



സി.പി.എഫ്

SFI GEC PALAKKAD

Reg No.:

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Second Semester B.Tech Degree Examination July 2021 (2019 scheme)

Course Code: EST120**Course Name: BASICS OF CIVIL & MECHANICAL ENGINEERING
(2019 Scheme)****PART I: BASIC CIVIL ENGINEERING**

Max. Marks: 50

Duration: 90 min

PART A*Answer all questions, each carries 4 marks.*

Marks

- 1 What are the responsibilities of an engineer in ensuring the safety of built environment? (4)
- 2 What are the principles of surveying? (4)
- 3 List out the different varieties of timber available in Kerala. (4)
- 4 Differentiate between stretcher and header bond. (4)
- 5 Write a note on ramp. (4)

PART B*Answer one full question from each module, each question carries 10 marks***Module-I**

- 6 a) Mention the factors to be considered while selecting the site for a building. (5)
- b) Draw a neat sketch showing important parts of a residential building. (5)

OR

- 7 List out the major disciplines of civil engineering and explain their role in the infrastructural framework. (10)

Module-II

- 8 a) Enumerate the physical and chemical properties of ordinary Portland cement. (5)
- b) Write a note on water proofing materials. (5)

OR

- 9 List out the modern construction materials used for construction. Explain any four. *Brick, cement, stone, steel.* (10)

Module-III

- 10 a) Explain the circumstances where pile foundations are adopted. (5)
- b) Explain well foundation with neat sketch. (5)

OR

- 11 Explain various elements of a green building design. (10)

PART II: BASIC MECHANICAL ENGINEERING

Max. Marks: 50

Duration:90 min

PART A*Answer all questions, each carries 4 marks.*

Marks

- | | | |
|----|---|-----|
| 12 | What is meant by compression ratio? Why is it limited to 6 to 10 in petrol engines? | (4) |
| 13 | With the help of a block diagram explain the CRDI system. | (4) |
| 14 | Differentiate between comfort air conditioning and industrial air conditioning. | (4) |
| 15 | Explain the concept of gear train ?Name important types of gear trains ? | (4) |
| 16 | Explain how metals are joined in a village smithy shop. | (4) |

PART B*Answer one full question from each module, each question carries 10 marks***Module-IV**

- 17 The minimum pressure and temperature in an Otto cycle are 100kPa and 300K. The compression ratio is 5 and the peak pressure is 2.1MPa Find out
 (1) Heat supplied /kg of air (2) Heat rejected/kg of air (3) Work done /kg of air
 (4) Theoretical thermal efficiency (5) Mean effective pressure

OR

- ~~18~~ a) Explain the working of 4 stroke diesel engine with neat sketches. (6)
~~18~~ b) Give the comparison between CI and SI engines. (4)

Module-V

- ~~19~~ a) With the help of a neat sketch, explain the working of a vapour compression refrigeration system? Also show the process in p-h and T-S diagrams. (8)
~~19~~ b) Explain why Carnot refrigerator is not practically possible. (2)

OR

- 20 a) Differentiate between window air-conditioner and split air conditioner. (5)
 b) Explain the working of Francis turbine, also give the field of application. (5)

Module-VI

- 21 a) With a block diagram explain the processes involved in a CNC system. (6)
 b) How does welding differ from brazing and soldering processes? (4)

OR

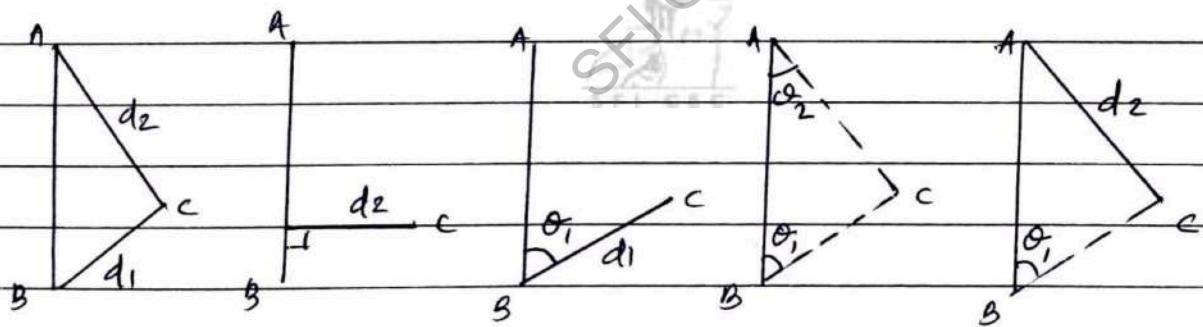
- 22 Describe the working of a Drilling machine with the help of a block diagram and indicate its main parts. (10)

2 Principles of surveying

(a) work from whole to part

- A system of control points are identified & they are located with high precision
- Then secondary control points are located using precise methods
- ~~The secondary control points are located using lesser precision~~
- The details of the localised areas are measured & plotted with respect to the secondary control points
- helps in localising the errors
- localised areas errors accumulated and may become unacceptable when large areas are covered

(b) Fixing a point with reference to two other points.



3 - timber logs

- wooden timber
- rosewood timber
- wood timber
- teakwood timber
- pine wood timber
- Sagwan timber

A ① Stretcher Bond

- All bricks are arranged in stretcher courses
- care should be taken to break vertical joints by using $\frac{1}{2}$ brick bats
- used for construction of partition walls that are half brick thick.

② Header Bond

- All bricks are arranged in header courses
- Used for construction of walls that are one brick thick

