Code No: 07A4EC15 **R07** **Set No. 2**

II B.Tech II Semester Examinations,December 2010
MECHANICS OF FLUIDS
Metallurgy And Material Technology

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Explain Weber model law?

   (b) A 100 mm ×50 mm venturimeter with C_d =0 .97 is to be replaced by an orifice meter having a value of $C_d = 0.7$ if both the meters are to give the same differential mercury manometer reading for a discharge of 70 lit/s and the inlet diameter to remain 100 mm what should be the diameter of orifice? [7+9]

2. (a) Expalin how the meta-centric height of a floating body can be determined experimentally?

   (b) How are manometers are classified? [8+8]

3. In a 45^0 bend a rectangular air duct of $1m^2$ cross-sectional area is gradually reduced to $0.5m^2$ area. Find the magnitude and direction of the force required to hold the duct in position .If the velocity of flow at the $1m^2$ section is 10m/s, and pressure is 2.943 N/cm^2.take density of air as 1.16 Kg/m^3 . [16]

4. (a) Find the velocity and acceleration at a point (1,2,3) after 1 sec. for a three-dimensional flow field given by
   u = yz + t, v=xz-t, w=xy, m/s

   (b) State the conditions for a three-dimensional flow to be irrotational. [10+6]

5. (a) Show the pressure distribution around a sphere placed in a flow and explain how the drag suddenly reduces when the Reynolds number is greater than 2 $\times 10^5$. Also explain how the drag on a sphere is affected by turbulence in the boundary layer on the surface of the sphere.

   (b) An automobile having a projected area of 1.6 m^2 and drag coefficient of 0.35 travels at uniform speed of 60 km/hour in still air at 20^0C. Calculate the power required to overcome the air resistance. If the drag coefficient of automobile is reduced by 15% by improving streamlining, what percentage increase in speed could be obtained with the same power. Take density of air as 1.2 kg/m^3. [8+8]

6. (a) What are minor losses in the pipes? Under what circumstances will they be negligible?

   (b) A pipe having a length of 6 km and diameter 0.70 m connects two reservoir A and B, the difference between their water levels is 30 m. Halfway along the pipe there is a branch through which water can be supplied to the third reservoir C. Determine the rate of flow of reservoir B when [8+8]

i. no water is discharged to Reservoir C and

ii. the quantity of water discharged to reservoir C is 0.15 m^3/sec. Neglect minor losses and Take f = 0.02 in $h_f = \frac{flV^2}{2gD}$.

7. (a) Show that the momentum correction factor for laminar flow through a circular pipe is equal to 4/3.

   (b) A shaft having a diameter of 50mm rotates centrally in a journal bearing having a diameter of 50.15 mm and length 100mm. The annular space between the shaft and the bearing is filled with oil having viscosity of 0.9 poise. Determine the power absorbed in the bearing when the speed of rotation is 60 rpm [8+8]

8. (a) What is the relation between pressure and density of a compressible fluid for?

   i. Isothermal process

   ii. Adiabatic process.

   (b) A gas is flowing through a horizontal pipe at a temperature of 4^0C. The diameter of the pipe is 8cm and at a section I in the pipe, the pressure is 30.3N/cm^2 (gauge). The diameter of the pipe changes from 8cm to 4cm at the section II, where pressure is 20.3N/cm^2 (gauge). Find the velocities of the gas at these sections assuming an isothermal process. Take R=287.14Nm/Kg.K and atmosphere pressure=10N/ cm^2. [6+10]

⋆⋆⋆⋆⋆

Code No: 07A4EC15 **R07** **Set No. 4**

II B.Tech II Semester Examinations,December 2010
MECHANICS OF FLUIDS
Metallurgy And Material Technology

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (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]

2. (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 γ=1.4 and R=287 J/Kg K. [8+8]

3. A Flow of 420 liters/min of oil of specific gravity 0.91 and viscosity 1.24 poise is pumped through a pipeline 75mm diameter having a length of 62m and whose outlet is 3m higher than its inlet. Estimate the power required for the pump if its efficiency is 60%. [16]

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 jet plane weighing 112.82 kN has a wing span of 9.6 m and wing area of 15.8 m^2. It flies at 350 km/hour at a steady level in still air. Find [8+8]
      i. The lift coefficient
      ii. The total drag on the wing taking coefficient of drag $(C_D) = 0.08$
      iii. Power required to maintain the airplane at this velocity Take density for air = 1.25 kg/m^3

5. (a) What is the disadvantage in having very high meta-centric heights for passenger ships? Expalin.
   (b) What are mechanical gauges? Name three important mechanical gauges:- [8+8]

6. A two-dimensional flow field is given by ϕ = 3xy, determine:
   (a) The stream function
   (b) The velocity at L(2,6) and M (6,6) and the pressure difference between the points L and M.
   (c) The discharge between the streamlines passing through the points L and M. [16]

7. (a) Differentiate Notches and Weirs and classify the Notches?

