SRM VALLIAMMAI ENGINEERINGCOLLEGE

SRM Nagar, Kattankulathur– 603203
(An Autonomous Institution)

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

III SEMESTER

ME3336 Fluid Mechanics and Machinery

Regulation – 2023

Academic Year 2026 - 2027

Prepared by

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DEPARTMENTOFMECHANICALENGINEERING

ME3336 - FLUID MECHANICS AND MACHINERY

UNIT-I FLUID PROPERTIES AND FLUID STATICS

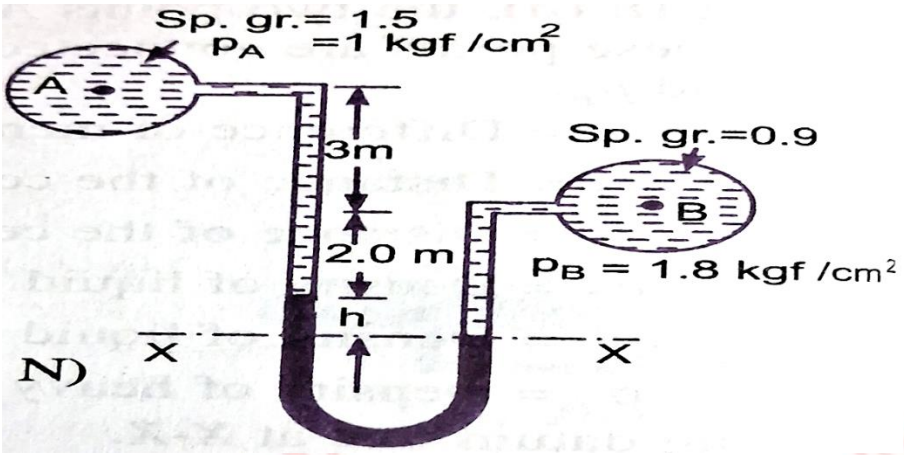
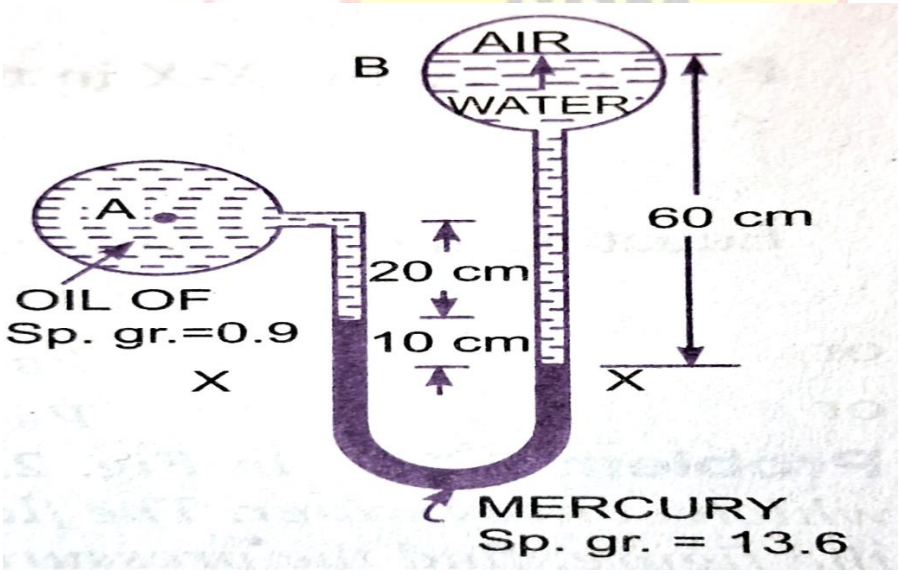
Fluid – definition, Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

