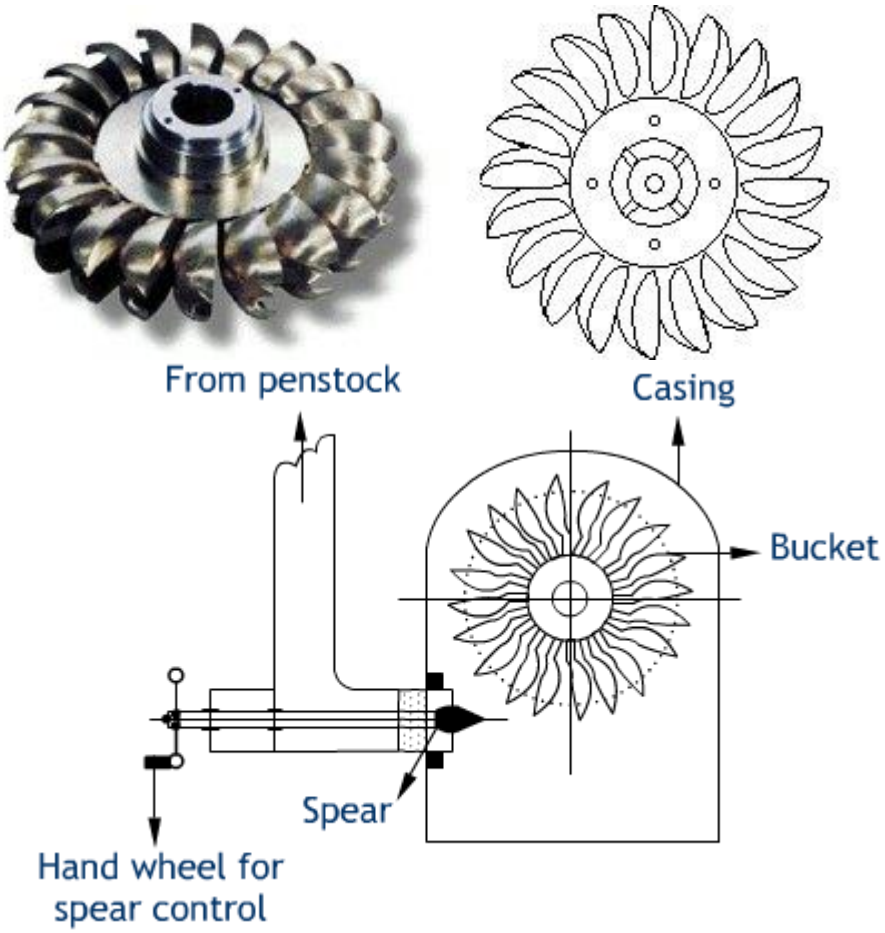
5. Exhaust value opens and inlet value closed
6. Piston moves from bottom dead centre to top dead centre.
7. The burnt gases escape from the cylinder.
8. Crank shaft completes the two revolutions and generates one power stroke.

8.Draw a neat sketch of a simple impulse water turbine indicating parts. Explain its working (july2016)

Soln:Pelton wheel:

- It is a tangential flow impulse turbine used for high heads and small quantity water flow
- Water from the high head reservoirs is supplied to the nozzle provided with a needle which controls the quantity of water flowing out of the nozzle

- As the water flows through the nozzle the potential energy is converted to kinetic energy
- The high velocity jet of water from the nozzle is made to impinge on the curved blades known as Pelton cups fixed around the runner
- The impulsive force of the high velocity jet of water sets the runner into rotary motion and the shaft coupled to the runner also rotates



9.Discuss the advantages of steam turbines over other prime movers (july2016)

Soln: The turbine consists of a series of curved blades fixed on the circumference of a single wheel called rotor which in turn is connected to a shaft

- The high pressure and low velocity steam generated in the boiler is used as a working fluid. The working fluid contains potential energy and kinetic energy
- Before reaching the turbine the fluid's potential energy gets changed to kinetic energy by accelerating the fluid through a nozzle

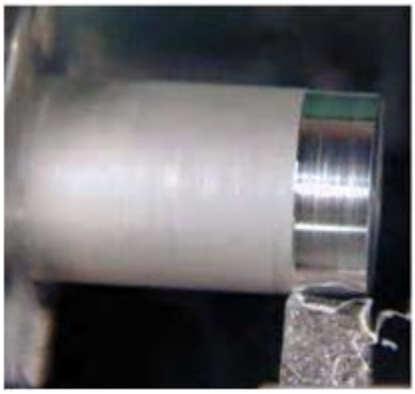
- The high velocity steam leaving the nozzle is directed towards the moving blades of the turbine
- The steam flowing over the blades undergoes a change in its velocity and direction thereby resulting in change of momentum
- This resulting impulse force pushes the blade in the same direction

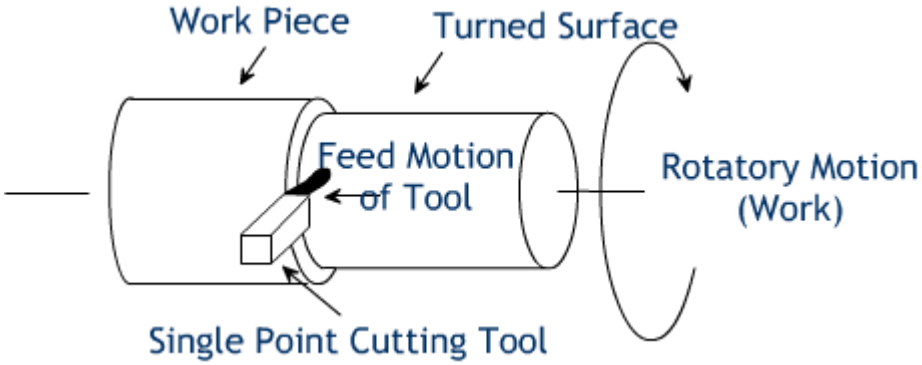
Module 3:

1. Explain any three machine tool operation. (Dec 2014) (July 2015)

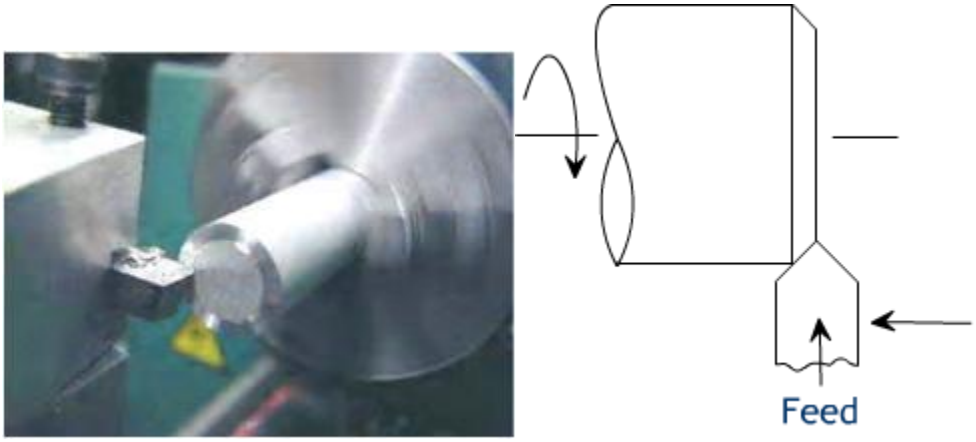
Soln: Turning:

Turning is the removal of metal from the outer diameter of a rotating cylindrical work piece. Turning is used to reduce the diameter of the work piece, usually to a specified dimension, and to produce a smooth finish on the metal. Often the work piece will be turned so that adjacent sections have different diameters.

