Code No: R050212102 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2006
MECHANICS OF FLUIDS
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Expain briefly the following mechanical gauges:
   i. Bourdon tube pressure gauge, and
   ii. Diaphragm gauge.
   (b) Distinguish between a Newtonian and non-Newtonian fluid
   (c) What are manometers? [8+4+4]

2. (a) In a fluid, the velocity field is given by
   V=(3x+2y)i+(2z+3 x^2)j+(2t-3z)k
   Determine:
   i. The velocity components u,v,w at any point in the flow field
   ii. The speed at point (1,1,1);
   iii. The speed at time t = 2s at point (0,0,2).
   Also classify the velocity field as steady, or unsteady, uniform or non-uniform and one, two or three dimensional.
   (b) Define convectional and local accelerations. [10+6]

3. An open circuit wind tunnel draws air from the atmosphere through a well contoured nozzle. In the test section, where the flow is straight and nearly uniform, a static pressure tap is drilled into the tunnel wall. A manometer connected to the tap shows that the wall pressure within the tunnel is 45 mm of water below atmospheric. Assume that air is incompressible and at 25^0 C, pressure is 100 Kpa(absolute). Calculate the velocity in the wind tunnel section. Density of water is 999kg/m^3 and characteristic gas constant for air is 287 J/Kg K. [16]

4. Explain the principle of Orifice meter with neat sketch and derive and expression for finding out actual discharge from a given Orificemeter. [16]

5. (a) Define boundary layer and explain the fundamental causes of its existence. Also discuss various methods of controlling the boundary layer.
   (b) A smooth flat plate 1m wide and 1.5 m long is rowed length wise through still air with a velocity of 10 m/sec. assuming the boundary layer to be fully laminar, estimate its thickness at the trailing edge. Mass density and kinematic viscosity of air are 1.216 kg/m^3 and 0.15 cm^2/sec respectively. [10+6]

6. (a) What do you mean by 'pipes in parallel'? When pipes are connected in parallel? What is the loss of head in the system.

(b) A pumping plant forces water through a 50 cm diameter main, the frictional head being 30 m. It is proposed to lay another main of appropriate diameter alongside the existing one so that the two pipes may work parallel for the entire length and reduce the friction head to 10 m only. Find the diameter of the new main if, with the exception of the diameter, it is similar to the existing one in every other aspect. [8+8]

7. (a) Sketch the Reynolds apparatus and explain how the laminar flow can be demonstrated with the help of this apparatus?

   (b) Oil of absolute viscosity 1.5 poise and relative density 0.85 flows through a 30cm diameter pipe .If the head losses in a 3000M length of a pipe is 20M.estimate the friction factor by assuming the flow to be laminar. [8+8]

8. (a) what is the relation between pressure and density of a compressible fluid for?

      i. Isothermal process

      ii. Adiabatic process.

   (b) A gas is flowing through a horizontal pipe at a temperature of 4^0C. The diameter of the pipe is 8cm and at a section I in the pipe, the pressure is 30.3N/cm^2 (gauge). The diameter of the pipe changes from 8cm to 4cm at the section II, where pressure is 20.3N/cm^2 (gauge). Find the velocities of the gas at these sections assuming an isothermal process. Take R=287.14Nm/Kg.K and atmosphere pressure=10N/ cm^2. [6+10]

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Code No: R050212102 **Set No. 2**

II B.Tech I Semester Regular Examinations, November 2006
MECHANICS OF FLUIDS
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Two large fixed parallel planes are 12mm apart. The space between the surfaces is filled with oil of viscosity 0.972Ns/ m^2. A flat thin plate 0.25 m^2 area moves through the oil at a velocity of 0.3m/s. Calculate the drag force:

   (a) When the plate is equidistant from both the planes and

   (b) When the thin plate is at a distance of 4mm from one of the plane surfaces. [16]

2. Two velocity components are given in the following cases, find the third component such that they satisfy the continuity equation.

   (a) $u = x^3 + y^2 + 2z^2; v = -x^2y - yz - xy;$

   (b) $u = \log(y^2 + z^2); v = \log(x^2 + z^2);$

   (c) $u = \frac{-2xyz}{(x^2+y^2)^2}; w = \frac{y}{(x^2+y^2)}$ [16]

3. A cylindrical vessel 12cm in diameter and 30cm deep is filled with water up to top, The vessel is open at the top. Find the quantity of liquid left in the vessel, when it is rotated about its vertical axis with a speed of [16]

   (a) 300 rpm. and

   (b) 600rpm.

