Code No:A109212102	R09	SET-1

B.Tech II Year - I Semester Examinations, December 2011
MECHANICS OF FLUIDS
(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Define specific weight, specific volume, specific gravity, viscosity, Surface tension and capillarity.

b) A "U"-tube manometer is being used to measure the pressure difference between two points on a horizontal pipe. The fluid in the pipe has a relative density of 0.8 and the manometric fluid has a density 13600 kg/m^3. The two readings on the manometer differ by 0.5m. What is the pressure difference measured by the manometer? [15]

2.a) Derive one dimensional continuity equation and clearly state its assumptions while deriving it.

b) A fluid flows through a horizontal conical pipe where inlet discharge varying linearly from 0.3 m^3/s to 0.6 m^3/s over two seconds. The pipe having an inlet diameter of 200mm and outlet diameter of 400 mm and a length of 2m. The velocity over any cross section may be considered to be uniform. Determine the convective and local acceleration at a section where the diameter is 300mm. [15]

3.a) What is the difference between pitot tube and pitot static tube?

b) Water flows at a rate of 0.5m^3/s rising through a 50 cm, contracting pipe bend. The diameter at the bend entrance is 700mm and at the exit is 500mm. If the pressure at the entrance to the bend is 200 kN/m^2, determine the magnitude and direction of the force exerted by the fluid on the bend. (The exit of the bend is 0.4m higher than the entrance and the bend has a volume of 0.2 m^3) . [15]

4.a) Explain about major and minor energy losses in the pipe.

b) Determine the rate of flow of water through a pipe of diameter 20 cm and the length 50m when one end of the pipe is connected to a tank and the other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4m above the center of the pipe. Consider all minor losses and the friction coefficient for the pipe material is 0.009. [15]

5.a) Derive an expression for velocity distribution for laminar flow through a circular pipe. Show that the Darcy friction coefficient is equal to 16/Re where Re is the Reynolds number.

b) Water at 60^0 flows between two large flat plates. The lower plate moves to the left at a speed of 0.3m/s. the plate spacing is 3mm and the flow is laminar. Determine the pressure gradient required to produce zero net flow at a cross-section. Take dynamic visocity of water at 60^0 is 4.7×10^{-4} pa.s. [15]

6.a) Define and explain about the following:

i) Displacement thickness   ii) Momentum thickness.

b) Discuss the phenomenon of separation for flow over curved surfaces and the prevention of separation. [15]

7.a) Derive for speed of sound in a compressible fluid.

b) Air at rest (p=101 kPa, T=288 K) in a chamber. It is expanded isentropically. What is the Mach number when the velocity becomes 200 m/s? What is the velocity when the speed becomes sonic? Also find out the maximum attainable speed. [15]

8. Write short notes on the following:

a) Kinetic energy Correction factor

b) Laminar sub-layer

c) Micromanometers. [15]

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B.Tech II Year - I Semester Examinations, December 2011
MECHANICS OF FLUIDS
(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Differentiate between absolute & gauge pressure, simple manometer & differential manometer, piezometer & pressure gauge.
b) A sphere of 1219 mm diameter floats half submerged in salt water (ρ=1025 kg/m^3). What minimum mass of concrete (ρ = 1025 kg/m^3) has to be used as an anchor to submerge the sphere completely.
c) Derive an expression for center of pressure of an arbitrary body submerged vertically in a static fluid. [15]

2.a) State and prove Bernoulli's theorem with a neat sketch and mention its limitations.
b) In a two-dimensional incompressible flow, the fluid velocity components are given by u = x- 4y and v = -y-4x. Show that the velocity potential exists and determine its form. Find also the stream function. [15]

3.a) Differentiate between distorted and non-distorted models.
b) A vertical venturimeter carries a liquid of specific gravity 0.8 and has inlet and throat diameter of 150mm and 75mm respectively. The pressure connection at the throat is 150mm above that at the inlet. If the actual rate of flow is 40 lit/s and the coefficient of discharge is 0.96, calculate
i) the pressure difference between the inlet and throat
ii) the difference in levels of mercury in a vertical U-tube manometer connected between these points. [15]

4.a) Derive the Darcy-Weisbach equation.
b) A pipe line, 50 cm diameter and 4500m long, connects two reservoirs A and B whose constant difference of water level is 12m. A branch pipe, 1250m long and taken from a point distant 1500m from reservoir A, leads to reservoir C whose water level is 15m below that of reservoir A, find the discharges to the reservoir B and C. Assume Darcy's friction coefficient of 0.03 for all pipes. [15]

5.a) Show that in case of a Couette flow, the shear stress at the horizontal mid-plane of the channel is independent of the pressure gradient imposed on the flow.
b) Water flows between two very large, horizontal, parallel flat plates 20mm apart. If the average velocity of water is 0.15 m/s. What is the shear stress (a) at the lower plate and at 5mm above the lower plate.
Assume dynamic viscosity of water is 1.1×10^{-3} pa-s. [15]

6. Describe with the aid of diagrams the following:
i) Boundary layer separation
ii) Magnus effect. [15]

7.a) Derive for speed of sound in a compressible fluid.
b) One problem creating high mach number flows is condensation of the oxygen component in air when the temperature reaches 50 K. if the temperature of a reservoir is 300 K and the flow is isentropic, at what Mach number will condensation of oxygen take place? [15]

8. Write short notes on the following:
a) Momentum Correction factor
b) Laminar sub-layer
c) Hydrostatic force on curved surfaces. [15]