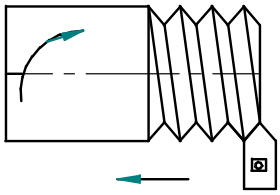




Facing: Facing is the process of removing metal from the end of a work piece to produce a flat surface. It is some time called squaring. The facing tool used is of round edge, if the tool is pointed then the work piece will not have good finishing. The work piece rotates about its axis and the facing tool is fed perpendicular to the axis of lathe. Most often, the work piece is cylindrical, but using a 4-jaw chuck you can face rectangular or odd-shaped work to form cubes and other non-cylindrical shapes.

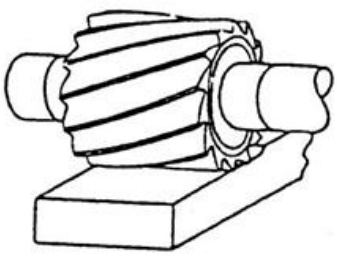


Thread cutting: A thread is a uniform helical groove cut on or in a cylinder or cone. The tool is ground to the shape of the thread and is moved longitudinally with uniform motion. The required pitch can be obtained by maintaining the appropriate gear ratio between the spindle and the lead screw which enables the tool to move longitudinally at appropriate speed.

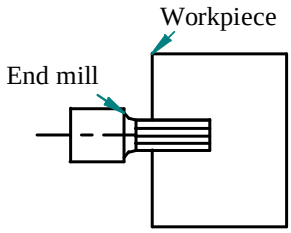


2.Explain plane milling, end milling, slot milling, with neat sketch (Dec 2014)

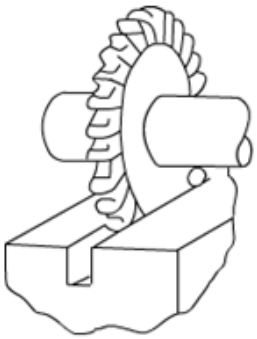
Soln: Plane milling: The plain milling is the operation of production of a plain flat horizontal surface parallel to the axis of rotation of a plain milling cutter. The operation is also called slab milling.

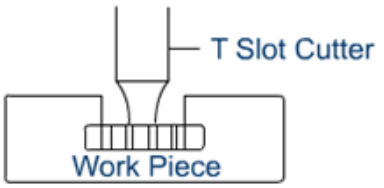


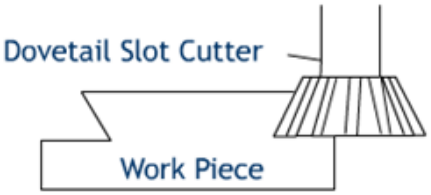
End milling: The end milling is the operation of production of a flat surface which may be vertical, horizontal or at an angle in reference to the table surface. Use to produce slots, grooves or key ways.



Slot milling: The process of producing keyways grooves and slots of varying shapes and sizes is known as slotting. The side milling cutter is mounted on to the arbor of a horizontal milling machine when slotting had to be done on Horizontal milling machine. T–Slots and dovetail slots are carried out on a veridical milling machine







3.Classify the robots on the basis of physical configuration (Dec 2014)

Soln: Classification based on configuration

- Polar Coordinate
- cylindricalCoordinate
- Cartesian Coordinate

4.Explaintypes of automation with example. (Dec 2014) (July 2015)

Soln: 1. Fixed automation (Hard automation): Fixed automation refers to the use of special purpose equipment to automate a fixed sequence of processing or assembly operations. Each

of the operation in the sequence is usually simple, involving perhaps a plain linear or rotational motion or an uncomplicated combination of two. It is relatively difficult to accomodate changes in the product design. This is called hard automation.

Advantages:

1. Low unit cost

2. Automated material handling

3. High production rate.

Disadvantages:

1. High initial Investment

2. Relatively inflexible in accommodating product changes.

2. Programmable automation: In programmable automation, the production equipment is designed with the capability to change the sequence of operations to accomodate different product configurations. The operation sequence is controlled by a program, which is a set of instructions coded. So that they can be read and interpreted by the system. New programs can be prepared and entered into the equipment to produce new products.

Advantages:

1. Flexible to deal with design variations.

2. Suitable for batch production.

Disadvantages:

1. High investment in general purpose equipment

2. Lower production rate than fixed automation.

Example: Numerical controlled machine tools, industrial robots and programmable logic controller.

3. Fixed Automation: (Soft automation): Flexible automation is an extension of programmable automation. A flexible automation system is capable of producing a variety of

parts with virtually no time lost for changeovers from one part style to the next. There is no lost production time while reprogramming the system and altering the physical set up.

Advantages:

1. Continuous production of variable mixtures of product.

2. Flexible to deal with product design variation.

Disadvantages:

1. Medium production rate

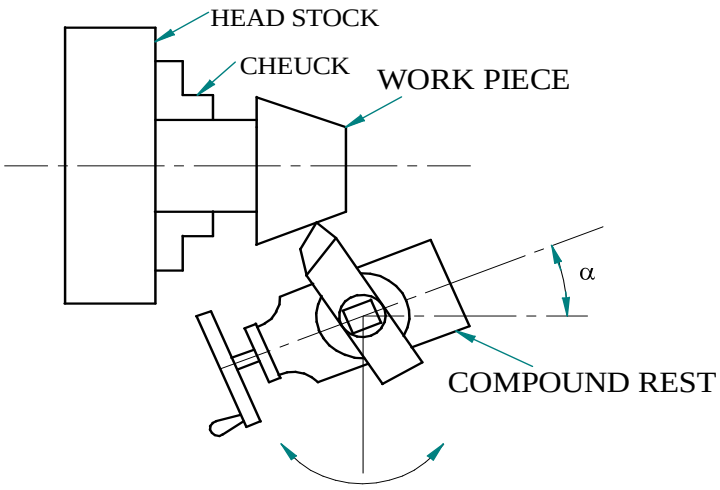
2. High investment.

3. High ‘unit cost relative to fixed automation.

5.Explain taper turning operation by swiveling the compound rest.

(Dec 2014) (july2016)

Soln: Taper Turning by swivelling the compound rest: In this method of taper the half taper angle is calculated. The compound rest has rotating base graduated in degrees, which can be rotated to any angle (according to the taper angle). In this method the tool is advanced by rotating the compound rest and hand wheel so that the tool moves according to set taper angle. This method produces taper length larger than form tool method.

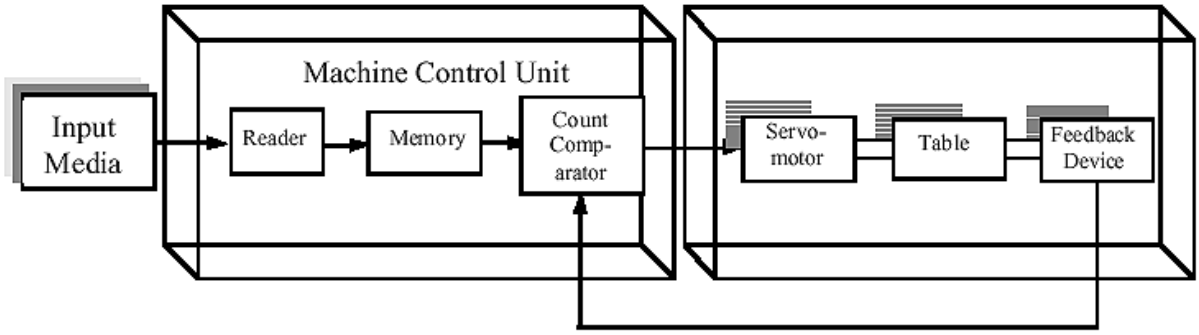


6.Explain NC and CNC machine with simple block diagram

(Dec 2014) (july2016)

