

Internal Assessment Test 2 – May 2019

Sub:	Elements of Mechanical Engineering	Sub Code:	18ME25	Branch:	CS/CV/IS
Date:	13/05/2019	Duration:	90 min's	Max Marks:	50
		Sem / Sec:	II/ A,B,C,D,E		
<u>Answer all the Questions</u>					
					MARKS
					CO RBT

9/1

1. With help of a neat sketch explain working of any one water tube boiler. 5+5 [10]
(Or)
List and briefly explain different Boiler mountings and accessories. 5+5 [5+5]
CO1 L2
2. With the help of a neat sketch explain working of a Pelton Wheel Turbine. Also differentiate between Impulse turbine and Reaction Turbine. 2+3 [10]
(Or)
Explain working of a Francis turbine with help of a neat sketch. 5 [10]
CO2 L2
3. Define composite materials. State advantages and applications of composite materials. 2 [10]
(Or)
List different ferrous and non ferrous materials. Write their properties and applications. 4+4 [5+5]
CO3 L1

4. Differentiate among Welding, Soldering and Brazing [10]
(Or)
What is an arc? Explain TIG welding process with the help of a neat sketch. [10]
2 + 4+4
CO3 L2
5. Derive equation for the length of belt in open belt drive. Also explain the concept of slip briefly. [10]
(Or)
(a) List advantages and disadvantages of gear drives over a belt drive. [10]
CO4 L3
(b) A shaft runs at 80 rpm and drives another shaft at 150rpm through belt drive. Determine the diameter of the driven pulley taking belt thickness 5mm and slip of 2% on each pulley. → 304mm [5+5]

Lathe
Milling
Shaper
Robotic
RAC

1. a) with help of a neat sketch explain working of any one water tube boiler.

Ans: * It is a horizontal, externally fired water tube boiler.
* It can raise steam normally between 10 bar to 20 bar at a steam rate.

* A high capacity boiler of this type can produce steam upto a pressure, of about 40 bar and steam rate as high as 4000 kg per hour.

Construction:

