SCHEME OF VALUATION (Scoring indicators)				
Revision: 2015			course code: 3034	
Course title: MECHANICAL ENGINEERING				
Question number	Scoring indicators	Split up score	Sub total	Total
I	PART A			
1	Pressure exerted by vapour formed at the free surface of a liquid.	2	2	2
2	a) By balancing the liquid column whose pressure is to be found out with the same or another column of different liquid. b) By balancing the liquid column whose pressure is to be found out with the same or another column of different liquid.	2x1	2	2
3	Pilot tube, venturi meter, orifice meter.	2	2	2
4	a) Purpose for which steam is generated b) Rate of steam generation. c) Operating pressure. d) Quality of steam. e) Type of load, fuel used etc.	2	2	2
5	Specific speed of a turbine is defined as the speed of an imaginary turbine, identical with the given turbine, which will develop unit power under a unit head $N_s = \frac{N\sqrt{P}}{H^{\frac{3}{4}}}$	2	2	2

	PART B			
II				
1	Steady flow – quantity of liquid flowing per second through any section is constant is called steady flow. Uniform flow- a flow in which velocities of liquid particles at all sections of pipe or channel are same. Turbulent flow- a flow in which liquid particle does not have a definite path and path of individual particles each other.	3x2	6	6
2	P=ρgh =1.025x1000x9.81x500 =5027625Pa =5.0270 Mpa	2 2 2	6	6
3	In a continuous stream of perfect incompressible liquid, the total energy of a liquid particle remains the same, which the particles moves from one point to another. $\frac{p_1}{\omega}+\frac{v_1^2}{2g}+Z_1=$ a constant Assumptions ➢ Liquid is perfectly incompressible. ➢ Non-viscous ➢ Continuous, steady and streamlined ➢ Velocity of flow is uniform.	3 3 3	6	6

4 <u>Minor losses</u>

1. Losses at inlet or entry of a pipe.
2. Losses due to sudden enlargement.
3. Losses due to sudden contraction
4. Losses due to change in direction.
5. Losses due to obstruction in path.
6. Losses at exit.

6x1 | 6 | 6

5

Fire tube boiler	Water tube boiler
Hot flue gases pass through tubes and water surrounds then.	Water passes through the tubes and flue gases surrounds them.
Operated at low pressures up to 20 bar.	Working pressure is high up to 250 bar.
Rate of steam generation and quality of steam are very low , there for not suitable for power generation.	Rate of steam generation and quality are better, suitable for power generation.
Load fluctuation can't be handle.	Load fluctuation can easily handle.
Overall efficiency is up to 75%	Overall efficiency 90%
It requires more flow area for a given output.	It requires less flow area.

6x1 | 6 | 6

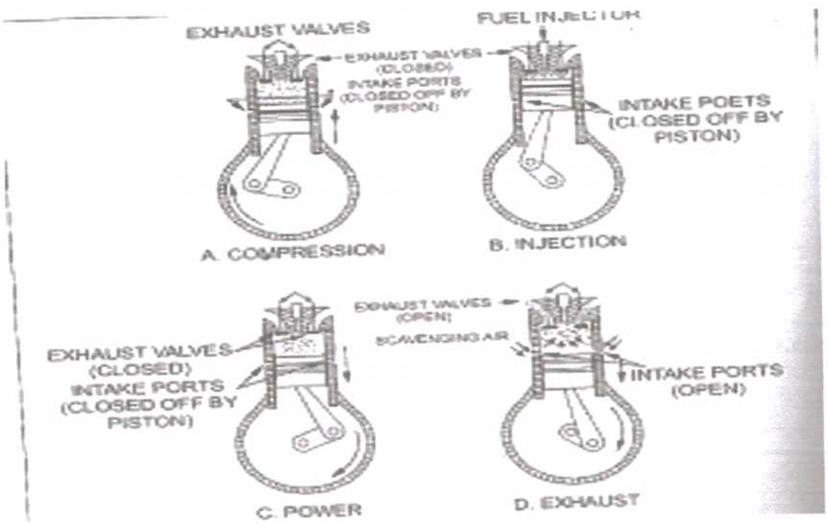
6 <u>4 stroke diesel engine</u>

In this there are 4 stroke .

1) Suction stroke: - inlet valve is open and exhaust valve is closed. The downward movement of piston creates vacuum and air is drawn into the cylinder.
2) Compression stroke: -both the valves are closed. The air is compressed as the piston moves upwards just before TDC, very finds spray of diesel is injected into the compressed air. The fuel ignites spontaneously.

