CBCS Scheme

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

15AE35

# Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
## Mechanics of Fluid

Time: 3 hrs. Max. Marks: 80

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



### Module-1

1 a. Distinguish between the following:
   i) Mass density and specific gravity
   ii) Ideal fluid and Newtonian fluid
   iii) Dynamic viscosity and kinematic viscosity **(06 Marks)**

b. State: i) Pascal's law, ii) Hydrostic law. **(02 Marks)**

c. Two large surfaces are 2.5 cm apart. This space is filled with glycerin of absolute viscosity 0.82 NS/m$^2$. Find what force is required to drag a plate of area 0.5 m$^2$ between the two surfaces at a speed of 0.6 m/s.
   i) When the plate is equidistant from the surfaces?
   ii) When the plate is at 1 cm from one of the surfaces? **(08 Marks)**

**OR**

2 a. Explain: i) Bouyancy, ii) Centre of pressure, iii) Newton's law of viscosity. **(06 Marks)**

b. A circular plate of 3.0 m diameter is immersed in water in such a way that it's greatest and least depth below the free surface are 400 cm and 150 cm respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **(05 Marks)**

c. A horizontal pipe contains an oil of specific gravity 0.8. A differential manometer connected at the two points A and B of the pipe. If the pressure difference is found to be 25113.6 Pa, find out the manometer reading. show it in the diagram. **(05 Marks)**

### Module-2

3 a. Define the following:
   i) Steady and unsteady flow
   ii) Uniform and non-uniform flow **(04 Marks)**

b. What do you understand by velocity potential function and flow net? **(06 Marks)**

c. If for a two dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$, determine the velocity at the point P(4, 5). Determine also the value of steam function $\psi$ at the point P. **(06 Marks)**

**OR**

4 a. Define stream function. **(02 Marks)**

b. Explain the difference between:
   i) Laminar and turbulent flow.
   ii) Rotational and irrotational flow.
   iii) Linear translation and linear deformation in fluid motion. **(06 Marks)**

c. Derive the continuity equation in the three dimensions, in the differential form and write the same for a steady incompressible flow. **(08 Marks)**

## Module-3

5 a. Derive Bernoulli's equation from Euler's equation and explain the terms used. **(04 Marks)**

b. How the discharge in measured using rectangular notch? Derive an expression for the flow rate. **(08 Marks)**

c. A vertical venturimeter has an area ratio 5. It has a throat diameter of 10 cm. When oil of specific gravity 0.8 flows through it. The mercury in the differential gauge indicates a difference in height of 12 cm. Find the flow rate through the venturimeter. Take $C_d = 0.98$. **(04 Marks)**

**OR**

6 a. What is meant by geometric, kinematic and dynamic similarities? **(06 Marks)**

b. The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft $\ell$, velocity V, air viscosity $\mu$, air density $\rho$, and bulk modulus of air K. Express the functional relationship between these variables and the resisting force. **(10 Marks)**

## Module-4

7 a. Define: i) Lift force, ii) Drag force, iii) Resultant force. **(06 Marks)**

b. A jet plane which weighs 29.43 kN and having a wing area of 20 $m^2$ flies at a velocity of 950 km/hr, when the engine delivers 7357.5 KW power. 65% of power is used to overcome the drag resistance of the wing. Calculate the coefficients of lift and drag flow the wing. The density of the atmospheric air is 1.21 $kg/m^3$. **(10 Marks)**

**OR**

8 a. Explain: i) Displacement thickness, ii) Momentum thickness. **(08 Marks)**

b. A man descends to the ground from an aeroplane with the help of a parachute which is hemispherical having diameter of 4 m against the resistance of air with a uniform velocity of 25 m/s. Find the weight of the man if the weight of the parachute is 9.81 N. Take $C_D = 0.6$ and density of air = 1.25 $kg/m^3$. **(08 Marks)**

## Module-5

9 a. What is Mach angle? On the basis of Mach number define sub sonic, sonic and supersonic flow. **(04 Marks)**

b. Derive an equation for sound in terms of bulk modulus. **(04 Marks)**

c. Derive Bernoulli's equation for adiabatic process. **(08 Marks)**

**OR**

10 a. What do you mean by stagnation point? **(02 Marks)**

b. Name the basic equations of compressible flow. Derive continuity equation for compressible flow. **(08 Marks)**

c. An aeroplane is flying at an altitude of 15 km where the temperature is –50°C. The speed of the plane corresponds to Mach number of 1.6. Assuming K = 1.4 and R = 287 J/kg°K for air. find the speed of the plane and Mach angle $\alpha$. **(06 Marks)**

* * * * *