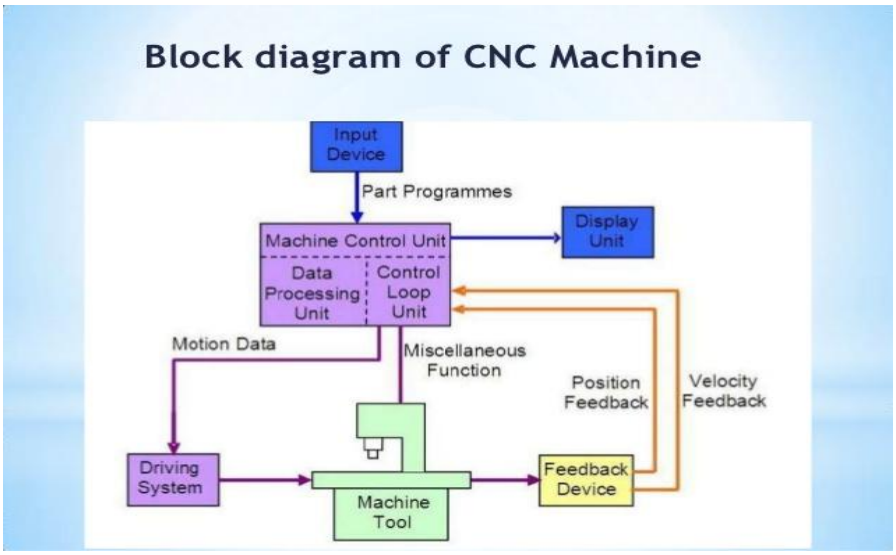
Soln: Numerical control (NC):

Numerical Control refers to the method of controlling the manufacturing operation by means of directly inserted coded numerical instructions into the machine tool. It is important to realize that NC is not a machining method; rather, it is a concept of machine control. Although the most popular applications of NC are in machining, NC can be applied to many other operations, including welding, sheet metalworking, riveting, etc.



Computer Numerical Control (CNC):

CNC is a self-contained NC system for a single machine tool that uses a dedicated computer controlled by stored instruction in the memory to implement some or all of the basic NC functions. It is flexible and relatively low-cost.



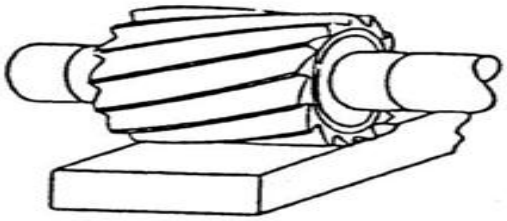
7. Explain with sketches.

i) Plain milling
ii) End milling.
iii) Slot milling. **(Jan 2016)**

Solution:

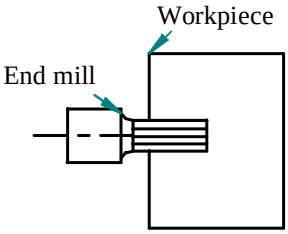
i) Plain milling

Plain milling: The plain milling is the operation of production of a plain flat horizontal surface parallel to the axis of rotation of a plain milling cutter. The operation is also called slab milling.



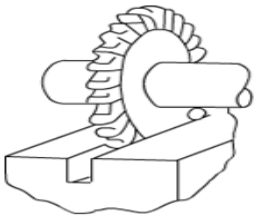
ii) End milling.

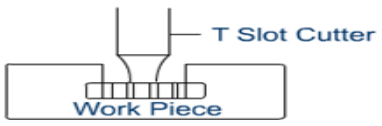
End milling: The end milling is the operation of production of a flat surface which may be vertical, horizontal or at an angle in reference to the table surface. Use to produce slots, grooves or key ways.

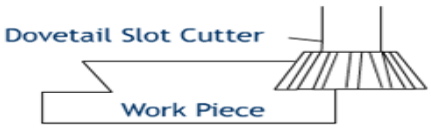


iii) slot milling.

Slot milling: The process of producing keyways grooves and slots of varying shapes and sizes is known as slotting. The side milling cutter is mounted on to the arbor of a horizontal milling machine when slotting had to be done on Horizontal milling machine. T–Slots and dovetail slots are carried out on a veridical milling machine.





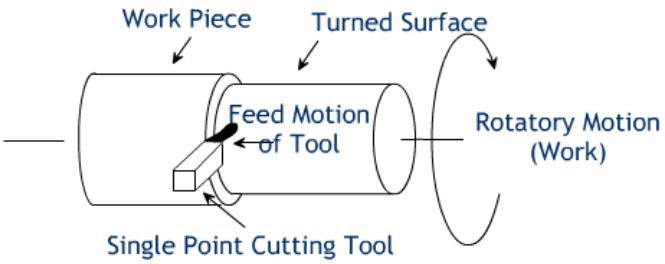


8. Explain the following machining operations on lathe machine with suitable sketches:
i) Turning.
ii) Thread cutting.
iii) Knurling
iv) Facing. **(Jan 2016)**

Solution:

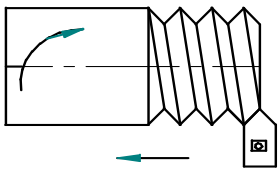
i) Turning.

Turning is the removal of metal from the outer diameter of a rotating cylindrical work piece. Turning is used to reduce the diameter of the work piece, usually to a specified dimension, and to produce a smooth finish on the metal. Often the work piece will be turned so that adjacent sections have different diameters.



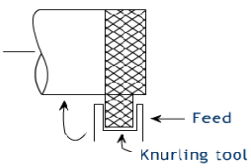
ii) Thread cutting.

A thread is a uniform helical groove cut on or in a cylinder or cone. The tool is ground to the shape of the thread and is moved longitudinally with uniform motion. The required pitch can be obtained by maintaining the appropriate gear ratio between the spindle and the lead screw which enables the tool to move longitudinally at appropriate speed.



iii) Knurling

It is the process of embossing a required shaped pattern on the surface of the work piece. This diagram shows the knurling tool pressed against a piece of circular work piece. The lathe is set so that the chuck revolves at a low speed. The knurling tool is then pressed against the rotating work piece and pressure is slowly increased until the tool produces a pattern on the work piece.



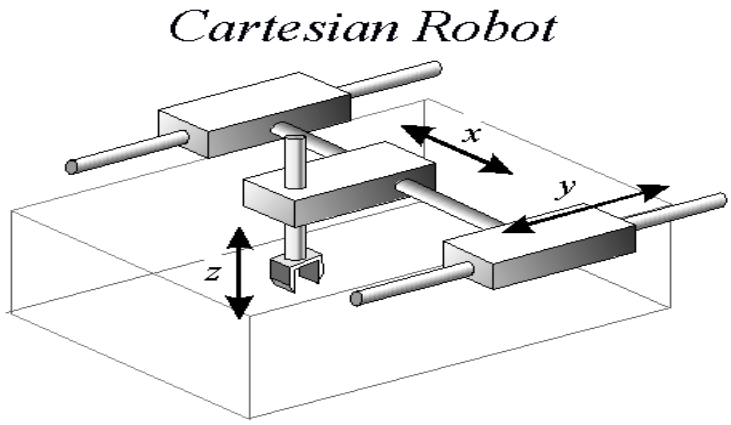
9. Write classification of robot configurations and explain Cartesian coordinate with a suitable sketch. **(July 2015) (Jan 2016)**

Solution:

Classification based on robots configuration

- Polar Coordinate
- cylindrical Coordinate
- Cartesian Coordinate

Cartesian coordinate: Other names for this configuration include rectilinear robot and x-y-z robot. It is composed of three sliding joints, two of which are orthogonal.



10. Define automation and explain flexible and fixed automation. **(Jan 2016)**

Solution:

Automated manufacturing is a manufacturing method that relies on the use of computerized control systems to run equipment in a facility where products are produced.

