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

II B.Tech. I Semester Supplementary Examinations, May -2005
MECHANICS OF FLUI DS
(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 pnenomena 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.

2. (a) Derive three dimensional continuity equation.
   (b) The x and y components in a three dimensional flow are given by
   $U = X^2 + Z^2$ $\vartheta = Y^2 + Z^2$
   Find the simplest z component of velocity that satisfies the continuity equation.

3. (a) What are the applications of Bernoillis equation.
   (b) A conical pipe has diameter 0.40 m & 0.80 m at its two ends. The smaller end is 2 m above the larger end. For a flow of 0.30 m^3/ sec of water the pressure at the lower end is 10 kPa. Assuming a head loss of 2 m and kinetic energy correction factor a = 1.1 and 1.5 at the smaller and larger ends respectively, estimate the pressure at the smaller end.

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.

5. (a) What are static and stagnation temperature?
   (b) Oxygen flows in a conduit at an absolute pressure of 170 KN/m^2If the absolute pressure and temperature at the nose of small object in the stream are 200 KN/$m^2 and 70.16^0$ C respectively.
   Determine the velocity in conduit if $\gamma = 1.4 and R = 281.43 J/Kg^0K$

6. (a) Explain the velocity and shear stress distribution for laminar flow in a circular pipe with a neat sketch.
   (b) A fluid of mass density $1790 kg/m^3$ and viscosity of 2.1 pascal-sec flow at a velocity of 3 m/sec in a 6 cm diameter pipe. Estimate the head loss in a length of 12 m of pipe.

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. (a) A venturimeter is used for measuring the flow of petrol (G = 0.81) in a pipeline inclined at 35^0 to the horizontal. The throat area ratio is 4. If the difference in mercury levels in the gage is 50 mm, calculate the flow if the pipe dia is 30 m. Take $C_d = 0.975$. Take specific gravity of mercury as 13.6.

   (b) Explain the working of Bourdon pressure gage with a sketch.

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1. (a) Derive an expression for the torque and power required to overcome the viscous drag for a shaft running at a particular r.p.m.
   (b) A hydraulic lift shaft of 500 mm diameter moves in a cylindrical sleeve the length of engagement being 2m. The interface is filled with oil of kinematic viscosity of 2.4 X 10^{-4} m^2/sec and density of 888 kg/m^3. The drag resistance when the shaft moves at 0.2 m/sec is 267.81 N. Determine the internal diameter of the cylinder.

2. (a) What are the methods available for describing the fluid flow? and explain each method.
   (b) A circular pipe 10 cm in diameter has 2 m length which is porous, In this porous section the velocity of exit is known to be constant. If the velocities at the inlet and outlet of the porous section are 2.0 m/sec and 1.2 m/sec respectively, estimate (i) the discharge emitted out through the walls of the porous pipe and (ii) the average velocity of this emitted discharge.

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.

4. (a) State stokes law. Prove that the drag coefficient for sphere for Reynolds number up to 0.2 is given by $C_D = 24/\mathrm{R}$
   (b) A spherical sand particle of 0.1-mm diameter falls under the action of gravity in water. Determine its terminal fall velocity.
   (c) Determine the bending moment at the base of a 40 m high chimney of cylindrical shape of diameter 2.5 m in a wind of uniform velocity 25 m / s. TakeC_D = 0.35 and pair = 1.25 kg /m^3.

5. (a) Differentiate between compressible and incompressible flows.
   (b) A large vessel fitted with a nozzle ,contains air at pressure of 2500 KN/m^2 and a temperature of 20^0C .If the pressure at the outlet of the nozzle is 1750 KN/m^2 find the velocity of air flowing at the outlet of the nozzle?

6. (a) Explain the velocity and shear stress distribution for laminar flow in a circular pipe with a neat sketch.

   (b) A fluid of mass density $1790 kg/m^3$ and viscosity of 2.1 pascal-sec flow at a velocity of 3 m/sec in a 6 cm diameter pipe. Estimate the head loss in a length of 12 m of pipe.

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. (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.

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Code No: RR212101 **Set No.3**

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain how liquids vaporize at normal temperature. What are the effects of vaporisation.
   (b) Two large vertical plane parallel surfaces are 5mm apart and the space between them is filled with a fluid. A thin square plate of 12.5 cm falls freely between the planes along the central plane and reaches a stready velocity of 2m/sec. Determine the weight of the plate if the viscosity of the fluid filling the space is 0.02 Pa-s.

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.

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.

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

5. (a) Explain the formation of shock waves at various section in a convergent divergent nozzle .
   (b) Calculate the Mach number of an object traveling at 300 m/s in an environment of air at 200 K . Estimate also the corresponding tagnation temperature.

6. (a) Explain Reynolds number and its significance in detail? What is the significance of upper and lower critical Reynolds numbers.

(b) A viscous fluid of viscosity 2.2 poise and specific gravity 1.4 flows through a 40 cm diameter pipe. If the loss of head is 3 m in 100 m length, determine the shear stress at the wall pipe and velocity of flow assuming the flow to be laminar.

7. (a) Explain different laws of fluid friction in detail?

   (b) A siphon of diameter 20cm connects two reservoirs having a difference in elevation of 20m. The length of the siphon is 500m and the summit is 3m above the water level in the upper reservoir. The length of the pipe from upper reservoir to the summit is 100m. Determine the discharge through the siphon and also pressure at the summit by neglecting minor losses and taking coefficient of friction as 0.005.

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

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

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   (b) Two large vertical plane parallel surfaces are 5mm apart and the space between them is filled with a fluid. A thin square plate of 12.5 cm falls freely between the planes along the central plane and reaches a stready velocity of 2m/sec. Determine the weight of the plate if the viscosity of the fluid filling the space is 0.02 Pa-s.

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.

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.

4. (a) Sketch the growth of boundary layer on a flat plate and explain the different regions of it.
   (b) Find the displacement thickness and wall shear stress for the velocity distribution in a boundary layer (u / U) = (y / δ) where U is the Velocity and d is the boundary layer thickness.

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

6. (a) Derive an expression for mean velocity of flow for laminar flow through inclined pipes.
   (b) Derive the necessary condition for mean velocity for the laminar flow between parallel flat plates when both the plates are at rest.

7. (a) Define and explain the terms hydraulic gradient line and total energy line.

(b) A pipe 20cm diameter and 1800 m long connects two reservoirs one being 30m below the other. The pipe line crosses a ridge whose summit is 7.5m above the upper reservoir. What will be the minimum depth of the pipe below the summit of the ridge in order that the pressure at the apex doesn't fall below 7.5m vacuum. The length of the pipe from the upper reservoir to the apex is 300m. Taking f= 0.032 determine the rate of flow to the lower reservoir in lit/min.

8. (a) Define the terms (i) gage pressure (ii) vaccum pressure and (iii) absolute pressure. Explain with a sketch.

(b) Differentiate between simple and differential type of manometers

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