9. (a) Define boundary layer and explain the fundamental causes of its existence. 10

(b) Determine the wall shearing stress in a pipe of diameter 100 mm which carries water. The velocities at the pipe centre and 30 mm from the pipe centre are 2 m/s and 1.5 m/s respectively. The flow in the pipe is given as turbulent. 10

B.Tech. (ME) 4th Semester F-Scheme

Examination, May-2019

FLUID MECHANICS

Paper-ME-208-F

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt **five** questions. **Question No. 1 is compulsory.** Attempt any **one** question from each section.*

1. (a) Convert 1 kg/s-m dynamic viscosity in to poise.

(b) Define velocity potential function and stream function.

(c) Explain concept of system and control volume.

(d) What do you mean by 'Viscous Flow' ?

(e) What do you understand by turbulent flow ?

5×4=20

Section-I

2. (a) Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the centre of plate is 3 m below the free surface of water. Find the position of centre of pressure also. 10

(b) What is a 'Flow-net' ? Enumerate the methods of drawing flow nets. 10

3. (a) What are different types of flow ? Explain in detail. 10

(b) The diameter of a pipe at sections 1-1 and 2-2 are 200 mm and 300 mm respectively. If the velocity of water flowing through the pipe at section 1-1 is 4 m/s, find :

(i) Discharge through the pipe, and

(ii) Velocity of water at section 2-2 10

Section-II

4. (a) What is Euler's equation of motion ? How will you obtain Bernoulli's equation from it ? 12

(b) Define Mach number. What is the significance of Mach number in compressible fluid flows ? 8

5. At some section in the convergent-divergent nozzle, in which air is flowing, pressure, velocity, temperature and cross-sectional area are 200 KN/m^2, 170 m/s, 200^{o}C and 1000 mm^2 respectively. If the flow conditions are isentropic, determine :

(i) Stagnation temperature and stagnation pressure

(ii) Sonic velocity and Mach number at its section 20

Section-III

6. (a) Derive Darcy-Weisbach formula for calculating loss of head due to friction in pipe ? 10

(b) A shaft of 100 mm, diameter rotates at 80 r.p.m. in a 20 cm long bearing. Taking that the two surfaces are uniformly separated by a distance of 0.5 mm and taking linear velocity distribution in the lubricating oil having dynamic viscosity of 5 centipoises, find the power absorbed in the bearing. 10

7. At a sudden enlargement of water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10 mm. Calculate the rate of flow. 20

Section-IV

8. A thin plate is moving in still atmospheric air at a velocity of 5 m/s. The length of the plate is 0.6 m and width is 0.5 m. Calculate :

(i) The thickness of the boundary layer at the end of the plate, and

(ii) Drag force on one side of the plate. Take density of air as 1.24 kg/m^3 and kinematic viscosity 0.15 stokes. 20