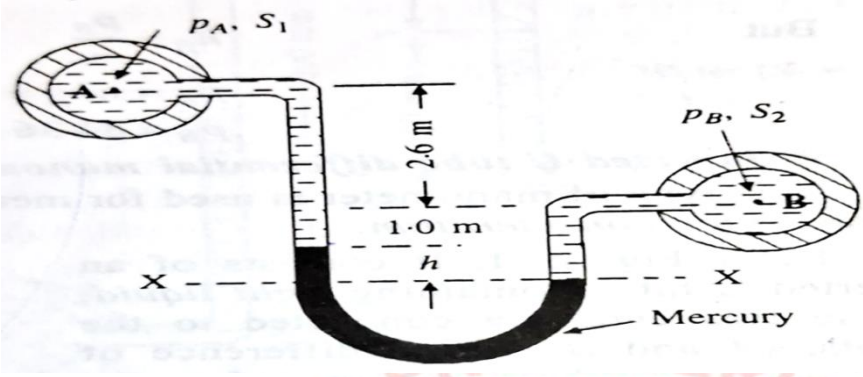
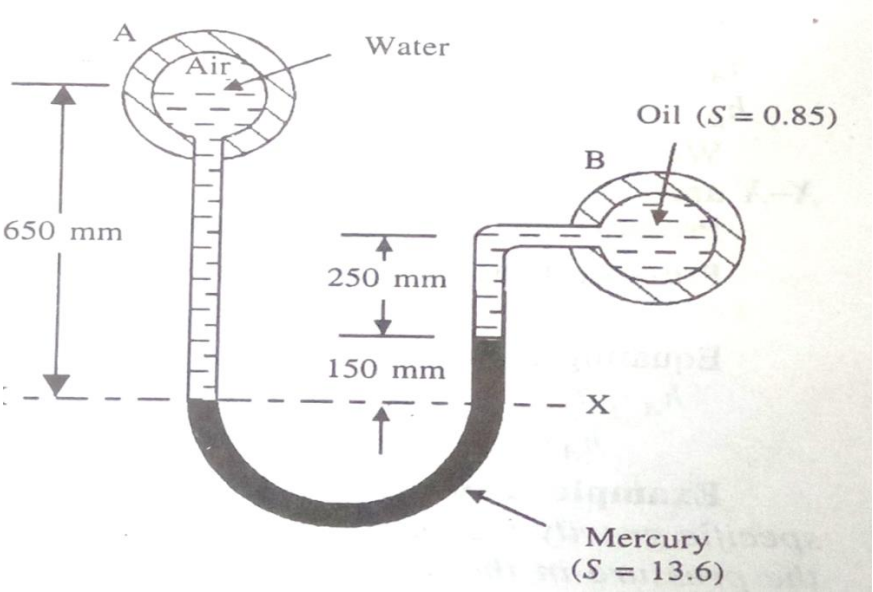
PART -A (2 MARKS)

1.	Give the properties of ideal fluid.	BT-1	Remember
2.	Define Weight density.	BT-1	Remember
3.	What is specific gravity? How is it related to density?	BT-2	Understand
4.	Calculate the specific weight and specific gravity of 1 litre of a liquid which weighs 7 N.	BT-2	Understand
5.	Define Newton's law of Viscosity.	BT-1	Remember
6.	Draw the shear stress-velocity gradient profile for Newtonian fluids.	BT-2	Understand
7.	Differentiate compressible and incompressible fluids. Give suitable examples.	BT-2	Understand
8.	Give some examples for viscous fluid.	BT-1	Remember
9.	When a fluid is considered steady and unsteady?	BT-1	Remember
10.	What are Non-Newtonian fluids? Give suitable examples.	BT-1	Remember
11.	Differentiate kinematic viscosity with dynamic viscosity.	BT-2	Understand
12.	What is the effect of temperature on viscosity of liquids and gases?	BT-2	Understand
13.	Define surface tension.	BT-1	Remember
14.	Define the term capillarity.	BT-1	Remember
15.	What is meant by vapor pressure of a fluid?	BT-2	Understand
16.	Identify absolute pressure in terms of gauge pressure, atmospheric pressure and vacuum pressure.	BT-1	Remember
17.	Where inverted U–tube differential manometer used. Why?	BT-1	Remember
18.	What is the effect of cavitations?	BT-2	Understand
19.	Define steady and unsteady flow.	BT-1	Remember
20.	A soap bubble is formed when the inside pressure is 5 N/m^2 above the atmospheric pressure if surface tension in the soap bubble is 0.0125 Nm.	BT-2	Understand
21.	Differentiate between cohesion and adhesion.	BT-1	Remember
22.	Calculate the height of capillary rise for water in a glass tube of diameter 1mm.Take surface tension = 0.0075 N/m.	BT-2	Understand
23.	Distinguish between manometers and mechanical gauges.	BT-2	Understand
24.	What are the factors depending on the magnitude of capillary?	BT-1	Remember
25.	Differentiate between simple manometer and differential manometer.	BT-1	Remember

	PART -B (16 MARKS)			
1.	The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine (i) Dynamic viscosity of the oil in poise. (ii) Kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95.	8 8	BT-4	Analyze
2.	(i) Explain various properties of fluids. (ii) Explain various classifications of fluids with the help of a stress-strain Graph. Give suitable examples.	8 8	BT-3	Apply
3.	(i) The pressure outside the droplet of water of diameter 0.04 mm is 10.32 N/cm² (atmospheric pressure). Calculate the pressure within the droplet if surface tension is given as 0.0725 N/m of water. (ii) Calculate the capillary effect in millimeters in a glass tube of 4 mm diameter, when immersed in (i) water and (ii) mercury. The temperature of the liquid is 20°C and the values of the surface tension of water and mercury at 20°C in contact with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero that for mercury is 130°. Take density of water at 20°C as equal to 998 kg/m^3.	8 8	BT-4	Analyze
4.	A 150 mm diameter shaft rotates at 1500 r.p.m. in a 200 mm long journal bearing with 150.5 mm internal diameter. The uniform annular space between the shaft and the bearing is filled with oil of dynamic viscosity 0.8 poise. Calculate the power dissipated as heat.	16	BT-4	Analyze
5.	The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90mm.The thickness of the oil film is 1.5 mm.	16	BT-3	Apply
6.	An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5 m and it rotates at 200 r.p.m. calculate the power lost in oil for a sleeve length of 100mm.The thickness of oil film is 1.0mm.	16	BT-4	Analyze