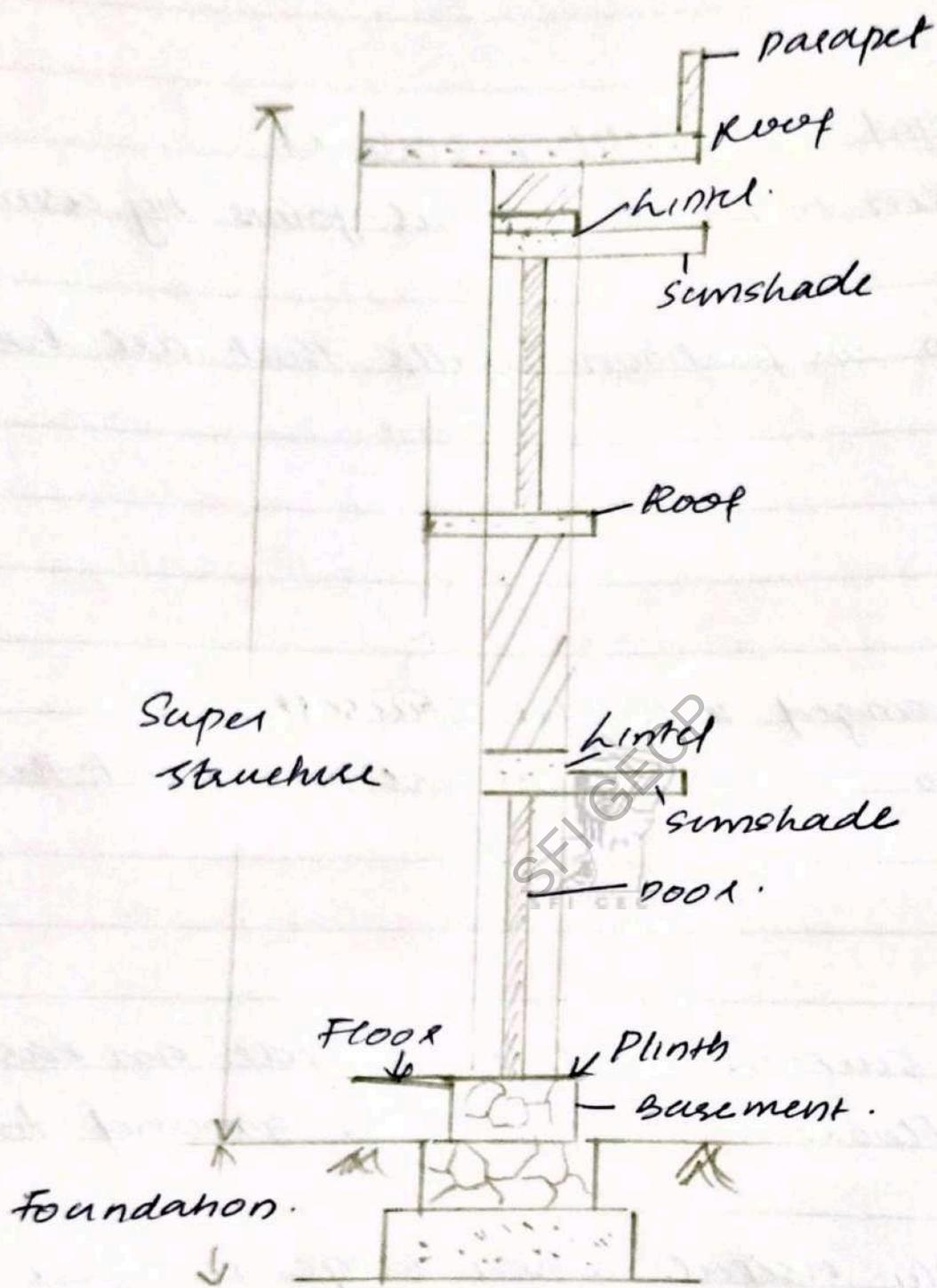
5 Ramp

- Ramps are sloping surfaces used to provide an easy connection b/w the floors or areas from ground to the floors.
- They are especially useful when large number of people or vehicles have to be moved from floor to floor.
- They are usually provided at places such as gauges, railway stations, stadiums, town halls etc.
- As per the prevailing building bye laws, ramps are to be provided in all public buildings and residential apartments for the use of physically challenged persons.
- It is also provided in hospitals to facilitate movement of stretchers and wheel chairs from one floor to other floor.

- Ramps are generally given slope of 15%. But slope of 8 to 10 percent is usually preferred. A level & landing of minimum 1.1m is provided at places where direction of ramp changes or at door stops.
- Minimum width of pedestrian ramp is 1.2m.

6 (a) Selection of site for buildings.

- i) Selected site should not be undulating.
- ii) Should be near to road.
- iii) Should be near to civic services.
- iv) Should not be a water water logged area.
- v) Should not be a made up land.
- vi) Should be large enough to provide sufficient light & air.
- vii) Should possess good soil at reasonable depth.
- viii) Should have adequate space to accommodate all essential accessories.
- ix) Type of building also affects the selection of site.
- x) For industrial building, selection of site should be such that:
 - (1) All raw materials should be available.
 - (2) No problem for labour and labourers.
 - (3) Should be enough space for future expansion of industry.
 - (4) Should have disposal plant to treat waste produced.
 - (5) Climate also plays an important role in selecting the site for industry eg: a cool and moist weather is more favourable for weaving & textile mills.



* construction eng

- Turns designs into reality
- Management of construction resources: labor, materials, equipment, money and time
- Application of knowledge of construction methods and equipment, along with the principles of financing, planning and management, to turn the designs into successful facilities

* structural eng

- Analyze and design of structures that support their own weight and the loads they carry and resist extreme forces from wind, earthquakes, bombings, temperature & others
- Structural engineers develop appropriate combinations of steel, concrete, timber, plastic & new exotic materials
- Must also consider the economics, aesthetics and social implications of their creations

* Geotechnical eng

- Develop projects below the ground e.g.: tunnels, foundations, offshore platforms, and containment structures for solid and liquid wastes.
- Analyze the properties of soil and rock that support and affect the behavior of these structures.
- Evaluate potential settlements of buildings, the stability of slopes and fills, seepage of ground water and effects of earth quakes.

* water resources eng

- Deals with physical control of water.

- work with others to prevent floods, supply of water, protect beaches or to manage redirect, rivers.
- Design, construct and maintain hydroelectric power facilities, dams, pipelines, pumping stations etc.

* Surveying & Remote sensing

- Surveying is to determine the positions of points on, above or below surface of the earth by means of direct or indirect measurements of distances, elevations & directions.
- Surveying has advanced from chain surveying to remote sensing with the advent of various electronic sophisticated instruments.

* Environmental eng

- resolve the problems of providing safe drinking water, cleaning up contaminated sites with hazardous materials, disposing of waste water and managing solid wastes.
- translate physical, chemical & biological processes into systems to destroy toxic substances, remove pollutants from water, reduce non-hazardous solid waste volumes etc.

* Transportation eng

- plan, design, construct, maintain & operate various transportation facilities (eg: highway, railway, airports, ports, etc)
- upgrading our transportation capability by improving traffic control and mass transit systems.

