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

Term-End Examination

00542 **December, 2016**

BIME-006 : THERMOFLUID ENGINEERING

Time : 3 hours *Maximum Marks : 70*

Note : Attempt any seven questions. All questions carry equal marks. Use of calculator is allowed.

1. (a) What happens when the pressure of a liquid flowing in a passage drops and falls below the vapour pressure at that temperature ?

   (b) How would you classify the regimes of fluid flow on the basis of

   (i) fluid properties i.e., density and viscosity ?

   (ii) compressibility phenomenon, i.e., Mach number of the flow ? *5+5=10*

2. The stream function for a two-dimensional flow is given by

$$\psi = 2xy.$$

Calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ.   *10*

3. Calculate

   (a)   the pressure gradient along flow,

   (b)   the average velocity, and

   (c)   the discharge for an oil of viscosity $0.02 \, Ns/m^2$

   flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/sec.   *10*

4. Prove that the head loss due to friction is equal to one-third of the total head for maximum power transmission through the pipes.   *10*

5. Two tanks are connected with the help of two pipes in series. The lengths of the pipes are 1000 m and 800 m whereas the diameters are 400 mm and 200 mm respectively. The coefficient of friction for both the pipes is 0.008. The difference of water level in the two tanks is 15 m. Find the rate of flow of water through the pipes, considering all losses.   *10*

6. Define the following : 5×2=10

   (a) Laminar boundary layer

   (b) Turbulent boundary layer

   (c) Laminar sublayer

   (d) Boundary layer thickness

   (e) Displacement thickness

7. A flat plate, 1·5 m × 1·5 m, moves at 50 km/hour in stationary air of density 1·15 kg/m^3. If the coefficient of drag and lift are 0·15 and 0·75 respectively, determine

   (a) the lift force,

   (b) the drag force,

   (c) the resultant force, and

   (d) the power required to keep the plate in motion. 10

8. (a) What are a nozzle and a diffuser ?

   (b) What do you understand by choking in nozzle flows ? 5+5=10

9. What is a Fanno line ? Why do the end states of a normal shock lie on the Fanno line ? 10

10. A stream of air flows in a duct of 100 mm diameter at a rate of 1 kg/sec. The stagnation temperature is 37°C. At one section of the duct the static pressure is 40 kPa. Calculate the Mach number, velocity and stagnation pressure at this section. 10