Automation of production systems can be classified into three basic types:

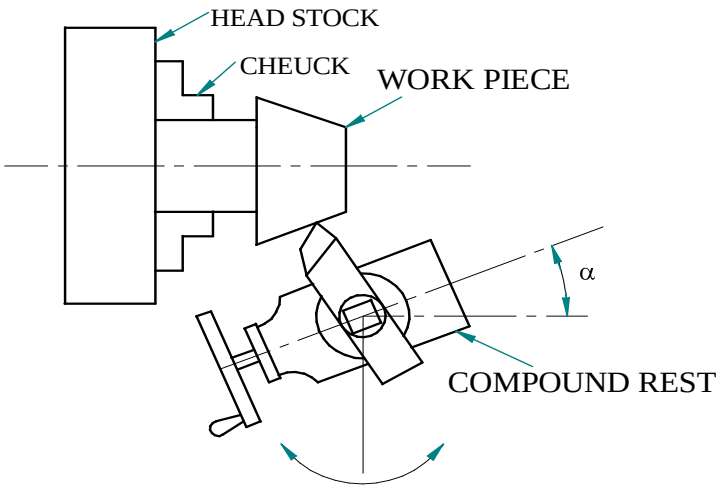
1. Fixed automation (Hard Automation)
2. Programmable automation (Soft Automation)
3. Flexible automation.

Fixed automation (Hard automation): Fixed automation refers to the use of special purpose equipment to automate a fixed sequence of processing or assembly operations. Each of the operation in the sequence is usually simple, involving perhaps a plain linear or rotational motion or an uncomplicated combination of two. It is relatively difficult to accomodate changes in the product design. This is called hard automation.

Fixed Automation: (Soft automation): Flexible automation is an extension of programmable automation. A flexible automation system is capable of producing a variety of parts with virtually no time lost for changeovers from one part style to the next. There is no lost production time while reprogramming the system and altering the physical set up.

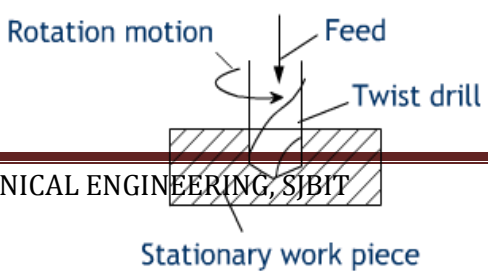
11.. Explain taper turning operation by swiveling the compound rest

Taper Turning by swivelling the compound rest: In this method of taper the half taper angle is calculated. The compound rest has rotating base graduated in degrees, which can be rotated to any angle (according to the taper angle). In this method the tool is advanced by rotating the compound rest and hand wheel so that the tool moves according to set taper angle. This method produces taper length larger than form tool method.

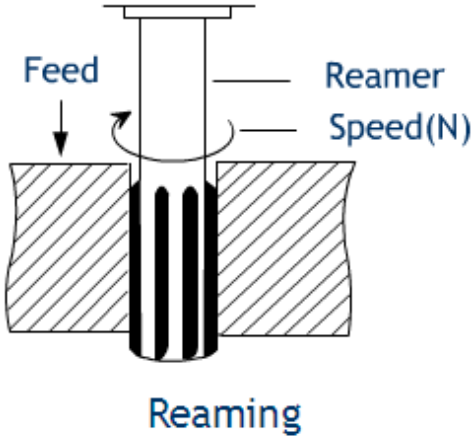


12.Differentiate between 1.Drilling and reaming 2.boring and counter boring (july2016)

Soln: Drilling: The drilling is one of the simplest methods of producing a hole. Before drilling a hole, the center point of the hole has to be marked on the work piece. The center point of the hole is marked by just drawing two cross lines or by using instruments. The mark is indented using a center punch. The hole to be drilled may be a through hole or a blind hole. Through hole can be drilled on any machine, but to drill a blind hole we need a sophisticated machine.

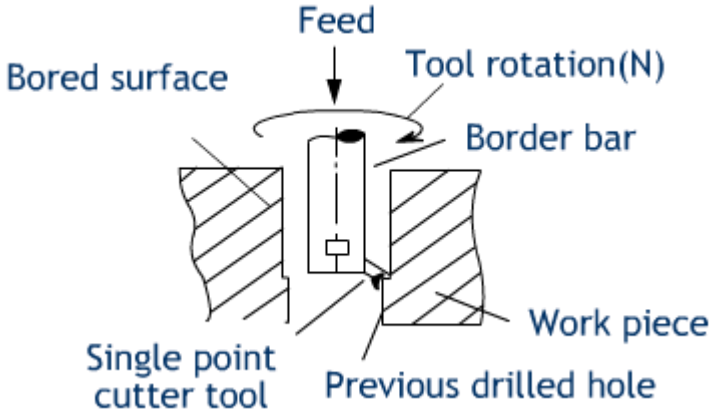


Reaming: Reaming is a sizing and finishing operation performed on a previously drilled hole. The tool used for reaming operation is known as reamer, which has multiple cutting edges. The spindle speed is half compared to drilling operation. Reamers cannot produce hole, but follow the path already defined by the drilling. The metal removed in this process is small, range is about 0.35 mm.



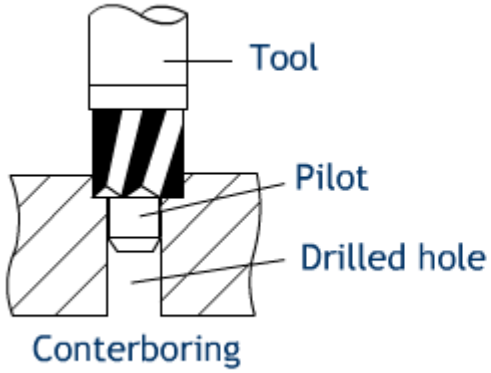
Reaming

2)Boring: It is an operation employed to enlarge a hole by means of an adjustable cutting tool with only one cutting edge. This is necessary where suitable sized drill is not available or where the hole diameter is so large that it cannot be ordinarily drilled. It is used to finish a hole accurately and to bring it to the required size. In precision machines the accuracy is as high as 0.00125mm; the process is slower compared to reaming and requires several passes of tool.



counter Boring: Is an operation of enlarging the end of a hole cylindrically. The enlarged hole forms a square shoulder with the original hole. The tool is guided by a pilot which extends beyond the end of the cutting edges. The pilot fits into the small diameter hole having

running clearance and maintains the alignment of the tool. Counter boring is done to accommodate the heads of bolts, studs, pins etc. Counter boring can give accuracy of about 0.050mm.



12.Mention the advantages and limitations of automation (July 2015) (july2016)

Advantages:

1. Low unit cost

2. Automated material handling

3. High production rate.

4. Flexible to deal with design variations.

5. Suitable for batch production

6. Continuous production of variable mixtures of product.

7. Flexible to deal with product design variation.

Disadvantages:

