USN | | | | | | | | | |

CMRIT
CMR INSTITUTE OF TECHNOLOGY, BENGALURU
ACCREDITED WITH A+ GRADE BY NAAC

Internal Assessment Test 3 – APRIL 2018

Sub:	Elements of Mechanical Engineering		Sub Code:	17 EME 24	Branch:	ALL Branches
Date: 22/05/2018	Duration: 90 min's	Max Marks: 50	sem./sec:	A,B,C,D,E,F,G	OBE	

(ANSWER ANY FIVE)

		MARKS	CO	RBT
1.	List different types of robot configurations and explain cylindrical type with suitable diagram.	[10]	CO4	L1
2.	What is composite material? Give its classification. List the applications of Composites in Automobiles.	[10]	CO5	L1
3.	With a neat sketch explain the working principle of nuclear power plant. State its advantages and disadvantages.	[10]	CO1	L1
4.	Explain closed cycle gas turbine with a neat sketch.	[10]	CO2	L1

5.	Define steam turbine and explain working of De Laval's turbine with help of neat sketch and pressure-velocity profile.	[10]	CO2
6.	Explain the construction and working of Francis turbine with help of a neat sketch.	[10]	CO2
7.	Explain the following with a neat sketch : a) Slab Milling b) Taper turning by swivelling the compound rest	[10]	CO3
8.	With a neat sketch explain the principle of the following : a) Photo-Voltaic cell b) Solar Pond	[10]	CO1

EME - 17EME24.

Elements of Mechanical Engineering - Scheme & Evaluation

Q1) Listing robot configuration (3).
Explanation (4)
Diagram (3).

Q2) Composite definition [2].
classification [4]
Applications [4]

Q3) Sketch of Nuclear Power plant [4].
Working Principle (4)
Advantages [2]
Disadvantages. [2]

Q4) Closed cycle gas turbine [5]
Sketch [5]

Q5) Steam Turbine definition [1]
Working of De Laval Turbine [3]
Velocity - Pressure Profile [3]
sketch [3]

Q6) Francis turbine explanation [5] ; sketch [5]

Q7) (a) Slab milling explanation [5] + sketch (b) Taper turning explanation + sketch [2.5+2.5]

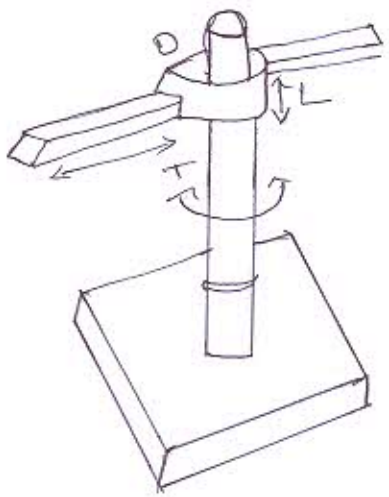
Q8) (a) Photo-voltaic cell [5] sketch [5] ; Solar Pond [2.5] sketch [2.5]

01. List different types of robot configuration and explain cylindrical type with suitable diagram.

→

i) Polar configuration
ii) cylindrical configuration
iii) Cartesian coordinate robot
iv) jointed arm robot.

ii) cylindrical configuration



This robot configuration consists of a vertical column, relative to which an arm assembly is moved up or down. The arm can be moved in and out relative to the axis of the column.

using a T joint to rotate the column about its axis an L joint is used to move the arm assembly vertically along the column, while an O joint is used to achieve radial movement of the arm.

---

02 What are the different types of automation and explain each one of them with at-least one application.

→ I. Fixed automation: Fixed automation is a system in which the sequence of processing operation is fixed by the equipment configuration. Each of the operations in the sequence is usually simple, involving perhaps a plain linear or rotational motion or an uncomplicated combination of two.

Ex: machinning transfer lines.

2. Programmable automation: In programmable automation The production equipment is designed with the capability to change the sequence of operation to accommodate different product configuration. 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.
ex: Industrial Robots

3. Flexible automation: Flexible automation is an extension of programmable automation. A flexible automated 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 setup. the system can produce various combinations and schedules of parts or products instead of requiring that they be made in batches.

Q) What is composite material? Give its classification. List the applications of composites in automobiles.

-> A combination of two or more materials which differ in form or composition on a macro scale is called a composite material.

