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

B. E / B. TECH.DEGREE EXAMINATIONS, MAY 2023

Third Semester

AE18303 – FLUID MECHANICS AND HYDRAULIC MACHINES

(Automobile Engineering)

(Regulation 2018A)

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

CO1 Describe the fluids in static, kinematic and dynamic equilibrium.
CO2 Analyze the applicability of physical laws in addressing problems of hydraulics.
CO3 Apply dimensional analysis and modeling to describe fluid properties and dimensionless quantities.
CO4 Critically analyze the performance of rotodynamic pumps and reciprocating pumps used in automotive application
CO5 Explain the working principles of turbines and select the type of turbine for particular application.

PART- A(10x2=20Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Define specific weight and specific gravity.	1	1
2.	What is the difference between dynamic viscosity and kinematic viscosity?	1	2
3.	What do you understand by the terms of boundary layer and boundary layer thickness?	2	2
4.	Differentiate laminar flow and turbulent flow.	2	2
5.	Explain the term, 'dimensionally homogenous equation'.	3	2
6.	Define Reynold's number and Mach's number.	3	1
7.	What do you mean by manometric efficiency and mechanical efficiency of a centrifugal pump?	4	2
8.	Compare between centrifugal pump and reciprocating pump.	4	2
9.	How will you classify the turbines?	5	2
10.	Distinguish between an inward and an outward flow reaction turbine.	5	2

PART- B (5x 14=70Marks)

			Marks	CO	RBT LEVEL
11. (a)	(i)	A plate, 0.025 mm distant from a fixed plate, moves at 60 cm/s and requires a force of 2 N per unit area to maintain this speed. Determine the fluid viscosity between the plates.	(07)	1	3
	(ii)	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 1poise.	(07)	1	3

(OR)

(b)		A 0.3 m diameter pipe conveying water, branches into two pipes of diameters 0.2 m and 0.15 m respectively. If the average velocity in the 0.3 m diameter pipe is 2.5 m/s. Find the discharge and mass flow rate in this pipe and also find the velocity in 0.15 m diameter pipe if the average velocity in 0.2 m diameter pipe is 2 m/s.	(14)	1	3
12. (a)	(i)	Air is flowing over a flat plate 500 mm long and 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. Find 1. Boundary layer thickness 2. Shear stress at 200 mm from the leading edge 3. Drag force on one side of the plate. Take velocity profile over the plate $\frac{u}{U} = \sin\left[\frac{\pi}{2}, \frac{y}{8}\right]$	(14)	2	3

(OR)

(b)	(i)	A main pipe divides into two parallel pipes which again forms one pipe as shown in figure 1. The length and diameter for the first parallel pipe are 2000 m and 1 m respectively, while the length & diameter of 2nd parallel pipe are 2000 m and 0.8 m, find the rate of flow in each pipe, if total flow in the main 3 m^3/s. The co-efficient of friction for all pipe is 0.005.	(14)	2	3

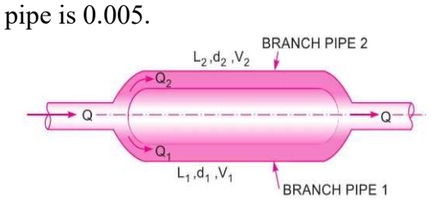

Figure 1

13. (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 $T = D^5N^2\,\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. Prove this by the method of dimensions.	(14)	3	3

(OR)

(b)		A spillway model is to be built a geometrically similar scale 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 on the 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?	(07)	3	3

Q. Code: 627201

14. (a)	A centrifugal pump having outer diameter of 400 mm and outlet width of 50 mm is running at 800 rpm. Works against a total head of 15 m. The vanes angle outlet is 40^0 and manometric efficiency is 0.75. Find 1. Velocity of the flow at outlet 2. Velocity of water leaving 3. Discharge of the flow, 4. Angle made by absolute velocity at outlet.	**(14)**	**4**	**3**
	(OR)			
(b)	**(i)** A single acting reciprocating pump, running at 50 r.p.m., delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length 400mm. Determine: (i) The theoretical discharge of the pump, (ii) Co-efficient of discharge, and (iii) Slip and the percentage slip of the pumps	**(07)**	**4**	**3**
	(ii) A double-acting reciprocating pump, running at 40 r.p.m., delivers 1 m^3/min. The pump has a stroke of 400 mm. The diameter of the piston is 200 mm. The delivery and suction head are 20 m and 5 m respectively. Find the slip of the pump and power required to drive the pump.	**(07)**	**4**	**3**
15. (a)	A Pelton wheel is receiving water from a penstock with a gross head of 510 m. one-third of gross head is lost in friction in the penstock. The rate of flow through the nozzle fitted at the end of the penstock is 2.2 m^3/s. The angle of deflection of the jet is 165^0. Take speed ratio is 0.45 and coefficient of velocity is 0.98. Determine the power given by water to the runner and also hydraulic efficiency of the Pelton wheel.	**(14)**	**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% and 84% respectively. If the velocity of the whirl is zero at the outlet. Find 1. Runner vane angle at inlet and outlet 2. Speed 3. Specific speed.	**(14)**	**5**	**3**

PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Explain the working of the following pumps with the help of neat sketches and mention two applications of each. (i) External gear pump (ii) Lobe pump (iii) Vane pump	**(10)**	**4**	**2**

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