7.	A 400 mm diameter shaft is rotating at 200 r.p.m. in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7N.s/m^2 determine torque required to overcome friction in bearing and power utilized in overcoming viscous resistance.	16	BT-3	Apply
8.	A U-tube is made up of two capillaries of bores 1.2 mm and 2.4mm respectively. The tube is held vertical and partially filled with liquid of surface tension 0.06 N/m and zero contact angle. If the estimated difference in the level of two menisci is 15 mm determine the mass density of the liquid.	16	BT-4	Analyze
9.	What are the gauge pressure and absolute pressure at a point 3 m below the free surface of a liquid having a density of 1.53 X 10^3 Kg/m^3 if the atmospheric pressure is equivalent to 750mm of mercury? The specific gravity of mercury is 13.6 and density of water =1000 kg/m^3.	16	BT-4	Analyze
10.	The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to pipe in which a fluid of specific gravity 0.9 is flowing. The center of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.	16	BT-4	Analyze
11.	A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m². Calculate the new difference in the level of mercury. Sketch the arrangements in both cases.	16	BT-4	Analyze

12.	A differential manometer is connected at the two points A and B of two pipes as shown in Fig.1. The pipe A contains a liquid of specific gravity=1.5 while pipe B contains a liquid of specific gravity =0.9.The pressure at A and B are 1 kgf/cm^2 and 1.80 kgf/cm^2 respectively. Find the difference in mercury level in the differential manometers.  Fig.1	16	BT-5	Evaluate
13.	A differential manometer is connected at the two points A and B as shown in Fig.2. At B air pressure is 9.81 N/cm^2.find the absolute pressure at A.  Fig.2	16	BT-5	Evaluate
14.	A U-tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. Its left end is connected to the pipe and the right limb is open to the atmosphere .The center of the pipe is 100 mm below the level of mercury (specific gravity=13.6) in the right limb. If the difference of mercury level in the right limb. If the difference of mercury level in the two limbs is 160 mm determine the absolute pressure of the oil in the pipe.	16	BT-4	Analyze

15.	The Fig.3 shows a U-tube differential manometer connecting two pressure pipes at A and B. The pipe A contains a liquid of specific gravity 1.6 under a pressure of 110 KN/m^2.The pipe B contains oil of specific gravity 0.8 under a pressure of 200KN/m^2.Find the difference of pressure measured by mercury as fluid filling U-tube.  Fig.3	16	BT-5	Evaluate
16.	The Fig.4 shows a differential manometer connected at two points A and B. At A air pressure is 100 KN/m^2.Find the absolute Pressure at B.  Fig.4	16	BT-4	Analyze
17.	Explain briefly the working principle of Bourdon pressure gauge with a neat sketch.	16	BT-4	Analyze
18.	Explain briefly the working principle of diaphragm gauge with a neat sketch.	16	BT-4	Analyze

UNIT II: FLUID KINEMATICS AND FLUID DYNAMICS

Fluid Kinematics - types of flow - velocity field and acceleration - continuity equation - Equation of streamline - stream function - velocity potential function - circulation - flow net. Fluid Dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube.

PART - A (2 MARKS)

1.	Differentiate steady flow and unsteady flow.	BT-1	Remember
2.	Define control volumes.	BT-1	Remember
3.	State Bernoulli's theorem as applicable to fluid flow.	BT-2	Understand
4.	Why is it necessary to assume that the flow is steady before integrating Euler's equation to derive Bernoulli's equation?	BT-2	Understand
5.	Name the different forces present in a fluid flow. For the Euler's equation of motion. Which forces are taken into consideration?	BT-1	Remember
6.	Write Euler's equation?	BT-1	Remember
7.	What are the assumptions made in the derivation of Euler's equation?	BT-2	Understand
8.	Explain the continuity equation.	BT-1	Remember
9.	The converging pipe with inlet and outlet diameters of 200mm and 150mm carries the oil whose specific gravity is 0.8.The velocity of oil at the entry is 2.5m/.find the velocity at the exit of the pipe and oil flow rate in kg/s.	BT-1	Remember
10.	What are the assumptions made in deriving Bernoulli's equation?	BT-1	Remember
11.	Write down the limitations of Bernoulli's equation.	BT-2	Understand
12.	How does redwood viscometer work?	BT-2	Understand
13.	State significance of Navier-stroke equation.	BT-2	Understand
14.	What is venturimeter? And explain its basic principles,	BT-1	Remember
15.	The coefficient of discharge of venturimeter is always greater than orifice meter. Why?	BT-1	Remember
16.	Why large reduction of diameters from inlet to throat is not allowed in venturimeter?	BT-2	Understand
17.	What are the various parts of venturimeter?	BT-2	Understand
18.	Define 'Vena-contracta'.	BT-2	Understand
19.	Write down the expression for discharge through a venturimeter explaining each term in it.	BT-2	Understand
20.	Define coefficient of friction.	BT-1	Remember
21.	What is orifice meter? And mention its basic principle.	BT-2	Understand
22.	Define coefficient of contraction.	BT-1	Remember
23.	How can pressure be measured in pitot tube?	BT-1	Remember
24.	What is coefficient velocity?	BT-1	Remember
25.	State the principle of momentum.	BT-1	Remember

