Faculty of Engineering & Technology

Third Semester B.E. (Mechanical Power Engg.)

(C.B.S.) Examination

FLUID MECHANICS

[Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

1) All questions carry marks as indicated

2) Solve any SIX questions as follows

Q No 1 OR Q No 2

Q No 3 OR Q No 4

Q No 5 OR Q No 6

Q No 7 OR Q No 8

Q No 9 OR Q No 10

Q No 11 OR Q No 12

3) Use of programmable calculator is prohibited

4) Figures to the right indicate full marks

5) Assume suitable data wherever necessary

1. (a) Explain the following terms briefly :

(i) Surface Tension

(ii) Bulk Modulus. 6

(b) Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8 m × 0.8 m and an inclined plane with angle of inclination 30° as shown in Fig. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm.

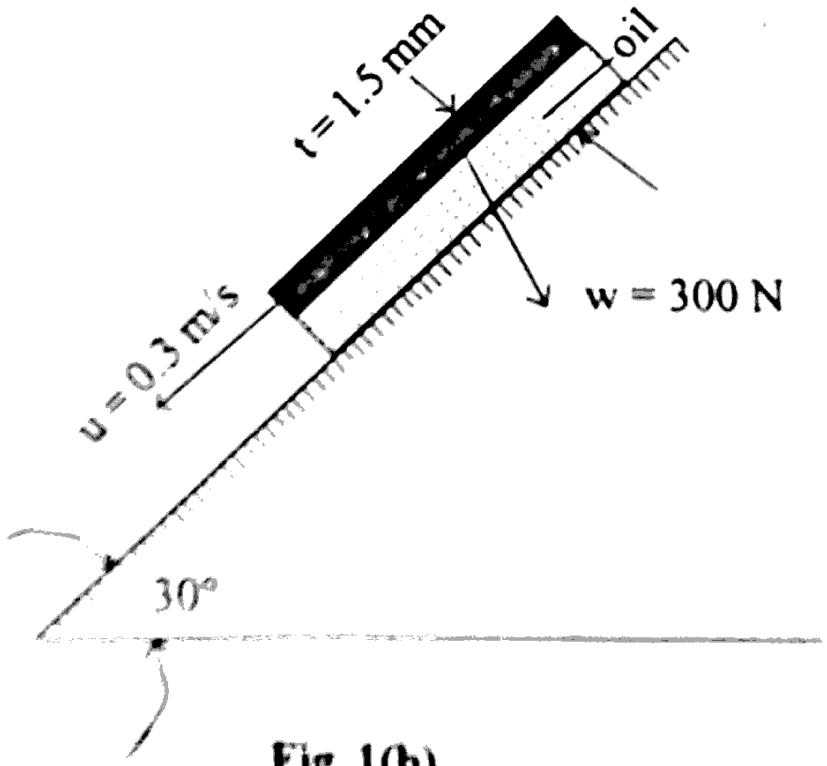

Fig. 1(b) 7

OR

2 (a) Explain the following terms with example :

(i) Uniform and Non-uniform flow

(ii) One, two and three-dimensional flow. 6

(b) The following cases represent the two velocity components, determine the third component of velocity such that they satisfy the continuity equation.

(i) $u = x^3 + y^2 + z^2$; $v = xy^2 - yz^2 + xy$

(ii) $v = 2y^2$; $w = 2xyz$. 7

3. (a) What is the "Hydrostatic Law" ? Derive its equation. 6

(b) A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-Tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. 7

OR

4. (a) A solid cylinder of diameter 4.0 m has a height of 4.0 m. Find the meta-centric height of the cylinder if the specific gravity of the material of cylinder = 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. 7

(b) Explain the stability of sub-merged bodies with neat figures. 6

5. (a) Derive the expression for Bernoulli's equation with Euler's equation of motion. 7

(b) An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. 7

OR

6. (a) An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Co-efficient of discharge for the orifice meter is given as 0.6. Find the discharge of water through pipe. 7

(b) Derive the expression of pitot tube for measuring the velocity. Also sketch different arrangement of pitot tube. 7

7. (a) What power is required per kilometer of a line to overcome the viscous resistance to the flow of glycerine through a horizontal pipe of diameter 100 mm at the rate of 10 liter/sec ? Take μ = 8 poise and Kinematic viscosity (ν) = 6.0 stokes. 7

(b) Derive Darcy-Weisbach equation, for major losses in pipe. 6

OR

8. (a) The time period (t) of a pendulum depends upon the length (h) of the pendulum and acceleration due to gravity (g). Derive an expression for the time period by using Rayleigh's Method. 6

(b) Using Buckingham's π-Theorem, show that the resisting force (R) of supersonic plane during flight is given by :

$$R = \rho l^2 v^2 \phi \left[\frac{\mu}{lv\rho}, \frac{K}{v^2\rho} \right] \text{ where,}$$

l = length of aircraft, v = velocity,

μ = air viscosity, ρ = air density and

K = Bulk Modulus of air. 7

9. (a) Calculate the discharge through a pipe of diameter 200 mm, when the difference of pressure head between the two ends of a pipe 500 m apart is 4 m of water. Take the value of 'f' = 0.009 in the formula $h_f = \frac{4fLv^2}{2gd}$. 6

(b) Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the centre of the pipe. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4.f.L.v^2}{d \times 2g}$. Draw the Hydraulic Gradient Line (H.G.L.) and Total Energy Line (T.E.L.). 7

OR

10. (a) Derive the expression for power transmission through pipe. 6

(b) A pipe line of length 2000 m is used for power transmission. If 110.3625 kW power is to be transmitted through the pipe in which water having a pressure of 490.5 N/cm² at inlet is flowing.

Find the diameter of the pipe and efficiency of transmission if the pressure drop over the length of pipe is 98.1 $\frac{N}{cm^2}$. Take f = 0.0065. 7

11. (a) Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by,

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2.$$ 7

(b) A flat plate 1.5 m × 1.5 m moves at 50 km/hour in stationary air of density 1.15 kg/m³. If the coefficients of drag and lift are 0.15 and 0.75 respectively, determine :

(i) The lift force

(ii) The drag force

(iii) The resultant force

(iv) Power required to keep the plate in motion. 7

OR

12. Write short notes on (any **three**) :

(i) Drag and Lift

(ii) Streamline and Bluff Body

(iii) Pressure Drag and Friction Drag

(iv) Boundary Layer Concept. 14