3

3) Expansion stroke: - both the valves are closed. The high pressure rise due to combustion drives the piston in the downward direction, there by producing some useful work this stroke also called as power stroke.
4) Exhaust stroke: - inlet valve remain closed and exhaust valve is open . the upward movement of the piston pushes the burnt gas out of the cylinder through exhaust valve.

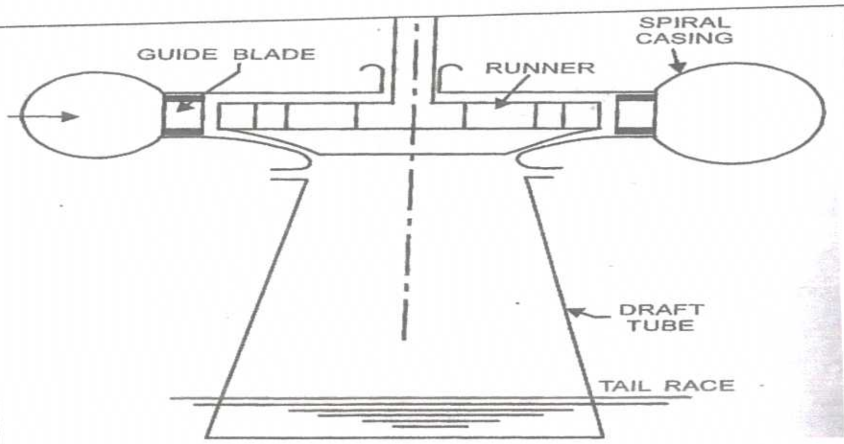


3 6 6

7 Francis turbine.

It is a inward flow reaction turbine. It is essentially a mixed flow turbine suitable for medium head. In this turbine water enters from penstock to a spiral casing which surrounds the run up. The guide vanes direct water on to the runner vanes imparting tangential velocity as well as angular momentum to water. Finally water flows through the draft tube.

3



3 6 6

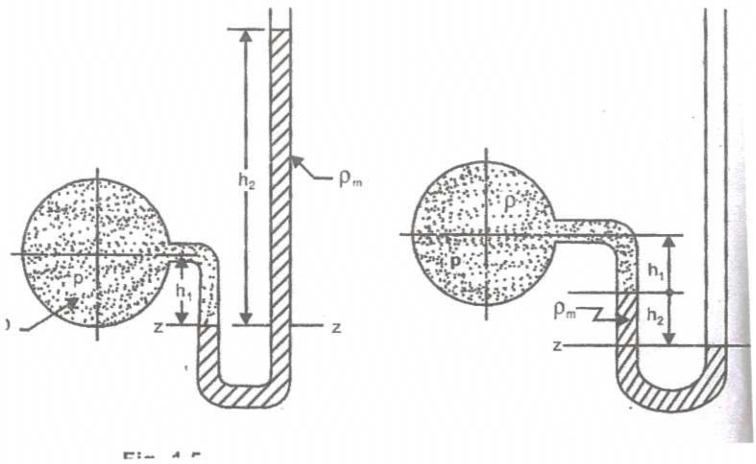
PART C

III

a U tube manometer

It consists of 2 tubes joined at the ends to form a u-shaped tube. The 2 sides of the manometer are called limbs. A U -tube manometer is used to measure the pressure in any fluid, pressure above and below atmospheric can also measure.

4



3 7 7

For <u>positive pressure measurement</u>

pressure in the left limb at ZZ =pressure in right limb at ZZ

$$p + \rho g h_1 = \rho_m g h_2$$

for <u>negative pressure measurement</u>

pressure in the left limb at ZZ =0

$$p + \rho g h_1 + \rho_m g h_2 = 0$$

b h_1=180-120=60mm

h= gauge pressure in pipe in terms of water head.

2

Pressure head is left limb above ZZ=h+$h_1 s_1$

=h+0.82*.60

= h+ 48 mm of water 2

Pressure head in the right above ZZ=$S_2 h_2$

= 13.6*180

=2448 mm of water

Equating h+48=2448 2

h=2400 mm

=2.4mm of water.