PART -B (16 MARKS)				
1.	A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s.	16	BT- 4	Analyze
2.	The diameter of a pipe at the section 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 m/s.determine also the velocity at section 2.	16	BT-3	Apply
3.	Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5m diameter. At C, the pipe branches. Branch CD is 0.8 m in diameter and carries one- third of the flow in AB.The flow velocity in branch CE is 2.5 m/s.find the volume rate of flow in AB. The velocity in BC, the velocity in CD and the diameter of CE.	16	BT-4	Analyze
4.	A 25 cm diameter pipe carries oil of specific gravity 0.9 at a velocity of 3m/s. At another section the diameter is 20 cm. Find the velocity at this section and also mass rate of flow of oil.	16	BT-3	Apply
5.	The diameter of a pipe at the section 1-1 and 2-2 are 200 mm and 300 mm respectively. If the velocity of water flowing through the pipe at section 1-1 is 4 m/s,find: (i) Discharge through the pipe,and (ii) Velocity of water at section 2-2.	16	BT-3	Apply
6.	Derive Euler equation of motion along a stream-line and obtain Bernoulli's equation by its integration. State all assumptions made.	16	BT-4	Analyze
7.	State Bernoulli's theorem for a steady flow of an incompressible fluid and derive an expression for Bernoulli's equation from first principle.	16	BT-3	Apply
8.	A pipe, through which water is flowing, is having diameter, 20cm and 10 cm at the cross-sections 1 and 2 respectively. The velocity of water at section 1 is given 4.0 m/s. find the velocity head at sections 1 and 2 and also rate of discharge.	16	BT-4	Analyze
9.	The water is flowing through a pipe having diameter 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. the section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm^2,find the intensity of pressure at section 2.	16	BT-4	Analyze

10.	Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 $N/cm^2$and the pressure at the upper end is 9.81 N/cm^2.Determine the difference in datum head if the rate of flow through	16	BT-4	Analyze
11.	The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the lower end, at the rate of 50 liters/s. The pipe has a slope of 1 in 30.Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2.	16	BT-4	Analyze
12.	An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm.The oil-mercury differential manometer shows a reading of 25cm.calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$.	16	BT-5	Evaluate
13.	A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of specific gravity 0.8.The discharge of oil through venturimeter is 60 litres/sec.Find the reading of the oil-mercury differential manometer Take $C_d = 0.98$.	16	BT-4	Analyze
14.	The inlet and throat diameter of a horizontal venturimeter are 30 cm and 10 cm respectively. The liquid flowing through the meter is water .The pressure intensity at inlet is 13.734 N/cm^2.While the vacuum pressure head at the throat is 37cm of mercury. Find the rate of flow, Assume that 4% of the differential head is lost between the inlet and throat. Find also the value of C_d for the venturimeter.	16	BT-5	Evaluate
15.	A 30 cm x 25 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm.The differential U-tube mercury manometer shows a gauge deflection of 25 cm. calculate: (i) the discharge of oil, and (ii) The pressure difference between the entrance section and the throat section. Take the co-efficient of discharge as 0.98 and specific gravity of mercury as 13.6.	16	BT-5	Evaluate

16.	An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauge fitted upstream and downstream of the orifice meter gives readings of 19.62 $N/cm^2$and 9.81 N/cm^2 respectively.co-efficient of discharge for the orifice meter is given as 0.6 Find the discharge of water through pipe.	16	BT-4	Analyze
17.	An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of specific gravity 0.9 when the co-efficient of discharge of the orifice meter =0.64.	16	BT-5	Evaluate
18.	Describe with the help of sketch the construction, operation and use of pitot-static tube.	16	BT-4	Analyze



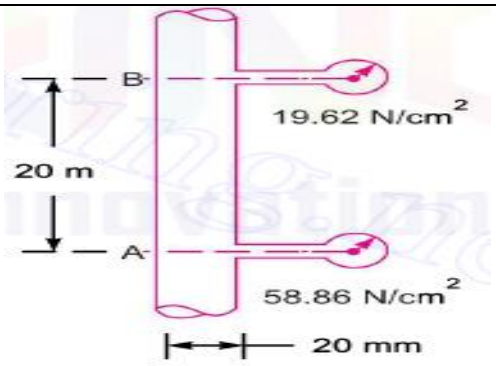
UNIT III: FLOW THROUGH CIRCULAR CONDUITS

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

PART - A (2 MARKS)

