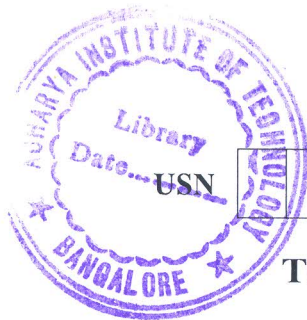# CBCS SCHEME

USN | | | | | | | | | |

15AE35

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanics of Fluids

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define viscosity and obtain an expression for viscosity stating Newton's law of viscosity. How fluids are classified with indicative graph. **(08 Marks)**
   b. Derive an expression version for pressure differences between two pipes at different level measured using U-tube differential manometer. **(08 Marks)**

OR

2 a. Derive an expression for total pressure and centre of pressure for inclined plane surface submerged in liquid. **(08 Marks)**
   b. A circular plate 3m diameter is immersed in water such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of centre of pressure. **(08 Marks)**

Module-2

3 a. Derive continuity equation in 3-dimension. **(08 Marks)**
   b. Write a short note on equipotential line, line of constant stream function and flow net. **(08 Marks)**

OR

4 a. In 2-D incompressible flow, the fluid velocity components are given by $U = x - uy$ and $V = -y - ux$. Show that velocity potential exists and determine its form. Also find the stream function. **(08 Marks)**
   b. Prove that the stream lines of the doublet will be family of circles tangent to the X-axis. **(08 Marks)**

Module-3

5 a. Sketch and derive an expression for actual discharge through venturimeter. **(08 Marks)**
   b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet in $17.658N/cm^2$ and the vaccum pressure at throat is 30cm of mercury. Find the discharge of water through venturimeter. Take $Cd = 0.98$. **(08 Marks)**

OR

6 a. What are the methods of dimensional analysis? Describe the Buckingham's π theorem for dimensional analysis. **(08 Marks)**
   b. What is dimensional homogeneity? What are the five dimensionless number and their equation? **(08 Marks)**

Module-4

7 Explain the following terms with relevant equations:
a. Displacement thickness
b. Momentum thickness
c. Energy thickness
d. Boundary layer thickness **(16 Marks)**

OR

8 a. Explain boundary separation and write down the condition for attached flow, detached flow and condition of separation. **(08 Marks)**
b. Explain Von-Karman's momentum integral theory. **(08 Marks)**

Module-5

9 a. Derive an expression for velocity of sound wave in a fluid. **(08 Marks)**
b. Find the velocity of bullet fired in standard air if Mach angle is 30°. Take R = 287.14 J/kg K and K = 1.4 for air. Assume temperature as 15°C. **(08 Marks)**

OR

10 Sketch and explain the propagation of disturbance or pressure waves, when the Mach number is less than, equal to or greater than 1. Also explain with respect to the above:
a. Mach angle
b. Zone of action
c. Zone of silence. **(16 Marks)**

* * * * *