Code -

G. S. Mandal's

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

END SEMESTER EXAMINATION

Second Year B.Tech (Mechanical Engineering) – Feb/Mar-2023

Course Code: MED 202 **Course Name : Fluid Mechanics and Fluid Machines**

Duration : 2 Hrs **Max. Marks: 50** **Date:**

Instructions:

i) All questions are compulsory

ii) Use of nonprogrammable calculator is allowed

iii) Assume suitable data wherever necessary and clearly state it

iv) Figures to right indicate full marks

Q. 1	Answer any five(Marks:10)				
		Marks	CO	BL	PI
a)	Mass density is defined as mass per unit volume and its unit is kg/m^3. And Specific gravity is defined as mass density of any fluid by mass density of standard fluid (No unit)	2	01	I	1.1.1
b)	Define Velocity potential function and stream function The velocity potential function is a scalar function such that its negative derivative along any direction will give the velocity component in that direction. $u = -\partial\varphi/\partial x$ $v = -\partial\varphi/\partial y$ The stream function is a scalar function such that its derivative along any direction gives the velocity component in the perpendicular direction, in the clockwise or anti-clockwise direction. $u = \partial\psi/\partial y$, $v = -\partial\psi/\partial x$	2	01	I	1.1.1
c)	According to Bernoulli's theorem, the sum of the energies possessed by a flowing liquid at a point is constant and head loss of energy have to consider between two points, provided that the liquid is incompressible and viscous and flow in streamline.	2	01	I	1.4.1
d)	1. Head loss at entrance 2. Head loss due to sudden enlargement 3. Head loss due to sudden contraction 4.Head loss die to obstacles in pipeline 5. Head loss due to Bend 6. Head loss due to exit at pipe 7. Head loss in pipe fitting	2	01	I	1.3.1
e)	Mass density Weight density Specific gravity Viscosity, surface tension , capillarity	2	01	I	1.1.1
f)		2	01	I	1.4.1

<table>
<tr><td>g)</td><td>Impulse turbine is that turbine in which energy available at inlet is kinetic energy and in reaction turbine energy available at inlet is kinetic as well as pressure energy</td><td>2</td><td>01</td><td>I</td><td>1.1.1</td></tr>
<tr><td>h)</td><td>The function of draft tube is to deliver the water to tailrace without head or energy loss</td><td>2</td><td>01</td><td>I</td><td>1.1.1</td></tr>
<tr><td>Q. 2</td><td>

Solution. Given :

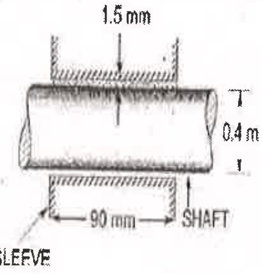


Fig. 1.5

Viscosity $\mu = 6$ poise $= \frac{6}{10}\frac{Ns}{m^2} = 0.6 \frac{Ns}{m^2}$

Dia. of shaft, $D = 0.4$ m

Speed of shaft, $N = 190$ r.p.m

Sleeve length, $L = 90 \text{ mm} = 90 \times 10^{-3}$ m

Thickness of oil film, $t = 1.5 \text{ mm} = 1.5 \times 10^{-3}$ m

Tangential velocity of shaft, $u = \frac{\pi D N}{60} = \frac{\pi \times 0.4 \times 190}{60} = 3.98$ m/s

Using the relation $\tau = \mu \frac{du}{dy}$

where du = Change of velocity $= u - 0 = u = 3.98$ m/s

dy = Change of distance $= t = 1.5 \times 10^{-3}$ m

$$\tau = 10 \times \frac{3.98}{1.5 \times 10^{-3}} = 1592 \text{ N/m}^2$$

This is shear stress on shaft

∴ Shear force on the shaft, F = Shear stress × Area

$= 1592 \times \pi D \times L = 1592 \times \pi \times .4 \times 90 \times 10^{-3} = 180.05$ N

Torque on the shaft, $T = \text{Force} \times \frac{D}{2} = 180.05 \times \frac{0.4}{2} = 36.01$ Nm

∴ *Power lost $= \frac{2\pi NT}{60} = \frac{2\pi \times 190 \times 36.01}{60} = 716.48$ W. Ans.