1.	Write down Hagen-Poiseuille equation for laminar flow.	BT-1	Remember
2.	Sketch the velocity and shear stress distribution for laminar flow of an incompressible fluid through a circular pipe.	BT-1	Remember
3.	Differentiate between T.E.L and H.G.L.	BT-2	Understand
4.	Discuss the importance of Darcy weisbach formula.	BT-2	Understand
5.	Write down four examples of laminar flow.	BT-1	Remember
6.	Write down the equation to find head loss due to friction.	BT-1	Remember
7.	State the significance of Moody's diagram.	BT-2	Understand
8.	What are significances of HGL?	BT-1	Remember
9.	What do you understand by hydraulic diameter?	BT-1	Remember
10.	What are the basic equations for solving flow through branched pipes?	BT-1	Remember
11.	Differentiate between laminar and turbulent flow.	BT-2	Understand
12.	What is equivalent pipe? Mention the equation used for it.	BT-2	Understand
13.	What is meant by boundary layer separations?	BT-2	Understand
14.	Give four examples of laminar flow.	BT-1	Remember
15.	Define boundary layer thickness.	BT-1	Remember
16.	What is syphon? Mention its applications.	BT-2	Understand
17.	List the major and minor losses encountered in pipe flow.	BT-2	Understand
18.	What are the losses experienced by a fluid when it is passing through a pipe?	BT-1	Remember
19.	What do you mean by flow through parallel pipes?	BT-1	Remember
20.	Identify the applications of Moody's diagram.	BT-1	Remember
21.	Write down the causes of minor energy losses in flow through pipes.	BT-2	Understand
22.	Define displacement thickness.	BT-1	Remember
23.	Define momentum thickness.	BT-1	Remember
24.	Give the expression of loss of energy due to sudden contraction and enlargement.	BT-1	Remember
25.	Define the terms Drag and lift.	BT-1	Remember

PART - B (16 MARKS)				
1.	Derive the equation of flow of viscous fluid through circular pipe and obtain the equation for parabola, ratio of maximum to average velocity, pressure drop.	16	BT-3	Apply
2.	Derive the expression for shear stress and velocity distribution for the flow through circular pipe and using that derive the Hagen Poiseuille formula.	16	BT-3	Apply
3.	An oil of viscosity 0.1 Ns/m² and relative density 0.9 is flowing through a circular pipe of diameter 50 cm and of length 300m. The rate of flow of fluid through the pipe is 3.5 litre / sec. Find the pressure drop in a length of 300 m and the shear stress at the pipe wall.	16	BT-4	Analyze
4.	A liquid with a specific gravity 2.8 and a viscosity 0.8 poise flows through a smooth pipe of unknown diameter, resulting in a pressure drop of 800 N/m^2 in 2 km length of the pipe. What is the pipe diameter if the mass flow rate is 2500 kg/hr.	16	BT-4	Analyze
5.	Derive expression for Chezy's formula to find velocity of flow through pipe.	16	BT-3	Apply
6.	An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litre/sec. Find the head lost due to friction for a 500 m length of pipe. Find the power required to maintain this flow.	16	BT-4	Analyze
7.	At a sudden enlargement of a water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10 mm. Estimate the rate of flow.	16	BT-4	Analyze
8.	Crude oil of μ=1.5 poise and relative density 0.9 flows through a 20 mm diameter vertical pipe. The pressure gauges fixed 20m apart read 58.86 N/cm² and 19.62 N/cm² as show in Fig.2. Find the direction and rate of flow through the pipe.	16	BT-4	Analyze

	 Fig. 2			
9.	For the velocity profile in laminar boundary layer as $\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$. Find the thickness of the boundary layer and shear stress, 1.5 m from the leading edge of a plate. The plate is 2 m long and 1.4 m wide is placed in water, which is moving with a velocity of 200 mm/sec. Find the total drag force on the plate if μ for water 0.01 poise.	16	BT-4	Analyze
10.	For the velocity profile for laminar boundary layer $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$. Obtain an expression for boundary layer thickness, shear stress, drag force on one side of the plate and co-efficient of drag in term of Reynold's number.	16	BT-4	Analyze
11.	Find the head lost due to friction in a pipe of diameter 300mm and length 50m, through which water is flowing at a velocity of 3m/s using (i) Darcy formula, (ii) Chezy's formula for which C=60. Take v for water = 0.01 stroke.	16	BT-4	Analyze
12.	A horizontal pipe line 40 m long is connected to a water tank at one end discharge freely into atmosphere other end for the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the center of the pipe. Considering all losses of head which occur. Determine the rate of flow. Take f = 0.01 for both sections of the pipe.	16	BT-5	Evaluate
13.	The rate of flow of water through a horizontal pipe is 0.25 m^3/sec. The diameter of the pipe is suddenly enlarged from 200 mm to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine (i) loss of head due to sudden enlargement (ii) pressure intensity in the large pipe and (iii) power lost due to enlargement.	16	BT-4	Analyze