4. In a vertical pipe conveying oil of specific gravity 0.8 two pressure gauges, have been installed at A & B where the diameters are 16cms and 8cms respectively. A is 2m above B The pressure gauge reading have shown that the pressure at 'B' is greater than at 'A' by 0.981 N/cm^2 . Neglecting all lasses, calculate the flow rate. If the gauges at A and B are replaced by tubes filled with the same liquid and connected to a U-tube contains mercury, calculate the difference of level of mercury in the two limbs of the U-tube. [16]

5. (a) For a fluid flowing over a flat plate, draw

      i. Velocity distribution in the laminar and turbulent boundary layers

      ii. Shear stress distribution for the boundary layer developing on either side of the plate.

   (b) A plate 4 m x 1.5 m is held in water moving at 1 m/sec parallel to its length. If the flow in the boundary layer is laminar at the leading edge of the plate, find [6+10]

i. the distance from leading edge where the boundary layer flow changes from laminar to turbulent flow

ii. the thickness of boundary layer at this section, and

iii. the frictional drag on both sides of the plate.

6. A pipeline ABC 180 m long is laid on an upward slope of 1 in 60. The length of portion AB is 90 m and its diameter is 0.15 m. At B the pipe section suddenly enlarges to 0.30 m diameter and remains so for the remainder of its length BC, 90 m. A flow of 50 litres per second is pumped into the pipe at its lower end A and is discharged at the upper end C into a closed tank. The pressure at the supply end A is 137.34 kN/m^2. Sketch [16]

   (a) the total energy line

   (b) the hydraulic gradient line and also find the pressure at discharge end C. Take f = 0.02 in $h_f = \frac{flV^2}{2gD}$

7. (a) Explain characteristics of laminar flow. Give examples where such a flow is encountered?

   (b) A pipe of diameter 20 cm and length 200 m connecting two reservoirs, having difference of water level of 20m.Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200m is attached to the last pipe 1200 m length of the existing pipe, find the increase in discharge. Take f=0.015 and neglect minor losses. [8+8]

8. (a) Derive Bernoulli's equation for compressible flow undergoing adiabatic process?

   (b) Find the Mach number when an aero plane is flying at 1100Km/hr through still air having a pressure of 7 N/ cm^2 and temperature -5^0C. Wind velocity may be taken as zero. Take R=287.14J/KgK. Calculate the pressure, temp and density of air at stagnation point on the nose of the plane. Take K=1.4. [8+8]

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Code No: R050212102 **Set No. 3**

II B.Tech I Semester Regular Examinations, November 2006
MECHANICS OF FLUIDS
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Discuss factors which affect the viscosity of a liquid.
   (b) What do you mean by a single column manometer?
   (c) What are the laws of floatation? [6+6+4]

2. (a) When 2500 litres of water flows per minute through a 0.3m diameter pipe which later reduces to a 0.15 diameter pipe, calculate the velocities of flow in the two pipes.
   (b) How are fluid flows classified?
   (c) What are the properties of a 'stream tube'. [6+6+4]

3. (a) Derive an expression for the depth of paraboloid formed by the surface of a liquid in a cylindrical tank which is rotated at a constant angular velocity 'w' about its vertical axis?
   (b) A taper pipe has diameters 0.35m and 0.75m at its two end. The smaller end is 3m above the large end. For a flow of $0.3m^3$/sec of water the pressure at the lower end is 10 Kpa. Assuming a head loss of 2m and kinetic energy correction factor $\alpha = 1.2$ and 1.5 at the smaller and larger ends respectively estimate the pressure at the smaller end? [7+9]

4. (a) Discuss the relative merits and demerits of venturimeter with respect to orifice meter
   (b) A rectangular channel 6mts wide carries 2800 lit/sec at the depth of 0.9mts. What height of a broad crested rectangular weir must be installed to **double** the depth? Assume a weir co coefficient as 0.86. [7+9]

5. (a) Explain physically and mathematically the followin:
      i. Displacement thickness
      ii. Momentum thickness
      iii. Energy thickness.
   (b) Atmospheric air at 30^0C flows parallel to a flat plate at a velocity of 2.5 m/sec. Estimate the boundary layer thickness at distance from leading edge of the plate. Use Von-Karman integral method. Assume for air kinematic viscosity as 16.83 $\times 10^{-6}$ m^2/sec. [12+4]

6. (a) Derive Darcy-Weisbach equation for loss of head in a pipe.

