53 (CE 303) FLMC

2015

FLUID MECHANICS

Paper : CE 303

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions*

1. *(a)* Set a relation between Absolute, Gauge, atmospheric and vacuum pressures along with the definition of each type of the pressure. 8

   (b) What are the gauge pressure and absolute pressure at a point $3m$ below the free surface of a liquid having a density of $1{\cdot}53\times10^3\,kg/m^3$ if the atmospheric pressure is equivalent to $750mm$ of mercury ? The specific gravity of mercury is 13·6 and density of water is $1000\,kg/m^3$. 12

2. Discuss properties of fluid in detail. A plate is 0·025mm distant from a fixed plate, moves at 60cm/s and requires a force of 2N per unit area, i.e. $2N/m^2$ to maintain this speed. Determine the fluid viscosity between the plates. 12+8

3. *(a)* Differentiate between notches and weirs. Classify notches and weirs in different categories. 10

(b) Determine the height of a rectangular weir of length 6m to be built across a rectangular channel. The maximum depth of water on the upstream side of the weir is 1·8m and discharge is 2000l/s. Take $C_d = 0·6$ and neglect end contractions. 10

4. *(a)* What is meant by dimensional homogeneity. Illustrate with example. 3

(b) State Buckingham's theorem. The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. 2+15

5. *(a)* Discuss continuity equation and derive for the equation $A_1V_1 = A_2V_2$, where symbols have their usual meaning. 6

(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 $2 \cdot 5 m/s$, find the discharge in this pipe. Also determine the velocity in 15*cm* pipe if the average velocity in 20*cm* diameter pipe is $2 m/s$. 14

6. *(a)* Derive Bernoulli's equation from Euler's equation of motion. Also list out the assumptions made in the derivation of Bernoulli's equation. 4+2

(b) A pipe of diameter 400*mm* carries water at a velocity of $25 m/s$. The pressure at the points *A* and *B* are given as $29 \cdot 43 N/cm^2$ and $22 \cdot 563 N/cm^2$ respectively while the datum head at *A* and *B* are 28*m* and 30*m*. Find the loss of head between *A* and *B*. 14

7. *(a)* What are the general practical applications of Bernoulli's equation? Discuss *at least about two* of them. 10

(b) A horizontal venturimeter with inlet diameter 20*cm* and throat diameter 10*cm* is used to measure the flow of oil of specific gravity 0·8. The discharge of oil through venturimeter is 60*l*/*s*. Find the reading of the oil-mercury differential manometer. Take $C_d = 0{\cdot}98$. 10