B.Tech II Year II Semester (R09) Supplementary Examinations December/January 2015/2016

MECHANICS OF FLUIDS

(Aeronautical Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

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1 (a) Explain the terms:
(i) Stable equilibrium. (ii) Unstable equilibrium. (iii) Neutral equilibrium of floating bodies.
(b) Each gate of lock is 6 m high and is supported by two hinges placed on the top and bottom of the gate. When the gates are closed, they make an angle of 120°. The width of the lock is 5 m. If the water levels are 4 m and 2 m on the upstream and downstream sides respectively, find the magnitude of the forces on the hinges due to water pressure.

2 (a) What is free vortex? Give some examples of its occurrence. Show how the velocity and pressure vary with radius in a free vortex flow.
(b) Derive an expression for continuity equation in three dimensions for cylindrical coordinate which is applicable for steady and incompressible flow.

3 (a) State Bernoulli's theorem and write down all the assumptions made in its derivations.
(b) At a point in the pipeline where the diameter is 200 mm, the velocity of water is 4 m/s and the pressure is 343 kN/m^2. At a point 15 m downstream the diameter gradually reduces to 100 mm. Find the pressure at this point, if the pipe is: (i) Horizontal. (ii) Vertical with flow downward. (iii) Vertical with flow upward.

4 (a) Differentiate between fundamental and derived dimensions.
(b) Write about similarity laws and difference between distorted and non distorted models.

5 Water of kinematic viscosity 1.02 x 10^{-6} m^2/sec is steadily owing over a smooth at plate at zero angle of attack with a velocity 1.6 m/sec. The length of the plate is 0.3 m. Calculate:
(a) The thickness of boundary layer at 15 cm from the leading edge.
(b) Shear stress at trailing edge of the plate.
Assume a parabolic profile. Take density = 1000 kg/m^3.

6 (a) Define stagnation points. How the position of the stagnation point for a rotating cylinder in a uniform flow is determined? What is the condition for single stagnation point?
(b) A flat plate 1.5 m x 1.5 m moves at 50 km/hr in stationary air of density 1.15 kg/m^3. If the coefficient of drag and lift are 0.15 and 0.75 respectively. Find: (i) The lift force. (ii) The drag force. (iii) The resultant force. (iv) The power required to keep the plate in motion.

7 (a) Show that in laminar flow through a circular pipe the total kinetic energy of fluid passing per second is twice the value obtained on the basis of average velocity.
(b) A fluid of viscosity 0.8 Pascal-sec and specific gravity 1.1 flows in a horizontal pipe of diameter 10 cm. If the pressure drops per meter length is 4 kN/m, find the power required for 200 m length of pipe.

8 (a) Explain briefly about the shock waves and how these shock waves are formed in convergent and divergent nozzle.
(b) Find the velocity of air flowing at the outlet of a nozzle, fitted to a large vessel which contains air at a pressure of 294.3 N/cm (abs) and at a temperature of 20℃. The pressure at the outlet of the nozzle is 206 N/cm (abs). Take K = 1.4 and R = 287 J/kg k.

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