Code No: RR212101 **Set No.1**

II B.Tech. I Semester Regular Examinations, November -2005
MECHANICS OF FLUID
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the phenomena of capillarity and surface tension
   (b) A cylinder 0.25m in radius and 2 m in length rotates coaxially inside a fixed cylinder of the same length and 0.30m radius. Olive oil of viscosity 5.0 Pa-s fills the space between the cylinders. A torque of 5.0 N- m is applied to the inner cylinder. After constant velocity is attained, calculate the velocity gradients at the inner walls, the resulting r.p.m. and the power dissipated by fluid resistance ignoring end effects. [8+8]

2. (a) State the continuity equation for a three dimensional flow. How is it modified for 2 dimensional and 1 dimensional flows.
   (b) A pipe line 60 cm in diameter bifurcates at a y-junction into two branches of 40 cm and 30 cm diameter. If the ratio of flow in the main pipe $1.2m^3/s$ and the mean velocity of flow in the 30 cm dia. Pipe is 7.5 m/s, determine the rate of flow in the 40 cm pipe. [8+8]

3. (a) Derive Bernoulli's equation for flow along a stream line.
   (b) A pipe 200 m long slopes down at 1 in 100 and tapers from 800 mm diameter at the higher end to 400 mm diameter at the lower end and carries 100 lps of oil (S = 0.85). If the pressure gauge reading at the higher end reads 50 kN / m^2, determine, (i) Velocities at the two ends and (ii) pressure at the lower end. Neglect losses [8+8].

4. (a) What is meant by smooth boundary and a rough boundary?
   (b) Describe briefly the phenomenon of boundary layer separation.
   (c) At what wind speed must a 127 mm diameter sphere travel through water to have a drag of 5 N. [4+6+6]

5. (a) How are shocks formed? Give some practical examples.
   (b) During a normal shock in a constant area duct containing air, the initial conditions are $P_1 = 10N/m^2, T_1 = 0^0c$; U = 1000 m/s Calculate (i) the corresponding trans shock condition and (ii) percentage change in density across the shock if R= 287 J/Kg^0k [8+8]

6. (a) Derive Hazen-poisehille equation for laminar flow in circular pipes.
   (b) Explain in detail how the flow is demonstrated using Reynolds experiment.

   [8+8]

7. (a) Prove that the head lost due to friction is equal to one third of the total head at inlet for maximum power transmission through pipes.

   (b) The rate of flow of water pumped into a pipe ABC, which is 200m long is 20lit/sec. The pipe is laid on an upward slope of 1 in 40. The length of the portion AB is 100m and its diameter is 10cm, while the length of the portion BC is also 100m but its diameter is 20cm. The change of diameter at B is sudden. The flow is taking place from A to C where the pressure at A is $19.62 N/cm^2$and end C is connected to a tank. Find the pressure at C taking f=0.008. [8+8]

8. (a) An orifice meter is to be fitted into a horizontal pipe 20 cm dia, carrying oil of specific gravity 0.85 for the purpose of flow measurement. The differential head is to be indicated by a U-tube Manometer containing mercury (specific. Gravity = 13.6). If the manometer reading is not to exceed 0.2m when the flow is 15Kg/sec, what should be the diameter of the orifice? Assume C_d= 0.62

   (b) Write a detailed note on pressure gauges [8+8]

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Code No: RR212101 **Set No.2**

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

Answer any FIVE Questions
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1. (a) Explain the phenomena of capillarity and surface tension
   (b) A cylinder 0.25m in radius and 2 m in length rotates coaxially inside a fixed cylinder of the same length and 0.30m radius. Olive oil of viscosity 5.0 Pa-s fills the space between the cylinders. A torque of 5.0 N- m is applied to the inner cylinder. After constant velocity is attained, calculate the velocity gradients at the inner walls, the resulting r.p.m. and the power dissipated by fluid resistance ignoring end effects. [8+8]