14.	Two reservoirs whose water surface elevations differ by 12 m are connected by the following horizontal compound pipe system starting from the high level reservoir. Take L_1 =200 m, D_1 =0.2 m, f_1 = 0.008, andL_2 = 500 m, D_2 = 0.3 m, f_2= 0.006. Considering all head losses and assuming that all changes of section are abrupt, compute the discharge through the system. Find the equivalent length of a 0.25 m diameter pipe if minor losses are neglected and friction factors are assumed to be the same. Sketch HGL and TEL.	16	BT-5	Evaluate
15.	Three pipes of diameters 300 mm, 200 mm and 400 mm and lengths 450 m, 255 m and 315 m respectively are connected in series. The difference in water surface levels in two tanks is 18 m. Determine the rate of flow of water if coefficients of friction are 0.0075, 0.0078 and 0.0072 respectively considering: (a) Minor losses also and (b)Neglecting minor losses.	16	BT-4	Analyze
16.	Two sharp ended pipes of diameters 50 mm and 100 mm are connected in parallel between two reservoirs which have a difference of level of 10 m. If the co-efficient of friction for each pipe is 0.32, calculate the rate of flow for each pipe and also the diameter of a single pipe 100 m long which would give the same discharge, if it were substituted for the original two pipes.	16	BT-5	Evaluate
17.	A pipe line of length 2000m is used for power transmission. If 110.3625 kW power is to be transmitted through the pipe in which water having a pressure of 490.5N/cm² at inlet is flowing. Find the diameter of the pipe and efficiency of transmission if the pressure drop over the length of the pipe is 98.1N/cm². Take f=0.0065.	16	BT-4	Analyze
18.	A syphon of diameter 20 cm connects two reservoirs whose water surface level differ by 60 m. The total length of the pipe is 6000 m. The pipe crosses a ridge. The summit of ridge is 6 m above the level of water in the upper reservoir. Determine the minimum depth of the pipe below the summit of the ridge, if the absolute pressure head of the summit of syphon is not to fall below 3.0 m of water, Take f=0.006 and atmospheric pressure head – 10.3 m of water. The length of syphon from the upper reservoir to the summit is 600 m. Find the discharge also.	16	BT-4	Analyze

UNIT IV DIMENSIONAL ANALYSIS

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

PART - A (2 MARKS)

1.	List the methods of dimensional analysis.	BT-1	Remember
2.	What is Dimensional homogeneity?	BT-2	Understand
3.	State the advantages of Dimensional and model analysis.	BT-2	Understand
4.	State and apply the significance Buckingham's π theorem.	BT-2	Understand
5.	What is meant by similitude?	BT-1	Remember
6.	Difference between Rayleigh's method and Buckingham's π theorem.	BT-1	Remember
7.	How to calculate the number of π terms while applying Buckingham's π theorem?	BT-1	Remember
8.	What are the basic dimensions required to specify any property?	BT-1	Remember
9.	What are dimensional constants?	BT-1	Remember
10.	Express the dimensions of the following Physical Quantities: (i) Pressure (ii) Surface Tension	BT-2	Understand
11.	What are the types of similarities between model and prototype?	BT-2	Understand
12.	Mention the circumstance which necessitates the use of distorted models.	BT-2	Understand
13.	Submarine is tested in the air tunnel. Identify the model law applicable.	BT-1	Remember
14.	Define Froude's number and Euler's number	BT-1	Remember
15.	What is meant by undistorted model?	BT-2	Understand
16.	State the Fourier law of dimensional homogeneity.	BT-2	Understand
17.	Apply dimensional homogeneity for thee quation v= u+ at.	BT-2	Understand
18.	How are the repeating variables selected for dimensional analysis?	BT-2	Understand
19.	Mention the significance of Reynolds's model law.	BT-2	Understand
20.	What is meant by dimensional analysis?	BT-1	Remember
21.	How are the equations derived in Raleigh's method?	BT-1	Remember
22.	State three demerits of a distorted model.	BT-2	Understand
23.	State Euler model law and give its significance	BT-1	Remember
24.	Define Mach number and state its applications	BT-1	Remember
25.	What are the applications of Fourier law in model analysis?	BT-1	Remember

PART – B (16MARKS)

1.	i) List the criteria for selecting repeating variable in this dimensional analysis?	8	BT-3	Apply
	ii) Check whether the following equation is dimensionally homogeneous.$T=2\pi\sqrt{(L/g)}$	8	BT-4	Analyze
2.	i) List out the criteria for selecting repeating variable in dimensional analysis. ii) Write a short note on dimensional homogeneity with suitable examples.	8 8	BT-3	Apply
3.	The resisting force (R) of a supersonic plane during flight can be considered as dependent upon the length of the air craft 'l', velocity 'V', air viscosity 'μ', air density 'ρ' and bulk modulus of air is 'K'. Express the	16	BT-4	Analyze