(b) Two tanks are connected by a 300 mm diameter 1000 m long pipe. Find the rate of flow if the difference of water level in the tank is 10 m. Take 4f = 0.04 and ignore minor losses. [10+6]

7. (a) What do you meant by viscous flow? Mention various forces to be considered in Navier Stroke's equation.

   (b) Through a horizontal circular pipe of diameter 100 mm and of length 10m, an oil of dynamic 0.097 poise and relative density 0.9 is flowing. Calculate the difference of pressure at the two ends of the pipe, if 100 Kg. of the oil is collected in a tank in 30 seconds. [10+6]

8. Find the mass flow rate of air through venturimeter having inlet diameter as 400 mm and through diameter 200mm. The pressure at the inlet of the venturimeter is 27.468 N/ cm^2 (abs) and temperature of a air at inlet is 20^0C. The pressure at the throat is given as 25.506 N/ cm^2 (abs).Take R=287 J/Kg-K and K=1.4. [16]

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Code No: R050212102 **Set No. 4**

II B.Tech I Semester Regular Examinations, November 2006
MECHANICS OF FLUIDS
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Discuss factors which affect the viscosity of a liquid.
   (b) What do you mean by a single column manometer?
   (c) What are the laws of floatation? [6+6+4]

2. (a) In a fluid, the velocity field is given by
   V=(3x+2y)i+(2z+3 x^2)j+(2t-3z)k
   Determine:
      i. The velocity components u,v,w at any point in the flow field
      ii. The speed at point (1,1,1);
      iii. The speed at time t = 2s at point (0,0,2).
      Also classify the velocity field as steady, or unsteady, uniform or non-uniform and one, two or three dimensional.
   (b) Define convectional and local accelerations. [10+6]

3. (a) What is the importance of kinetic energy and momentum correction factors.
   (b) A nozzle of diameter 20mm is fitted to a pipe of diameter 40mm. Find the force exerted by the nozzle on the water, which is flowing through the pipe at the rate of $1.2m^3$/minute [7+9]

4. (a) Explain the working principle of Venturimeter and Orifice meter?
   (b) [7+9]
      i. A broad crested weir of 50mts length, has 50cms height of water above its crest. Find the maximum discharge. Take Cd =0.6. Neglect Velocity of approach.
      ii. If the velocity of approach is to be taken into consideration, find the maximum discharge when the channel has cross sectional area of $50m^2$ on the upstream side.

5. (a) For a fluid flowing over a flat plate, draw
      i. Velocity distribution in the laminar and turbulent boundary layers
      ii. Shear stress distribution for the boundary layer developing on either side of the plate.
   (b) A plate 4 m x 1.5 m is held in water moving at 1 m/sec parallel to its length. If the flow in the boundary layer is laminar at the leading edge of the plate, find [6+10]

i. the distance from leading edge where the boundary layer flow changes from laminar to turbulent flow
ii. the thickness of boundary layer at this section, and
iii. the frictional drag on both sides of the plate.

6. (a) Derive Darcy-Weisbach equation for loss of head in a pipe.
   (b) Two tanks are connected by a 300 mm diameter 1000 m long pipe. Find the rate of flow if the difference of water level in the tank is 10 m. Take 4f = 0.04 and ignore minor losses. [10+6]

7. (a) Explain the terms
      i. Long pipes
      ii. Inclined pipes
      iii. Equivalent pipe.
   (b) Two sharp ended pipes of diameters 50 mm and 100 mm respectively, each of length 100m are connected in parallel between two reservoirs which have a difference of level of 10M.If the coefficient of friction for each pipe is (4f) 0.32, calculate the rate of flow for each pipe and also the diameter of a single pipe 100m long which would give the same discharge ,if it were substituted for the original two pipes. [10+6]

8. (a) Write short notes on:
      i. Mach angle,
      ii. Zone of Action,
      iii. Zone of silence.
   (b) Define Mach number and explain sonic flow, subsonic flow and super - sonic flow
   (c) An Aeroplane is flying at an height of 15 Km where the temperature is - 50^0 C. The speed of the plane is corresponding to M=2. Assume K = 1.4and R = 287 J/Kg. K, find the speed of the plane. [5+5+6]

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