CBCS SCHEME

USN | | | | | | | | | | |

15AE35

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
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. What is meant by viscosity? Explain fully with Newton's law of viscosity. **(06 Marks)**

b. Recall surface tension and capillarity. Explain both terms with neat sketch. Give expression for capillary rise. **(04 Marks)**

c. Two large plane surfaces are 2.4cm apart. The space between the surfaces is filled with oil of dynamic viscosity 8.10×10^{-1} ns/m^2. Calculate force required to drag a very thin plate of surface area 0.5m^2 between plane surface at 0.6 m/s, if

i) Thin plate is in the middle of two planes.

ii) Thin plate at a distance of 0.8cm from lower plane. **(06 Marks)**

OR

2 a. Explain Pascal's law and find the pressures on X, Y, Z directions. **(05 Marks)**

b. Briefly explain the types of manometers with neat sketch. Also explain different types of pressure. **(05 Marks)**

c. Figure shows a gate having a quadrant shape of radius 2m. Find the resultant force due to water per metre length of gate. Also find total force and angle of total force. **(06 Marks)**

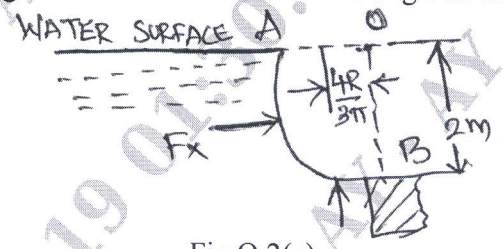

Fig.Q.2(c)

Module-2

3 a. Water flows through a pipe AB 1.2m diameter at 3m/s and then passes through a pipe BC 1.5m diameter. At C, pipe branches into C_D and C_E. CD is 0.8m in diameter and carries one-third of flow in AB. Flow velocity in CE is 2.5 m/s. Find discharge in AB, velocity in BC, velocity in CD and diameter of CE. **(05 Marks)**

b. Define source, sink, doublet with neat sketch. **(05 Marks)**

c. In a 2-dimensional incompressible flow, the fluid velocity components are given by $u = x - 4y$, $v = -y - 4x$. Show that velocity potential exists and find stream function expression. **(06 Marks)**

OR

4 a. Derive the integral form of continuity equation with necessary sketch. **(06 Marks)**

b. What is the need for energy equation? Then derive Navier-Stokes equation and explain the terms. **(10 Marks)**

Module-3

5 a. A pipeline carrying an oil of specific gravity 0.87, changes in diameter from 200mm at A to 500mm at B. Position B is 4m above A. If pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and discharge is 200 lit/sec. Find loss of head and direction of flow. **(05 Marks)**

b. A nozzle of diameter 20mm is fitted to a pipe of diameter 40mm. Find force exerted by the nozzle on water which is flowing through the pipe at $1.2m^3$/minute. **(05 Marks)**

c. Explain the working of pitot tube. Derive the expression to calculate velocity in actual and theoretical. What arrangements should be made to measure velocity from pitot tube? **(06 Marks)**

OR

6 a. Explain dimensionless numbers used in fluid mechanics. Also explain uses of model laws and dimension less numbers. **(05 Marks)**

b. What is the use of mach model law and give the expression and applications? **(03 Marks)**

c. Thrust developed by a propeller depends on angular velocity w, speed V, diameter D, dynamic viscosity μ, mass density ρ, elasticity of fluid that is speed of sound C. Using Buckingham's π-theorem derive parameters for thrust developed by propeller P. **(08 Marks)**

Module-4

7 a. Define boundary layer. Explain the terms:
i) Boundary layer thickness
ii) Displacement thickness
iii) Momentum thickness. **(06 Marks)**

b. Derive Von-Karman momentum integral equation. **(08 Marks)**

c. Define KUTTA Joukowsky theorem and its application. **(02 Marks)**

OR

8 a. Derive the expression for lift and drag over a body in a real fluid. **(05 Marks)**

b. A man weighing 882.9N descends to ground from an aeroplane with the help of parachute against resistance of air. Parachute is hemispherical in shape and descending at 20m/s. Find diameter of parachute. Take $C_D = 0.5$ and $\rho_{air} = 1.25$ kg/m^3. **(05 Marks)**

c. How will you avoid boundary layer separation? Explain the techniques used in the field of aerodynamics to avoid separation. **(06 Marks)**

Module-5

9 a. Derive Bernoulli's equation for Adiabatic process. **(05 Marks)**

b. Define Mach number and classify the flow according to Mach number. **(05 Marks)**

c. A gas with a velocity of 300m/s is flowing through a horizontal pipe at a section where pressure is 6 N/cm^2 and temperature 40°C. The pipe changes in diameter and the pressure increased to 9N/cm^2. Find velocity of gas at this section if flow is adiabatic. Take R = 287 J/kg K, $\gamma = 1.4$ **(06 Marks)**

OR

10 a. Explain about mach cone with neat sketch. Also give expression for mach angle. **(06 Marks)**

b. With a neat sketch explain normal shock and oblique shock. Also explain the difference between them. **(04 Marks)**

c. Find mach number of an aircraft flying at 1100km/hr through the air having pressure of 7N/cm^2 and temperature -5°C. Wind velocity is zero. Calculate stagnation pressure, temperature and density of air at stagnation point. Take $\gamma = 1.4$ and R = 287.14J/kg K. **(06 Marks)**

* * * * *