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C037513(037)

B. Tech. (Fifth Semester) Examination, Nov.-Dec. 2021

AICTE (~~New~~ Scheme)

(Mech. Engg. Branch)

FLUID MACHINES

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

***Note** : Attempt all questions. From each question part (a) is compulsory and carries 4 marks and attempt any **two** parts from (b), (c) and (d) each carries 8 marks.*

Unit-I

1. (a) Define boundary layer and boundary thickness. 4

   (b) Derive an expression for Von-Karman momentum equation for boundary layer flow. 8

(c) A plate 450 mm × 150 mm has been placed longitudinally in a steam of crude oil (specific gravity 0·925 and kinematic viscosity of 0·9 stoke) which flows with velocity of 6 m/s. Calculate : 8

(i) The friction drag on the plate

(ii) Thickness of the boundary layer at the trailing edge, and

(iii) Shear stress at the trailing edge.

(d) A kite weighing 9.8 N having an area 1 m^2 make an angle of 7° to the horizontal when flying in a wind of 36 km/h. If pull on the string attached to the kite is 49 N and it is inclined to the horizontal at 45°. Calculate the lift and drag coefficients for the kite in the given position. Take density of air is 1·2 kg/m^3. 8

Unit-II

2. (a) Derive the forece exerted on a stationary flat plate held normal to the jet. Explain with proper diagram. 4

(b) A jet of water from a nozzle is deflected through 60° from its original direction by curved plate which it enters tangentially without shock with a velocity of 30 m/s and leaves with a mean velocity of 25 m/s. If the discharge from the nozzle is 0·8 kg/s, calculate

the magnitude and direction of the resultant force on the vane, if the vane is stationary. 8

(c) A stationary vane having an inlet angle 0° and outlet angle 25° receives water at velocity 50 m/s. determine the components of force acting on it in the direction of jet velocity and normal to it. Also find magnitude and direction per kg of flow. 8

(d) A pelton wheel is to be designed for the following specifications : 8

Power (brake of shaft)	=	9560 kW
Head	=	35 metres
Speed	=	750 r.p.m.
Overall efficiency	=	85%
Jet dimeter	=	not to exceed $1/6^{th}$ of the wheel diameter

Determine the following :

(i) The wheel diameter,

(ii) Diameter of the jet, and

(iii) The number of jets required.

Take C_v (Co-efficient of velocity) = 0·985, Speed ratio = 0·45

Unit-III

3. (a) What are tubular or bulb turbine? 4

(b) An inward flow reaction turbine has external and internal diameters as 1·08 and 0·54 m. The turbine is running at 200 r.p.m. The width of the turbine at inlet is 240 mm and velocity of flow through the runner is constant and is equal to 2·16 m/s. The guide blades make an angle of 10° to the tangent of the wheel and discharge at the outlet of the turbine is radial. Draw the inlet and outlet velocity triangles and determine : 8

(i) The absolute velocity of water at inlet of the runner,

(ii) The velocity of whirl at inlet,

(iii) The relative velocity at inlet,

(iv) The runner blade angles,

(v) Width of runner at outlet.

(c) A kaplan turbine develops 22000 kW at an average head of 35 m. Assuming a 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 88%, calculate the diameter, speed and specific speed of the turbine. 8

(d) Show that in a turbine, with radial vanes at inlet and outlet, the hydraulic efficiency is given by :

$$\eta = \frac{2}{2 + \tan^2 \alpha}$$

Assuming the velocity of flow is remaining constant. 8

Unit-IV

4. (a) Define cavitation phenomenon in centrifugal pump. 4

(b) Draw a neat sketch of centrifugal pump and explain how it operates. 8

(c) Explain the following efficiencies of a centrifugal pump.

(i) Manometric efficiency

(ii) Volumetric efficiency

(iii) Mechanical efficiency

(iv) Overall efficiency 8

(d) A centrifugal pump is to discharge 0·118 m^3/s at a speed of 1450 r.p.m. against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75 percent. Determine the vane angle at the outer periphery of the impeller. 8

Unit-V

5. (a) Define slip, percentage of slip and negative slip of reciprocating pump. 4

(b) With neat and clean figure explain the "Indicator Diagram". 8

(c) Define the main components and working of reciprocating pump. 8

(d) A single-acting reciprocating pump, running at 50 r.p.m. and delivers 0·00736 m^3/s of water. The diameter of the piston is 200 mm and stroke length 300 mm. The suction and delivery heads are 3·5 m and 11·5 respectively. Determine :

(i) Theoretical discharge

(ii) Co-efficient of discharge

(iii) Percentage slip of the pump, and

(iv) Power required to run the pump. 8