Based on the material -

1. metal matrix composites (MMCs): These composites are composed of a metallic matrix such as aluminium, magnesium, cobalt, iron, copper and a dispersed phase in the form of ceramics, carbides or lead, tungsten, etc.

2. ceramic matrix composites (CMCs): Are composed of a ceramic matrix and embedded fibers of other ceramic material.

3. Polymer matrix composites (PMCs): are composed of a matrix like thermosets with embedded fibers of glass, steel or Kevlar

Based on the reinforcing material:

i) Particulate composites: These consist of a matrix reinforced by a dispersed phase in the form of particles.

ii) Fibrous composites:

a) short fiber-reinforced composites: The fibers used to reinforce are normally of the length less than 100 times their diameter.

b) Long-fiber-reinforced composites: consist of reinforcing phase in the form of long fibers. The fibers may be uni-directional, bi-directional, woven, knitted etc.

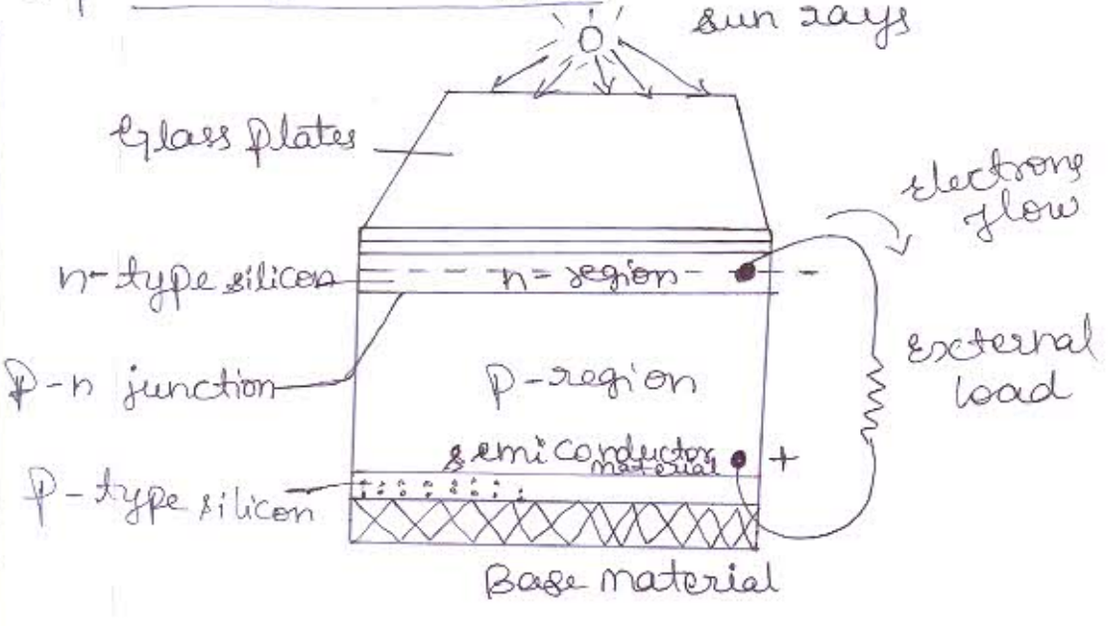
c) metal-reinforced composites: These have reinforcing phase in the form of high strength metals like steel, tungsten etc.

d) Glass-fiber-reinforced composites: These are made up of glass fibers as reinforcement with a plastic matrix.

e) carbon-carbon composites: These materials have a graphite fiber reinforced in a carbon matrix.