</td><td>8</td><td>02</td><td>II</td><td>1.3.1</td></tr>
<tr><td>Q. 3</td><td>

Differentiate between

(i) Laminar flow and turbulent flow

Laminar flows are smooth and streamlined, whereas turbulent flows are irregular and chaotic.

A low Reynolds number indicates laminar flow while a high Reynolds number indicates turbulent flow. The flow behavior drastically changes if it is laminar vs. turbulent.

In complex systems, the analysis of laminar and turbulent flow becomes crucial for efficient operational design.

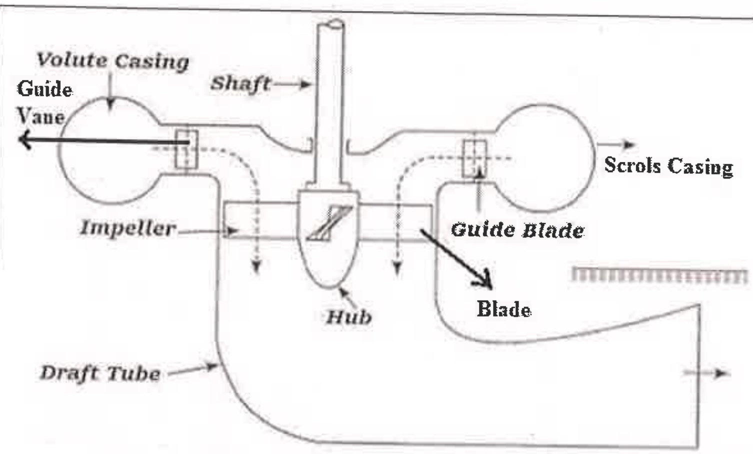
(ii) Venturimetr and orifice meter

Orificemeter	Venturimeter
Generally used to measure the liquid flow rate	Used to measure the flow rate of fluids
Cheap	Expensive
Easy to install	Fabrication is highly technical
Simple Construction	Difficult construction

</td><td>8</td><td>03</td><td>II</td><td>1.4.1</td></tr>
</table>

More head loss	Less head loss
High power losses	Less power losses
Highly flexible	Less flexible
Small in size	Large in size
Less costly	Higher cost

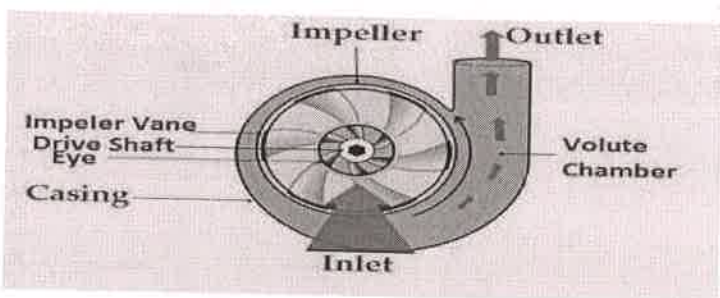
Q. 4	1 Scroll Casing It is a spiral type of casing that has decreasing cross section area. The water from the penstocks enters the scroll casing and then moves to the guide vanes where the water turns through 90° and flows axially through the runner. It protects the runner, runner blades guide vanes and other internal parts of the turbine from an external damage. **2. Guide Vane Mechanism** It is the only controlling part of the whole turbine, which opens and closes depending upon the demand of power requirement. In case of more power output requirements, it opens wider to allow more water to hit the blades of the rotor and when low power output requires it closes itself to cease the flow of water. If guide vanes is absent than the turbine can not work efficiently and its efficiency decreases. **3. Draft Tube** The pressure at the exit of the runner of Reaction Turbine is generally less than atmospheric pressure. The water at exit cannot be directly discharged to the tail race. A tube or pipe of gradually increasing area is used for discharging water from the exit of turbine to the tail race. This tube of increasing area is called Draft Tube. One end of the tube is connected to the outlet of runner while the other end is sub-merged below the level of water in the tail-race. Runner vanes: The heart of the component in kaplan turbine are its runner blades, as it the rotating part which helps in production of electricity.Its shaft is connected to the shaft of the generator. The runner of the this turbine has a large boss on which its blades are attached and the the blades of the runner is adjustable to an optimum angle of attack for maximum power output. The blades of the Kaplan turbine has twist along its length.	8	02	II	2.1.1