2. (a) Define and distinguish laminar and turbulent flows. Give two real fluid flow examples of each. How are they distinguished in real fluid flow?
   (b) For steady, incompressible flow, verify whether the following values of u and v are possible:
      i. i) u = 4 x y +y2 , v = 6xy + 3x
      ii. ii) u = 2 x2 +y2 , v =- 4xy and
      iii. iii) $\frac{x}{(x^2+y^2)!}, v = \frac{-y}{(x^2+y^2)!}$ [8+8]

3. (a) What are the body forces considered in fluid flow problems?
   (b) A 15-cm diameter pipe is reduced to 7.5 cm diameter through a gradual contraction. The difference between the piezometric heads at the main and contracted section is 4 cm of mercury. By neglecting losses calculate the discharge of water. [8+8]

4. (a) Describe with the help of neat sketch, the variation of drag coefficient for a cylinder over a wide range of Reynolds number.
   (b) Oil with a free stream velocity of 3 m/s flows over a thin plate 1.25-m wide and 2 m long. Determine the boundary layer thickness and the shear stress at mid length and calculate the total, double-sided resistance of the plate. Take Density = 860 kg/$m^3 and v = 10^{-3}$. [8+8]

5. (a) How are the disturbance in compressible fluid propagates?
   (b) Air at a velocity of 1400 Km/hr has a pressure of $10 KN/m^2$(vacuum) and temperature of 50.16^0 C. Calculate local Mach number and stagnation pressure, density and temperature .Take$\gamma = 1.4 and R = 281.43 J/Kg^0K$, barometric pressure = $101.325 KN/m^2$. [8+8]

6. (a) Prove that the boundary shear stress is directly proportional to the pressure gradient and the boundary spacing for the case of laminar flow between parallel flat plates when both the plates are at rest.

(b) What do you know about Couette flow? Explain. [8+8]

7. (a) Sketch and explain the hydraulic gradient and total energy line for an inclined pipe and horizontal pipe discharging freely in atmosphere.

   (b) Write a note on power transmitter through popes. [8+8]

8. (a) An orifice meter is to be fitted into a horizontal pipe 20 cm dia, carrying oil of specific gravity 0.85 for the purpose of flow measurement. The differential head is to be indicated by a U-tube Manometer containing mercury (specific. Gravity = 13.6). If the manometer reading is not to exceed 0.2m when the flow is 15Kg/sec, what should be the diameter of the orifice? Assume C_d= 0.62

   (b) Write a detailed note on pressure gauges [8+8]

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1. (a) Give an example each where air can be treated as an incompressible fluid and water has to be treated as compressible fluid. Explain.
   (b) The bulk modulus of water is 210 KN/cm^2. What pressure is required to reduce its volume by 2%? Also prove that the increase in the mass density will be 2% only. [8+8]

2. (a) Define equipotential line and a line of constant stream function, Show that these lines intersect orthogonally.
   (b) Given that u = x^2y^2 and v = - 2xy. Check whether stream function exists. If so determine the stream function and potential function for the flow. [8+8]

3. (a) Derive an expression for Bernoullis equations for flow along a stream line.
   (b) A U - tube contains a liquid of relative density 1.25 to a height of 25 cm in both the columns. It is rotated about a symmetrical vertical axis which is 15 cm from both the limbs. Calculate the pressures at the bottom horizontal connecting points and mid point when the speed of rotation is 240 rpm.[8+8]

4. (a) Define the following terms for an air foil. (i) Camber (ii) Angle of attack (iii) Profile centerline (iv) Aspect ratio
   (b) Calculate the diameter of a parachute to be used for dropping a body weighing 1000 N so that the maximum terminal velocity of dropping is 5 m/s. The drag coefficient for parachute which may be treated as hemispheroid is 1.3 and the value of the mass density of the air is 1.2 kg /m^3.
   (c) How does the drag coefficient change with (i) surface roughness (ii) turbulence level [6+6+4]