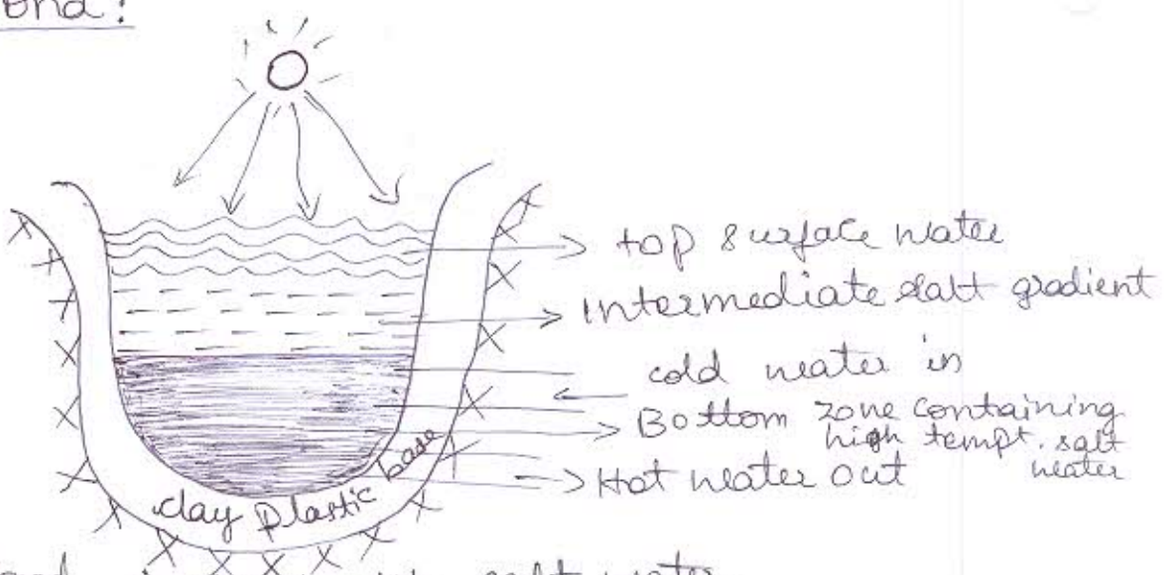
05 with a neat sketch explain working principle of the following.

a) photo voltaic cell



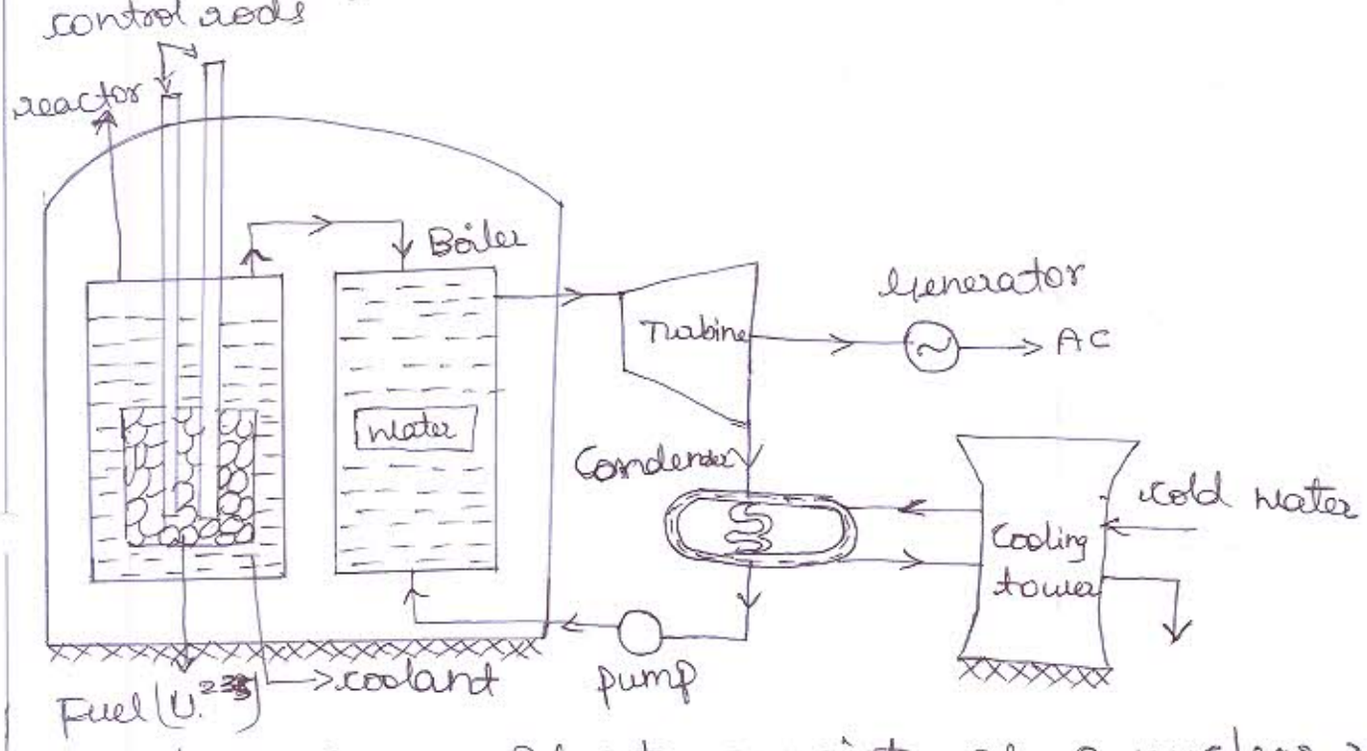
- When sun rays fall on top of solar cell, the glass plate scatters them all over the surface.
- The photons contained in solar radiation strike the n-type silicon side and penetrate through p-n junction.
- The semiconductor absorbs the photons and creates free $\bar{e}$s. As a result, an electric field builds up near the p-n junction.
- n-region gets -vely charged and p-region gets +vely charged.
- If an external load is connected across the p-n junction, the charge difference drives a electric current, which can be used or stored as required.

