

**D-180235****B. Tech. EXAMINATION, 2018**

Semester III (CBS)

MECHANICS OF FLUIDS-I

CS-302

Time : 3 Hours

Maximum Marks : 60

*The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.*

**Note :** Attempt all questions.

1. (a) The velocity distribution of flow over a plate is parabolic with vertex 0.3 m from the plate, where the velocity is 1.8 m/s. If the viscosity of the fluid is  $0.9 \text{ Ns/m}^2$ , find the velocity gradients and shear stresses. 3
- (b) Derive the formula of capillary rise/fall in a capillary tube. 3

- (c) A circular lamina of radius  $R$  is kept immersed in a liquid such that its top most point  $A$  is on the free surface. Determine the depth and width of the horizontal chord  $BC$  so that the total thrust due to hydrostatic pressure on the  $\Delta ABC$  is maximum. 4

Or

2. (a) A 80 mm diameter composite cylinder consists of an 80 mm diameter, 20 mm thick metallic plate having specific gravity 4.0 attached at the lower end of an 80 mm diameter wooden cylinder of specific gravity of 0.8. Find the limits of the length of the wooden portion so that the composite cylinder can float in stable equilibrium in water (specific gravity 1.0) with its axis vertical. 5
- (b) The profile of a vessel is quadrant of a circle of radius  $R$ . Derive the horizontal and vertical components of the total pressure. 5
3. (a) Derive the continuity equation in Cartesian coordinates. 5

- (b) The following data relate to an inclined venturimeter :

Diameter of the pipeline = 400 mm

Inclination of the pipeline with the horizontal =  $30^\circ$ .

Throat diameter = 200 mm

The distance between the mouth and throat of a meter = 600 mm

Specific gravity of oil flowing through the pipeline = 0.7

Specific gravity of heavy liquid in U-tube = 13.6

Reading of the differential manometer = 50 mm.

The coefficient of the meter = 0.98

Determine the rate of flow in the pipeline. 5

Or

4. (a) A drainage pump has tapered suction pipe. The pipe is running full of water. The pipe diameters at the inlet and at the upper end are 1 m and 0.5 m respectively. The free water surface is 2 m above the centre of inlet and centre of upper end is 3 m above the top of free water surface. The pressure at the tip end of pipe is 25 cm of mercury and it is known that loss of

head by friction between top and bottom is one-tenth of the velocity head at the top section. Compute the discharge in litre/sec. Neglect loss of head at the entrance of the tapered pipe. 5

- (b) The streamlines are represented by :

(i)  $\psi = x^2 - y^2$

(ii)  $\psi = x^2 + y^2$ .

Determine the (a) velocity and its direction  $\phi$  (2, 2). (b) sketch the streamlines and show the direction of flow in each case. 5

5. (a) A tank has two identical orifices in one of its vertical sides. The upper orifices is 2 m below the water surface and the lower one is 4 m below the water surface. Find the point, at which the two jets will intersect, if the coefficient of velocity is 0.95 for both the orifices. 5

- (b) Derive the expression for discharge of flow over triangular notch. 5

Or

6. (a) Derive the formula for the error in the discharge being measure by the weir when the error lies in the measurement of head over the weir if the weir is :

(i) Rectangular

(ii) Triangular. 5

Or

- (b) A streamlined nozzle of diameter  $d$  is supplied at constant head ( $H$ ), the magnitude of the head being larger compared to  $d$ . The nozzle discharge directly into the atmosphere and is so shaped that the issuing jet is parallel at the nozzle exit. To increase the flow rate a shroud of the diameter  $D$  is firmly secured to the nozzle. The jet expands to fill the shroud and the shroud is long enough to ensure that the flow is leaving steady and parallel. Determine :
- (i) The diameter of the shroud so that the flow rate is maximized.
  - (ii) The percentage increase in discharge. 5
7. (a) A pipeline 50 cm diameter takes off from a reservoir whose water surface elevation is 145 m above datum. The pipe is 4500 m long is laid completely at the datum level. In the last 1000 m of the pipe, water is withdrawn by a series of pipes at a uniform rate of  $0.075 \text{ m}^3/\text{s}$  per 250 m. Find the pressure at the end of pipeline. Assume friction factor as 0.018 and the pipeline to have a dead end. 5
- (b) Derive the expression for rise of pressure in pipeline due to water hammer generated by gradual closure of valve in elastic pipes. 5

8. (a) The pipes of diameter  $D$  and  $d$  of equal length  $L$  are considered. If the pipe are arranged in parallel, the loss of head for either pipe for a flow  $Q$  is  $h$ . If the pipes are arranged in series and the same quantity  $Q$  flows through them, the loss in head is  $H$ . If  $d = 0.5 D$ , find the percentage of total flow through each pipe when place parallel and the ratio of  $H$  to  $h$  neglecting (minor losses and assuming friction factor to be constant and equal for each pipeline. 5
- (b) Find the maximum power transmitted by a jet of water discharging freely out of a nozzle fitted to pipe of 300 m long and 100 mm diameter with coefficient of friction as 0.01. The available head at the nozzle is 90 m. 5
9. Fill in the blanks with correct option :
- (a) Cohesion is the force between molecules of.....medium. (Same/Different)
  - (b) Buoyancy is.....force. (Apparent/Real)
  - (c) The imaginary lines tangent on which at a point represents direction of velocity vector at the point are called as.....

(Streak lines/Stream lines)

- (d) Bernoulli's theorem is based on law of conservation of..... (Mass/Energy)
- (e) Gravity force is a.....force. (Surface/Body)
- (f) The property due to which soap bubble acquires spherical shape is.....  
(Capillarity/Surface tension)
- (g) The property associated with the instrument which shows the effect of real fluid in discharge measurement is called as.....  
(Coefficient of Velocity/Coefficient of discharge)
- (h) The formation of neck in the fluid flow while flowing through an orifice is called as.....  
(Vena Contracta/Nappe)
- (i) The line showing the sum of all possible energies of flow is called as.....  
(Hydraulic gradient line/Total energy line)
- (j) The process of generation of large pressure in pipe due to sudden or gradual closure of valve is called as.....  
(Water hammer/Hydraulic surge)

**2×10=20**