Gauge pressure in oil head ,p=ωh

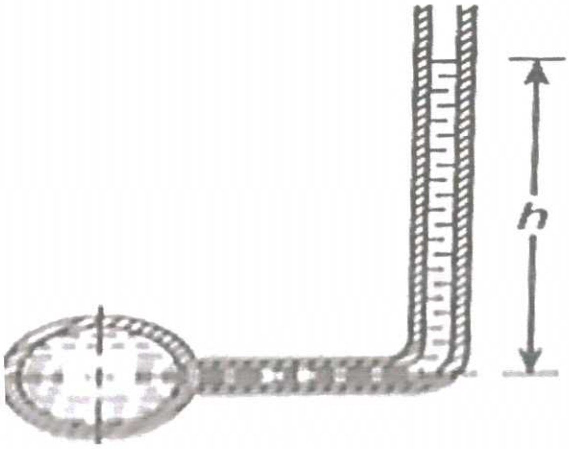
= 9.81x2.4 2 8 8

= 23.544 kN/m^2

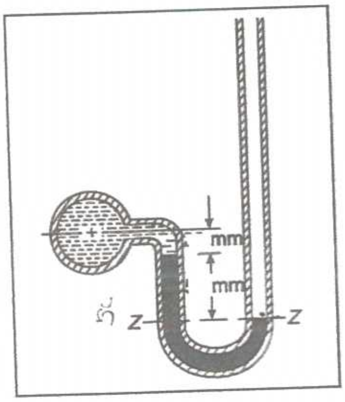
IV a Piezometer is a glass tube gauge. It is a vertical tube with its upper and usually open to atmosphere and its lower ends connected to the point at which pressure is to be measured. Liquid will rise up into this vertical glass tube. The height of liquid column in the tube given the static pressure head directly. 4

Piezometer is meant for measuring gauge pressure only. It is not suitable for negative pressure.

b



3 7 7



h=60m

h_1=20m

s_1=1 (water) 3

s_2=13.6

h=gauge pressure in the pipe in terms of head of water.

Pressure head in left limb= h+$h_1 s_1$+$h_2 s_2$ 2

= h+1*30+13.6*60

=h+30+816

=846+h

Pressure in right limb=0

Equating h=-846mm 3 8 8

=-0.846 m of water.

In term of gauge pressure p= ωh

=9.81x0.8466

=8.305 kPa

V					
	a	Energies of liquid 1) Pressure energy It is the energy possessed by the a liquid particle, by virtue of its existing pressure. if a liquid particle is under a pressure of p kPa then pressure energy of the particle will be p/ρ (N-m)/kg pressure energy of head is equal to p/ω m of liquid. 2) Kinetic energy It is the energy possessed by a liquid particle by virtue of its motion or velocity. If a liquid particle is flowing with a mean velocity of v m/s, then kinetic energy of the particle will be $\frac{v^2}{2g}\frac{Nm}{kg}$ of the liquid. Velocity head will be $\frac{v^2}{2g}$ meter of the liquid. 3) Potential energy It is the energy possessed by a liquid by virtue of its position. If a liquid particle is Z meter above the horizontal datum, then potential energy will be Z N-M per kg of liquid. Potential head of the liquid will be Z meter of the liquid.	2 2 3	7	7
	b	d_1=320mm =0.32m d_2=160mm =0.16m p_1=150kPa p_2=340mm of Hg =ρgh= 13.6*9.81*0.34 = 45.36 Kn/m^2 $Z_1 = Z_2$ $\frac{p_1}{\omega}+\frac{v_1^2}{2g}=\frac{p_2}{\omega}+\frac{v_2^2}{2g}$ $\frac{V_2^2-V_1^2}{2g}=\frac{p_1-p_2}{\omega}$	2 2		

$\frac{V_2{}^2-V_1{}^2}{2g} = \frac{150-45.36}{9.81}$ =10.66 ………… (1)