b) Solar pond:



- The solar pond is filled with salt water.
- During daytime, the temperature of the pond increases due to energy absorbed from solar surface of the pond. High temperature water at about 90°C remains at the bottom of the pond.
- Salt gradient at the middle layer separates the low density water from the water at the bottom.

06 With a neat sketch explain the working principle of nuclear power plant, state its advantages and disadvantages.



- Nuclear power plant consists of a nuclear reactor, a steam generator, cooling water condenser, cooling towers, turbines and generators.
- control rods are placed into reactor vessel and they control the splitting of uranium atoms.
- The reactor and steam generators are housed inside a structure.
- Nuclear reactions produce enormous amount of energy which is tranferred to steam generators, where steam is produced by reaction of heat with cooling water.
- This steam is used to drive turbines and turbines are coupled with generators to produce power.
- The low pressure steam from the turbine passes through condensers and hence its temperature is lowered. It is further cooled by mixing with cooling water drawn from cooling towers.

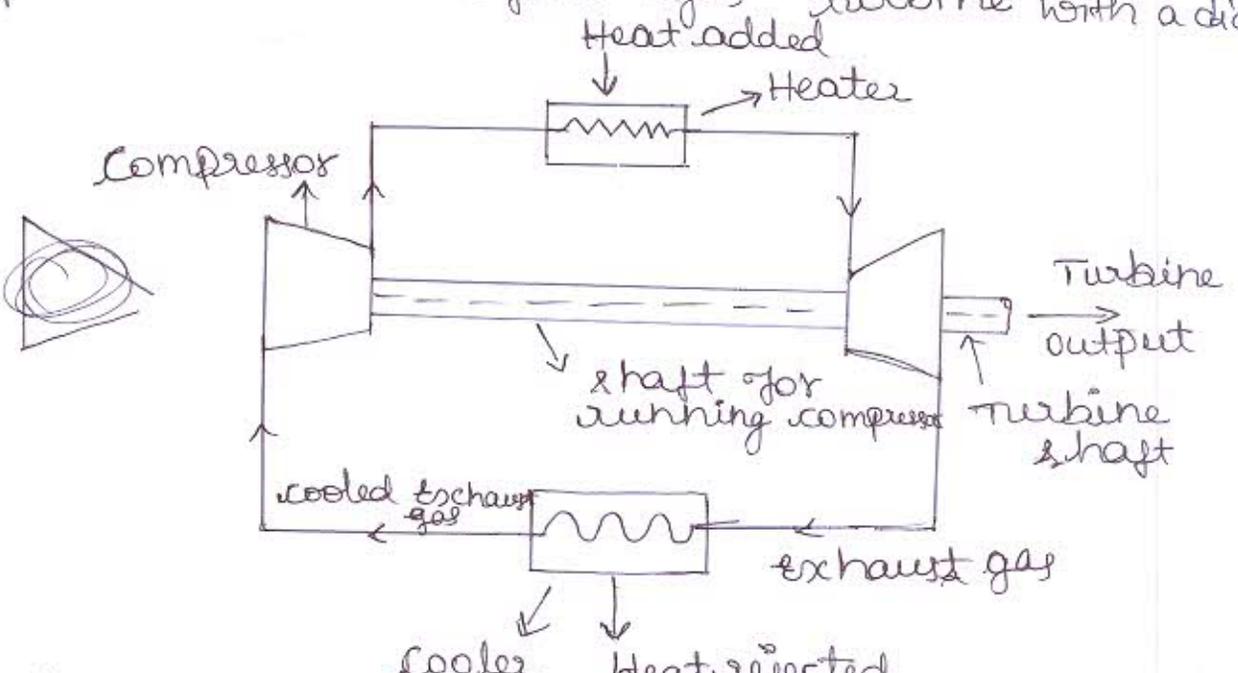
Advantages:

- Reliable source of energy.
- High power generation.
- storage and transportation costs of fuel are less.
- Free from air pollution.