1. High initial Investment

2. Relatively inflexible in accommodating product changes

3.High investment in general purpose equipment

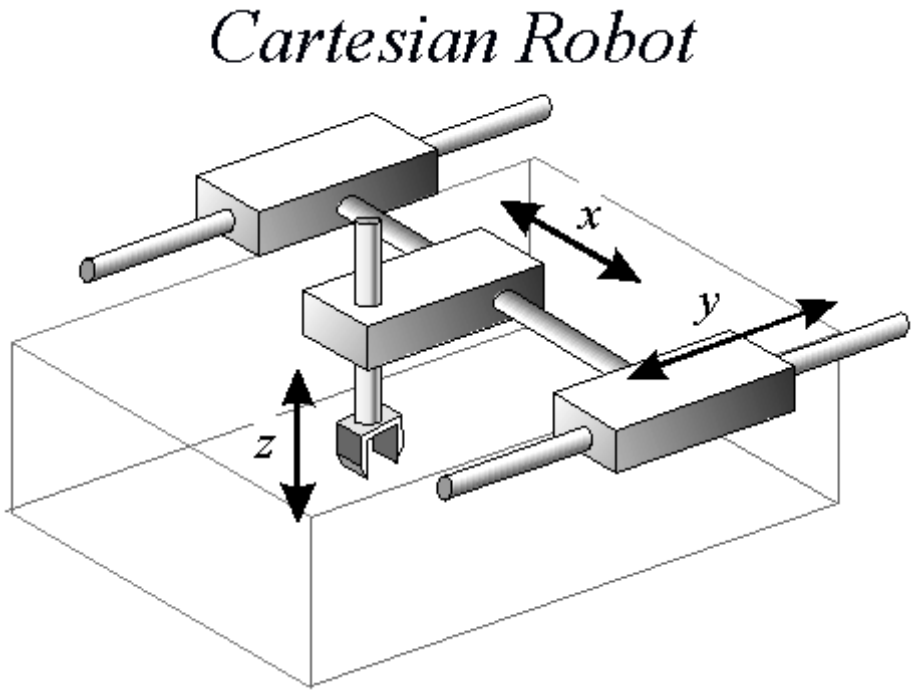
4. Lower production rate than fixed automation

5.Medium production rate

6. High investment.

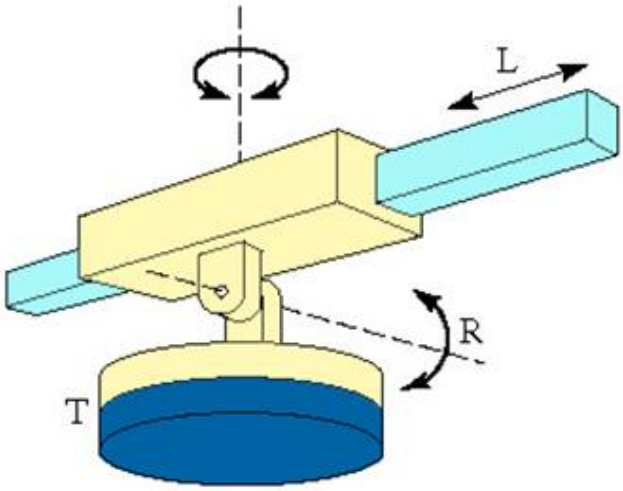
7. High ‘unit cost relative to fixed automation

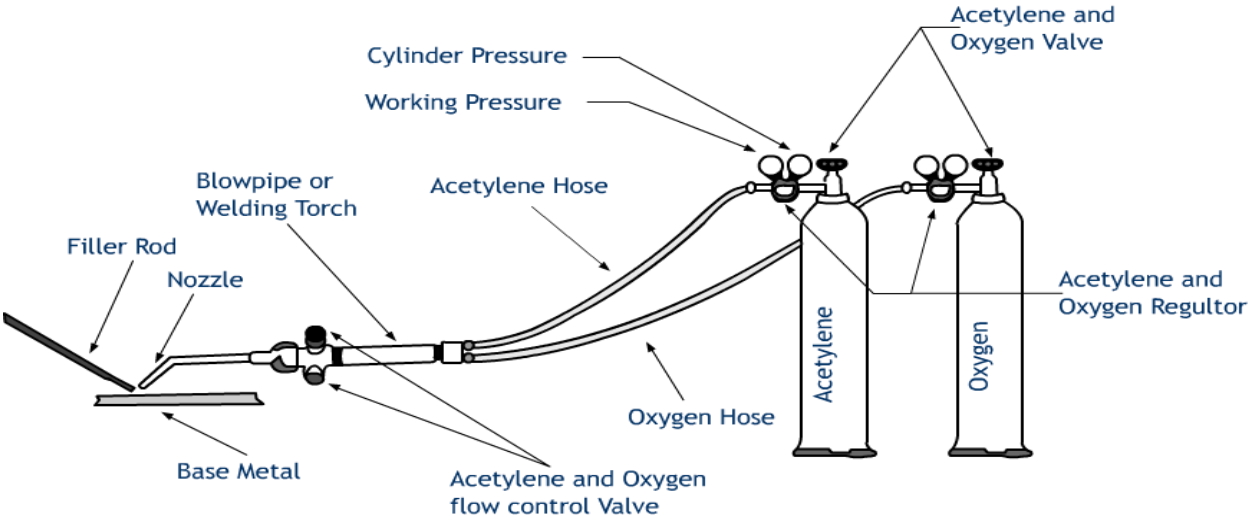
13.Explain the Cartesian co-ordinate configuration and polar coordinate configuration of robots with neat sketches. (july2016)



Cartesian coordinate: Other names for this configuration include rectilinear robot and x-y-z robot. It is composed of three sliding joints, two of which are orthogonal

Polar Coordinate: This configuration Consists of a sliding arm (L joint) actuated relative to the body, which can rotate about both a vertical axis (T joint) and horizontal axis (R joint)

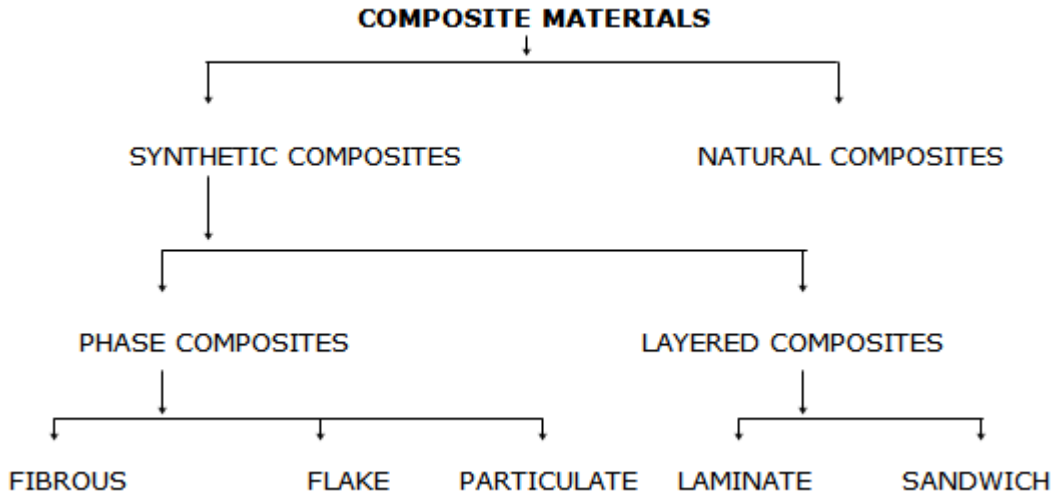

L
R
T


Acetylene and
Oxygen Valve
Cylinder Pressure
Working Pressure
Blowpipe or
Welding Torch
Acetylene Hose
Filler Rod
Nozzle
Acetylene and
Oxygen Regultor
Acetylene
Oxygen
Oxygen Hose
Base Metal
Acetylene and Oxygen
flow control Valve

MODULE 4

1. Define composites and list its classification (Dec 2014) (july2016)

A composite material is made by combining two or more materials – often ones that have very different properties. The two materials work together to give the composite unique properties. However, within the composite you can easily tell the different materials apart as they do not dissolve or blend into each other.



Classification of composites I (based on matrix material)

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.

Ceramic Matrix Composites (CMC)

Ceramic Matrix Composites are composed of a ceramic matrix and embedded fibers of other ceramic material (dispersed phase).

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).

Classification of composite materials II(based on reinforcing material structure)

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.