* Babcock and Wilcox water tube boiler mainly consists of 4 parts

① Water and Steam Drum

② Water tubes

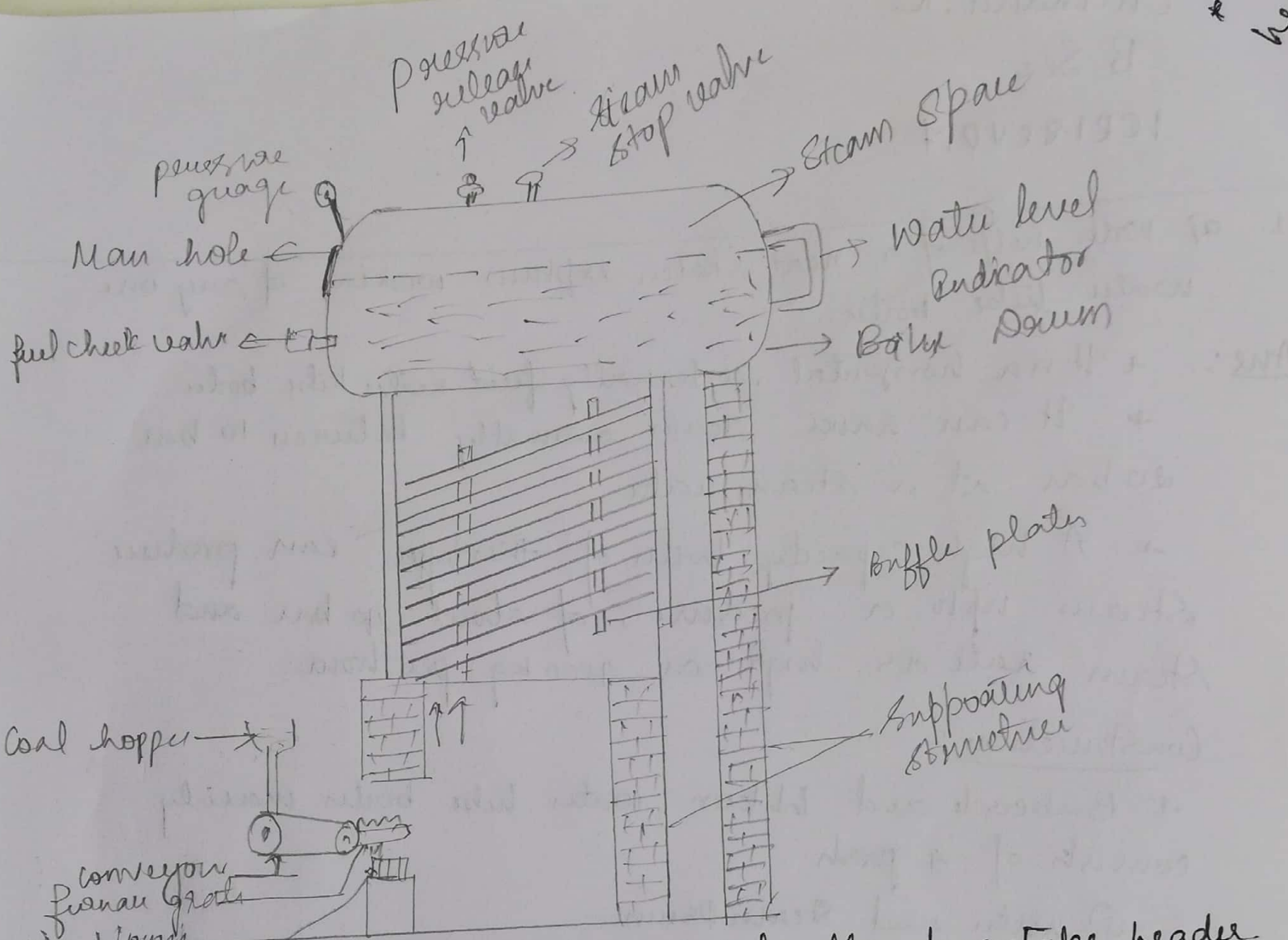
③ Chain grate stoker

④ Superheater tube

* The water and steam drum is suspended from iron girders resting on iron columns

* A no of inclined water tubes at a very low inclination of maximum upto 15° are connected at right angle to the end boxes or tubes called as headers

* Each set of the headers are in turn connected to the boiler drum



- * A mud box is provided just below the down take header
- * Sediments in water due to its heavier specific gravity settles down in the mud box as is taken out through a blow off pipe
- * The moving grate is provided at the front end below the uptake header

- * Boiler is fitted with a super heater which is placed in the combustion chamber underneath the boiler drum.

Working :-

- * The water is introduced into the boiler drum through the feed valve
- * A constant water level is maintained in the boiler drum

- * The water descends at the rear end into the downtake header and then passes in the inclined water tubes, uptake header and in the tubes connecting the uptake header and down.
- * During combustion, the hot gases from the furnace grate move upwards around the water tubes.
- * There are baffle plates which guide the path of the flue gases in a particular direction as shown in the figure in order to have maximum coverage.
- * It finally pass out of the boiler through the exit door and chimney.
- * The water in these portions of the water tubes get vaporized.
- * The water and steam mixture ascends or moves upward through the uptake header to the boiler drum.
- * Due to this flow, a continuous rapid circulation of water is established between the drum and water tubes.
- * The wet steam is then made to flow through the anti-priming device which separates the moisture making it as a dry saturated steam.
- * This dry steam is then made to flow through the superheater present in the combustion.
- * There is exchange of heat and the dry saturated steam is converted into superheated steam.
- * The superheated steam is then passed to its point of application through the steam stop valve.

57 List and briefly explain diff boiler mountings and accessories.

Ans: Boiler Mountings

* Boiler Mountings are the fittings or devices necessary for the safety and smooth operation of the boiler.

* The boiler mountings are listed as follows.

① Safety Valve

Location: fitted directly on the top of the boiler shell

Function: To maintain a safe pressure inside the boiler.