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Code No:A109212102 | R09 | SET-3

B.Tech II Year - I Semester Examinations, December 2011
MECHANICS OF FLUIDS
(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Explain stable, unstable and neutral equilibrium of floating body.

b) If 30 cm diameter circular plate is placed over a fixed bottom plate with a 2.5mm gap between the two plates filled with glycerin. Determine the torque required to rotate the circular plate slowly at 2 rpm. Assume the velocity distribution in the gap is linear and the shear stress on the edge of the rotating plate is negligible.[15]

2.a) What do you understand by convective and local accelerations? Find out the expression for total acceleration if the flow is passing through a diffuser.

b) A three dimensional flow field is represented by the velocity components as $u = 2x^2 + 2xy; and \; w = z^2 - 4xz - 2yz$ find out the third velocity component if the flow field exists. [15]

3.a) Derive the Bernoulli's equation of motion through the derivation of Euler's equation of motion and clearly state the assumptions involved in it.

b) A pipeline carrying oil of specific gravity 0.8, changes in diameter from 300mm at a position A to 500 mm diameter of a position B, which is 5m at a higher level. If the pressures at A and B are 200 kPa and 152 kPa respectively and discharge is 150 liter/sec. Determine the loss of head and direction of flow. [15]

4.a) Explain about the concept and types of Physical similarity

b) A sphere advancing at 1.5 m/s in a stationary mass of water experiences a drag of 4.5 N. Find the flow velocity required for dynamic similarity of another sphere twice the diameter, placed in a wind tunnel. Calculate the drag at this speed if the kinematic viscosity of air is 13 times that of water and its density is 1.25 kg/m^3. [15]

5.a) What is flow separation? What causes it? What is the effect of flow separation on the drag coefficient?

b) Water having dynamic viscosity 0.018 poise is flowing over a smooth thin plate of 5m × 3m at a velocity of 1 m/s parallel to 5 m side. The boundary layer changes from laminar to turbulent at Reynold's number 5×10^5. Find

i) boundary layer thickness where laminar flow ends.

ii) the total drag-force on one side of the plate and the boundary layer thickness at the trailing edge of the plate. [15]

6.a) What is the physical significance of the Reynolds number? How is it defined for
i) flow in a circular pipe of inner diameter D.
ii) flow in a rectangular duct of cross section $a \times b$.

b) Water is discharged from one tank to another with 30 m difference of water levels through a pipe 1200 m long. The diameter for the first 600 m length of the pipe is 400 mm and 250 mm for the remaining 600 m long. Find the discharge in lit/s through the pipe. Assume the coefficient of friction as 0.008 for both the pipes. [15]

7.a) Write down general Euler's equation of motion and then find out Bernoulli's equation for isothermal process.

b) Find the pressure on the nose of an aircraft flying with 800km/hr through still air and Mach number when atmospheric air pressure and temperature are 68.7 kN/m^2 and -1^0C. Take ρ = 1.295 kg/m^3 for the air. [15]

8. Write a short notes on the following:
a) Magnus effect
b) Hydrodynamically smooth and rough boundaries
c) Meta center and meta-centric height. [15]

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Code No:A109212102 | R09 | SET-4

B.Tech II Year - I Semester Examinations, December 2011
MECHANICS OF FLUIDS
(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Explain the terms
i) stable equilibrium ii) unstable equilibrium
iii) neutral equilibrium of floating bodies.

b) Each gate of lock is 6m 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 120^0. The width of the lock is 5m. if the water levels are 4m and 2m on the upstream and downstream sides respectively, find the magnitude of the forces on the hinges due to water pressure. [15]

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 dimension for cylindrical coordinate which is applicable for steady and incompressible flow. [15]

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 200mm, the velocity of water is 4m/s and the pressure is 343 kN/m^2. At a point 15m downstream the diameter gradually reduces to 100mm. Find the pressure at this point, if the pipe is
i) horizontal ii) vertical with flow downward
iii) vertical with flow upward. [15]

4.a) Differentiate between Fundamental and Derived dimensions.

b) Using the Buckingham's π theorem, show that the velocity U through a circular orifice is given by

$$U = (2gH)^{0.5}\phi(D/H, \rho UH/\mu)$$

where H is the head causing the flow, D is the diameter of the orifice, μ is the coefficient of dynamic viscosity, ρ is the density of fluid flowing through the orifice and g is the acceleration due to gravity. [15]

5.a) Prove that for a steady laminar flow between two fixed parallel plates, and for laminar flow, is equal to 1.5 times of the average velocity of flow.

b) What are the velocities involved in a turbulent flow. Explain?

c) Derive the expression for loss of head due to sudden contraction. [15]

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 1.5m × 1.5m moves at 50km/hr in stationary air of density 1.15 kg/m^3. if the co-efficient 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.

[15]

7.a) Write down general Euler's equation of motion and then find out Bernoulli's equation for adiabatic process.

b) Air is flowing through a pipe with a velocity of 285 m/s where its pressure and temperature are 0.6 bar (absolute) and 300K. The pipe along the flow changes in diameter and its pressure at that section was found to be 0.9 bar. Assuming the flow is adiabatic, find the velocity at this section. Assume any other data if necessary. [15]

8. Write a short notes on the following

a) boundary layer separation

b) Hydrodynamically smooth and rough boundaries

c) Meta center and meta-centric height. [15]

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