Code No: R05220302 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2008
MECHANICS OF FLUIDS
(Common to Mechanical Engineering, Metallurgy & Material Technology and Automobile Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is pascal's law?
   (b) When does capillary fall take place? Expalin.
   (c) Explain the importance of vapour pressure in fluid mechanics. [4+4+8]

2. (a) Obtain the equation to the streamlines for the velocity field given as: V= 2 x^3i - 6 x^2yj
   (b) Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. [8+8]

3. (a) Derive an expression for the difference of pressure between two points in a free vertex flow.
   (b) A jet of water is initially 10cm in diameter and when directed vertically upward reaches a maximum height of 25m. Assuming the jet remains circular, determine the rate of water flowing and the diameter of the jet at a height of 15m. [7+9]

4. (a) Explain the concentric cylinder viscometer in detail with diagram and also derive the expression to find the value of viscosity of a given fluid.
   (b) Water flows in 300mm pipe. Two pitot tubes are installed in the pipe, one on the centerline and other 75mm from the centerline. If the velocities at the two points are 3mt/sec and 2mt/sec respectively. Calculate the reading on the differential mercury Manometer connected to the two tubes. [7+9]

5. (a) Explain with a neat sketch the boundary layer characteristics when a fluid is flowing over a flat plate.
   (b) A thin flat plate 0.3 m wide and 0.6 m long is suspended and exposed parallel to air flowing with a velocity of 3 m/sec. Calculate drag force on both sides of the plate when the 0.3 m edge is oriented parallel to free stream. Consider flow to be laminar and assume for air kinematic viscosity is 0.18 stokes and density is 1.2 kg/m^3. [10+6]

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. Two reservoirs are connected by a pipeline of diameter 600 mm and length 4000M. The difference of water level in the reservoirs is 20 M. At a distance of 1000M from the upper reservoir, a small pipe is connected to the pipeline. The water can be taken from the small pipe. Find the discharge to the lower reservoir, if
   (a) No water is taken from the small pipe, and
   (b) 100 lit/s of water is taken from small pipe. Take f=0.005 and neglect minor losses. [16]

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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1. (a) A plate having an area of 0.6 m^2 is sliding down the inclined plane at 30^0 to the horizontal with a velocity of 0.36 m/s. There is a cushion of fluid 1.8 mm thick between the plane and the plate . Find the viscosity of the fluid if the weight of the plate is 280 N.
   (b) State Archimedes principle and prove it from first principles. [8+8]

2. A conical pipe diverges uniformly from 1200mm to 200mm diameter over a length of 1 meter. Determine the local and convective acceleration at the mid-section assuming
   (a) A study Rate of flow is 0.12 m^3/s
   (b) Rate of flow varies uniformly from 0.12 m^3/s to 0.24 m^3/s in 5 sec., at t = 2sec. [16]

3. (a) Derive kinetic energy correction factor?
   (b) A pipe through which water is flowing is having diameter 40cm and 20cm at the cross sections 1 and 2 respectively. The velocity of water at section 1is given 5m/s. Find the velocity head at the section 1 and 2 and also rate of discharge [7+9]

4. (a) Derive an expression for discharge as liquids through a rectangular notch.
   (b) A 120mm $\times$ 60mm venturimeter with $C_d = 0.98$ is to be replaced by an orifice meter having a value of $C_d = 0.6$, is both the meters are to give the same differential mercury monometer reading for a discharge of 100 lit/sec and the inlet diameter to remain 125 mm. what should be the diameter of orifice.[7+9]

5. (a) How does the boundary layer thickness for flow over a flat plate vary with the distance from the leading edge for
      i. Laminar flow and
      ii. Turbulent flow.
   (b) A smooth flat plate 1.5 m x 3 m long is to be towed lengthwise in water. If the laminar boundary layer exists up to a Reynolds number 5 x 105. Determine [8+8]
      i. Maximum distance from the leading edge up to which laminar boundary layer persists

ii. Frictional drag and

iii. Power required to tow the plate.
The velocity of plate is 2.5 m/sec. Take kinematic viscosity as 0.9 centistokes and density as 1000 kg/m^3.
Assume transitional formula $C_D = \frac{0.455}{(\log_{10} \mathrm{Re}_L)^{2.58}} - \frac{1700}{\mathrm{Re}_L}$

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. Two reservoirs are connected by a pipeline of diameter 600 mm and length 4000M. The difference of water level in the reservoirs is 20 M. At a distance of 1000M from the upper reservoir, a small pipe is connected to the pipeline. The water can be taken from the small pipe. Find the discharge to the lower reservoir, if

   (a) No water is taken from the small pipe, and

   (b) 100 lit/s of water is taken from small pipe. Take f=0.005 and neglect minor losses. [16]

8. (a) Write the importance of Mach number briefly.

