Code No: RR220301 **Set No.1**

II B.Tech. II Semester Regular Examinations, April/May -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) A trapezoidal plate having its parallel sides equal to 2a and a at a distance h apart is immersed vertically in a liquid with 2a side uppermost and at a distance h below the surface of the liquid. Find the thrust on the surface and the depth of the centre of pressure.
   (b) A caisson for closing the entrance of a dry dock is of trapezoidal form 16m wide at the top and 12m wide at the bottom and 8m deep, Find the total pressure on the caisson if the water on the outside is 1 m below the top level of the caisson and dock is empty.

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.

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) What are static and stagnation temperature?
   (b) Oxygen flows in a conduit at an absolute pressure of 170 KN$/m^2$If 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) 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) 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) Derive an expression for discharge of liquids through a rectangular notch. Explain how it is modified to take into account the effect of end contractions and velocity of approach.

   (b) Explain the working of Viscometers.

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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.

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) Derive an expression for the difference of pressure between two points in a free vortex flow.
   (b) An open circular cylinder of 15 cm diameter and 100 cm long contains water up to a height of 70 cm. Find the speed at which the cylinder is to be rotated about its axis so that the axial depth becomes zero.

4. (a) How do you explain the difference between surface drag, form drag and deformation drag and give one example each.
   (b) A kite weighing 12 N has an effective area of $1m^2$. It is maintained in air at an angle of 10^o to the horizontal. The string attached to the kite makes an angle of45^o to the horizontal and at the position the values of C_D andC_L are 0.6 and 0.8 respectively. Find the speed of the kite and tension of the string. Take unit weight of air = 12.5 N / m^3.

5. (a) What is the difference between isotropic and adiabatic flow?
   (b) A normal shock wave occurs in a diverging section when air is flowing at velocity of 420 m/s ,pressure $100KN/m^2$ and temperature 10^0C . Determine (i) Mach number before and after shock (ii) pressure rise and (ii) the velocity and temperature after shock.

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

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) 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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Code No: RR220301 **Set No.3**

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

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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) Give the complete classification of types of flow.
   (b) Given the velocity field
   $\bar{v} = (6 + 2xy + t2)\,\bar{i} - (xy2 + 10t)\,\bar{j} + 25\,\bar{k}$
   Determine the acceleration of a particle at P(3,0,2) and at time t = 1.

3. (a) Derive an expression for the difference of pressure between two points in a free vortex flow.
   (b) An open circular cylinder of 15 cm diameter and 100 cm long contains water up to a height of 70 cm. Find the speed at which the cylinder is to be rotated about its axis so that the axial depth becomes zero.

4. (a) How do you explain the difference between surface drag, form drag and deformation drag and give one example each.
   (b) A kite weighing 12 N has an effective area of $1m^2$. It is maintained in air at an angle of 10^o to the horizontal. The string attached to the kite makes an angle of45^o to the horizontal and at the position the values of C_D andC_L are 0.6 and 0.8 respectively. Find the speed of the kite and tension of the string. Take unit weight of air = 12.5 N / m^3.

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

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.

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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   (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.

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.

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) Give four examples in every day life where separation takes place. Draw flow pattern in each case.
   (b) A jet plane, which weighs 30 kN and has a wing area of 20 m^2 flies at a velocity of 1000 km/hr when the engine delivers 7350 kN. 65% Of the power is used to overcome the drag resistance of the wing, Calculate coefficient of lift and drag for the wing. The mass density of air is 1.2 kg/m^3.

5. (a) What is mach number? Why is this parameter is so important for the study of flow of compressible fluid?
   (b) A supersonic aircraft flies at an altitude of 1.8 Km where the temperature is 4^0C. Determine the speed of aircraft if its sound is heard 4 second after its passage over the head of observer.Take$\gamma = 1.4 and R = 281.43 J/Kg^0$K.

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

7. (a) Two reservoirs are connected by three pipes laid in parallel, their diameters are d,2d, and 3d respectively and they are of the same length l, assuming f to be the same for all pipes, determine the discharge through each of the larger pipes, if the smallest pipe is discharging 1 cumec.

(b) Three pipes of same length L, diameter D and friction factor f are connected in parallel. Determine the diameter of the pipe of length L and friction factor f which will carry the same discharge for the same head loss. Use the formula $h_f = fLV^2/2gD$.

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.

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