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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech III Semester End Examinations (Supplementary) - February, 2018

Regulation: IARE – R16

## FLUID MECHANICS AND HYDRAULICS

(Aeronautical Engineering)

Time: 3 Hours

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

### UNIT – I

1. (a) Define density, weight density, specific volume and specific gravity of fluid. [7M]
- (b) Find the volume of the water displaced and position of center of buoyancy for a wooden block of width 2.5 m and of depth 1.5 m, when it floats horizontally in water. The density of wooden block is  $650 \text{ kg/m}^3$  and its length 6.0 m. [7M]
2. (a) Define surface tension. Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by  $p = \frac{4\sigma}{d}$ . [7M]
- (b) The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which liquid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm. [7M]

### UNIT – II

3. (a) Differentiate between stream function and velocity potential function. [7M]
- (b) A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s. [7M]
4. (a) Define Stream line , Path line and Streak line. [7M]
- (b) A vertical cylinder 300mm in diameter is fitted at the top with a tight but frictionless piston and filled with water at  $70^0 \text{ C}$  as shown in Figure 1. The outer portion of the piston is exposed to atmospheric pressure of 101.3 kPa. Calculate the minimum force applied on the piston that will cause water to boil at  $70^0 \text{ C}$ . Take Vapor pressure of water at  $70^0 \text{ C}$  as 32k Pa. [7M]

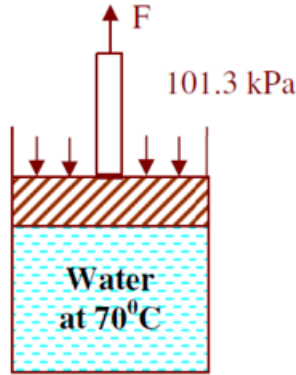


Figure 1

### UNIT – III

5. (a) Develop Euler's equation of motion and obtain Bernoulli's equation from it? [7M]
- (b) A horizontal venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the rate of flow. Take  $C_d = 0.98$ . [7M]
6. (a) Explain Vortices, Irrotational flow and compressible flows. [7M]
- (b) Explain about Venturi meter and Orifice tube. [7M]

### UNIT – IV

7. (a) What is meant by laminar boundary layer and turbulent boundary layer. [7M]
- (b) Define Froude Number and state its applications. [7M]
8. (a) Explain Reynolds's experiment with neat sketch and explain how to determine laminar and turbulent flows. [7M]
- (b) Show that the difference of pressure head for a given length of the two parallel plates which are fixed and through which viscous fluid is flowing is given by [7M]

$$h_f = \frac{12\mu u L}{\rho g t^2}$$

### UNIT – V

9. (a) Explain the classification of turbo machines with neat a sketch. [7M]
- (b) A turbine stage with a rotational speed of 3000 rpm is to be designed with an absolute inlet angle of  $-60^\circ$  and an absolute exit angle of  $-60^\circ$  at a mean radius of 0.4 m. The machine is to be designed for a constant axial velocity of 450 m/sec. Estimate the specific work from this stage. [7M]
10. (a) What are the reasons for minor losses in pipes? Give the appropriate formula to calculate the losses. [7M]
- (b) Define impulse momentum and derive the momentum equation. [7M]