Limitations:

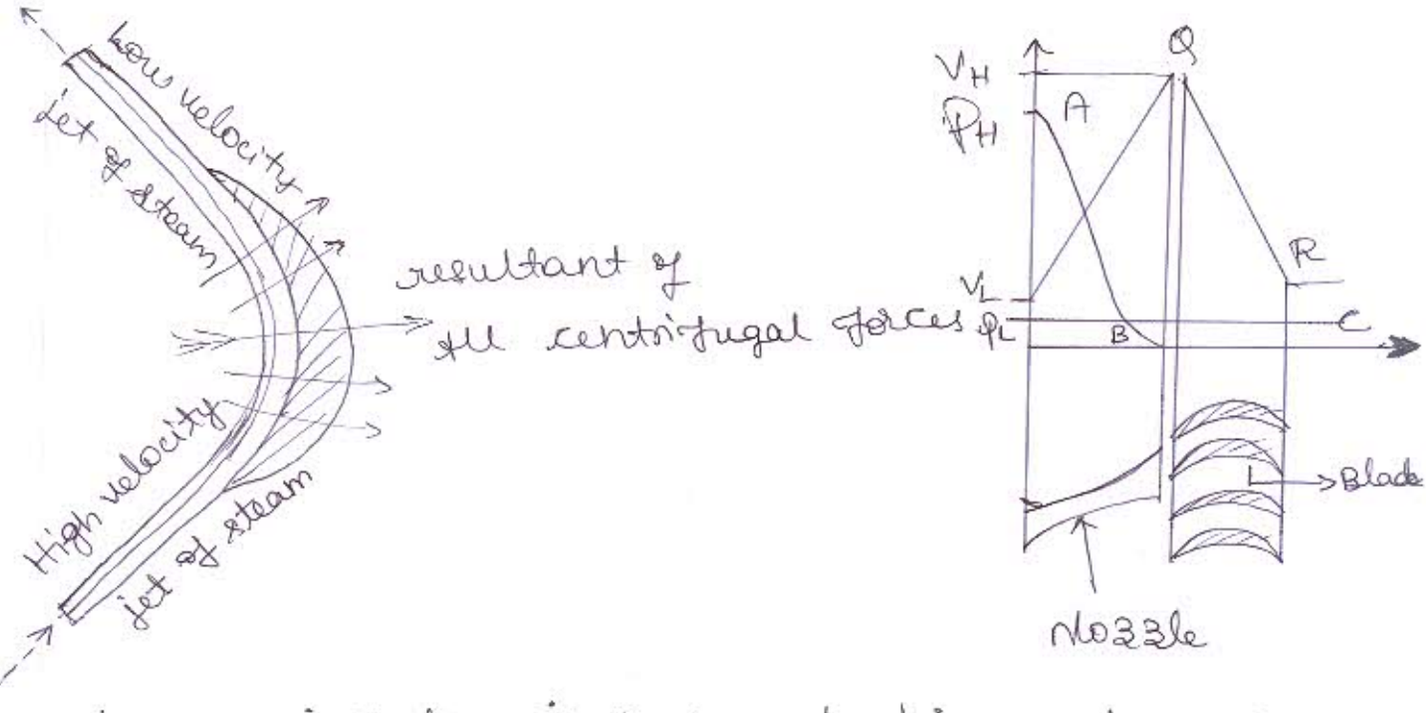
- Plant installation cost is very high.
- Fuel cost is high.
- Plant maintainance cost is high.
- chances of radiation hazards is more.
- Disposal of radio active waste is difficult.