	functional relationship between these variables and the resisting force.			
4.	The power P developed by a water turbine depends on the rotational speed N, operating head H, gravity g, diameter D and width B of the runner, density ρ and viscosity μ of water. Show by dimensional analysis that $P = \rho D^5 N^3 \Phi[\frac{H}{D}, \frac{D}{B}, \frac{\rho D^2 N}{\mu}, \frac{ND}{\sqrt{gH}}]$	16	BT-4	Analyze
5.	The efficiency η of a fan depends on ρ (density), μ (viscosity) of the fluid, ω (angular velocity), d (diameter of rotor) and Q (discharge). Express η in terms of non-dimensional parameters. Use Buckingham's π theorem.	16	BT-4	Analyze
6.	Using Buckingham's π- theorem, show that the velocity through a circular orifice in a pipe is given by $v = \sqrt{2gH}\emptyset\,[\frac{D}{H}, \frac{\mu}{\rho VH}]$ where v is the velocity through orifice of diameter d and H is the head causing the flow and ρ and μ are the density and dynamic viscosity of the fluid passing through the orifice and g is acceleration due to gravity.	16	BT-4	Analyze
7.	Explain the step by step procedure of Buckingham's π–theorem with suitable example.	16	BT-3	Apply
8.	i) Explain the Rayleigh's method of dimensional analysis with an example. ii) List out the advantages of dimensional analysis.	8 8	BT-3	Apply
9.	The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness. Using Buckingham's π theorem, obtain an expression for Δp.	16	BT-4	Analyze
10.	A partially submerged body is towed in water. The resistance R to its motion depends on the density ρ, the viscosity μ of water, length l of the body, velocity v of the body and the acceleration due to gravity g. Express the functional relationship between these variables and resisting force. Using Rayleigh's method.	16	BT-4	Analyze
11.	The power developed by hydraulic machines is found to depend on the head H, flow rate Q, density ρ, Speed N, runner diameter D and acceleration due to gravity g. Obtain suitable dimensionless parameters to correlate experimental results.	16	BT-5	Evaluate
12.	The capillary rise h is found to be influenced by the tube diameter D, density ρ, gravitational acceleration g and surface tension σ, determine the dimensional parameters for the correlation of experimental results.	16	BT-4	Analyze

13.	Classify Models with scale ratios and explain.	16	BT-3	Apply
14.	Write short notes on the following i) Dimensionless Homogeneity with example. ii) Euler Model Law. iii) Similitude. iv) Undistorted and Distorted Models.	 4 4 4 4	BT-3	Apply
15.	Explain Reynold's law of similitude and Froude's law of similitude.	16	BT-3	Apply
16.	A Ship 300m long moves in sea water, whose density is 1030 kg/m³, A1:100 model of ship is to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30m/s and the resistance of model is 60N. Determine the velocity of ship in sea water and also the resistance of the ship in sea water. The density of air is given as 1.24 kg/m^3. Take the kinematic viscosity of sea -water and air as 0.012 stokes and 0.018 respectively.	16	BT-5	Evaluate
17.	A spillway model is to be built to geometrically similar scale of 1/ 50 across a flume of 600 mm width. The prototype is 15 m high and maximum head on it is expected to be 1.5 m (i). What height of model and what head of model should be used? (ii). If the flow over the model at a particular head is 12 litres per second, what flow per metre length of the prototype is expected? (iii). If the negative pressure in the model is 200 mm, what is the negative pressure in prototype? Is it practicable?	16	BT-4	Analyze
18.	The ratio of length of a submarine and its model is 30:1. The speed of submarine (prototype) is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ration of the drag (resistance) between the model and prototype. Take the value of kinematic viscosities of sea water and air as 0.012 stokes and 0.016 stokes respectively. The density of sea water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively.	16	BT-4	Analyze

UNIT V TURBINES AND PUMPS

Impact of jets – Hydro turbines: definition and classifications - Euler's equation for turbo machines. Turbines: definition and classifications - working principles - Impeller turbine - Reaction turbine - velocity triangles. Pumps: definition and classifications - Centrifugal pump - Reciprocating pump - velocity triangles, indicator diagram, specific speed, cavitations in pumps.

PART - A (2 MARKS)

1.	What is meant by impact of jets?	BT-1	Remember
2.	Classify turbine according to flow.	BT-1	Remember
3.	Differentiate the impulse turbine and reaction turbine.	BT-1	Remember
4.	List down the main components of Pelton wheel turbine.	BT-1	Remember
5.	Why does a Pelton wheel not posses any draft tube?	BT-2	Understand
6.	Define volumetric efficiency of turbine.	BT-1	Remember
7.	What is draft tube and why is it necessary for a reaction turbine?	BT-2	Understand
8.	Differentiate the inward flow reaction turbine and outward flow reaction turbine.	BT-2	Understand
9.	Define unit speed of turbine.	BT-1	Remember
10.	What is meant by governing of turbine?	BT-1	Remember
11.	What are the functions of a casing in a centrifugal pump?	BT-2	Understand
12.	What are Roto dynamic pumps? Give examples.	BT-2	Understand
13.	Compare centrifugal pump with reciprocating pump.	BT-1	Remember
14.	List the main components of reciprocating pump.	BT-2	Understand
15.	Define “Slip” of reciprocating pump.	BT-1	Remember
16.	List the functions of an air vessel.	BT-2	Understand
17.	Define mechanical efficiency of a pump.	BT-1	Remember
18.	What are rotary pumps? Give examples.	BT-2	Understand
19.	Define the manometric efficiency and mechanical efficiency of a pump.	BT-1	Remember
20.	Illustrate hydraulic efficiency.	BT-1	Remember
21.	What is meant by NPSH?	BT-1	Remember
22.	Define negative slip. How does it occur?	BT-1	Remember
23.	What are the uses of indicator diagram?	BT-2	Understand
24.	Examine the cavitation problem in centrifugal pump.	BT-1	Remember
25.	What are the precautions to be taken to prevent cavitation?	BT-1	Remember