In case the pressure inside the boiler increases, the excess steam will automatically be released through the Safety valve, thereby preventing the explosion of boiler.

② Water level Indicator

Location: fitted outside the boiler shell for clear inspection.

Function: To indicate a safe water level inside the shell to avoid damage due to overheating in case of low water level.

③ Fusible plug

Location: fitted above the crown of the furnace

Function: To protect the boiler from explosion in case of overheating due to low water level. When the water falls below the minimum level, the plug melts and allows the water to extinguish the fire in the furnace and the steam to escape through the plug hole.

① pressure gauge

location:- fitted in front and at the top of the boiler shell for clear inspection.

function:- To indicate the pressure of the steam inside the boiler.

② feed check valve:-

location:- fitted on the feed water pipe line very close to the furnace.

function:- To feed water into the boiler continuously. It has to regulate the rate of flow of feed water and prevent the back flow of water from the boiler.

③ Steam Stop Valve:-

location:- fitted at the highest part of the boiler shell.

function:- To regulate the flow of steam from the boiler to the required place and to stop whenever not required.

Boiler Accessories:-

Boiler accessories are auxiliary fittings or devices required for the smooth operation of the boiler and to increase its overall efficiency.

① Steam Superheater

location:- fitted in the path of the hot flue gas outside the boiler shell.

function:- To absorb heat from the flue gas and superheat the dry saturated steam coming out of the boiler shell.

① Anti-priming Device

Location: fitted inside the boiler shell in the steam space.

Function: To prevent the water particles to be carried in the steam before it enters into the steam stop valve. As the wet steam passes through it, the water particles condense and fall back into the shell.

② Chimney

Location: Built at the exit end of the boiler.

Function: To expel the products of combustion to the atmosphere and draw the hot gases from the boiler.

③ Economizer

Location: fitted near the chimney.

Function: To heat the feed water using the heat of the exhaust hot flue gases.

④ Feed pump

Location: fitted to the feed water pipe line

Function: To pump the water into the boiler.

⑤ Steam trap

Location: fitted to a small bypass pipe which branches from the main steam pipeline.

Function: To drain off the condensed water accumulated in the steam pipe or from the steam separator without allowing the steam to escape through it.

⑥ Air preheater

Location: fitted between economizer and chimney.

function: To transfer heat from the free gases to the air that is fed into the furnace for combustion then, it is used to produce a high furnace temp and to accelerate the combustion.

Q) Fan draught

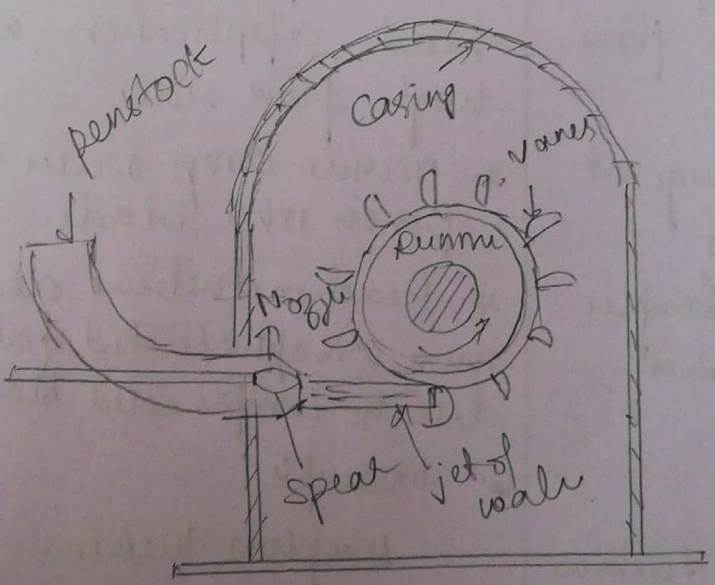
location: fitted near the grate

function: - to supply air artificially to the grate also called as artificial draught.

