Q. Code:304095

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Third Semester

AE22302 – FLUID MECHANICS AND HYDRAULIC MACHINES

(Automobile Engineering)

(Regulation 2022)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Describe the fluids in static, kinematic and dynamic equilibrium.	**3**
CO 2	Analyze the applicability of physical laws in addressing problems of hydraulics.	**3**
CO 3	Apply dimensional analysis and modeling to describe fluid properties and dimensionless quantities.	**3**
CO 4	Critically analyze the performance of rotodynamic pumps and reciprocating pumps used in automotive application.	**3**
CO 5	Explain the working principles of turbines and select the type of turbine for particular application.	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Calculate the density, specific weight of one liter of petrol which has specific gravity of 0.7	**1**	**3**
2.	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 the dynamic viscosity of the oil in poise	**1**	**3**
3.	The capillary rise in the glass tube is not to exceed 0.2 mm of water. Determine its minimum size, given that surface tension for water in contact with air is 0.0725 N/m.	**1**	**3**
4.	What is the application of the continuity equation?	**1**	**2**
5.	Explain the terms: (i) Hydraulic gradient line and (ii) Totally energy line.	**2**	**2**
6.	List out the types of energy losses in the pipe.	**2**	**2**
7.	Sketch the velocity distribution and shear stress distribution across a section of the circular pipe.	**2**	**3**

8.	Differentiate laminar boundary layer flow and turbulent boundary layer flow.	**2**	**3**
9.	Compare Buckingham's Π theorem and Rayleigh's method, highlighting the former's efficiency in simplifying mathematical models and identifying relevant parameters while accounting for di mensionless groups.	**3**	**3**
10.	How the repeating variables are selected for dimensional analysis?	**3**	**2**
11.	Check whether the following equation is dimensionally homogeneous. $V = \sqrt{2gh}$	**3**	**3**
12.	What are the similarities between model and prototype?	**3**	**2**
13.	1. Elucidate four main differences between centrifugal pump and reciprocating pump?	**4**	**3**
14.	2. Obtain an expression for the work done by impeller of a centrifugal pump on water per second per unit weight of water.	**4**	**2**
15.	3. What is priming? Why is it necessary?	**4**	**2**
16.	4. Find an expression for the head lost due to friction in suction and delivery pipes.	**4**	**2**
17.	5. What do you mean by manometric efficiency and mechanical efficiency of a turbine?	**5**	**2**
18.	6. Distinguish between an Pelton turbine and Francis turbine.	**5**	**3**
19.	7. Obtain an expression for unit speed, unit discharge and unit power of a turbine.	**5**	**2**
20.	8. Write the equation for specific speed of turbine.	**5**	**2**

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	A flat plate of area 1.5 x 10^6 mm^2 is pulled with a speed of 0.4 m/s relative to another plate located at a distance of 0.15 mm from it. Find the force and power required to maintain this speed, if the fluid separating them is having viscosity as 1 poise.	**(10)**	**1**	**3**

(OR)

(b)	A 0.4 m diameter pipe conveying water, branches into two pipes of diameters 0.3 m and 0.2 m respectively. If the average velocity in the 0.4 m diameter pipe is 3 m/s. Find the discharge and mass flow rate in this pipe and also find the velocity in 0.2 m if the average velocity in 0.3 m diameter pipe is 2.5 m/s.	**(10)**	**1**	**3**
22. (a)	A horizontal pipe line 40 m long is connected to a water tank at one end and discharge freely in to the atmosphere at other end as shown in figure 1. 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 centre of the pipe. Consider the all minor loses. Find the discharge in the pipe. Take friction factor is 0.01 for both section.	**(10)**	**2**	**3**

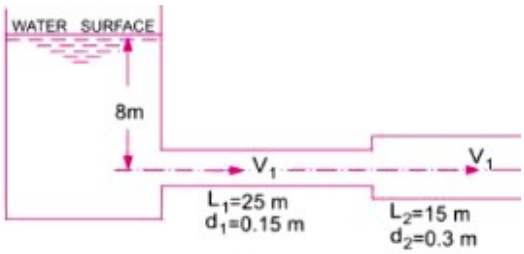

Figure 1

(OR)

(b)	Air is flowing over a flat plate 500 mm long & 600 mm wide; density of the fluid is 1.24 kg/m^3 with a velocity of 4 m/s. The kinematic viscosity of air is 0.15 x 10^{-4} m^2/s. Determine the 1. Boundary layer thickness 2. Shear stress at 200mm from the leading edge 3. Drag force on one side of the plate. Take velocity profile over the plate $\frac{u}{U} = \sin\left[\frac{\pi}{2}, \frac{y}{8}\right]$	**(10)**	**2**	**3**
23. (a)	The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5 N^2 \rho \, \phi\left[\frac{\mu}{D^2 N \rho}\right]$ Prove this by the method of dimensions.	**(10)**	**3**	**3**

(OR)

(b)	The ratio of lengths of a sub-marine and its model is 30:1. The speed of sub-marine (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 ratio of the drag (resistance) between the model and its prototype. Take the value of kinematic viscosities for sea water and air as 0.012 stokes and 0.016 stokes respectively. The density for sea-water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively.	**(10)**	**3**	**3**
24. (a)	The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 rpm. The vane angles of the impeller inlet and outlet are 20^0 and 30^0 respectively.The water enters the impeller radially and velocity of flow is constant. Find work done by the impeller per unit weight of water.	**(10)**	**4**	**3**
	(OR)			
(b)	The length and diameter of the delivery pipe are 30 m and 10 cm respectively and water is delivered by the pump to a tank which is 20 m above the centre of the pump. The pump has a plunger of diameter 15 cm and a stroke length of 35 cm. The atmospheric pressure head is 10.3 m of water and pump is running at 35 rpm. Determine the 1. Pressure head due to acceleration at the beginning of delivery stroke, 2. Pressure head in the cylinder at the beginning of the delivery stroke, and 3. Pressure head in the cylinder at the end of the delivery stroke	**(10)**	**4**	**3**
25. (a)	A Pelton wheel is to be designed for the following specification. shaft power is 11772 kW, head is 380 m, the speed of the turbine is 750 rpm and the overall efficiency of the Pelton wheel is 86%, jet diameter is not to exceed one sixth of the wheel diameter. Find 1.Wheel diameter; 2. No. of jet required; 3. Diameter of jet; take K_{v1}=0.985, K_{u1}=0.45.	**(10)**	**5**	**3**
	(OR)			
(b)	A Kaplan turbine under a head of 20 m develops 11772 kW shaft power. The outer diameter of the runner 3.5 m and hub diameter 1.75 m. The guide blade angle of the runner is 35^0. The hydraulic and overall efficiency are 88% & 84% respectively. If the velocity of the whirl is zero at the outlet. Find 1.	**(10)**	**5**	**3**

Runner vane angle at inlet and outlet 2. Speed of the turbine 3. Specific speed of the turbine.

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	Compare and contrast the working principles of lobe pump and vane pump, highlighting their respective advantages and limitations.	**(10)**	**4**	**3**

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