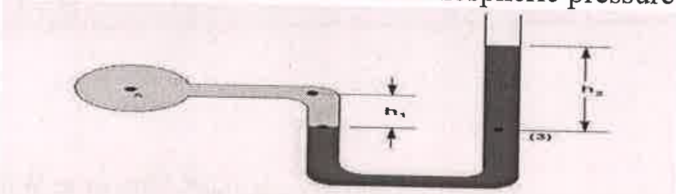
OR

Explain with neat sketch Centrifugal pump??

A centrifugal pump is a mechanical device designed to move a fluid by means of the transfer of rotational energy from one or more driven rotors, called impellers. Fluid enters the rapidly rotating impeller along its axis and is cast out by centrifugal force along its circumference through the impeller's vane tips. The action of the impeller increases the fluid's velocity and pressure and also directs it towards the pump outlet. The pump casing is specially designed to constrict the fluid from the pump inlet, direct it into the impeller and then slow and control the fluid before discharge. The impeller is the key component of a centrifugal pump. It consists of a series of curved vanes. These are normally sandwiched between two discs (an enclosed impeller). For fluids with entrained solids, an open or semi-open impeller (backed by a single disc) is preferred (Figure)Fluid enters the impeller at its axis (the 'eye') and exits along the circumference between the vanes. The impeller, on the opposite side to the eye, is connected through a drive shaft to a motor and rotated at high speed (typically 500-5000rpm). The rotational motion of the impeller accelerates the fluid out through the impeller vanes into the pump casing.There are two basic designs of pump casing: volute and diffuser. The purpose in both designs is to translate the fluid flow into a controlled discharge at pressure.



Q. 5	Spped Ratio = 2.09 U_1 = 21.95 m/Sec V_{f1} = 7.12 m/Sec	8	4,6	III	1.3.1

	$Q = 192.5 m^3/Sec$ **$D_o = 6.21$ m** N= 67.5 rpm **$N_s = 746$** **OR** For Laminar flow in a pipe the drop in pressure Δp is function of pipe length L, its diameter D, mean velocity of of flow V, and the dynamic viscosity μ, Using Raleigh's method, develop the expression for Δp. $\Delta p = fn(L,D,V,\mu)$ this can be written in terms of dimensionless constant as $\Delta p = K L^a D^b V^C \mu^d$ Using LMT system of basics $(M L^{-1}T^{-2}) = [L]^a [L]^b[LT^{-1}]^c[ML^{-1}T^{-1}]^d$ Equating the powers of M d=1 L -1= a + b +c + d T, -2=c-d= -c=-1, c=1 $\Delta p = K L^{-1-b}D^bV\mu = K\{V\mu/L\}(D/L)^b$ $\Delta p= V\mu/Lfn(D/L)$				
Q. 6	Write a short note on (i) U Tube Manometer U-tube manometer features a vertical or inclined U-tube column that is filled with a reference liquid (mercury) to display the pressure level. When the columns of the device are exposed to the atmosphere, the levels of liquid in the limbs are equal and this indicates the atmospheric pressure.  U - Tube Manometer (ii) Major and Minor losses in pipe Head loss due to friction 1. Head loss at entrance 2. Head loss due to sudden enlargement 3. Head loss due to sudden contraction 4.Head loss die to obstacles in pipeline 5. Head loss due to Bend 6. Head loss due to exit at pipe 7. Head loss in pipe fitting **OR** (i)Draft tubes Draft Tube is a diverging tube fitted at the exit of runner of turbine and used to utilize the kinetic energy available with water at the exit of runner. '. This draft tube at the end of the turbine increases the pressure of the exiting fluid at the expense of its velocity. Types of draft tubes (i)Conical draft tube. (ii)Simple elbow draft tube.	8	2	III	2.1.1