Q. with the help of a neat sketch explain working of a pelton wheel turbine. Also differentiate b/w Impulsive turbine and Reaction Turbine.

Ans.: Pelton wheel turbine

* pelton wheel turbine is a tangential flow. impulsive turbines used for high heads and small quantity of water flow rate.



- * It consist of following parts ; (1) Nozzle with Spear head
- (2) Runner / Rotor (3) Bucket / Vanes (4) Casing

Working

- * Water from the dam reservoir having potential energy flow through the penstock and enters through nozzle.
- * The nozzle converts this potential energy into kinetic energy by increasing the velocity of water entering the nozzle.
- * This high velocity water jet striking the bucket imparts an impulse force to the bucket.
- * This impulse force gives the runner rotary motion.
- * Hence, the shaft coupled to the runner wheel also rotates thereby useful shaft work.
- * Thus, potential energy of water converts into Mechanical work.
- * Water is discharged at tail-race after doing useful-work on runner.

Impulsive Turbine

- * Most of the energy available at the inlet of turbine is kinetic energy.

- * Generally used for high head and low flow rate application.

- * No pressure change at the turbine blades.

- * Fabrication is simpler than reaction turbines.

- * Example

Pelton wheel turbine

Reaction Turbine

- * Most of the energy available at the inlet of turbine is Pressure Energy.

- * Used for low and medium head applications, with high flow rate.

- * Pressure drop occurs as water passes over blades.

- * Reaction turbine require more sophisticated fabrication due to complicated blade design.