07 Explain closed cycle gas turbine with a diagram.



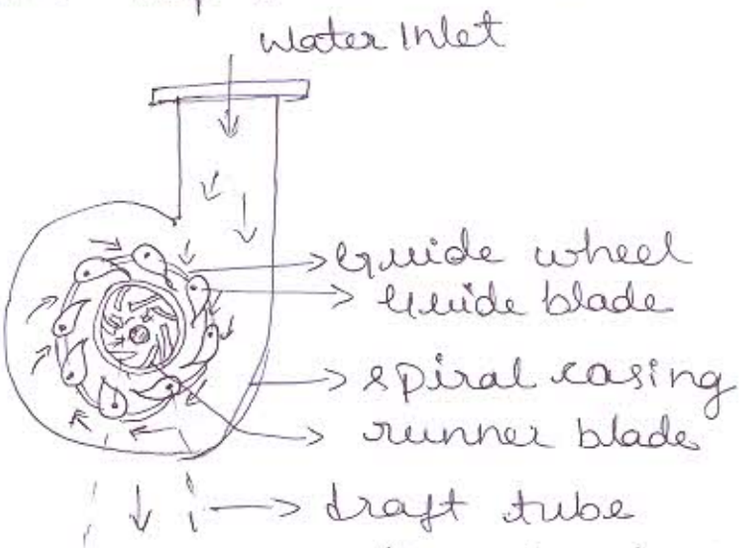
- consists of a compressor, a heater, a cooler and the gas turbine.
- Both the compressor and gas turbine are mounted on the same shaft.
- The compressed air coming out of compressor is heated by the heater.
- The high pressure and high temperature gas is made to pass over turbine blades, where it expands and thus its pressure drops.
- The gas coming out of turbine is made to pass through cooler where it is cooled. The low pressure, cooled gas enters the compressor again and it is compressed.

08 Define steam turbine and explain working of De Laval's turbine with help of neat sketch and pressure velocity profile.



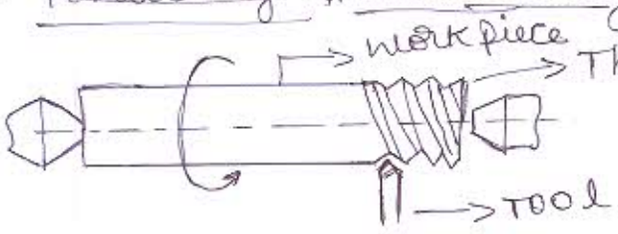
- It is an impulse impulse turbine. steam is initially expanded in a nozzle from high pressure to low pressure and from low velocity to high velocity.
- The high velocity steam coming out of the nozzle is made to glide over a curved vane called blade.
- The change in direction of steam leads to a change in momentum of the blades, therefore a change in force is created.
- The steam particles exert centrifugal pressure all along their path on blades. The resultant of this causes the blades to move. When a number of such blades are fitted on a circular wheel called rotor.
- Figure shows the pressure-velocity diagram of the DeLaval turbine operation. Pressure drop in the nozzle is represented by the curve AB. As there is no change in pressure while steam flows over the blades, it is shown by the horizontal line BC. Velocity increase of steam in nozzle is shown by the line PQ and velocity reduction on the blades is shown by the line QR.

09 Explain the construction and working of Francis turbine with help of a neat sketch.



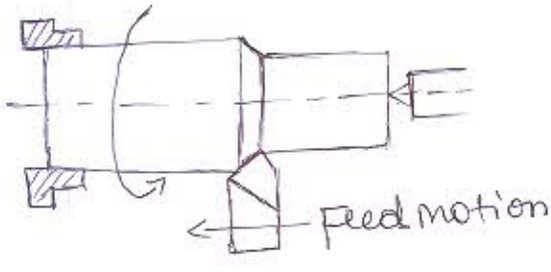
- Francis turbine is a medium-head reaction turbine in which water flows radially inwards.
- It consist of a spiral casing with a number of stationary guide blades fixed all around the circumference of an inner ring of moving blades forming the runner, which is fixed to the turbine shaft.
- Water at high pressure enters through the inlet of the casing and flows radially inwards to the outer periphery of the runner through the guide blades. From the runner, it flows inwards through the moving vanes and comes out at lo pressure.
- During this flow, it imparts kinetic energy to the runner and hence the runner rotates. TO discharge the water at low pressure, a conical tube called draft tube is fitted at the centre of the runner.
- The other end of the draft tube is immersed in the discharging side of the water called tailrace.

c) ~~Knurling~~ thread cutting:



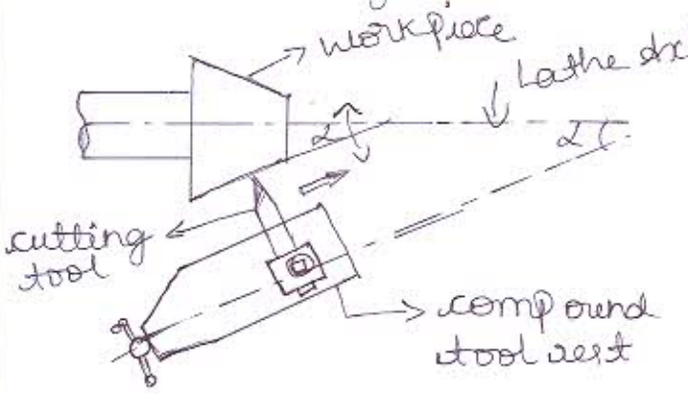
- A thread is a helical groove formed on a cylindrical or conical rod. Thread cutting is the operation of producing helical grooves on a cylindrical or conical surface. Threads may be square or V threads. The threads of any pitch, shape and size can be cut on a work piece.
- here the tool is moved longitudinally with a uniform motion while the workpiece is rotating at a uniform speed. By maintaining an appropriate gear ratio between the spindle on which the workpieces is mounted & the lead screw of the lathe.
- During thread cutting, both work piece and lead screw rotate at the same speed. the pitch of the lead screw is equal to pitch of workpiece. to cut threads, the tool is brought in contact with the workpiece. the tool is ~~not~~ moved along the axes, generates the threads on the workpiece. this process is repeated several times till the required depth, pitch and finish is obtained.

d) turning:



- The principle of a metal cutting operating using a single point cutting tool on a lathe. the workpiece is supported between the two centres which permit the rotation of the workpiece.
- A single point cutting tool is fed perpendicular to the axis of the workpiece to a known depth of cut and is then moved parallel to the workpiece.
- Turning is done to reduce the diameter of the work piece, usually to a specified dimension, and to produce a smooth finish of the metal.

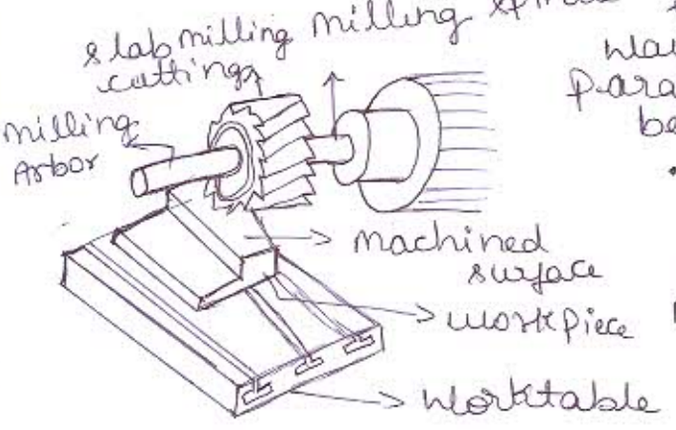
10 Explain with a neat diagram, taper turning by swiveling the compound rest.



- This method is suitable for workpiece which require steep taper over short lengths.
- The compound tool rest is swiveled to the required taper angle and then locked in that angular position. The compound tool rest has a rotating base with angles graduated in degrees.
- The carriage is also locked at that position.
- For taper turning, the compound tool rest is moved linearly at an angle so that the cutting tool produces the tapered surface on the workpiece.

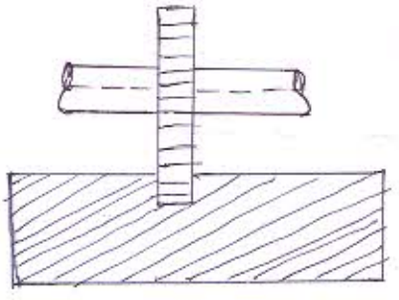
11 Explain the following with a neat sketch.

a) Slab milling:



- Plain milling (slab milling) is a process used to mill flat surfaces of workpiece in such a way that the milling cutter axis is parallel to the surface of that is being milled.
- Figure illustrates the plain milling operation carried out on a workpiece using a horizontal milling machine tool.

b) Slot milling:



- Slot milling is a process of milling slots using a different type of milling cutter called a slot drill, which has a capacity to cut through solid materials.
- Slot drill is majorly used in cases where it takes a lot of time to pre-drill a hole from an end mill and when there is not enough space for the end mill to plunge in to helical motion.