$a_1 v_1 = a_2 v_2$ 2

$v_1 = v_2 * (\frac{d_2}{d_1})^2$

$= v_2$x0.25

$v_2 = 4\text{x}v_1$

Eqn 1 becomes $\frac{(4v_1)^2-v_1{}^2}{2g}$=10.66

v_1=3.73 m/s

Discharge Q= $a_1 v_1$ 2 8 8

=0.299 m^3/s

= 299 lit/s

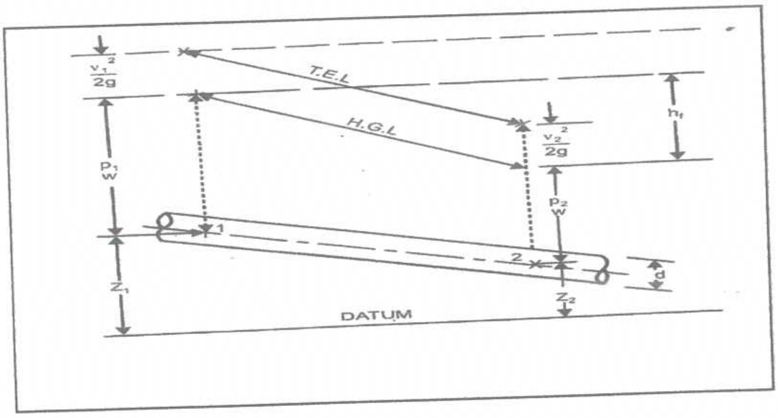
VI

a HGL &TEL

Figure shows a pipe of uniform section carrying liquid under pressure consider two parts 1&2. L meter apart with reference to column plane ,$z_1, \frac{P_1}{w}, \frac{V_1{}^2}{2g}$ represent datum head , pressure head and velocity head at 1 and $z_2, \frac{P_2}{w}, \frac{V_2{}^2}{2g}$ represent corresponding values at 2.since $v_1 = v_2$. 4

If the ord ($z_1 + \frac{P_1}{w}$) is generally joined to the ordinate $z_2 + \frac{P_2}{w}$,we get a line called hydraulic gradient line (HGL). 3 7 7

If the line drawn parallel to HGL at a distance of $\frac{v^2}{2g}$ from it, we



get total energy line (TEL). 3

b

d_1=140mm =0.14m

a_1=0.01539 m^2 2

d_2=70mm =0.070m

a_2=0.00384 m^2

S =0.82

Discharge of venturi meter , Q=$\frac{a_1 a_2 \sqrt{2gh}}{\sqrt{a_1{}^2 - a_2{}^2}}$ 3

=45 lit

=0.045

$0.045 = \frac{0.01539X0.00384X\sqrt{2x9.81xh}}{\sqrt{(0.01539^2 - 0.00384^2)}}$

h=6.84m of oil

$h_{oil} = h_m(\frac{s_m}{s_{oil}} - 1)$

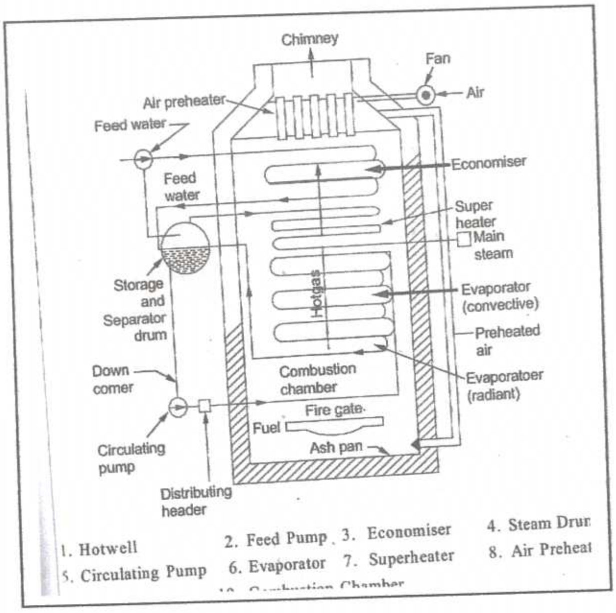
=0.439 m of Hg 3 8 8

<table>
<tr><td>VII
a</td><td>

La Mont boiler

La Mont boiler is a forced circulation high pressure water tube boiler. The principle involved is employing a high velocity water, higher rate of heat transmission can be obtained. It deals with smaller quantity of water and operate at higher pressure.

Water is applied through an economiser to a steam separating drum which is set practically outside the boiler. A circulating pump draws water from drum and delivers it to the evaporator. The mixture of water and steam from these tube passes into the drum. Steam gets separated in the super heater and leaves to produce work in prime mover.



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4</td><td>7</td><td>7</td></tr>
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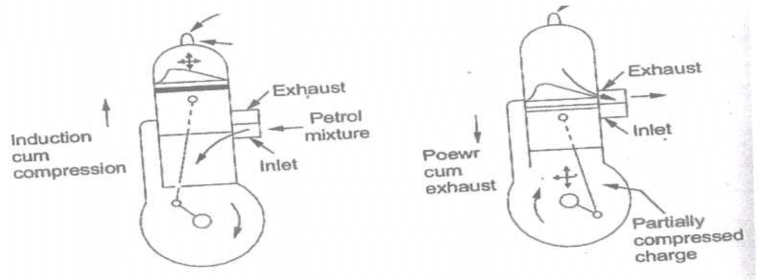
b Working of 2 Stroke petrol engine



4

In two stroke engine, all the processes completes in 2 strokes of the piston. One power stroke is obtained for one crank rotation. No valves present in 2 stroke engine. The flow of charge entering and leaving the cylinder is controlled by the reciprocating motion of the engine piston.

