SRK/KW/14/6947/6973

Faculty of Engineering & Technology
Third Semester B.E. (Mech./Power Engg.) (C.B.S.)
Examination
FLUID MECHANICS

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Solve **SIX** questions as follows :

Que. No. **1** **OR** Que. No. **2**

Que. No. **3** **OR** Que. No. **4**

Que. No. **5** **OR** Que. No. **6**

Que. No. **7** **OR** Que. No. **8**

Que. No. **9** **OR** Que. No. **10**

Que. No. **11** **OR** Que. No. **12**

(3) Due credit will be given to neatness and adequate dimensions.

(4) Illustrate your answers wherever necessary with the help of neat sketches.

(5) Use of Drawing instruments is permitted.

(6) Use of Non programmable Calculator is permitted.

(7) Assume suitable data wherever necessary.

1. (a) Two large plane surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerine. What force is required to drag a very thin plate of surface area 0.5 square metre between the two large plane surfaces at a speed of 0.6 m/sec. if (i) the thin plate is in the middle of the two plates and (ii) the thin plate is at a distance of 0.8 cm from one of the plate surfaces ? Take μ for glycerine = 8.10×10^{-1} Ns/m^2. 7

(b) Explain the phenomenon of capillary. Obtain an expression for capillary rise of a liquid. 6

OR

2. (a) A fluid flow is given by : $V = xy^2i - 2yz^2j - \left(2y^2 - \frac{2z^3}{3}\right)k$; prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (1, 2, 3). 7

(b) Obtain an expression for continuity equation for a three-dimensional flow. 6

3. (a) A simple U-tube containing mercury is connected to a pipe in which a fluid of sp. gr 0.8 and having

vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find pressure in pipe if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below. 7

(b) State and prove the Pascal Law. 6

OR

4. (a) A rectangular pantoon 8 m long , 7 m broad and 3 m deep, weight 588.6 kN. It carries on its upper deck an empty boiler of 4 m diameter weighting 392 kN. The centre of gravity of the boiler and the pantoon are at their respective centers along a vertical line. Find the meta-centric height. Weight density of sea water is 10104 N/m^3. 7

(b) Explain with sketches the condition of equilibrium of a floating body and a submerged body. 6

5. (a) Derive Euler's equation of motion along a stream line for an ideal fluid stating clearly the assumptions. Explain how this is integrated to get Bernoulli's equation along a stream line. 7

(b) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. 7

OR

6. (a) Explain the classification of orifices based on their shape, size and sharpness. 7

(b) A submarine moves horizontally in sea and has its axis 20 m below the surface of water. A Pitot tube placed in front of submarine and along its axis is connected to the two limbs of a U-tube containing mercury. The difference of mercury level is found to be 20 cm. Find the speed of submarine. Take S.G. of sea water 1.026. 7

7. (a) What are the methods of dimensional analysis ? Describe them. 6

(b) The variable controlling the motion of a floating vessel through water are the drag force 'F', the speed v,

the length L, density ρ and dynamic viscosity μ of water and acceleration due to gravity g. Derive an expression for $F = \rho L^2 v^2 \phi \left[\frac{\mu}{\rho v L}, \frac{Lg}{v^2}\right]$. 7

OR

8. (a) Derive Darcy-Weisbach equation for the loss of head due to friction in pipes. 6

(b) A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 sec. 7

9. (a) Find an expression for the power transmission through pipes. What is the condition for maximum transmission of power and corresponding efficiency of transmission ? 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 tank is 4 m above the centre of the pipe. Consider all minor losses and take f = 0.009; also draw HGL and TEL. 7

OR

10. (a) Find the head loss due to friction in a pipe of diameter 250 mm and length 60 m, through which water is flowing at a velocity of 3 m/s using (i) Darcy formula and (ii) Chezy's formula for which C = 55. Take ν for water is 0.01 stoke. 7

(b) What do you mean by equivalent pipe ? Obtain an expression for equivalent pipe. 6

11. (a) A kite 60 cm × 60 cm weighing 2.943 N, assume an angle of 10° to the horizontal. The string attached to kite makes an angle of 45° to the horizontal. If the pull on the string is 29.43 N when the wind is flowing at a speed of 40 km/hr. Find the corresponding coefficient of drag and lift. 7

(b) What do you mean by 'Terminal velocity of a body' ? What is the relation between the weight of the body, drag force and buoyant force when the body has acquired terminal velocity ? 7

OR

12. (a) Define laminar boundary layer, turbulent boundary layer, laminar sub-layer and boundary layer thickness. 7

(b) A plate of 600 mm length and 400 mm wide is immersed in a fluid of sp. gr. 0.9 and kinematic viscosity $10^{-4} m^2/s$. The fluid is moving with a velocity of 6 m/s. Determine :

(i) Boundary layer thickness

(ii) Shear stress at the end of the plate

(iii) Drag force on one side of the plate. 7