5. (a) What is meant by co-efficient of compressibility?
   (b) A diffuser of area ratio 2 :1 operates at the inlet condition $P_1 = 500KN/m^2, T_1$= 500 K , $M_1 = 0.6, \gamma = 1.4$ .Estimate the following at the exit (i) velocity (ii) pressure (iii) Temperature (iv) Mach number [6+10]

6. (a) Sketch the velocity distribution of laminar flow in ideal and real fluid flow and explain it in detail.
   (b) A fluid of viscosity 0.883 pascal-sec and specific gravity 1.26 is pumped along a horizontal pipe of 65 m long and 10 cm diameter at a flow rate of $0.18m^3/sec$. Determine the Reynolds Number and calculate the pressure loss in the pipe if the flow is laminar. [8+8]

7. (a) Sketch and explain the hydraulic gradient and total energy line for an inclined pipe and horizontal pipe discharging freely in atmosphere.
   (b) Write a note on power transmitter through popes. [8+8]

8. (a) A pipe containing water at 172 kN/m^2 pressure is connected by a differential gage to another pipe 1.5 m lower than the first pipe and containing water at high pressure. If the difference in heights of the two mercury columns of the gage is equal to 75 mm, what is the pressure in the lower pipe? G of mercury = 13.6.
   (b) Obtain an expression for inclined manometer and explain its use. [8+8]

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Code No: RR212101 **Set No.4**

II B.Tech. I Semester Regular Examinations, November -2005
MECHANICS OF FLUID
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Give an example each where air can be treated as an incompressible fluid and water has to be treated as compressible fluid. Explain.
   (b) The bulk modulus of water is 210 KN/cm^2. What pressure is required to reduce its volume by 2%? Also prove that the increase in the mass density will be 2% only. [8+8]

2. (a) A stream function is defined by
   $\psi = X^2 - Y^3$
   Show that the flow cannot be a potential flow.
   (b) Explain the characteristics of stream and velocity potential functions. [8+8]

3. (a) Derive Eulers equation of motion along a stream line. State assumptions made in the derivation.
   (b) In an inclined pipe of uniform diameter 25 cm, a pressure of 50 kPa was observed at section - 1 which was at elevation 10.0 m. At another section -2 at elevation 12.0 m the pressure was 20 kPa and the velocity was 1.25 m/s. Determine the direction of flow and the head loss between these two sections. The fluid in the pipe is water. [8+8]

4. (a) What forces influences the motion of (i) a ship (ii) a sub marine (iii)an aeroplane flying at suspension speed.
   (b) Define and derive the expression for displacement thickness.
   (c) For laminar boundary layer on a flat plate held parallel to a stream of uniform velocity, determine the location of the section where drag up to that section is twice the drag on remaining region. [4+8+4]

5. (a) What is the function of wind tunnel?
   (b) What is meant by stagnation point. Explain [8+8]

6. (a) Obtain an expression for the head loss in laminar flow in a circular pipe. Also write down the equation for head loss due to laminar flow between parallel plates and for flow down an inclined plane. Give the Reynolds numbers up to which these equations are valid.
   (b) An oil of specific gravity 0.9 flow at a rate of $0.2m^3/sec$ through a horizontal pipe of 7.5 cm diameter. The pressure drop is $400KN/m^2$over 300m length of pipe. Find the viscosity of the oil. [8+8]

7. (a) Sketch and explain the hydraulic gradient and total energy line for an inclined pipe and horizontal pipe discharging freely in atmosphere.

   (b) Write a note on power transmitter through popes. [8+8]

8. (a) The rate of flow of water in a 150mm diameter pipe is measured with a venturimeter with a 50mm dia. throat. When a mercury manometer is connected across the converging section reads 8mm, the flow rate is 2.7 kg/s. What is the coefficient of discharge at that flow rate and what is permanent loss of head? Specific gravity of mercury = 13.6

   (b) What is the device used for measuring fluid pressure? Explain briefly the principle of an inclined Manometer. [8+8]

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