Roll No. ....

OLE-24066

B. Tech. 3rd Semester (Civil) Examination – April, 2021

FLUID MECHANICS - I

Paper : CE-205-F

Time : Three Hours]   *[Maximum Marks : 100*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note :   Attempt *five* questions in total selecting *one* question from each Section. Question No. **1** is *compulsory*. All questions carry equal marks.

1.   (i)   Explain compressibility and capillarity.

     (ii)   What is a Fluid ? How are fluids classified ?

     (iii)   Explain effect of temperature on Viscosity.

     (iv)   Define total pressure and centre of pressure.

     (v)   List the assumptions which are made while deriving Bernoulli's equation. $5 \times 4 = 20$

SECTION – A

2. (a) A vertical cylinder of diameter 180 mm rotates concentrically inside another cylinder of diameter 181.2 mm. Both the cylinders are 300 mm high. The space between the cylinders is filled with a Liquid whose viscosity is unknown. Determine the viscosity of the fluid if a torque of 20 Nm is required to rotate the inner cylinder at 120 r.p.m. **10**

(b) Calculate the capillary effect in millimetres in a glass tube of 4 mm diameter, when immersed in (i) water and (ii) mercury. The temperature of the liquid is 20°C and the values of surface tension of water and mercury at 20°C in contact with air are 0.0735 N/m and 0.51 N/m respectively. The contact angle for water $\theta = 0°$ and for mercury $\theta = 130°$. Take specific weight of water at 20°C as equal to 9790 N/m³. **10**

3. (a) The velocity potential function for a two-dimensional flow is $\phi = x(2y-1)$. At a point P(4, 5) determine : (i) The Velocity, and (ii) The value of stream function. **10**

(b) Explain Flow nets and methods of drawing flow nets. Also define uses of flow nets. **10**

SECTION – B

4. Explain briefly the following with neat sketches : **20**

(i) Piezometer.

(ii) U-tube manometer.

(iii) Differential manometers.

(iv) Absolute and Gauge Pressure

5. (a) A 1.0 m wide and 1.5 m deep rectangular plane surface lies in water in such a way that its plane makes an angle of 30° with the free water surface. Determine the total pressure and position of centre of pressure when the upper edge is 0.75 m below the free water surface.   10

(b) A wooden block of width 1.25 m, depth 0.75 m and length 3.0 m is floating in water. Specific Weight of the wood is 6.4 kN/m³. Find :   10

(i) Volume of water displaced, and

(ii) Position of centre of buoyancy.

SECTION – C

6. (a) Water is flowing through a pipe having diameters 600 mm and 400 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 350 kN/m² and the pressure at the upper end is 100 kN/m². Determine the difference in datum head if the rate of flow through the pipe is 60 litres/sec.   10

(b) A horizontal venturi meter with inlet diameter 200 mm and throat thickness 100 mm is used to measure the flow of water. The pressure at inlet is 0.18 N/mm² and the vacuum pressure at the throat is 280 mm of mercury. Find the rate of flow. The value of C_d may be taken as 0.98.   10

7. (a) A smooth plate 2 m wide and 2.5 m long is towed in oil (sp. Gr. = 0.8) at a velocity of 1.5 m/s along its length. Find the thickness of boundary layer and shear stress at the trailing edge of the plate. $V_{oil} = 10^{-4} \, m^2/s$.   10

(b) In which cases the boundary layer separation takes place and also discuss the methods of Preventing the separation of boundary layer. 10

SECTION – D

8. Determine the dimensions of the following quantities : 20

(i) Discharge

(ii) Kinematic viscosity

(iii) Force, and

(iv) Specific weight.

9. A 7.2 m high and 15 m long spillway discharges 94 m³/s discharge under a head of 2.03. If 1:9 Scale model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experiences a force of 7500 N, determine force on the prototype. 20

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