10 (a) Deep Foundation

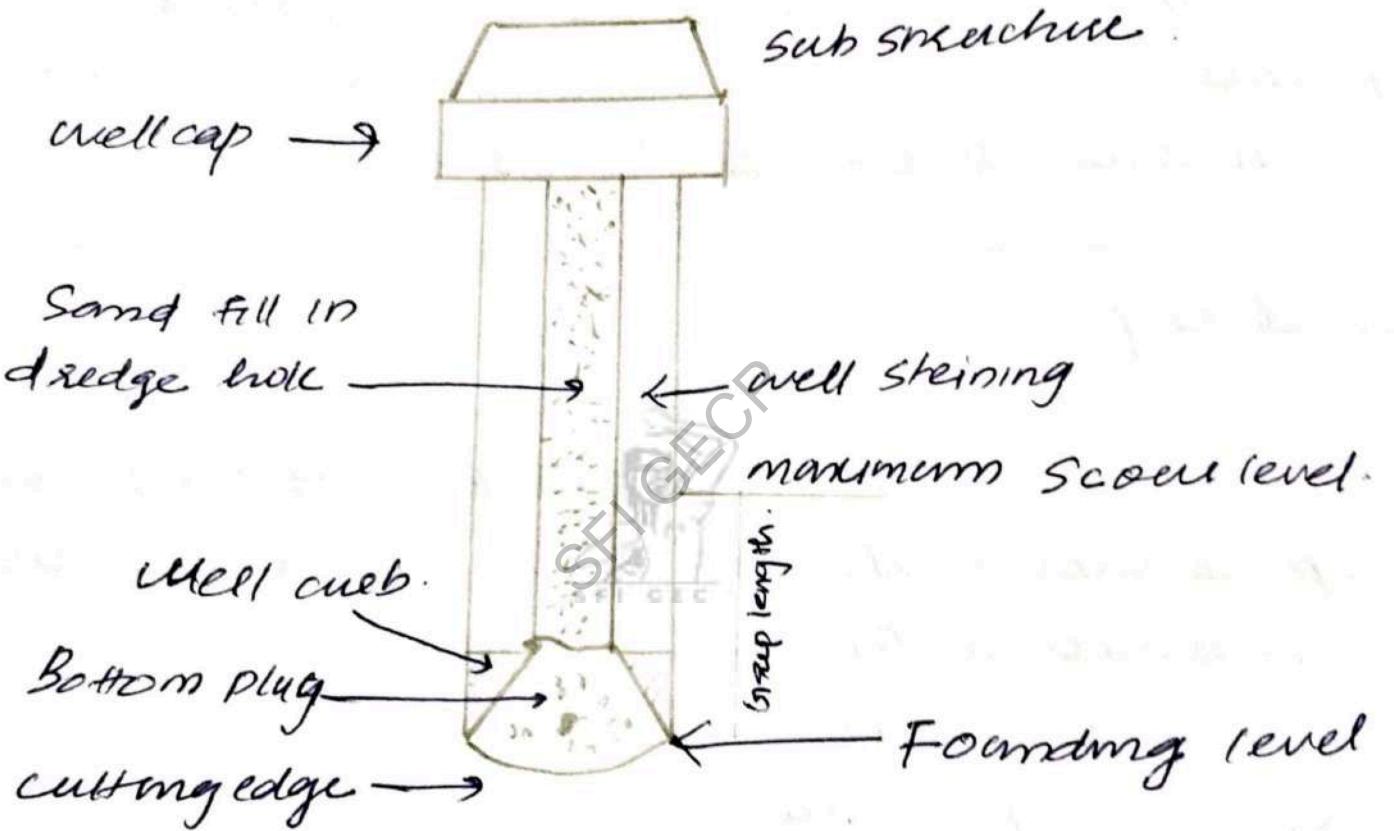
pile foundation

well foundation

- 1) Load is heavy
- 2) Bearing capacity of soil is less
- 3) water table level is very high or fluctuating
- 4) When the top soil is expansive.
- 5) Deep water carrying structures like canals, irrigation ducts etc .. nearby.

(b) well foundation

- It is a deep foundation.
- used to transfer heavy load to deep strata in river or sea bed for bridges, transmission towers & harbour structures.
- Well have different shapes and accordingly they are classified as circular wells, dumb bell, double - D well, double octagonal well, single & double rectangular well & multiple dredged hole well.



components of well foundation are

(1) well cap :

- it is an RCC slab laid on top of well stemming and it is cast monolithically with stemming.
- it transmits load of superstructure to stemming.

(2) stemmer :

- it is the main body of well which transfers load to sub soil.
- provides weight for sinking of structure.

(3) cub. :

- lower wedge shaped portion of well stemmer.
- facilitates the process of sinking.

(4) cutting edge :

- lower most portion of well cub.
- it cuts & into soil during sinking.

(5) Bottom plug :

- after the well is sunk to the required depth, base of the well is plugged with concrete, which is called bottom plug.
- transmits load to sub soil.

(6) dredge hole :

- well is sunk by excavating soil from within the well.
- hole formed due to excavation is called dredge hole, which is later filled with sand.
- this helps in distributing load of superstructure to bottom plug.

i) The sole purpose of prevention through design is to enhance safety at construction sites. During the design phase of building, engineers prioritize the overall well-being of construction and maintenance staff. Engineers also provide a parapet wall that is tall enough to prevent fall from heights. They also ensure lighting fixtures are fitted safely and in easy to access areas. Proper handling of building materials is essential for the safety of laborers at any construction site. Many activities involved in handling and storage of construction materials put workers at risk of injuries caused by falling objects and improper lifting of items manually or by machine. Engineers are aware of the importance of evaluating incoming materials. They will look for items that are likely to cause hazards and store them separately to avoid accidents.

8)

(b)

Water proofing materials:-

Commonly used materials for waterproofing in building are cementitious material, bituminous material, liquid waterproofing membrane and polyurethane liquid membrane etc.

- Cementitious materials

- easiest method of water proofing
- easy available
- easy to mix and apply.

- Liquid-water proofing membrane

Types:

- Acrylic liquid membrane
- Polyurethane liquid membrane
- Bituminous emulsion membrane

→ A thin coating which consists of usually a primer coat and two coats of top coats.

Applied by spray, roller or towel.

- Water proofing paints

Mainly used on exterior walls, terraces, sunshades

i) Masonry paint

ii) Acrylic paint

iii) Epoxy paint.

- pre-formed water proofing membrane.
 - It is being used since ages.
 - Requires technical operators.
 - eg:- Tar felt, plastic felt, pvc etc.

8) (a)

- Physical properties :-
 - The colour of cement should be uniform
 - cement should be free from lumps.
 - cement should be uniform when touched.
 - fineness of cement should be less than 10 percent in sieve test.
 - If a small quantity of cement is thrown into a bucket of water, it should sink.
 - Heat of hydration should not be more than 75 cal/gm after 28 days.
- Chemical properties :-
 - Excess use of alumina quicken the setting time but weakens the cement.
 - Iron oxide (ferric oxide) is responsible for the colour of the cement.
 - If the lime is used more than 65%; it may result in the problem of expansion.

9) Modern construction materials:-

- Architectural glass
- ceramics
- plastics
- composite materials
- Thermal and acoustic insulating materials.
- Decorative panels
- Waterproofing materials.
- Modern uses of gypsum
- pre-fabricated building components.

• Architecture glass

Architectural glass that is used as a building material. It is most typically used as transparent glazing material in the building envelope. Including windows in the external walls. It is also used as internal partitions for its architectural elegance.

• Ceramics

Ceramics are a material often used in construction made from a mixture of minerals, typically silica sand with a clay binder and some impurities and water. They are fired at a higher temperature than bricks, so that the silica re-crystallises to form a glassy

material that has greater density, strength, hardness, resistance to chemicals and a greater dimension stability.

- Composite materials

Composite material, also called composite is a solid material that results when two or more different materials are combined to create a new substance whose properties are superior to those of the original components in a specific application.

- ii. Explain various elements of a green building design?
- a) Fiberous materials are used for construction purpose. Better strength is obtained by reinforcing it with glass or other fibers.
 - b) Engineered wood - Process of conversion of raw timber to wood boards has wastages. Such wastages used to make parts like doors, wall etc.
 - c) Structural insulated panel - consist of 2 sheets of oriented boards with a foams layer between them. They are available in large size. Heavy equipment are necessary for installation
 - d) insulated concrete form - consist 2 insulation layers with space in between them. The space contains reinforcement bars. Once the system is placed in site concrete is poured into the space.
 - e) cordwood - short and round piece of wood laid one above the another widthwise and bounded with mortar.

- d) Timbercrete - formed from wooden waste and concrete.
It allows minimum transfer of heat and radiation, use friendly
- e) Ferrock + concrete + recycled materials like Steel dust.
It is stronger than concrete and carbon neutral.