Fibrous Composites

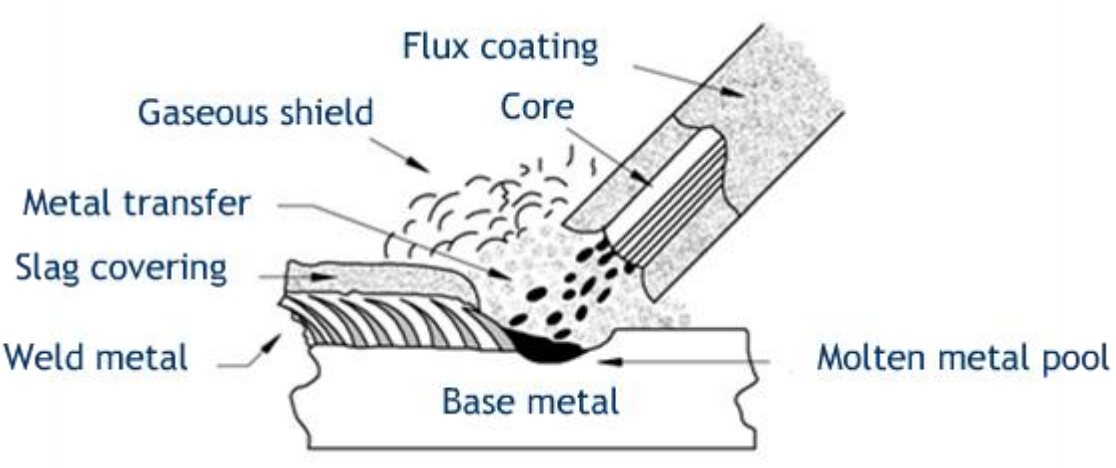
1. Short-fiber reinforced composites. Short-fiber reinforced composites consist of a matrix reinforced by a dispersed phase in form of discontinuous fibers (length < 100*diameter).
   I. Composites with random orientation of fibers.
   II. Composites with preferred orientation of fibers.
2. Long-fiber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

Laminate Composites

When a fiber reinforced composite consists of several layers with different fiber orientations, it is called multilayer (angle-ply) composite.

2. Explain arc welding process with a neat sketch (Dec 2014) (july2016)

Electric Arc Welding



Arc welding is one of several fusion welding processes for joining metals. By applying intense heat through a electric arc, metal at the joint is melted and caused to intermix - directly, or with an intermediate molten filler metal. Upon cooling and solidification, a metallurgical bond is created. Since the joining is an intermixture of metals, the final weldment potentially has the same strength properties as the metal of the parts.

2.Write down applications of ferrous metals(Dec 2014) (July 2015)

Name	Composition	Properties and characteristics	Principal uses
Cast iron	*Alloy* of iron and 2-5% carbon, 1-3% silicon and traces of magnesium, sulphur and phosphorus.	*Hard* skin, softer underneath, but *brittle*. It *corrodes* by rusting.	Parts with complex shapes which can be made by casting
Mild steel	Alloy of iron and 0.15 - 0.3% carbon	*Tough*, *ductile* and *malleable*. Good *tensile strength*, poor resistance to *corrosion*	General-purpose engineering material
Medium carbon steel	Alloy of iron and 0.35 - 0.7% carbon	*Strong*, hard and tough, with a high tensile strength, but less ductile than mild steel.	Springs; any application where resistance to wear is needed
High carbon steel	Alloy of iron and carbon: 0.7 - 1.5% carbon	Even harder than medium carbon steel, and more brittle. Can be heat-treated to make it harder and tougher	Cutting tools, mechanical elements
Stainless steel	Alloy of iron and carbon with 16-26% chromium, 8-22% nickel and 8% magnesium	Hard and tough, resists wear and corrosion	Cutlery, kitchen equipment
High speed steel	Alloy of iron and 0.35 - 0.7% carbon (medium carbon steel) with tungsten, chromium, vanadium, and sometimes cobalt	Very hard, high *abrasion*- and heat-resistance	Cutting tools for machines

3.Explain types of ferrous metals (Dec 2014) (July 2015)

Name	Composition	Properties and characteristics	Principal uses
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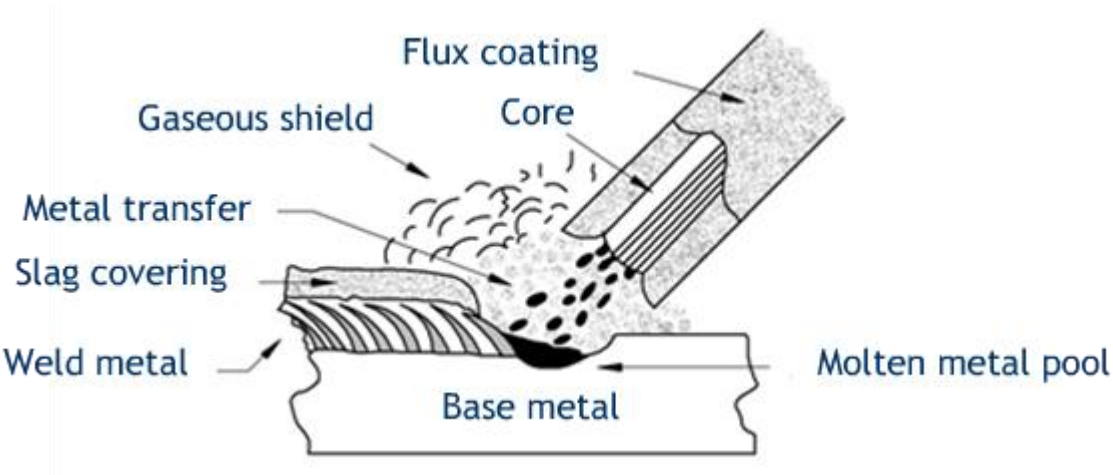
4. Explain electric arc welding and oxy-acetylene welding with neat sketch (Dec 2014)

Soln: Electric Arc Welding



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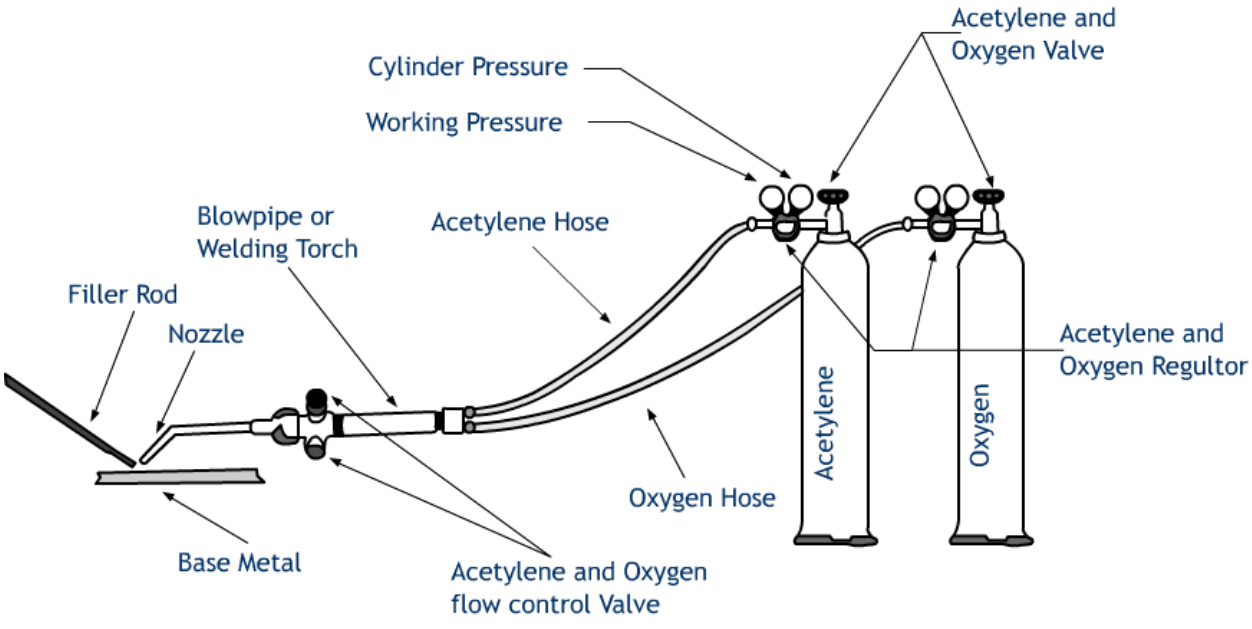
Oxy-Acetylene Welding



