Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree (S,FE) Examination December 2022 (2015 scheme)

Course Code: ME200

Course Name: FLUID MECHANICS AND MACHINERY

Max. Marks: 100 Duration: 3 hours

PART A

Answer any three full questions, each carries 10 marks. Marks

1 a) Compare surface tension in liquid droplet, hollow bubble and liquid jet. (5)

b) Viscosity of an oil is 7.5 poise. It is used for the lubrication between a shaft and sleeve. The diameter of the shaft is 0.7 m. It is rotating at a speed of 200 rpm. Calculate the power lost in oil for a sleeve length of 120 mm. The thickness of oil film is 1.5 mm. (5)

2 a) Illustrate Newtonian fluid, compressible fluid and real fluid. (5)

b) Calculate the density, specific volume, specific weight and weight of 2 litre of petrol of specific gravity = 0.7. (5)

3 With neat sketches, illustrate and prove Pascal's Law. (10)

4 The bottom portion of a vessel is curved like a quarter of a circle. The radius of the curved portion is 3 m. It is filled with water. The level of liquid in the vessel is 5 m (includes the radius of the curved portion). Compute the horizontal and vertical components of the total force acting on the curved surface. Take the width of the curved surface as unity. (10)

PART B

Answer any three full questions, each carries 10 marks.

5 a) Illustrate various fluid flows with example. (5)

b) A 40 cm diameter pipe, conveying water, branches in to two pipes of diameters 25 cm and 20 cm respectively. If the average velocity in the 40 cm diameter pipe is 3 m/s, find the discharge through it. Also determine the velocity in the 20 cm pipe, if the average velocity in the 25 cm diameter pipe is 3 m/s. (5)

6 a) With neat sketches, derive Bernoulli's equation. (5)

b) A fluid flow field is given by $V= x^2y\ i+y^2z\ j-(2xyz+yz^2)\ k$. Prove that the equation represents a steady incompressible flow. Also calculate the velocity of the flow. (5)

7 a) With neat sketches, illustrate the basic concepts on Boundary layer theory. (5)

b) The velocity of air flowing over a smooth plate is 20 m/s. The length and width of the plate are 2m and 1m. If laminar boundary layer exists up to a value of $R_e = 2.5 \times 10^5$, find the maximum distance from the leading edge up to which laminar boundary layer exists. Find the maximum thickness of laminar boundary layer if the velocity profile is given by $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$, Take kinematic viscosity for air = 0.15 stokes. (5)

8 The inlet diameter of a venturimeter is 25 cm. Its throat diameter is 15 cm. An oil of specific gravity equal to 0.75 is flowing through this. The oil-mercury differential manometer shows a reading of 30 cm. Calculate the discharge of oil through this horizontal venturimeter. Take $C_d = 0.96$. (10)

PART C

Answer any four full questions, each carries 10 marks.

9 Compare impact of jet centrally on a moving flat and curved plate. (10)

10 For a Pelton wheel, the head at the base of the nozzle is 100 m. Diameter of the jet is 120 mm. Discharge of the nozzle is 0.40 m^3/s. Power at the shaft is 220 kW. Power absorbed in mechanical resistance is 5 kW. Determine the power lost in the nozzle and the power lost due to hydraulic resistance in the runner. (10)

11 Draw neat sketch showing constructional details of a reaction turbine. (10)

12 a) Compare the performance of single acting and double acting reciprocating pump. (5)

b) The cylinder of a single-acting reciprocating pump is 20 cm in diameter and has a stroke of 40 cm. The pump is running at 40 rpm and discharges water to a height of 15 m. The diameter and length of the delivery pipe are 10 cm and 30 m respectively. If a large air vessel is fitted in the delivery pipe at a distance of 2.5 m from the centre of the pump, find the pressure head in the cylinder (i) at the beginning of the delivery stroke (ii) in the middle of the delivery stroke. Take f =0.01. (5)

13 a) Illustrate the effects of slip in reciprocating pump. (5)

b) Diameter of a piston in a single acting reciprocating pump is 250 mm. It is running at a speed of 70 rpm. Discharge of the pump is 3 m^3/s. The stroke length is 450 mm. Determine slip and the percentage slip in the pump. (5)

14 a) With neat sketches, illustrate various heads in a centrifugal pump. (5)

b) The outer and inner diameters of the impeller in a centrifugal pump are 500 mm and 250 mm respectively. The pump discharges 0.18 m^3/s of water against a head of 13 m. The speed of the impeller is 650 rpm. The vanes are bent back at 35^0 to the tangent at exit. If the area of flow remains 0.08 m^2 from inlet to outlet, calculate manometric efficiency of pump and the vane angle at inlet. (5)

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