PART II BASIC MECHANICAL ENGINEERING

12. What is meant by compression ratio? Why is it limited to 6 to 10 in petrol engines?

compression ratio (λ) - It is the ratio of total cylinder volume when the piston is at BDC to clearance volume.

$$\lambda = \frac{V_c + V_s}{V_c}$$

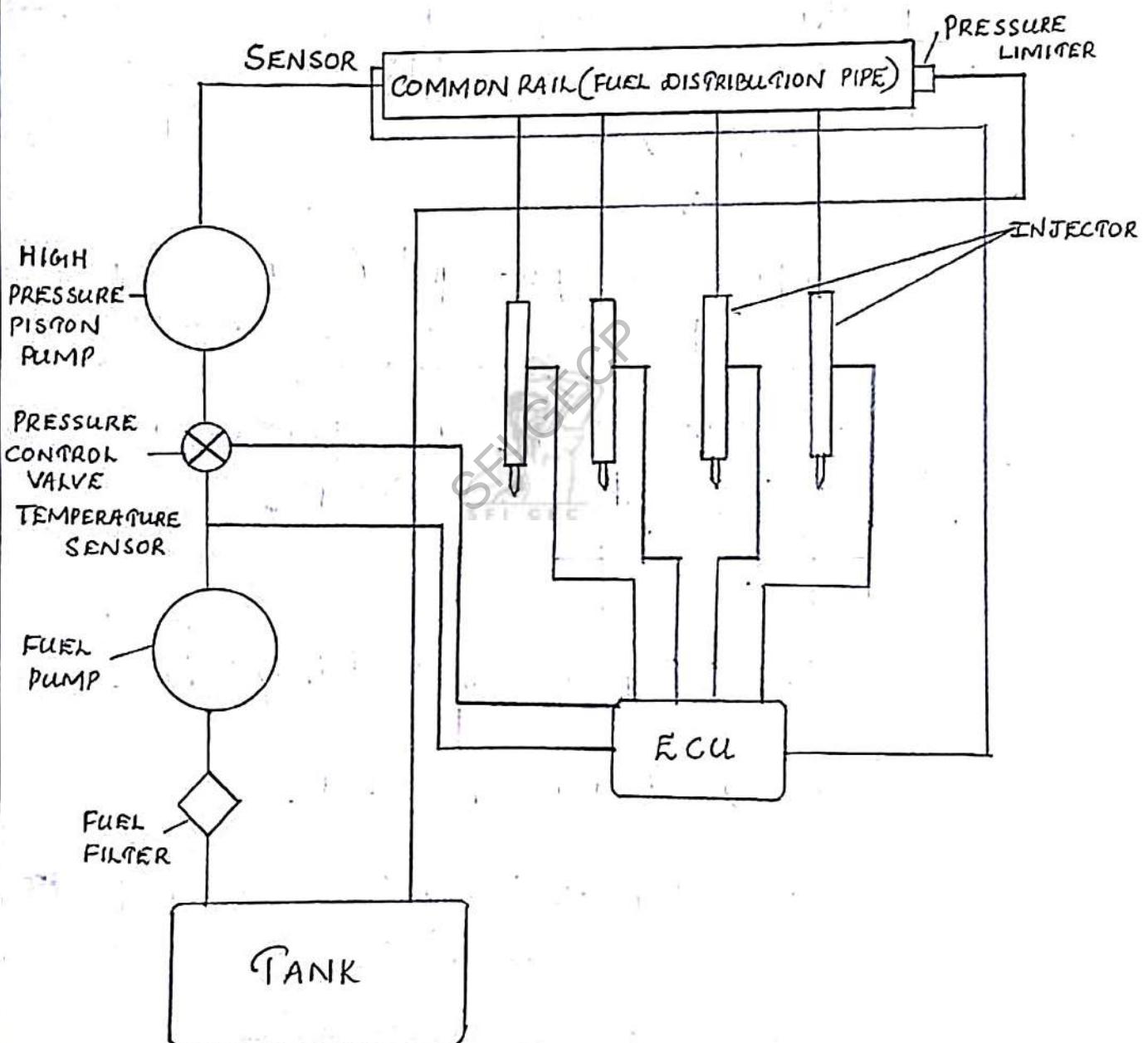
Petrol engines are spark ignition engines and petrol burns quickly as compared to diesel because it is more volatile in nature and it also has a low octane number (in regular petrol). So if more compression is given it may result into knocking of the engine so petrol engines have a low compression ratio.

13. What is CRDI, Explain with the help of a block diagram?

common Rail Direct Injection (CRDI)

This is a modern direct injection system for diesel engines. Conventional direct injection diesel engines must repeatedly generate fuel pressure (30-45 bar) for each injection. But in CRDI engines, the pressure is built up independently of the injection sequence and remains permanently available in the fuel line.

- CRDI mainly consist of a common rail which distributes the fuel to computer(ECU) controlled injector. This also control the amount of fuel to be injected.
 - In CRDI system the ECU receives signals from various sensors and uses those signals to operate injection.
- The various elements of CRDI are as follows.



14. Differentiate between comfort air conditioning and industrial air conditioning?

The difference between the comfort air conditioning and industrial air conditioning lies in the indoor requirement. In comfort air conditioning, the air is brought to the required dry bulb temperature and relative humidity for the human health comfort and efficiency, while in industrial air conditioning the inside dry bulb temperature and relative humidity of the air is kept constant for proper working of the machine and for the proper manufacturing processes.

15. Explain the concept of gear train? Name important types of gear trains?

Any combination of gear wheels by means of which motion is transmitted from one shaft to another shaft is called gear train.

- Simple gear train

A simple gear train is one in which each shaft carries one gear only. Each of the intermediate gear acts both as a driver and as a driver. These intermediate gear have no effect on the velocity ratio and hence these gears are known as 'idlers'. The function of idlers is to fill the gap between the rotation of the drivers gear as required.

Compound gear train.

When a series of gears are connected in such a way that two or more gears rotates about same axis, it is called a compound gear train. The intermediate shafts carry more than one gear. The speed ratio depends on the diameter of driver, the drivers and the intermediate gears.

Reverted gear train.

The reverted gear train is one in which the axes of first and last gears coincide. Such an arrangement is reverted gear train. Its application as a speed reducer.

16. Explain how metals are joined in a village Smithy shop?

Forge welding - is a solid-state welding process that joins two pieces of metal by heating them to a high temperature and then hammering them together. It also consists of heating and forcing the metals together with presses or other means, creating enough pressure to cause plastic deformation at the weld surfaces. Forge welding is versatile, being able to join a host of similar and dissimilar metals.