This is a common gas welding process. Acetylene is the fuel gas used. Acetylene produces high heat content in the range of 3200^0 C than other fuel gases. Acetylene gas has more available carbon (92.3 %) and hydrogen (7.7 %) by weight. The heat is released when the carbon breaks away from hydrogen to combine with O_2 and burn.

$$C_2H_2+O_2 = 2CO+H_2+Heat$$

Depending up on the gas pressure required for welding or cutting oxy acetylene welding is classified into two parts:

Low pressure System and

5. Compare soldering and brazing. **(Dec 2014)**

Sl. No.	Welding	Soldering	Brazing
1	These are the strongest joints used to bear the load. Strength of a welded joint may be more than the strength of base metal.	These are weakest joint out of three. Not meant to bear the load. Use to make electrical contacts generally.	These are stronger than soldering but weaker than welding. These can be used to bear the load upto some extent.
2	Temperature required is up to 3800^oC of welding zone.	Temperature requirement is up to 450^oC.	It may go to 600oC in brazing.
3	Workpiece to be joined need to be heated till their melting point.	No need to heat the workpieces.	Work pieces are heated but below their melting point.
4	Mechanical properties of base metal may change at the joint due to heating and cooling.	No change in mechanical properties after joining.	May change in mechanical properties of joint but it is almost negligible.
5	Heat cost is involved and high skill level is required.	Cost involved and skill requirements are very low.	Cost involved and sill required are in between others two.
6	Heat treatment is generally	No heat treatment is	No heat treatment is

	required to eliminate undesirable effects of welding.	required.	required after brazing.
7	No preheating of workpiece is required before welding as it is carried out at high temperature.	Preheating of workpieces before soldering is good for making good quality joint.	Preheating is desirable to make strong joint as brazing is carried out at relatively low temperature.

6. Write a short note on composites. (Jan 2016)

A composite material is made by combining two or more materials – often ones that have very different properties. The two materials work together to give the composite unique properties. However, within the composite you can easily tell the different materials apart as they do not dissolve or blend into each other.

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.

Ceramic Matrix Composites (CMC)

Ceramic Matrix Composites are composed of a ceramic matrix and embedded fibers of other ceramic material (dispersed phase).

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).

MODULE 5:

1. What are the properties of good refrigerants? (Dec 2014) (july2016)

Soln: Properties of good Refrigerants:

1. Thermodynamic Properties

a. A good refrigerant must have a low boiling temperature at atmospheric pressure.

b. A good refrigerant must have a very low freezing point because the refrigerant should not freeze at low temperatures.

c. In order to avoid the leakage of the atmospheric air and also to enable the detection of the leakage of the refrigerant, both the evaporator and condenser pressures should be slightly above the atmospheric pressure.

d. The latent heat of evaporation must be very high so that a minimum amount of refrigerant will accomplish the desired result in other words, it other words, it increases the refrigeration effect.

e. The specific volume of the refrigerant must be very low. The lower specific volume of the refrigerant at the suction of the compressor reduces the size of the compressor.

Physical properties

A good refrigerant must have low specific heat when it is in liquid state and high specific heat when it is vaporized.

a. The viscosity of a refrigerant at both the liquid and vapour states must be very low as it improves the heat transfer and reduces the pumping pressure.

b. A good refrigerant should be non-toxic,

c. A good refrigerant should be non-corrosive to prevent the corrosion of the metallic parts of the refrigerators.

d. Chemical stability an ideal refrigerant must not decompose under operating conditions.

e. The coefficient of performance of a refrigerant must be high so that the energy spent in refrigeration will be less.

f. A good refrigerant must be odourless, otherwise some foodstuff such as meat, butter, etc. lose their taste.

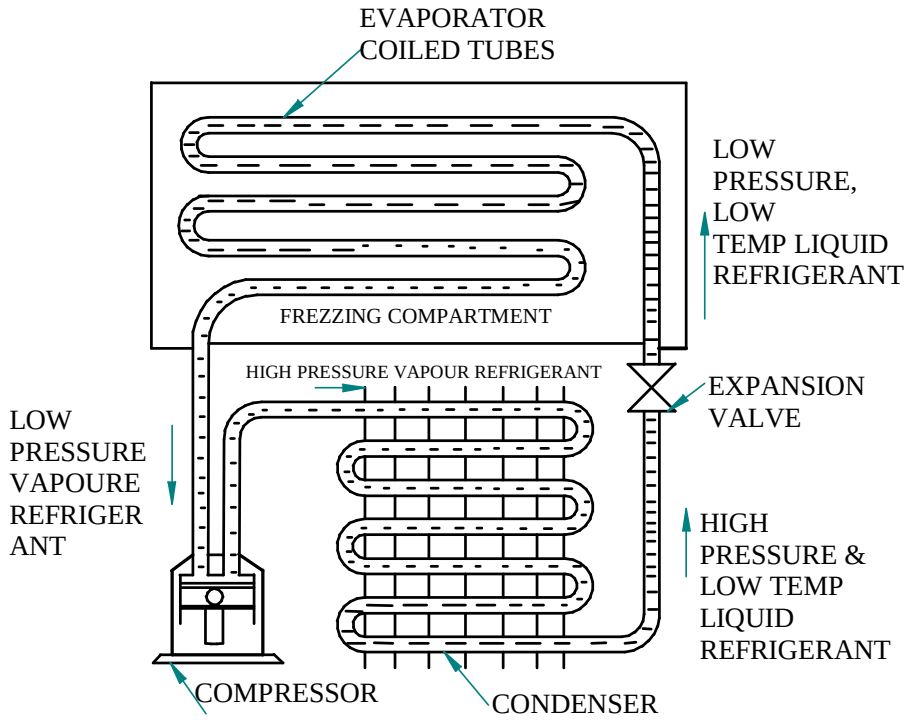
g. A good refrigerant should have any leakage can be detected by simple test.

h. A good refrigerant must not react with the lubricating oil used in lubricating the parts of the compressor.

2. **Explain with neat sketch Explain working principle of vapour compression refrigeration (Dec 2014) (July 2015)**

Soln: 1.The refrigerant at low pressure and low temperature, passing in the evaporator coils, absorbs the heat from the contents in the freezing compartment and evaporates.

3. The evaporated refrigerant at low pressure from the evaporator is drawn by a compressor. Which compresses it to, high pressure so that the saturation temperature of the refrigerant, corresponding to the increased pressure is higher than the temperature of the cooling medium in the condenser.
4. The high pressure-high-temperature refrigerant vapour from the compressor flows to the condenser where it gives off its latent heat to the atmospheric air.
5. As a result of the loss of latent heat in the condenser, the refrigerant condenses.
6. The high pressure condensed liquid refrigerant approximately at room temperature now flows to the throttle valve in which it expands to low pressure and then passes to the evaporator coils for recirculation once again.
7. Hence the refrigerant coming out of the expansion valve will be a very wet vapour and at a very low temperature which will be around -10degree. He required low temperature is maintained in the refrigerator by a thermostat switch which switches on and off the compressor motor by a relay as and when the temperature either falls below or rises above the required temperature. The refrigerant is Freon-12



8.