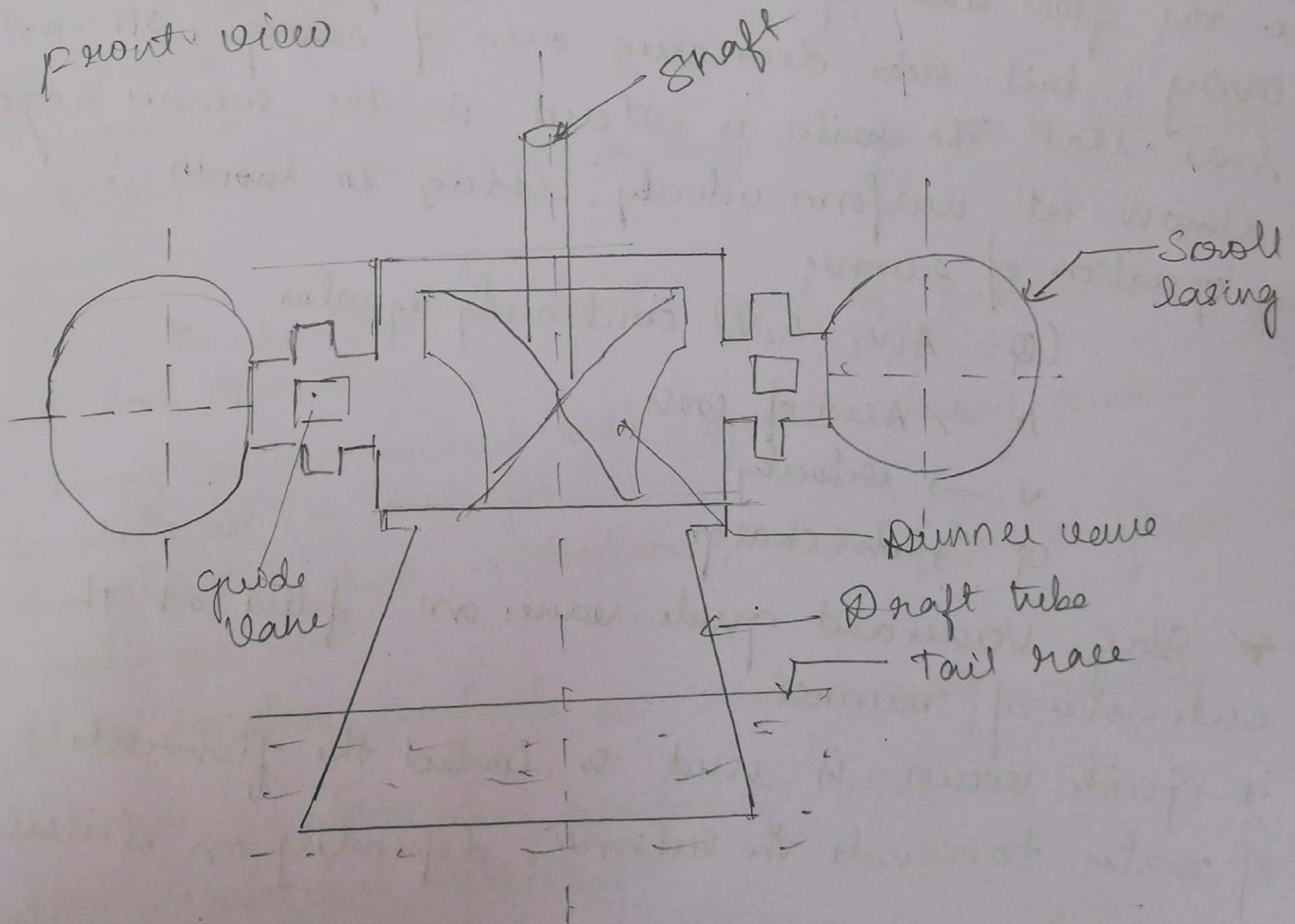
- * Example

Kaplan turbine

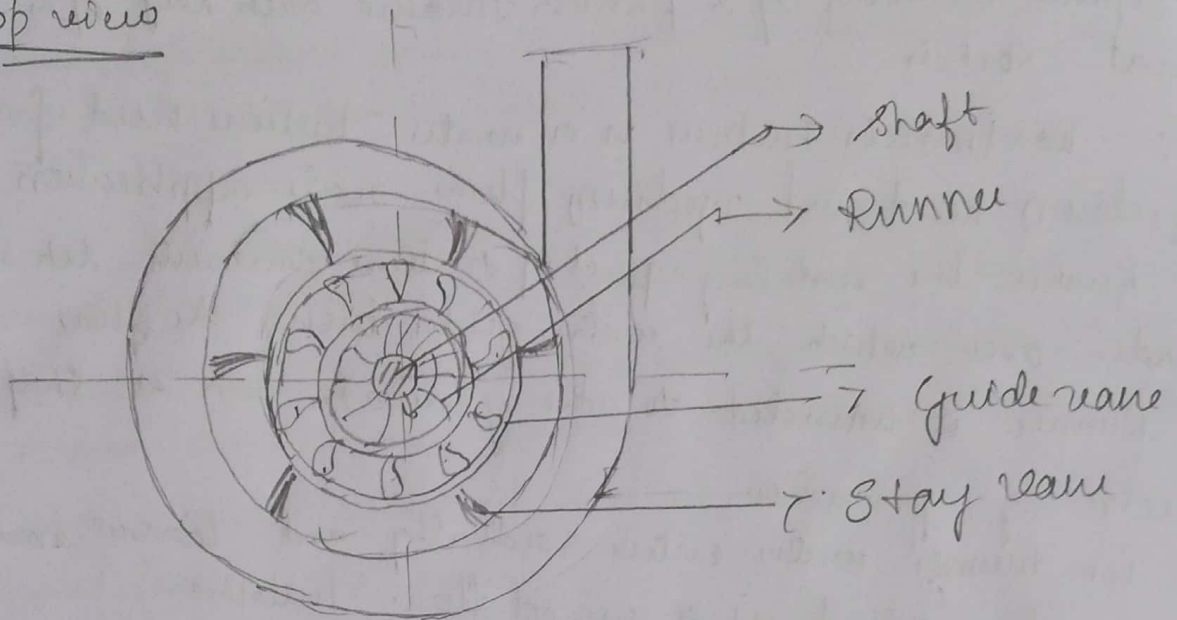
Q) Explain working of a Francis turbine with help of a neat sketch

