Q. Code:946399

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

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

Third Semester

AE18303 – FLUID MECHANICS AND HYDRAULIC MACHINES

(Automobile Engineering)

(Regulation 2018/2018A)

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(10x2=20Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	The surface tension of water in contact with air at 20°C is 0.0725 N/m. The pressure inside a droplet of water is to be 0.02 N/cm^2 greater than the outside pressure. Calculate the diameter of the droplet of water.	**1**	**3**
2.	Write an equation of the theoretical discharge for the Venturi meter.	**1**	**2**
3.	Write an equation of Darcy Weisbach's equation for the pipes.	**2**	**2**
4.	Sketch the velocity distribution and shear stress distribution across a section of the pipe.	**2**	**2**
5.	Check whether the following equation is dimensionally homogeneous. $Q = Cd \cdot a\sqrt{2gh}$	**3**	**3**
6.	Differentiate Reynold's number with Mach's number.	**3**	**3**
7. 1.	Elucidate four main differences between centrifugal pump and reciprocating pump?	**4**	**3**
8. 2.	Write an expression for the head lost due to friction in suction and delivery pipes.	**4**	**2**
9. 3.	Distinguish between an Francis turbine and Kaplan turbine.	**5**	**3**
10. 4.	Why is draft tube used in reaction turbine?	**5**	**2**

PART- B (5x 14=70Marks)

		Marks	CO	RBT LEVEL
11. (a)	Two large plane surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerine. What force is required to drag a very thin plate of	**(14)**	**1**	**3**

surface area 0.5 m^2 between the two large plane surfaces at a speed of 0.6 m/s. Find

(i) the thin plate is in the middle of the two plane surfaces, and

(ii) the thin plate is at a distance of 0.8 cm from one of the plane surfaces?

Take the dynamic viscosity of glycerine is 8.10 x 10^{-1} Ns/m^2.

(OR)

(b)	Water flows through a pipe AB 1.3 m diameter at 4 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.9 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.	**(14)**	**1**	**3**

12. (a)	A plate of 650mm length and 450mm wide is immersed in a fluid of specific gravity 0.9 and kinematic viscosity is $10^{-4}m^2/s$. The is moving with a velocity of 6 m/s. Determine the 1. Boundary layer thickness 2. Shear stress at the end of the plate 3. Drag force on one side of the plate.	**(14)**	**2**	**3**

(OR)

(b)	A pipe of diameter 20 cm and length 2000 m connects two reservoirs, having difference of water Levels as 20 m as shown in Figure 1. Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the 1200 m length of the existing Pipe, find the increase in the discharge. Take f = 0.015 and neglect the minor loss.	**(14)**	**2**	**3**

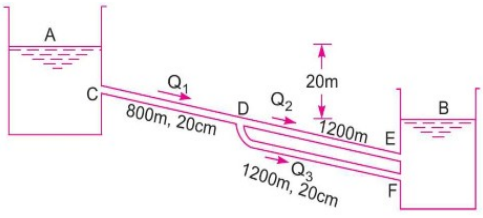

Figure 1

13. (a)	Using Buckingham's π – theorem, shown that the discharge Q consumed by an oil ring is given by	**(14)**	**3**	**3**

$$Q = Nd^3\phi\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{\rho N^2 d^3}, \frac{w}{\rho N^2 d}\right]$$

Where d is the internal diameter of the ring, N is rotational speed, ρ is density, μ is viscosity, σ is surface tension and w is the specific weight of oil.

(OR)

(b)	The characteristics of the spillway are to be studied by means of a geometrically similar model constructed to the scale ratio of 1:12. a) If the maximum rate of flow in the prototype is 30 m^3/s, what will be the corresponding flow in model? b) If the measured velocity in the model at a point on the spillway is 3.5 m/s, what will be the corresponding velocity in prototype? c) If the hydraulic jump at the foot of the model is 80 mm high, what will be the height of jump in prototype?	**(14)**	**3**	**3**
14. (a)	A centrifugal pump is running at 1000 rpm the output vane angle of the impeller is 45^0 and velocity of flow at outlet is 2.5 m/s. The discharge through the pump is 200 litres/sec when the pump is working against total head of 20 m. If the manometric efficiency is 80%. Find outer diameter of impeller the width of impeller at outlet.	**(14)**	**4**	**3**

(OR)

(b)	The cylinder bore diameter of a single - acting reciprocating pump is 150 mm and its stroke is 300 mm. The pumps runs at 50 rpm and lifts water through a height of 25 m. The delivery pipe is 22 m long and 100 mm in diameter. Find the theoretical discharge and the theoretical power required to run the pump. If the actual discharge is 4.2 litres/sec. Find the percentage of slip. Also determine the acceleration head at the beginning and middle of the delivery stroke.	**(14)**	**4**	**3**
15. (a)	A Pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 litres/sec, under a head of 30 m.The buckets deflects the jet through a angle of 160^0 . Calculate the power by water to the runner and the hydraulic efficiency of turbine. Assume co-efficient of velocity is 0.98.	**(14)**	**5**	**3**

(OR)

(b)	A Kaplan turbine is to be designed to develop 9500 kW. The net available head is 6 m. If the speed ratio is 2.5 and the flow ratio is 0.7, overall efficiency is 90% and the diameter of the boss is one third of the diameter of the runner. Find the diameter of the runner, its speed and specific speed of the turbine.	**(14)**	**5**	**3**

PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Explain the working principle of a reciprocating pump and discuss its advantages and limitations compared to other types of pumps.	**(10)**	**4**	**2**