Code: 9A21404

1

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April / MAY 2012

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 stable, unstable, neutral equilibrium conditions of submerged and floating bodies with the help of diagrams.
(b) If the velocity profile of a fluid over a plate is a parabolic with the vertex 20cm from the plate, where the velocity is 120cm/sec. Calculate the velocity gradients and shear stresses at a distance of 0, 10 and 20 cm from the plate, if the viscosity of the fluid is 8.5 poise.

2 (a) Derive the equations to find out the velocity and acceleration of a fluid particle.
(b) A 25cm diameter pipe carries oil of sp.gr.0.9 at a velocity of 3m/s. At another section the diameter is 20cm. Find the velocity at this section and also mass rate of flow of oil.

3 What is vortex flow? Explain forced and free vortex flow. Derive equations of motion for vortex flow.

4 Derive the equations to determine the velocity at any point with the help of pitot tube and also write difference between pitot-tube and pitot static tube. Draw neat sketches.

5 (a) Derive expression for drag and lift forces on an arbitrary shaped solid body placed in a real fluid.
(b) A slat plate 1.5m X 1.5m moves at 50km/hour 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, determine:
(i) The lift force (ii) The drag force (iii) The resultant force, and
(iv) The power required to keep the plate in motion.

6 (a) Derive the equation to determine the loss of head due to sudden enlargement.
(b) Find the loss of head when a pipe of diameter 200mm is suddenly enlarged to a diameter of 400mm. The rate of flow of water through the pipes is 250 liters/s.

7 A pipe line of 0.6m diameter is 1.5 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if 4f = 0.04. The head at inlet is 300mm.

8 A gas with a velocity of 300m/s is flowing through a horizontal pipe at a section where pressure is 6 X 10^4 N/m^2 (absolute) and temperature 40^0 C. The pipe changes in diameter and at this section the pressure is 9 X 10^4 N/m^2. Find the velocity of the gas at this section if the flow of the gas is adiabatic. Take R = 287 J/kg K and k = 1.4.

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MECHANICS OF FLUIDS

(Aeronautical Engineering)

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1 (a) Explain different types of fluid with the help of figure.
(b) Calculate the pressure due to a column of 0.3 m of (i) Water, (ii) An oil of sp.gr. 0.8 and (iii) Mercury of sp.gr. 13.6. Take density of water, p = 1000 kg/m^3.

2 A fluid flow field is given by
$V = x^2yi + y^2zj – (2xyz + yz^2)$ K. Prove that it is a case of possible steady in compressible fluid flow. Calculate the velocity and acceleration at the point (2, 1, 3).

3 (a) Derive Euler's equation of motion.
(b) Discuss what you understand about Navier-Stokes equation.

4 (a) Derive an expression for the discharge through a venturimeter.
(b) The head of water over the centre of an orifice of diameter 20 mm is 1m. The actual discharge through the orifice is 0.85 litre / s. Find the co-efficient of discharge.

5 Explain the following for the flow over a plate with the help of figure.
(a) Laminar boundary layer
(b) Turbulent boundary layer
(c) Laminar sub-layer.

6 (a) Derive the equation to determine the loss of head due to sudden contraction.
(b) Explain hydraulic gradient line with the help of figure.

7 A main pipe divides into two parallel pipes which again form one pipe. The length and diameter for the first parallel pipe are 2000m and 1.0m respectively, while the length and diameter of 2nd parallel pipe are 2000m and 0.8m. Find the rate of flow in each parallel pipe, if total flow in the main is 3.0 $m^3/_s$. The co-efficient of friction for each parallel pipe is same and equal to 0.005.

8 (a) Explain the differences between compressible and incompressible flow.
(b) Derive Bernoulli's equation for adiabatic process for compressible fluids.

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1 (a) Explain and derive the equation to find out the difference of pressure in two pipes are connected by 'U' tube.
(i) At different level and also contains liquids of different sp.gr.
(ii) At same level and contains the same liquid of density 'ρ'
(b) A pipe line which is 4m in diameter contains a gate valve. The pressure at the centre of the pipe is 19.6 N/cm^2. If the pipe is filled with oil of sp.gr. 0.87 find the force exerted by the oil upon the gate and position of centre of pressure.

2 Classify, define and explain the types of fluid flows.

3 Derive Bernoulli's equation from Euler's derivation.

4 (a) Explain orifice meter with the help of figure.
(b) Find the discharge of water following through a pipe 30cm diameter placed in an inclined position where a venturimeter is inserted, having a throat diameter of 15cm. The difference of pressure between the main and throat is measured by a liquid of sp.gr. 0.6 in an inverted U-tube which gives a reading of 30cm. The loss of head between the main and throat is 0.2 times the kinetic head of the pipe.

5 (a) Derive expression to find out displacement thickness for a flow over a plate with the help of figure.
(b) Explain boundary layer separation and control of boundary layer separation.

6 (a) Explain how to determine the type of flow from Reynolds number. Draw neat figure.
(b) A pipe-line carrying water has average height of irregularities projecting from the surface of the boundary of the pipe as 0.15 mm. What type of boundary is it? The shear stress developed is 4.9 N/m^2. The kinematic viscosity of water is 0.01 stokes.

7 (a) Obtain expression for the velocity distribution for turbulent flow in smooth pipes.
(b) Determine the distance from the centre of the pipe, at which the local velocity is equal to the average velocity for turbulent flow in pipes.

8 Air discharges from a large tank in which the pressure is 700 kN/m^2 and temperature 40^0 C through a convergent nozzle of 25 mm tip diameter. Calculate the flow rates when the pressure outside the jet is (a) 200 kN/m^2, and (b) 550 kN/m^2 and the barometric pressure is 101 kN/m^2. Also calculate the pressure, temperature, velocity and sonic velocity at the nozzle tip for these flow rates. Take K = 1.4 and R = 286.8 J/kg.K.

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B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April / MAY 2012

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(Aeronautical Engineering)

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1 Classify and explain the different devices to measure the pressure of a fluid with the help of neat sketches.

2 (a) Explain the terms stream line and streak line.
(b) Derive the continuity equation in three-dimensions then also write
(i) For steady flow (ii) Incompressible (iii) For 2D flow.

3 A 45^0 reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 600 mm and 400 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 N/cm^2 and rate of flow of water is 600 litres/s.

4 (a) Explain about hotwire anemometer.
(b) Derive the equation to determine the discharge over a triangular notch.

5 (a) Explain effect of pressure gradient on boundary layer separation. Draw a neat figure.
(b) For the following velocity profiles, determine whether the flow has separated or on the verge of separation or will attach with the surface.
(i) $u/U = 3/2(y/\delta) - ½(y/\delta)^2$ (ii) $u/U = 2(y/\delta)^2 - (y/\delta)^3$ (iii) $u/U = -2(y/\delta) + (y/\delta)^2$.

6 (a) Explain characteristics of real fluids.
(b) An oil of sp.gr. 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500litres/s. Find the head lost due to function and power required to maintain the flow for a length of 1000 m. Take ϑ = 0.29 stokes.

7 What do you understand by turbulent flow? What factor decides the type of flow in pipes? Explain with the help of figure.

8 (a) Derive Bernoulli's equation for isothermal and adiabatic process for compressible fluids.
(b) To what change in pressure a liquid of specific gravity 1.2 should be subjected to cause reduction in volume by one percent? The velocity of sound in the liquid is 1500 m/s.

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