 Set No. 1

II B.Tech II Semester Supplementary Examinations, November/December 2005

MECHANICS OF FLUIDS

(Common to Mechanical Engineering and Metallurgy & Material Technology)

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

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Explain in two cases of water flow, how the vaporisation takes place and its effects thereon.

   (b) A shaft of 145 mm diameter runs in journals with a uniform oil film thickness 0.5 mm. Two bearings of 20 cm width are used. The viscosity of the oil is 19 centipoises. Determine the speed if the power absorbed is 15 W. [8+8]

2. (a) Define and distinguish between steady flow and uniform flow. Give two examples of each flow.

   (b) Derive continuity equation for 1-D flow. [8+8]

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. [6+10]

4. (a) Why is it necessary to control the growth of boundary layer on most of the bodies? What methods are used for such a control?

   (b) A sphere has a projected area of $1m^2$. Compare the drag force in water and in air when travelling at a speed of 30 km/hr. [8+8]

5. (a) What is meant by Mach number (M), Zone of action and Zone of Silence?

   (b) Derive an expression for flow of compressible fluid through venturimeter .

   [8+8]

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6. (a) Derive Hazen-Poiseuille equation for laminar flow in the circular pipes.

   (b) Glycerin of viscosity 1.5 pascal-sec and mass density $1200 kg/m^3$ flows at a velocity of 5 m/sec in a 10 cm diameter pipe. Check whether the flow is laminar in pipe line. Find the boundary shear stress in the pipe. [8+8]

7. (a) Explain the terms Pipes in parallel, Equivalent pipe and Equivalent size of the pipe.

(b) Determine the difference in the elevations between the water surfaces in the two tanks which are connected by a horizontal pipe of diameter 30cm and length 400m. The rate of flow of water through the pipe is 300 lit/sec. Neglect the minor losses and take the value of f=0.008 . [8+8]

8. (a) What are the mechanical pressure gauges.

   (b) A horizontal venturimeter with inlet dia 20 cm and throat dia of 10 cm is used to measure the flow of an oil of specific gravity 0.8. The discharge of the oil through the meter is 60 lit/sec. Find the reading of the oil-mercury differential manometer. Take C_d=0.98. Specific gravity of mercury is 13.6. [8+8]

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Code No: RR220301 **Set No. 2**

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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) Define kinematic viscosity. How is this name attributed to this property?

   (b) Lateral stability of a long shaft 15cm diameter is obtained by means of a 25cm stationary bearing having an internal diameter of 15.025cm. If the space between bearing and shaft is filled with a lubricant having a viscosity 24 Pa-s, what power will be required to overcome the viscous resistance when the shaft is rotated at a constant rate of 180 r.p.m. [6+10]

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) Draw a neat sketch showing the variation of drag coefficient for a sphere with Reynolds number and explain the salient features.

   (b) A 1 m by 1.2 m plate moves at 13.5 m / s in still air at an angle of 12^0 with horizontal. Using C_D= 0.17 and C_L=0.72. Determine (i) the resultant force exerted by air on the plate (ii) the friction force (iii) the power required to keep plate moving. [8+8]

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

(b) A viscous liquid was flowing in laminar regime in a 6 cm diameter circular pipe. A pitot tube at a radial distance of 2 cm from the axis indicated a velocity of 0.6 m/sec. Calculate the maximum velocity, the mean velocity and the discharge in the pipe. [8+8]

7. (a) Obtain an expression for the optimum exit diameter of a nozzle to be fitted at the service end of a pipe for maximum power transmission.

   (b) Find the loss of head when a pipe of diameter 20 cm is suddenly enlarged to a diameter of 40cm. The rate of flow of water through the pipe is 250lit/sec.

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

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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. [8+8]

2. (a) State the basic principle of continuity equation. Obtain an expression of continuity equation for a three dimensional - steady - incompressible fluid flow.

   (b) A flow is described by the stream function $\psi = 2\sqrt{3}XY$. Locate the point at which the velocity vector has a magnitude of 4 units and makes an angle of 150^o with the x- axis. [8+8]

3. (a) State the momentum equation. How will you apply momentum equation for determining the force exerted by a flowing liquid on a pipe bend?

   (b) A nozzle at the end of a 80 mm hose produces a jet 40 mm in diameter. Determine the force on the joint at the base of the nozzle when it is discharging 1200 liters of water per minute. [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) What is the relation between pressure and density of a compressible fluid for (i) Isothermal process (ii) adiabatic process.

   (b) A 100 mm diameter pipe reduces to 50 mm diameter through a sudden contraction. When it carries air at 20.16^0 under isothermal condition, the absolute pressure observed in the two pipes just before and after the contraction are $400KN/m^2 and 320KN/m^2$ respectively. Determine the densities and velocities at the two section. Take $R = 290J/Kg^0$K [8+8]

6. (a) Enumerate distinguish characteristics of laminar flow? Give examples where such a flow is encountered.

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

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+8]

8. (a) A 150 mm x 75 mm Venturimeter with $C_d = 0.98$ is to be replaced by an orifice meter having a value of $C_d = 0.6$. If both the meters are to give the same differential mercury manometer reading for a discharge of 100 lps and the inlet dia. to remain 150 mm, what should be the diameter of orifice.

   (b) What is the necessity of ventilation of weirs. [8+8]

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

Answer any FIVE Questions

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1. (a) Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid.

   (b) A circular plate of diameter 0.75m is immersed in a liquid of relative density 0.80 with its plane making an angle of 30o with the horizontal. The centre of the plate is at a depth of 1.50m below the free surface. Calculate the total force on one side of the plate and the location of the centre of pressure. [8+8]

2. (a) Define and distinguish between steady flow and uniform flow. Give two examples of each flow.

   (b) Derive continuity equation for 1-D flow. [8+8]

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. [6+10]

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. Find the mass flow rate of air through Venturimeter having inlet diameter 300 mm and throat diameter 150 mm , The pressure and temperature of air at inlet section of venture meter are$137KN/m^2 and 15^0$ C respectively and pressure at throat is $127KN/m^2$. Take$R = 290J/Kg^0K$ and adiabatic expansion$\gamma = 1.4$. [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) 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+8]

8. (a) What is the purpose of a differential manometer, and what are the types of differential manometers

   (b) What are the devises to measure discharge in open channels. [8+8]

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