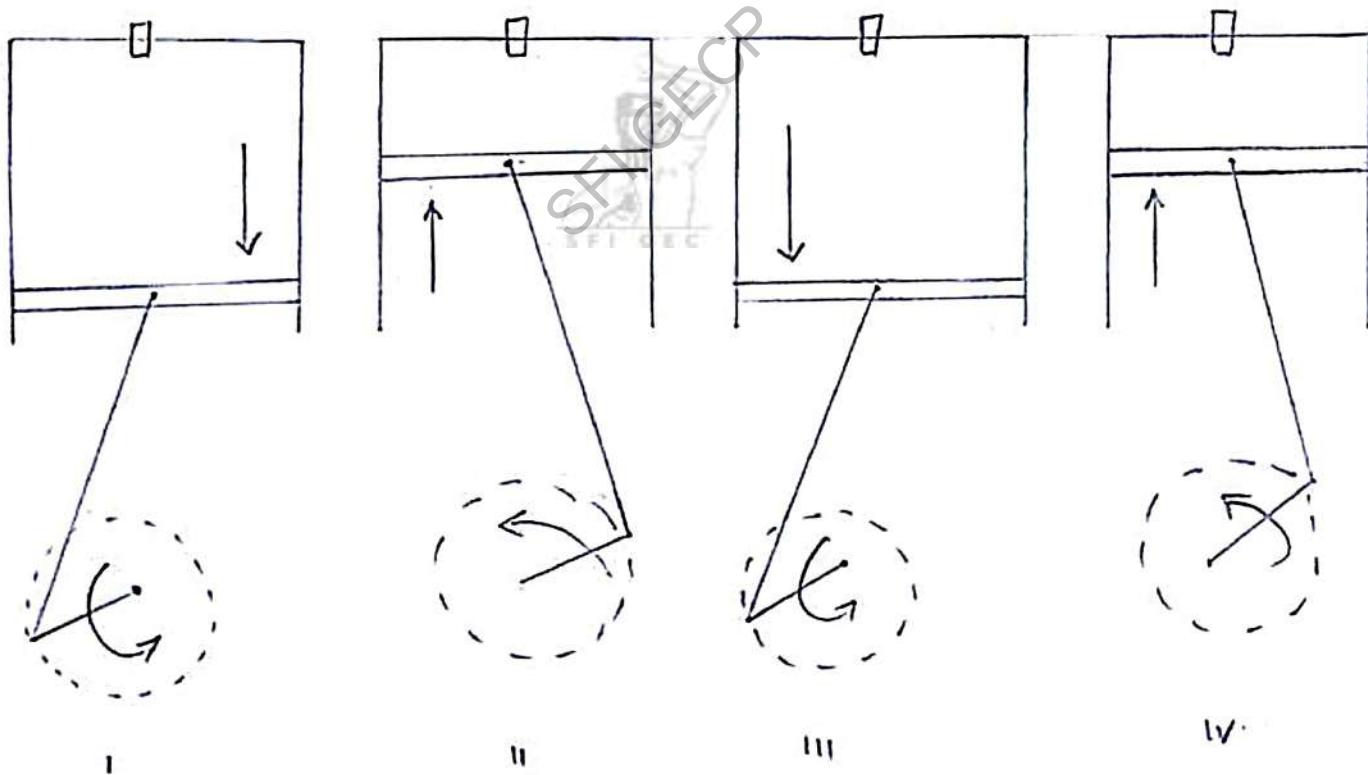
Manual hammering is done by heating the metal to the proper temperature, cooling with flux, overlapping the weld surfaces and then striking the joint repeatedly with a hand-held hammer.

18. a) Explain the working of 4 stroke diesel engine with neat sketches.

The diesel engines are otherwise known as compression ignition (CI) engines. Here, ignition fuel takes place by injecting the diesel fuel directly into highly compressed air in the cylinder which is at high temperature and pressure. Here no spark plug is used.

The four strokes of the engine are as follows;

1. Suction stroke.
2. compression stroke
3. Expansion or working stroke
4. Exhaust stroke.



1. Suction stroke

- Piston moves from TDC to BDC
- The inlet valve opens and air at atmospheric pressure is drawn to engine cylinder
- The exhaust valve remains closed.

2. Compression stroke.

- The piston moves towards TDC and compresses the air to high temperature and pressure.
- Both inlet and exhaust valve remains closed during this process.

3. Expansion or power stroke.

- Towards the end of compression stroke a metered quantity of fuel is injected in the form of fine spray into the compressed air
- The fuel starts burning and pushes the piston downwards from TDC.
- And thus work is obtained.

4. Exhaust stroke.

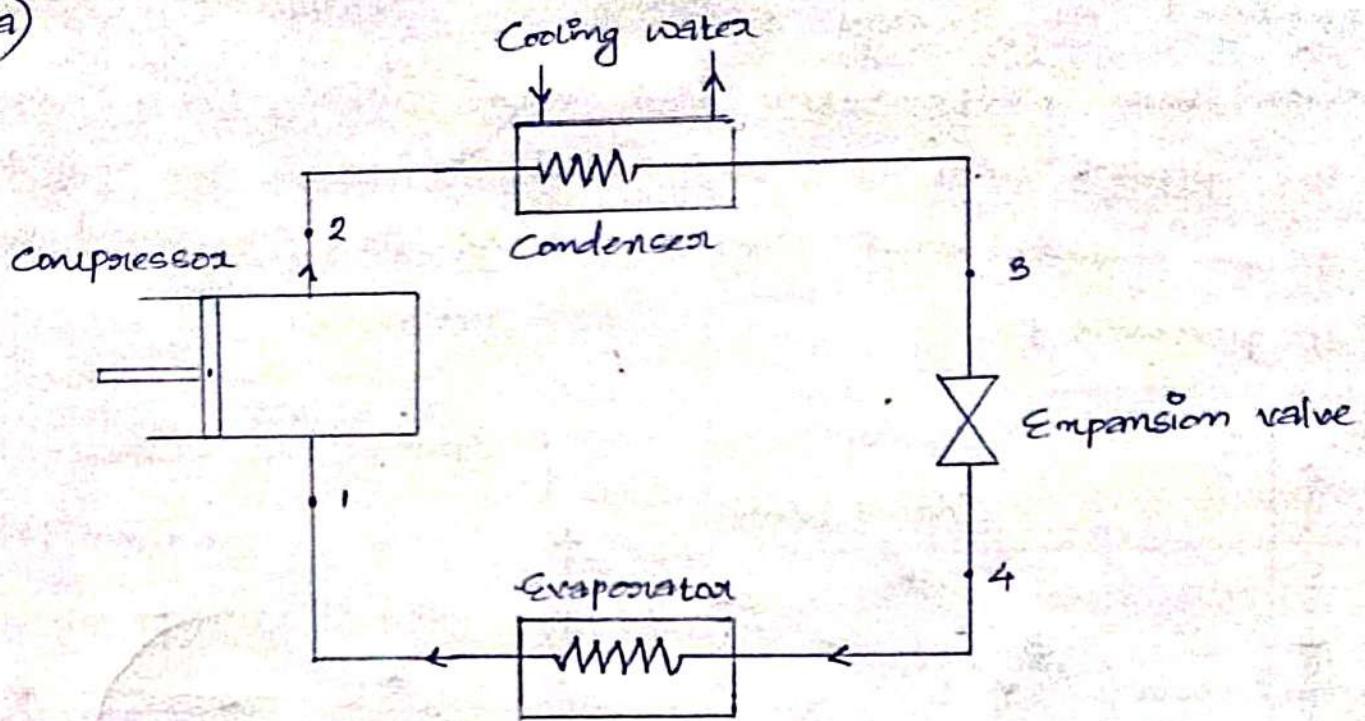
- The piston moves from BDC to TDC and the burned gas escape through exhaust valve.
- During this stroke, the inlet valve remains closed.

