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

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

Fourth Semester

ME18405 –FLUID MECHANICS AND MACHINERY

(Mechanical Engineering)

(Regulation 2018/2018A)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Students will understand the basic knowledge of properties and characteristics of fluids.	**4**
CO 2	Students will apply the physical laws in solving the problems in hydraulics.	**4**
CO 3	Students will perform dimensional and model analysis.	**4**
CO 4	Students will evaluate the performance of roto dynamic pumps and reciprocating pumps.	**4**
CO 5	Students will determine the performance of turbines and select the type of turbine for an application.	**4**

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	If the relative density of a fluid is 1.59, calculate its mass density, specific weight and specific volume.	**1**	**3**
2.	Convert intensity of pressure of 2 MPa into equivalent pressure head of oil of specific gravity 0.8.	**1**	**3**
3.	Sketch the development of boundary layer over a flat plate.	**2**	**3**
4.	Does the friction f remain constant during all flows.? If not, how does it change?	**2**	**3**
5.	Check the following equation is dimensionally homogeneous: Q = AV	**3**	**3**
6.	Cite a few examples where Reynold's model law is applied.	**3**	**3**
7.	What do you mean by Priming in centrifugal pumps? Why is it necessary?	**4**	**3**
8.	Why actual discharge be greater than theoretical discharge in a reciprocating pump?	**4**	**3**
9.	What is cavitation? How can it be avoided in a reaction turbine?	**5**	**2**
10.	Define Specific Speed and unit speed of a turbines.	**5**	**1**

PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	Two large Plane Surfaces are 150 mm apart. The Space between the surfaces is filled with oil of viscosity 0.972 Ns/m^2 . A flat thin plate of 0.05 m^2 area moves through the oil at velocity of 0.3 m/sec.Calculate the drag force. (i) When the plate is in the middle of the two plane surfaces and (ii) When the plate is at a distance of 30 mm from one of the planes.	**(14)**	**1**	**4**
	(OR)			
(b)	The inlet and throat diameters of a horizontal venturimeter are 200 mm and 100 mm respectively. The liquid flowing through the venturimeter is water. The pressure at inlet is 120 kPa while the vaccum pressure head at the throat is 150 mm of mercury. Find the coefficient of discharge. Assume that 3.33 % of the differential head is lost between the inlet and throat. Find also the rate of flow.	**(14)**	**1**	**4**
12. (a)	Derive Darcy-Weisbach formula for calculating loss of head due to friction in a pipe.	**(14)**	**2**	**3**
	(OR)			
(b)	Three Pipes of diameters 300 mm ,200 mm and 400 mm and lengths 450 m,255 m and 315 m respectively, are connecting two tanks. The difference in water surface levels in the two tanks is 18m. Determine the rate of flow of water, if coefficients of friction are 0.0075,0.0078,and 0.0072 respectively considering (i) minor losses and (ii) Neglecting minor losses	**(14)**	**2**	**3**
13. (a)	Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust **P** depends upon the angular velocity **ω** ,speed of advance **V**,diameter **D**,dynamic viscosity **μ**,mass density **ρ,**elasticity of the fluid medium which can be denoted by the speed of sound in the medium **C**.	**(14)**	**3**	**3**
	(OR)			
(b)	What do you mean by model analysis? Discuss the various laws on which models are designed for dynamic similarity.	**(14)**	**3**	**3**

14. (a)	The internal and external diameter of an impeller of a centrifugal pump which is running at 1000 r.p.m are 200 mm and 400 mm respectively. The discharge through pump is 0.04 m^3/s and velocity of flow is constant and equal to 2.0 m/s. The diameters of the suction and delivery pipes are 150 mm and 100 mm respectively and suction and delivery heads are 6m and 30 m of water respectively. If the outlet vane angle is 45˚ and power required to drive the pump is 16.186 kW, determine (i) Vane angle of the impeller at inlet (ii) The overall efficiency of the pump and (iii) Manometric efficiency of the pump.	**(14)**	**4**	**4**
	(OR)			
(b)	**(i)** Discuss the working principle of following two gear pumps with neat sketch (i) Internal gear pump (ii) External gear pump	**(7)**	**4**	**3**
	(ii) Describe the function of the air vessel for reciprocating pumps.	**(7)**	**4**	**3**
15. (a)	A Pelton wheel is working under a gross head of 400 m. The water is supplied through penstock of diameter 1 m and length 4 km from reservoir to the Pelton wheel. The co-efficient of friction for the penstock is given as 0.008. The jet of water of diameter 150 mm strikes the buckets of the wheel and gets deflected through an angle of 165˚.The relative velocity of water at outlet is reduced by 15% due to friction between inside surface of the bucket and water. If the velocity of the buckets is 0.45 times the jet velocity at inlet and mechanical efficiency as 85% determine (i)power given to the runner, (ii) Shaft power, (iii) Hydraulic efficiency and overall efficiency.	**(14)**	**5**	**4**
	(OR)			
(b)	An inward flow reaction turbine has an external diameter of 1m and its breadth at inlet is 200 mm. If the velocity of flow at inlet is 1.5 m/s, find the mass of water passing through the turbine per second. Assume 15% of the area of flow is blocked by blade thickness. If the speed of the runner is 200 r.p.m and guide blades make an angle of 15° to the wheel tangent, draw the inlet velocity triangle and find (i) The runner vane angle at inlet (ii) Velocity of wheel at inlet (iii) The absolute velocity of water leaving the guide vanes and (iv) The relative velocity of water entering the runner blade.	**(14)**	**5**	**4**

PART- C (1 x 10 = 10 Marks)
(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	An axial flow reaction turbine (vanes on the hub are adjustable) working under a head of 20 m develops 15 MW brake power. The hub diameter and runner diameter of the turbine are 1.5 m and 4 m respectively. The guide blade angle at the inlet is 30°, Hydraulic efficiency 0.9 and overall efficiency 0.8. The discharge is radial. Find the runner vane angles and turbine speed.	**(10)**	**5**	**4**

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