Total No. of printed pages = 3

ME 181602

30/8/22

Roll No. of candidate | | | | | | | | | | |

2022

B.Tech. 6th Semester (Regular) End-Term Examination

FLUID MECHANICS – II

(New Regulation & New Syllabus)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Choose the correct answer from the followings : (10 × 1 = 10)

(i) Stagnation point is the point in fluid mechanics where the velocity of the fluid at that point is

(a) zero (b) infinite

(c) constant (d) unity

(ii) With the increase in pressure, the exit velocity ———

(a) Decreases (b) Increases

(c) Same (d) Independent

(iii) Normal shock waves are ——— to the local flow.

(a) Parallel (b) Perpendicular

(c) Same (d) Independent

(iv) The maximum velocity in a circular pipe when flow is laminar occurs at

(a) The top of the pipe (b) The bottom of the pipe

(c) The centre of the pipe (d) Not necessarily at the centre

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(v) The shear in turbulent flow is mainly due to

(a) Heat transfer (b) Mass transfer

(c) Momentum transfer (d) All of the above

(vi) Eddies are in the turbulent flows give result in ———

(a) high diffusion coefficients (b) low diffusion coefficients

(c) high value of the sourced (d) low value source term

(vii) For viscous flow the co-efficient of friction is given by

(a) $f = 8/Re$ (b) $f = 16/Re$

(c) $f = 32/Re$ (d) $f = 60/Re$.

(viii) The layer through which the momentum and energy transfer take place via the movement of macroscopic lumps of matter from one region to another is called as

(a) the laminar sublayer (b) the buffer layer

(c) the turbulent layer (d) none of the above

(ix) The layer above the laminar sublayer with some turbulence and still having importance of viscous action is called as

(a) sub-sublayer (b) turbulent layer

(c) buffer layer (d) none of the above

(x) If Mach number is, $M < 1$ then the flow is

(a) sonic flow (b) supersonic flow

(c) sub sonic flow (d) none of the above

2. (a) Explain the term coefficient of friction. On what factors does this co-efficient depend? (5)

(b) Derive an expression for the loss of head due to friction in pipes. (10)

3. (a) Define compressible flow. What do you understand by stagnation pressure? (5)

(b) Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. (10)

4. (a) What do you mean by Prandtl mixing length Theory? (5)

(b) A smooth pipe of diameter 400 mm and length 800 m carries water at the rate of 0.04 m^3/s. Compute the head loss due to friction, wall shear stress, center-line velocity and thickness of laminar sublayer. Take the kinematic viscosity of water as 0.018 stokes. (10)

5. (a) Define the terms: Mach angle and Mach Cone. (5)

(b) A fluid of viscosity 0.5 poise and specific gravity 1.20 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 147.15 N/m^2,

Calculate :

(i) the pressure gradient,

(ii) the average velocity,

(iii) the Reynolds number of the flow. (10)

6. (a) What is meant by boundary layer? Why does it increases with distance from the upstream edge? (5)

(b) For the velocity profile for laminar boundary layer $\frac{u}{U}=\frac{3}{2}\left(\frac{y}{\delta}\right)-\frac{1}{2}\left(\frac{y}{\delta}\right)^3$.

Determine the boundary layer thickness, Shear stress and drag force interms of Reynold number. (10)

7. (a) An aeroplane is flying at an height of 15 km where the temperature is –50°C. The speed of the plane is corresponding to M = 2.0. Assuming k = 1.4 and R = 287 J/kg °K. Calculate the speed of the plane. (5)

(b) A nozzle of diameter 20 mm is fitted to a large tank which contains air at 20°C. The air flows from the tank into atmosphere. For adiabatic flow, Compute the mass rate of flow of air through the nozzle when pressure of air tank is :

(i) 5.886 N/cm^2 (gauge),

(ii) 29.43 N/cm^2 (gauge)

Take k =1.4, R = 287 J/kg K and atmospheric pressure = 9.81 N/cm^2. (10)