18 b). Give the comparison between CI and SI engines.

SI engines		CI engines.
• working based on Otto cycle.		• working based on diesel cycle.
• Highly volatile fuel is used eg: petrol		• less volatile fuel is used eg: Diesel.
• Fuel and air is introduced into the cylinder during suction stroke		• only air is coming in to the cylinder during suction stroke. Fuel is injected towards the end of compression stroke.

- | | |
|---|--|
| <ul style="list-style-type: none">• Requires spark to initiate combustion• less fuel economy• compression ratio ranges from 6 to 10 | <ul style="list-style-type: none">• utilizes the condition of high temperature and pressure produced by the compression of air in the cylinder.• Better fuel economy.• compression ratio ranges from 16 to 20. |
|---|--|

19. a)



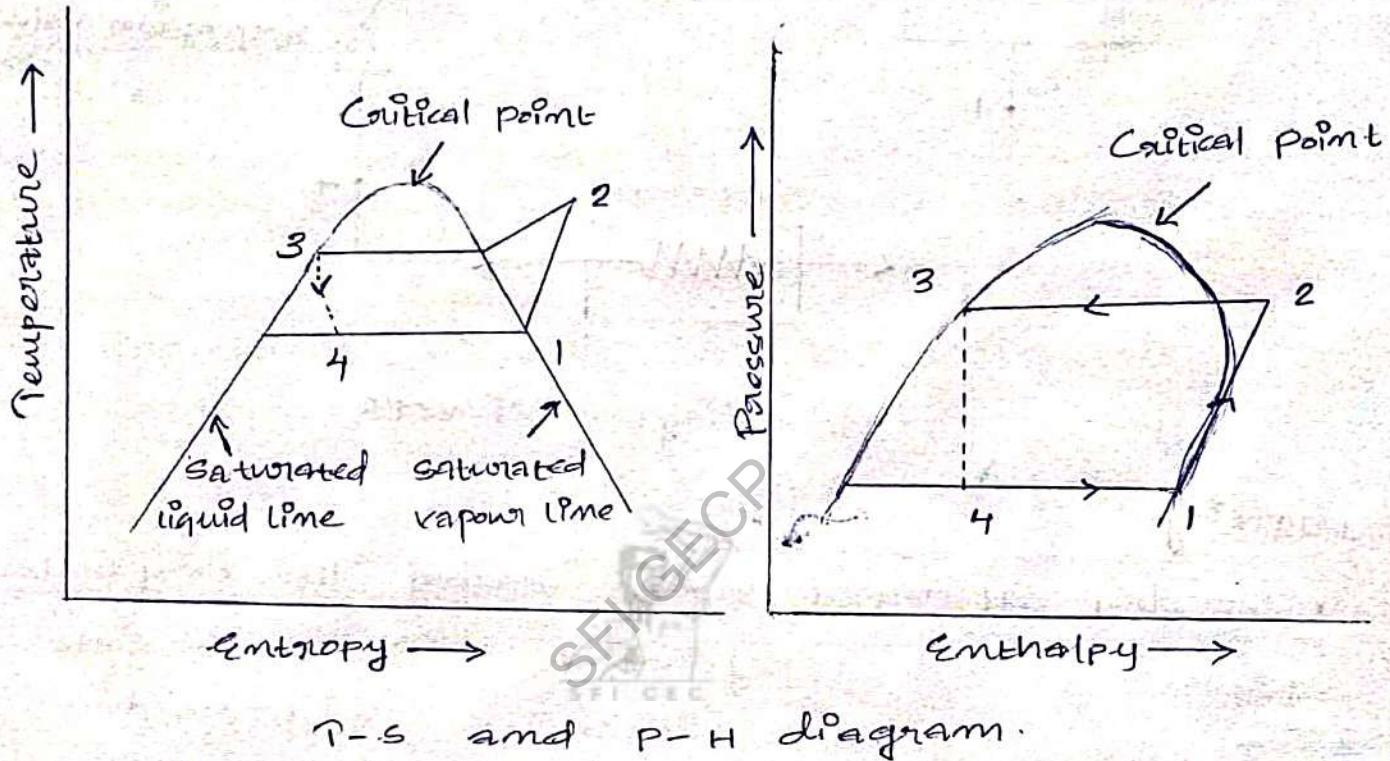
Block diagram of VCRS

Working

- The dry saturated vapour leaving the evaporator at pressure P_1 and temperature T_1 is drawn into the compressor cylinder where it's compressed isentropically to super-heated vapour P_2 and temperature T_2 .
- During the next stage the super-heated vapour passes to the condenser where cooling water is circulated to remove heat from the vapour. If the vapour is first cooled to saturated temperature and further removal of latent heat of condensation, to liquid at state 3.
- In the expansion valve, constant enthalpy expansion process takes place where the pressure of liquid refrigerant is lowered to P_1 . If during

throttling liquid partly evaporates and wet vapour is obtained at T_1 and P_1 .

- In the evaporator this wet refrigerant absorbs the latent heat of vaporization from the system to be cooled and evaporated to dry saturated vapour at pressure P_1 .



- b) The Carnot cycle is reversible whereas the real engines aren't reversible due to different reasons like friction, heat transfer to the insulating wall etc. In the Carnot cycle, all the reversible processes are extremely slow while real machines work faster. In real engines, the heat transfer occurs at a sudden difference in temperature whereas in Carnot cycle the heat transfer happens at a constant temperature of the source and the sink.

20. a)