   (b) Explain briefly the phenomenon of propagations of elastic waves. [8+8]

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1. (a) Expalin how the meta-centric height of a floating body can be detaermined experimentally?
   (b) How are manometers are classified? [8+8]

2. (a) For a two-dimensional flow, the velocity components are $u = \frac{x}{(x^2+y^2)}$, $v = \frac{y}{(x^2+y^2)}$ determine
      i. the acceleration components a_x and a_y;
      ii. the rotation of ω_z .
   (b) How is the 'circulation' is defined? [12+4]

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. (a) Explain Mach model law.
   (b) The maximum flow through a rectangular flume 1.5 m wide and .9 m deep is 1.3 m^3 /s. It is proposed to install a suppressed sharp crested rectangular weir across the flume to measure flow. Find the maximum height at which the weir crest can be. Take C_d=0.6 [7+9]

5. (a) Explain with a neat sketch the boundary layer characteristics when a fluid is flowing over a flat plate.
   (b) A thin flat plate 0.3 m wide and 0.6 m long is suspended and exposed parallel to air flowing with a velocity of 3 m/sec. Calculate drag force on both sides of the plate when the 0.3 m edge is oriented parallel to free stream. Consider flow to be laminar and assume for air kinematic viscosity is 0.18 stokes and density is 1.2 kg/m^3. [10+6]

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) 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. (a) Explain briefly about stagnation point?

   (b) Avessel fitted with a nozzle, contains air at pressure of 2500KN/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. Take K=1.4 and R=287 J/Kg K. [8+8]

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Code No: R05220302 **Set No. 4**

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1. (a) Define capillarity and surface tension and discuss the factors affecting them.
   (b) Explain with sketches how an inverted U-tube manometer is used to measure small pressure differences. [8+8]

2. (a) If ϕ=3xy, find x and y components of velocity at (1,3) and (3,3). Determine the discharge passing between streamlines passing through these points.
   (b) Define one-dimensional, two-dimensional and three-dimensional flows? [10+6]

3. (a) Write shorts notes on:
      i. Bernoulli's equation
      ii. Euler's equation
      iii. Vertex Flow.
   (b) A closed vertical cylinder 350mm in diameter and height 400mm height is filled with oil of relative density 0.9 to a depth of 280mm, the remaining volume containing air at atmosphere pressure. The cylinder rotates about its vertical axis at such a speed that the oil. Just begins to uncover the base. Calculate the speed of rotation for this condition. [6+10]

4. (a) What is Pitot Tube? How will you determine the velocity at any point with the help of pitot tube.
   (b) A horizontal venturimeter with inlet and throat diameters 40cms and 20cms respectively is used to measure the flow of water. The reading of differential Manometer connected to the inlet and the throat is 18 cm of mercury. Determine the rate of flow. Take C_d =0.97 [7+9]

5. (a) What are different types of drag? What is streamlining? What is its effect on the Different types of drag?
   (b) A cylinder 15 cm in diameter and 10 m long, is made to turn 1500 revolutions per minute with its axis perpendicular in a stream of air having uniform velocity of 25 m/sec. Assuming ideal fluid flow, find [8+8]
      i. Circulation
      ii. Lift force experienced by the cylinder and
      iii. The position of stagnation points Take density of air as 1.2 kg/m^3.

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) What do you understand by turbulent flow? What factors decides the type of flow in pipes?
   (b) Water is flowing through a rough pipe of diameter 40cm and length 3000m at the rate of 0.4 m^3/s. Find the power required to maintain this flow. Take the average height of roughness of K = 0.3mm. [6+10]

8. (a) What sonic velocity? On what factors does it depend?
   (b) A gas of velocity of 300 m/s is flowing through a horizontal pipe at a section where the pressure is 60 KN/m^2 and temperature 40^0C.The pipe changes in diameter and at this section pressure is 90 KN/m^2. If the flow of gas is adiabatic, find the velocity of the gas at this section. [8+8]

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