- Ans:- ~~to~~ Francis turbine is a water turbine used for medium head and medium flow rate application
- * Runner, the rotating part of turbine contains set of blades over which the water glides during the flow.
 - * Runner is connected to the generator via a shaft for electricity production
 - * In runner water enters radially and leaves axially, hence also called as a mixed flow turbine
 - * The bucket shape introduces an impulse force on runner.
 - * Hence both K.E and pressure energy drops down

front view



Top view



- * Water flows from nozzles through the penstock and enters spiral casing
- * The runner is positioned inside the spiral casing
- * The flow rate of water decreases along the length of casing, but the decreasing area of casing will make sure that the water is entered in the runner region almost at uniform velocity, leading to smooth operation of runner

$$Q = Av = A_1v_1 = A_2v_2 \text{ continuity equation}$$

$A \rightarrow$ Area of cross

$v \rightarrow$ velocity

$Q \rightarrow$ discharge

- * Stay Vanes and guide vanes are fitted at the entrance of runner

+ Guide vanes, is used to control the flow rate of water towards the runner, depending on electricity demand.

- * Stay Vanes direct the water to the runner sector reducing the swirl of inlet flow.

$$F_{\text{total}} = F_{\text{fl}} + F_{\text{imp}} + F_{\text{fric}}$$

Q) Define Composite materials, state advantages and application of composite materials

Ans:- Composite materials are materials made up of two or more materials, each having different physical and chemical properties, and combined together in a proper composition to produce a new material with properties that are superior to the individual components.

Advantages:

- * High strength to weight ratio @ high specific strength ratio
- * High creep resistance
- * High tensile strength at elevated temp
- * High toughness
- * Some composites can have much higher wear resistance than metals
- * Corrosion resistance
- * Dimensional changes due to temp changes can be much less.

Applications:

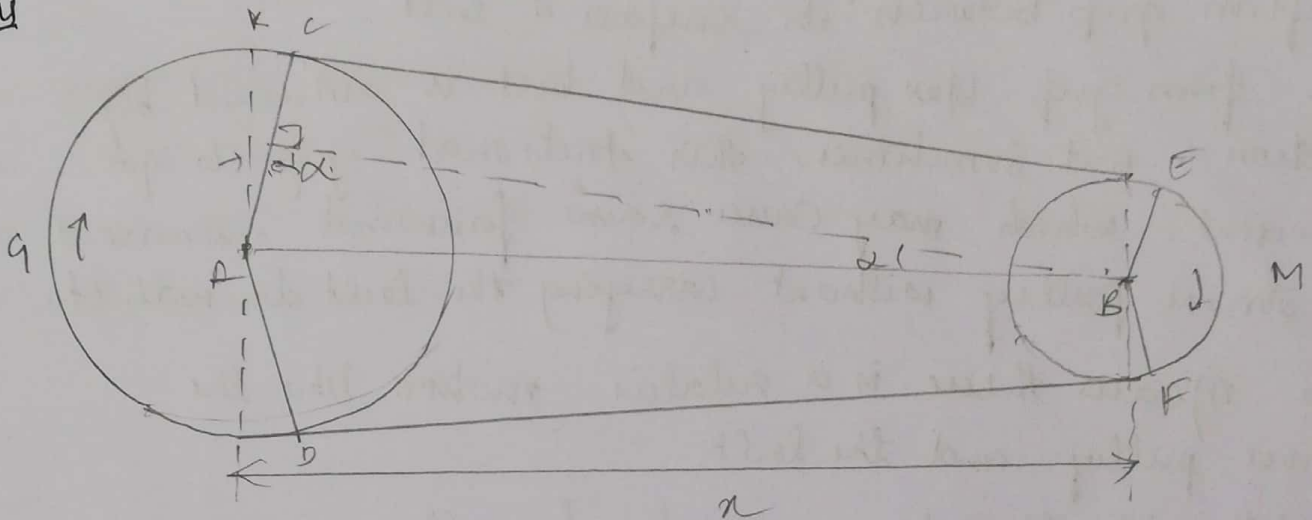
- * Glass fibre reinforced composites used as laminated panels and mouldings
- * Honey comb structures with metallic honey comb are materials used in aircrafts
- * For elevated temp. applications, carbon fibre reinforced composites are used
- * Metal matrix composites are used in wing assemblies
- * In sockets, glass fibre reinforced composites are used as structural material
- * Now cones of aircrafts are made of light weight carbon fibre reinforced composite

