No. of Printed Pages : 4

BIME-006(S)

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

December, 2016

00428

BIME-006(S) : THERMOFLUID ENGINEERING

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) What is the dimensional representation of

(i) Power

(ii) Modulus of elasticity

(iii) Specific weight

(iv) Angular velocity

(v) Viscosity

(b) Is it possible to accelerate a gas to a supersonic velocity in a converging nozzle ? Explain. *5+5*

2. (a) What is a Newtonian fluid ? How does the dynamic viscosity of liquids and gases vary with temperature ?

(b) What is cavitation ? Also, define 'net positive suction head' and 'required net positive suction head'. Explain how these two quantities are used to ensure that cavitation does not occur in a pump. *5+5*

3. (a) Prove that the point of maximum entropy on the Fanno line for the adiabatic steady flow of a fluid in a duct corresponds to the sonic velocity $M_a = 1$.

(b) The absolute pressure in water at a depth of 5 m is read to be 145 kPa.

Determine

(i) the local atmospheric pressure, and

(ii) the absolute pressure at a depth of 5 m in a liquid whose specific gravity is 0·78 at the same location. *5+5*

4. Derive an expression for area velocity relationship for a compressible fluid in the form

$$\frac{dA}{A} = \frac{dV}{V}(m^2 - 1).$$ *10*

5. A steady two-dimensional, incompressible flow field in the xy-plane has a stream function given by

$$\psi = ax^2 - by^2 + cx + dxy$$

where a, b, c and d are constants.

(a) Obtain expressions for the velocity components u and v.

(b) Verify that the flow field satisfies the incompressible continuity equation. *5+5*

6. (a) The velocity profile in fully developed laminar flow in a circular pipe of inner radius R = 2 cm, in m/s, is given by

$$u(r) = 4\left(1 - \frac{r^2}{R^2}\right).$$

Determine the average and maximum velocities in the pipe and the volume flow rate.

(b) What is a Pitot tube ? How will you determine the velocity at any point with the help of a Pitot tube ? *5+5*

7. Water flows through a pipe AB of diameter d_1 = 50 mm which is in series with a pipe of diameter d_2 = 70 mm in which the mean velocity V_2 = 3 m/sec. At C, the pipe forks and one branch CD is of diameter d_3 such that the mean velocity V_3 = 1·5 m/sec. The other branch CE is of diameter d_4 = 35 mm and the conditions are such that the discharge Q_2 from BC divides so that $Q_4 = \frac{Q_3}{2}$.

Calculate the values of Q_1, V_1, Q_2, Q_3, d_3, Q_4 and V_4. *10*

8. Briefly explain the construction and working of a Pelton turbine and derive an expression for maximum hydraulic efficiency. *10*

9. Discuss in general the main operating characteristics of a hydraulic turbine. Which of the Pelton, Francis and Propeller turbines gives better off-design performance and why ? *10*

10. Prove that for a steady laminar flow between two fixed parallel plates, the velocity distribution across a section is parabolic and that the average velocity is $\frac{2}{3}$rd of the maximum velocity. *10*