As the piston travels down, the mixture previously drawn into the crankcase is partially compressed. As the piston nears the bottom of the stoke, it uncovers the exhaust and intake ports. The exhaust flows out, reducing the pressure in the cylinder. When the pressure in the combustion chamber is lower than the pressure in the crank case through the port openings to the combustion chamber, the incoming mixture is deflected upward by a baffle on the piston. As the piston moves up, it compresses the mixture above and draws into the crankcase below a new air fuel mixture

4 8 8

VIII a

Impulse Turbine	Reaction Turbine
Steam expands completely in nozzle and flows over the blades under constant pressure	Steam expands partially in the nozzle and partially on the blades
Relative velocity of steam to the blade slightly reduces	Slightly increases
Blades are symmetrical	Asymmetrical & aerofoil section
Same pressure ration on the sides of the blades	Different pressure exist on the two sides of the moving blades

8 8 8

Lesser number of stages	Larger
Absolute velocity of steam and blade velocity are high	low

b

Petrol Engine	Diesel engine
The pressure at the end of compression is about 10 bar	35 bar
Compression ratio from 6 to 10	From 15 to 25
Works on Otto cycle	Diesel cycle
Thermal efficiency is about 26%	40%
Maintenance cost is less	More
Running cost is more	low

7 7 7

IX

a

Centrifugal Pump

A centrifugal pump consists of an impeller, it is a rotor with vanes and is made to rotate at high speed inside a spiral casing. Casing is air tight as well as water tight. Its cross-sectional area gradually increases towards the outlet of pump.

Liquid enters the impeller axially at the eye of pump and flows radially along the blades and then to the discharge pipe.

Water enters the impeller with a negligible velocity. The pump is driven by power from an external source. This gives a centrifugal head to the water in the pump, and water will leave the outer circumference with a high velocity and pressure. that is K.E of the impeller is transferred into pressure energy of water

7 7 7

b

d=350mm

L=350mm

N=65rpm

h_s=6m suction head

h_d=18m delivery head

$\dot{\eta}$=70%

A=$\frac{\Pi}{4}d^2$

4

$Q=\frac{LAN}{60}=0.0144\ m^3/s$

Theoretical power $=\omega Q(H_s + H_d)$

$= 7.17$ kw 3

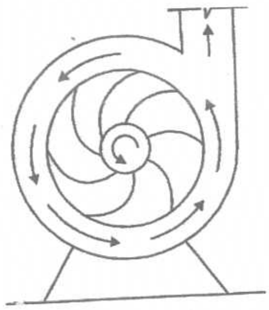
Actual power =10.25 kw 1 8 8

X a

Casing of Centrifugal pump

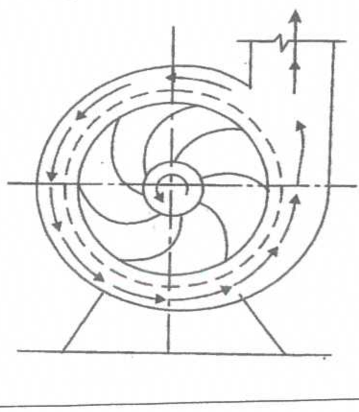
Impeller of a centrifugal pump is enclosed in a casing. Casing is designed that K.E of water is converted into pressure energy before water leaves it.

1. Volute casing: Impeller is surrounded by a spiral casing as shown in figure, such a casing provides a gradual increase in the area of flow, thus decreasing the velocity of water and correspondingly increase the pressure. main drawback – due to continuous increase in discharge ,eddies are formed in the casing. 2

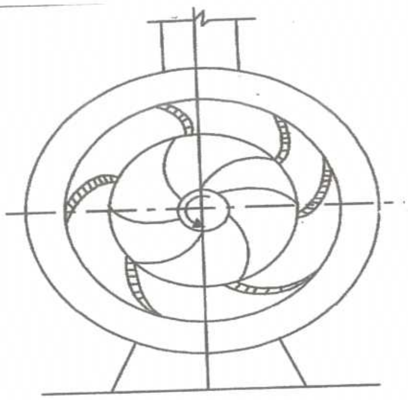


2

2. Vortex casing: It is an improved form of volute chamber. In this type, spiral casing is combined with a circular chamber shown dotted circle.



2

	3. <u>Diffuser</u>: This is a volute chamber with guide blades. Guide blades surrounding the impeller. Guide blades are designed that water enters without shock and form a passage of increasing area. The rim of guide blade is called diffuser. 	2	8	8
b	H=40m N=150rpm P=10mw $N_S=\frac{N\sqrt{P}}{H^{\frac{5}{4}}}$ =47.153 rpm	7	7	7