④ Differences among Welding, Soldering and Brazing

Welding	Soldering	Brazing
It is a high temp process where the base metals are heated above their melting temperature.	It is a low temp process where the base metals are not melted.	The base metals are not melted but are broadly heated to a suitable temperature.
The filler material used is made of same material as that of the base metal.	Filler material used is not the same as that of the base metal.	Filler material used is not same as that of the base metal.
* Joint is formed by the solidification.	* Joint is obtained by diffusion.	* Joint is obtained by means of diffusion.
* Strength of the joint obtained in welding is much stronger than the parent metal.	* Strength of the joint is obtained in soldering is very low when compared to that of brazed and welded joints.	* Strength of the joint lies in between that of welded and soldered joints.
* Requires certain finishing operations like grinding, fitting, etc.	* Joints can be used as is, without any finishing operations.	* Surface finish is good. In some cases, finishing operations are required.
* Welding produces stronger joints. Hence this process is used for fabrication and structural applications.	* Since the joint obtained is not much strong, this process is mostly used for joining thin sheet metals, pipes, wires, etc.	* finds applications in arts, jewellery work and also in industries.

Derive eq^o for the length of belt in open belt drive.
Also explain the concept of slip briefly.

Ans



Let x = Distance b/w centers of two pulleys

r_1 = radius of larger pulley. r_2 = radius of smaller pulley

L = total length of belt

From B draw $BN \parallel$ to EC . But CE is tangent at C. Hence $AE \perp CE$, which means $\angle AEC = 90^\circ$ @ $\pi/2$

$\angle ANB = 90^\circ$ @ $\pi/2$ radians

Let $\angle ABN = \alpha \Rightarrow \angle BAE = \alpha$

Length of Belt, $L = \text{Arc } DC + CE + \text{Arc } EF + FD$

$$= 2 [\text{Arc } GC + CE + \text{Arc } EH]$$

$$= 2 [r_1 (\pi/2 + \alpha) + BN + r_2 (\pi/2 - \alpha)]$$

In ΔANB

$$BN = \sqrt{(AB)^2 - (AN)^2}$$

$$= \sqrt{x^2 - (r_1 - r_2)^2}$$

$$\text{Length of Belt, } L = 2 [r_1 (\pi/2 + \alpha) + \sqrt{x^2 - (r_1 - r_2)^2} + r_2 (\pi/2 - \alpha)]$$

$$L = 2 \left[\frac{\pi}{2} (r_1 + r_2) + \alpha (r_1 - r_2) + \sqrt{x^2 - (r_1 - r_2)^2} \right]$$

Concept of Slip

* When driver pulley rotates, it carries the belt due to a firm grip between its surface & belt.

This firm grip b/w pulley and belt is obtained by friction. But sometimes, this frictional grip is not sufficient, which may cause some forward movement of driver pulley without carrying the belt with it.

This means there is a relative motion b/w the driver pulley and the belt.

The diff. b/w the linear speeds of pulley rim and the belt is a measure of slip. Slip is generally measured in %.

Similarly slip may also occur b/w the belt and the driven pulley, when belt moves faster without carrying the driven pulley with it.

(a) List advantages and disadvantages of gear drive over a belt drive.

Ans Advantages

- * It is a positive drive.
- * operation is smooth and service is reliable.
- * Transmit comparatively more power.
- * Transmits power in any desired direction.
- * Gear wheels, are interchangeable except bevel gears.

Disadvantages

- * Not suitable for large centre distance as drive becomes bulky.
- * production cost is high
- * Needs lubrication
- * power loss due to friction
- * Efficiency is less