B.Tech Odd Semester (CBCS) Exam., December—2018

AGRICULTURAL ENGINEERING

(3rd Semester)

Course No. : AECC–01

(Fluid Mechanics)

Full Marks : 50
Pass Marks : 15

Time : 2 hours

Note : 1. Answer *any* **five** questions.
2. Begin each answer in a new page.
3. Answer parts of a question at a place.
4. Assume reasonable data wherever required.
5. The figures in the right-hand margin indicate full marks for the questions.

1. *(a)* Write Euler's equation of motion along a stream line and integrate it to obtain Bernoulli's equation and list the assumptions made. 5

(b) Explain the surface tension and obtain the expression between surface tension and pressure inside the liquid droplet in excess of outside pressure. 5

2. *(a)* Find the gauge pressure and absolute pressure in N/m^2 at a point 4 m below the free surface of a liquid of sp. gravity 1·2, if the atmosphere pressure is equivalent to 750 mm of mercury. 5

(b) Derive an expression for discharge over a rectangular weir in terms of head of water over the crest of the weir. 5

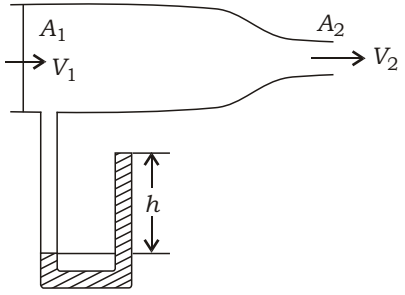
3. A circular plate of 1 m diameter is immersed in water in such a way that its plane makes an angle of 30° with the horizontal and its top edge is 1·25 m below the water surface. Find the total pressure on the plate and the point where it acts. 10

4. *(a)* Oil flows in a pipe 100 mm bore with a Reynolds number of 250. The dynamic viscosity is 0·018 Ns/m^2. The density is 900 kg/m^3. Determine the pressure drop per metre length, the average velocity and the radius at which it occurs. 4

(b) A cylinder 80 mm diameter and 200 mm long is placed in a stream of fluid flowing at 0·5 m/s. The axis of the cylinder is normal to the direction of flow. The density of the fluid is 800 kg/m^3. The drag force is measured

and found to be 30 N. Calculate the drag coefficient at a point on the surface the pressure is measured as 96 Pa above the ambient level. Calculate the velocity at this point. 6

5. A U-tube manometer containing water is connected to a nozzle of an air tunnel that discharges to the atmosphere as shown in the figure. The area ratio is A_2 / A_1 0 25. For given operational conditions, the level difference in the manometer is h 94 mm. Take the water density 1000 kg / m^3 and the air density $_{air}$ 1 23 kg / m^3 :



(a) What is the average air velocity at the nozzle exit, V_2?

(b) Schematically draw the longitudinal pressure distribution along the nozzle.

(c) Describe the pressure distribution in the nozzle exit. 10

6. An oil of viscosity 5 poise is used for lubrication between a shaft and a sleeve. The diameter of the shaft is 0·5 m and rotates at 200 r.p.m. Calculate the power lost in the oil for a sleeve length of 100 mm. The thickness of the oil film is 1·0 mm. 10

7. Water at 40 °F (62 42 lbm / ft^3 and 1 038 10^3 lbm / ft . *s*) is flowing through a 0 12 (0·010 ft) diameter 30 ft long horizontal pipe steadily at an average velocity of 3·0 ft/s. Determine *(a)* the head loss, *(b)* the pressure drop, and *(c)* the pumping power requirement to overcome this pressure drop. 10

8. Using Buckingham's theorem, deduce an expression for the relationship of the effect on pressure drop (*P*) of the variables *d*, *L*, *p*, and *v*. 10

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