PART – B (16 MARKS)

1.	Explain the constructional details of Pelton wheel with a neat diagram.	16	BT-3	Apply
2.	A Pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 lps under a head of 30 m. The buckets deflect the jet through an angle of 160^{o}. Identify the power given by the water to the runner and the hydraulic efficiency of the turbine. Assume coefficient of velocity as 0.98	16	BT-4	Analyze
3.	A Pelton wheel, working under a head of 500 m develops 13 MW when running at a speed of 430 rpm. If the efficiency of the wheel	16	BT-3	Apply

	is 85%, examine the rate of flow through the turbine, the diameter of the wheel and the diameter of the nozzle. Take speed ratio as 0.46 and coefficient of velocity for the nozzle as 0.98			
4.	Briefly explain the construction details of radial flow reaction turbine with neat sketch.	16	BT-4	Analyze
5.	A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area is 0.4 m^2. The angles made by absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Identify: (i) the volume rate of flow, (ii) the power developed, and (iii) the hydraulic efficiency. Draw the velocity triangle also. Assume whirl at outlet to be zero.	16	BT-3	Apply
6.	Explain the working principle of Francis turbine with constructional details.	16	BT-4	Analyze
7.	A Francis turbine with an overall efficiency of 75% is required to produce 148.25 KW. It is working under a head of 7.62 m. The peripheral velocity = $0.26\sqrt{2gH}$ and the radial velocity of the flow at inlet is $0.96\sqrt{2gH}$. The wheel runs at 150 rpm and the hydraulic losses in the turbine are 22% of the available energy. Assume radial discharge, determine. i) guide blade angle, ii) wheel vane angle at inlet, iii) diameter of wheel at inlet and iv) width of wheel at inlet. Draw the suitable velocity triangle.	16	BT-5	Evaluate
8.	Explain the working principle of Kaplan turbine with constructional details.	16	BT-3	Apply
9.	A Kaplan turbine develops 24647.6 kW power at an average head of 39 m. Assuming the speed ratio of 2, flow ratio of 0.6, diameter of the boss equal to 0.35 times the diameter of the runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine.	16	BT-5	Evaluate
10.	(i)A jet of water of diameter 75 mm moving with a velocity of 25 m/s strikes a fixed plate in such a way that the angle between the jet and plate is 60°. Find the force exerted by the jet on the plate (i) in the direction normal to the plate and (ii) in the direction of the jet. (ii) A jet of water of diameter 50 mm moving with a velocity of 40	8 8	BT-4	Analyze

	m/s, strikes a curved fixed symmetrical plate at the center. Find the force exerted by the jet of water in the direction of the jet, if the jet is deflected through an angle of 120° at the outlet of the curved plate.			
11.	Write the different classifications of rotary pumps and explain the working principle of gear pump with neat sketch.	16	BT-3	Apply
12.	Explain about the working principle of centrifugal pump with neat sketch.	16	BT-3	Apply
13.	The diameter and width of a centrifugal pump impeller are 300 mm and 60 mm respectively. The pump is delivering 144 litres of liquid per second with a manometric efficiency of 85%. The effective outlet vane angle is 30°. If the speed of rotation is 950 rpm. Calculate the specific speed of the pump.	16	BT-4	Analyze
14.	Explain the working of a single acting reciprocating pump with a neat sketch. Derive the expression for power required to drive it.	16	BT-3	Apply
15.	A single acting reciprocating pump has a plunger of diameter 150 mm, stroke of 300 mm length and discharges 200 liters of water per minute at 40 rpm. Neglecting losses, find i) theoretical discharge ii) co-efficient of discharge and iii) percentage slip of the pump.	16	BT-5	Evaluate
16.	Explain the working of a double acting reciprocating pump with a neat sketch. Derive the expression for work done of it.	16	BT-3	Apply
17.	A double acting reciprocating pump has a bore of 150 mm and stroke of 250 mm and runs at 35 rpm. The piston rod diameter is 20 mm. The suction head is 6.5 m and the delivery head is 14.5 m. The discharge of water was 4.7 lit/s. Prepare (Determine) the slip and the power required.	16	BT-4	Analyze
18.	A double acting reciprocating pump runs at 90 rpm. The diameter and stroke are 100 mm and 250 mm respectively. The suction pipe is 100 mm dia and 5 m long. Calculate the maximum permissible suction height assuming that no air vessel is fitted and separation occurs at 2 m of water absolute.	16	BT-4	Analyze