2014

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 out of **seven**.

1. *(a)* What is meant by dimensional Homogeneity ? Illustrate with any example.

    3

    (b) State Buckingham's theorem. The efficiency η of a fan depends on density ρ_1, dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge δ. Express η in terms of dimensionless parameters.   1+16

Contd.

2. *(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 2·5 *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

3. *(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 29·43 N/cm^2 and 22·563 N/cm^2 respectively while the datum head of A and B are 28*m* and 30*m*.

Find the loss of head between A and B. 14

4. *(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 sp. gr. 0·8. The discharge of oil through venturimeter is 60l/s. Find the reading of the oil-mercury differential manometer. Take $C_d = 0.98$. 10

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

(b) Determine the height of a rectangular weir of length 6*m* to be built across a rectangular channel. The maximum depth of water on the upstream side of the weir is 1·8*m* and discharge is 2000l/s. Take $C_d = 0.6$ and neglect end contractions. 10

6. Discuss properties of fluid in detail. A plate 0·025*mm* 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

7. *(a)* Set a relation between Absolute, Gauge, atmospheric and vacuum pressures along with the definition of each type of the pressures. 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 $1.53 \times 10^3 \, kg/m^3$ if the atmospheric pressure is equivalent to $750mm$ of mercury ? The specific gravity of mercury is 13.6 and density of water = 1000 kg/m^3. 12