3.Explain room air conditioner with a neat sketch

(Dec 2014) (july2016) (July 2015) (Jan 2016)

Soln: Room Conditioner:

The high pressure, low-temperature liquid refrigerant from the condenser is passed to the evaporator coils through the capillary tube where it undergoes expansion.

The evaporator fan continuously draws the air from the interior space within the room through air filler by forcing it to pass over the evaporator coils.

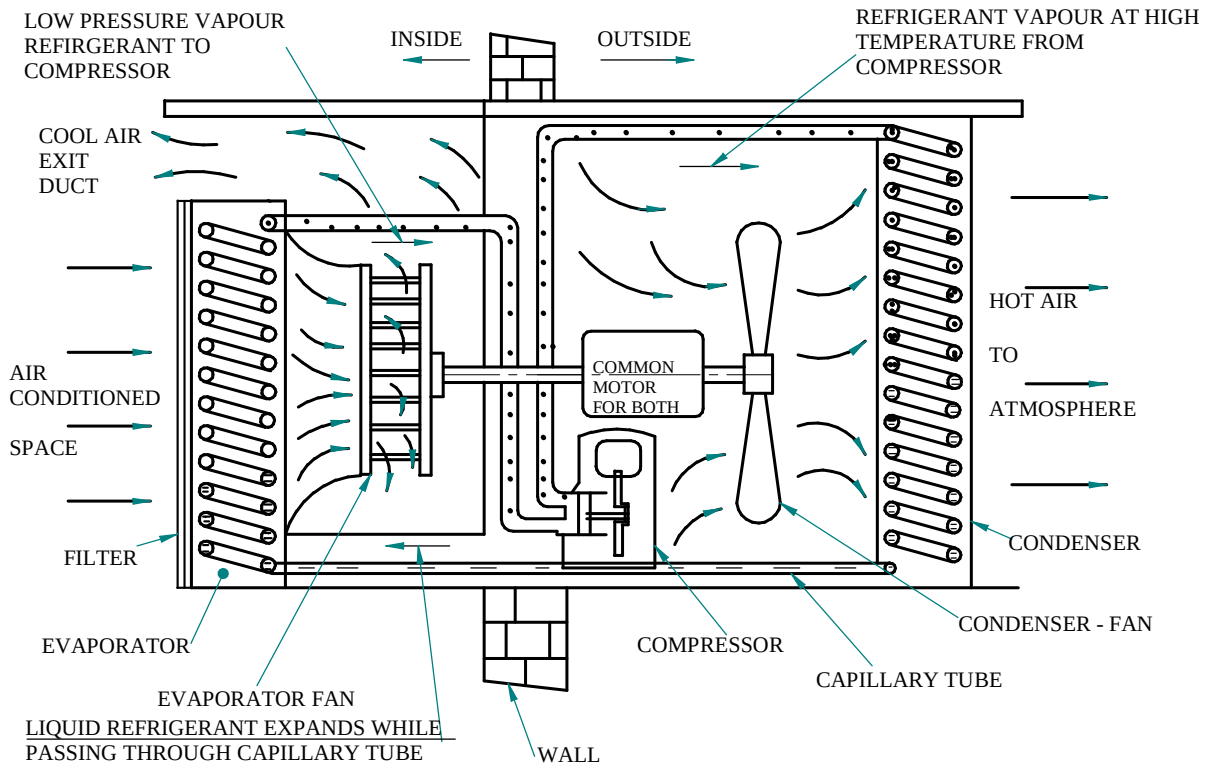
The air from the interior passing over the evaporator coils is cooled by the refrigerant which consequently evaporates by absorbing the heat from the air.

The higher temperature evaporated refrigerant from the evaporator is drawn by the suction of the compressor which compresses it and delivers it to the condenser.

The high pressure, high temperature refrigerant vapour now flows through the condenser coils.

The condenser fan draws the atmospheric air from the exposed side portions of the air conditioner which is projecting outside the building into the space behind it and discharges to pass through the centre suction of the condenser unit over the condenser coils.

The high pressure, high temperature refrigerant passing inside the condenser coils condensers by giving off the heat to the atmospheric air.



Room Air conditioner

4.Explain with a neat sketch vapour absorption process **(Dec 2014)**

Soln: Vapour Absorption Refrigerator:

- The liquid ammonia vapouries in the evaporator coils,
- Absorbing the latent heat from the freezing compartment thus keeping it cool and subsequently gives off heat when it condenses in a condenser.
- Dry ammonia vapour is dissolved in the cold water contained in the absorber, which will produce a strong ammonia solution which is flowing back from the heater-separator from the heat exchanger.
- The worm high pressure strong ammonia solution is passed to the heater-cum-separator provided with the heating coils.

Heating of the high pressure strong ammonia solution will drive out the ammonia vapour from it and consequently the solution in the heater-separator becomes weak which in turn flows back to the heat exchanger. Where it worms up the strong ammonia solution passing through it.

The high pressure ammonia vapour from the heater-separator now passes to a condensed.

The high pressure ammonia liquid is now expanded to a low pressure and low temperature in the throttle valve.

The low pressure condensed ammonia liquid at low temperature is passed onto the evaporator coils provided in the freezing compartment, where it absorbs the heat and evaporates.

5.What are the properties of good refrigerants (Dec 2014) (july2016)

Soln: Properties of good Refrigerants:

9. Thermodynamic Properties

f. A good refrigerant must have a low boiling temperature at atmospheric pressure.

g. A good refrigerant must have a very low freezing point because the refrigerant should not freeze at low temperatures.

h. In order to avoid the leakage of the atmospheric air and also to enable the detection of the leakage of the refrigerant, both the evaporator and condenser pressures should be slightly above the atmospheric pressure.

i. The latent heat of evaporation must be very high so that a minimum amount of refrigerant will accomplish the desired result in other words, it other words, it increases the refrigeration effect.

j. The specific volume of the refrigerant must be very low. The lower specific volume of the refrigerant at the suction of the compressor reduces the size of the compressor.

Physical properties

A good refrigerant must have low specific heat when it is in liquid state and high specific heat when it is vaporized.

i. The viscosity of a refrigerant at both the liquid and vapour states must be very low as it improves the heat transfer and reduces the pumping pressure.

j. A good refrigerant should be non-toxic,

k. A good refrigerant should be non-corrosive to prevent the corrosion of the metallic parts of the refrigerators.

l. Chemical stability an ideal refrigerant must not decompose under operating conditions.

m. The coefficient of performance of a refrigerant must be high so that the energy spent in refrigeration will be less.

n. A good refrigerant must be odourless, otherwise some foodstuff such as meat, butter, etc. lose their taste.
o. A good refrigerant should have any leakage can be detected by simple test.
p. A good refrigerant must not react with the lubricating oil used in lubricating the parts of the compressor.

6.a.Define the following
i) Ton of refrigeration
ii) Refrigerating effect
iii) Ice making capacity
iv)COP **(July 2015) (Jan 2016)**

Solution:

i) Ton of refrigeration
Ton of refrigeration: a ton of refrigeration is defined as the quantity of heat absorbed in order to form one ton of ice in 24 hours when the initial temperature of the water is 0^oC.

1 TON of refrigeration = 210 KJ/min = 3.5 KW

ii) Refrigerating effect
Refrigeration effect: in a refrigeration system, the rate at which the heat is absorbed in a cycle from the interior space to be cooled is called refrigerating effect.

iii) Ice making capacity
Ice making capacity: a ton of refrigeration is defined as the quantity of heat absorbed in order to form one ton of ice in 24 hours when the initial temperature of the water is 0^oC.

iv)COP
Coefficient of performance (COP): The COP of a refrigeration system is defined as the ratio of heat absorbed in a system to the work supplied.

If Q= Heat absorbed or removed, KW

W= work supplied, KW

COP = Q/W