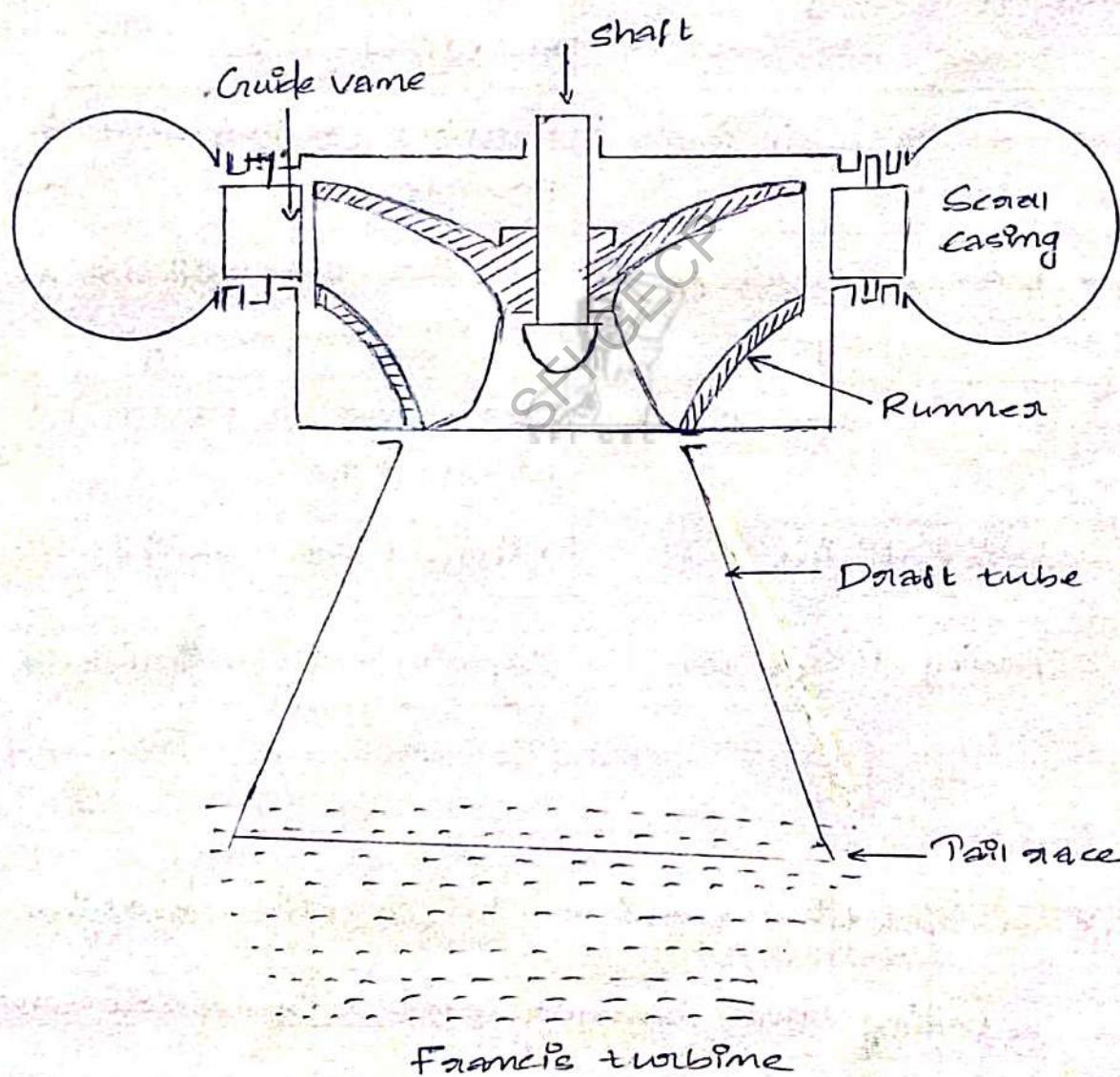
Window Air Conditioner	Split AC or conditioner
Heat exchangers, compressors, motors and connecting pipes are placed on the same base.	It consists of 2 units - indoor unit & outdoor unit.
Occupies more space than split AC.	Occupies less space
Installation is easy	Installation isn't easy as window AC.
Multiple cooling unit isn't possible.	Multiple cooling unit is possible.
Cheaper than the split AC for the same tonnage.	Costlier than window AC for the same tonnage.
More noise (AIR) than split AC	Less noise compared to window AC
Easy serviceability	Difficult for service
Max. capacity is 2.0 Ton	Capacity not restricted to 2.0 Ton

b)

It's a reaction turbine. In reaction turbines the water entering the runner possess potential energy and this water in turn does work on the vanes by the principle of reaction.

Fig. shows a simple diagrammatic representation of a Francis turbine, which is mostly used reaction turbine. It consists of an inner

of rotating vanes forming the runner, surrounded by an outer ring of stationary guiding mechanism. Water from the penstock which is the pipe connecting the reservoir and the turbine flows into a scroll casing surrounding the turbine runner. From the scroll casing water flows through the guiding mechanism and the runner.

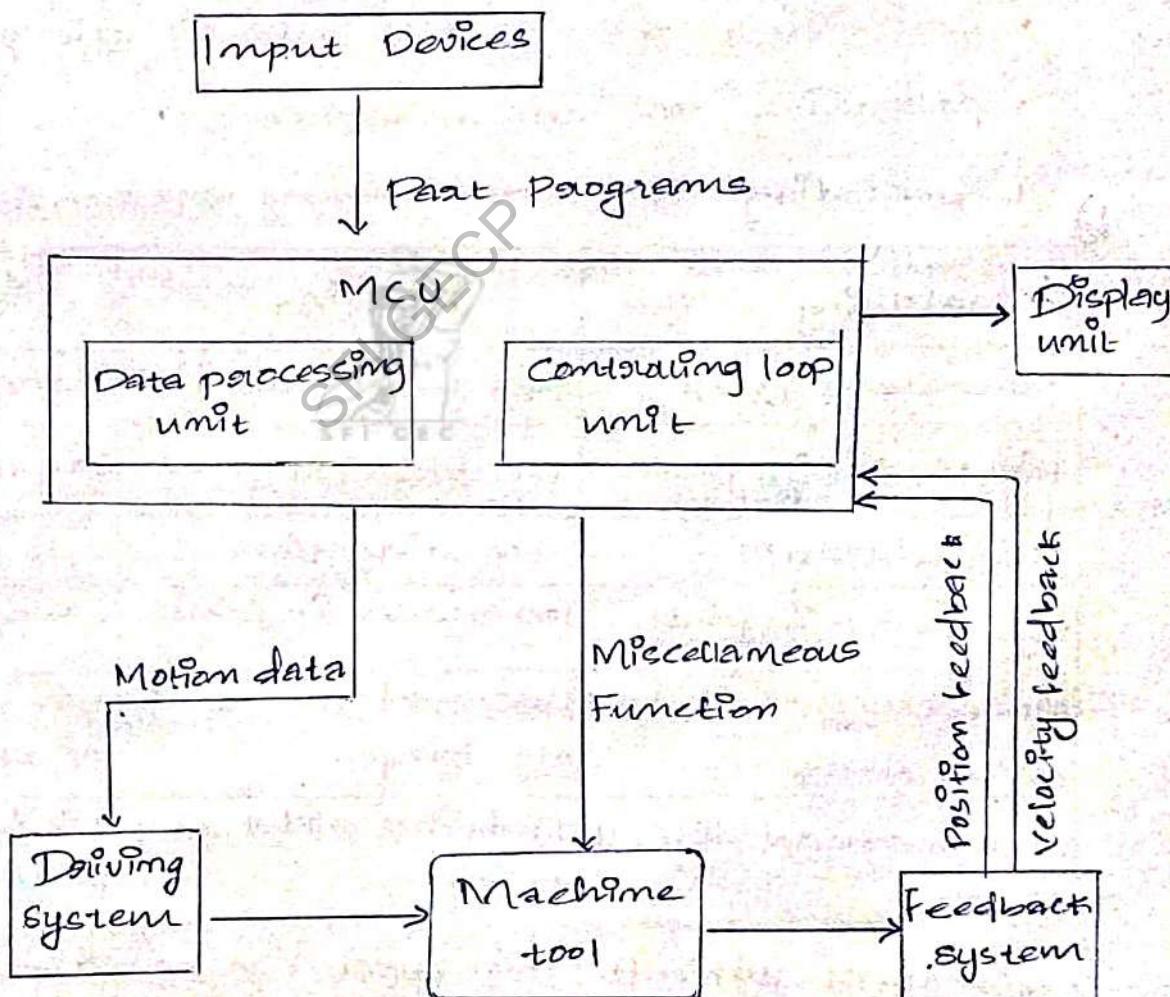


After imparting energy to the runner, the water discharging through draft tube. Draft tube is a metallic pipe or concrete tunnel.

Applications of Francis tube

Francis turbine is the most widely used turbine in hydro-power plants to generate electricity. Mixed flow turbine is also used in irrigation water pumping sets to pump water from ground for irrigation. It's efficient over a wide range of water head and flow rate.

21. a) Block diagram of CNC machine



Evolving from the numerical control (NC) machining process - which utilized punched tape cards, CNC machining is a manufacturing process which utilizes computerized controls to operate and

manipulate machine and cutting tools to shape stock material - eg: metal, plastic, wood, foam, composite etc - into custom parts and designs. While the CNC machining process offers various capabilities and operations, the fundamental principles of the process remain largely the same throughout all of them. The basic CNC machining process includes the following stages.

- Designing the CAD model.
- Converting the CAD file into a CNC program
- Preparing the CNC machine.
- b) • Executing the machining operation.

Welding	Brazing	Soldering
Base metal fused	Base metal doesn't fused	Base metal doesn't fused
High temp. High power	Low temp. low power	Low temp. low power
High distortion	low distortion	No distortion
High stresses in joints	low stresses in joints	low stresses in joints
Microstructure of base metal change	Base metal microstructure no change.	Base metal microstructure no change.
Dissimilar metal difficult to join	Dissimilar metal easy to join	Dissimilar metal easy to join
Thin sheet difficult to weld	Thin sheet can be joined	Thin sheet can be joined.
High strength of joints	Low strength of joints.	Low strength of joints
Tensile strength > 200 MPa	Tensile strength 100-150 MPa	Tensile strength < 75 MPa

22)

Drilling machine

Drilling is the operation of making holes in a workpiece by forcing a rotating tool called drill against it. The machine which primarily designed to make this operation is called drilling machine. Drilling is generally followed by some other operations like,

1. Reaming

Reaming is the operation of sizing and finishing a hole by means of reamer (reaming tool) having several cutting edges. The reamer does not originate a hole. It merely follows a drilled hole and removes a very small amount of metal.

2. Boring

Boring is the operation of enlarging a hole by means of an adjustable single point tool.

3. Counter boring

It's the operation of increasing the diameter of a hole for a certain distance down.

4. Counter沉ning

It's the operation by which a cone shaped enlargement is made at the end of a hole.

5. Spot facing

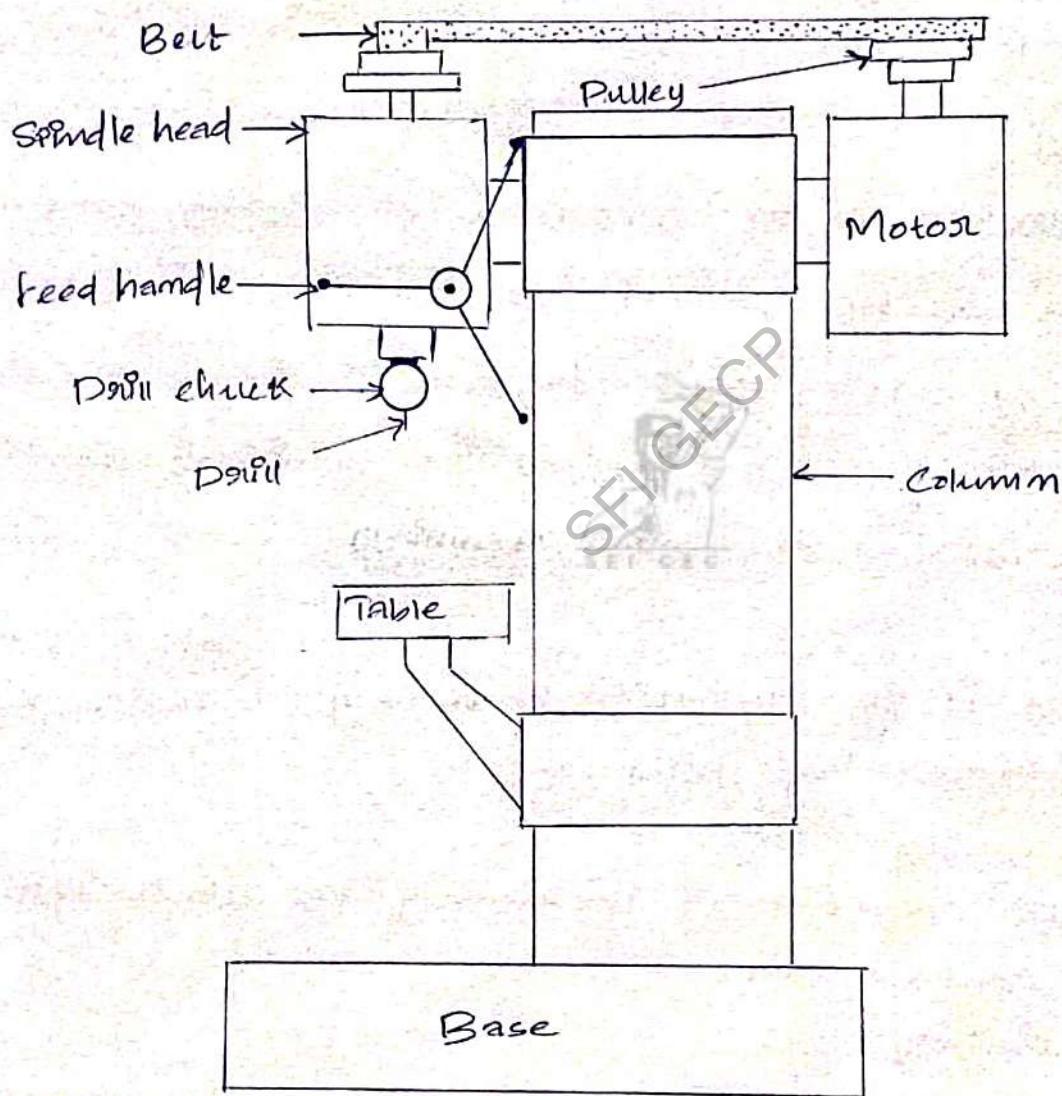
It's the operation smoothing and squaring the surface around a hole drilled in rough surface.

It provides a flat seating for nut and washer.

Tapping

It's the operation of cutting internal threads by means of a tool called tap. When a tap is screwed into the hole it removes metal and cuts internal threads.

Block diagram of drilling machine



(P) Base

The base of the drilling machine is rectangular casting on which the column is mounted.

(P) Column

The column is the vertical member of the machine which supports a table. The head supporting

the motor and spindle is mounted on the top of the column.

(iii) Table

The table of the drilling machine supports the workpiece or other work holding device. It can be moved up and down on the column. Also it can be set in various positions in the horizontal plane.

(iv) Drill head

It's mounted on top of the column and supports the spindle head and motor. The spindle head houses drill holding and rotating devices. A hand wheel is provided for upward and downward movement of the spindle. A drill chuck is mounted in the spindle for holding the drill.