   (b) The Coefficient of discharge for a venturimeter used for measuring the flow of an incompressible fluid was found to be constant when the rate of flow exceeded a certain volume. Show that under these conditions the loss of head h_f in the convergent portion of venturimeter can be expressed as K_1Q^2. Where K_1 is a constant. [7+9]

8. (a) Derive Euler's s equation of motion.

   (b) A pipe through which water is flowing is having diameters, 20cm and 10cm at the cross-section. I and II respectively. The velocity of water at section I is given 4.m/s. Find the velocity head at sections I and II and also rate of discharge. [10+6]

⋆⋆⋆⋆⋆

Code No: 07A4EC15 **R07** **Set No. 1**

II B.Tech II Semester Examinations,December 2010
MECHANICS OF FLUIDS
Metallurgy And Material Technology

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (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]

2. (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]

3. The following data relates to an inclined venturimeter diameter of the pipeline =400mm: Inclination of the pipeline with the horizontal= 30^0;Throat diameter =200 mm. The distance between the mouth and throat of the meter =600mm, specific gravity of oil flowing through the pipeline =0.7, specific gravity of heavy liquid (U-tube) =13.6:The reading of differential manometer =50 mm. The coefficient of the meter =0.98 Determine the rate of flow in the pipeline. [16]

4. In a two-dimensional incompressible flow, the fluid velocity components are given by u=x-4y and v=-y-4x . Show that velocity potential exists and determine its form as well as stream function. [16]

5. (a) Define Reynolds number and obtain expression for the Reynolds number. Also explain its significance.
   (b) From a reservoir two parallel pipes of diameter 180 mm and 250 mm each 125 m long convey a total discharge of 0.18 m^3/sec, find the head loss due to friction. If however, the two pipes are arranged in series to convey the same discharge what would be the head lost due to friction? Take 4f = 0.03. [8+8]

6. (a) For a turbulent flow over a flat plate, the experimental observations over a range of Reynolds number suggests $\frac{u}{u_\infty} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$. Prove that the ratio of displacement thickness (δ^*) of boundary layer to nominal thickness (δ) of boundary layer is equal to 3/10.
   (b) A ship has flat rectangular bottom 25 m long and 15 m wide. The ship is moving in sea water with a velocity of 1.5 m/sec. Determine the frictional drag on the bottom of the ship. For sea water dynamic viscosity is 0.001 N-sec/m^2 and density as 1025 kg/m^3. [8+8]

7. (a) The space between the two square flat parallel plates is filled with oil. Each side of the plate is 720 mm. The thickness of the oil film is 15 mm. The upper plate, which moves at 3 m/s requires a force of 120 N to maintain the speed. Determine:

   i. The dynamic viscosity of the oil,

   ii. The kinematic viscosity of oil if the specific gravity of oil is 0.95.

   (b) State and explain the Newton's law of viscosity. [10+6]

8. Air flows through a friction less adiabatic convergent divergent nozzle in which air is flowing at a pressure, velocity, temperature and cross section area are 200 KN/m^2 ,170 m/s,20^0c and 1000mm^2 respectively. If the flow conditions are isentropic, determine

   (a) sonic velocity and Mach number at inlet

   (b) Stagnation temperature and pressure

   (c) Mach number at outlet section where the pressure is 110KN/m^2 .Take R=290 J/kg.K and k=1.4,c_p=1kj/kg.K. [16]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A4EC15 **R07** **Set No. 3**

II B.Tech II Semester Examinations,December 2010
MECHANICS OF FLUIDS
Metallurgy And Material Technology

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. An open cylindrical vessel 180mm in diameter and 450mm deep is filled with water up to the top. Estimate the volume of water left in the vessel when it is rotated about its vertical axis: [16]
   (a) With a speed of 200 r.p.m, and
   (b) With a speed of 400 r.p.m.

2. Two large fixed parallel planes are 12mm apart. The space between the surfaces is filled with oil of viscosity 0.972Ns/ m^2. A flat thin plate 0.25 m^2 area moves through the oil at a velocity of 0.3m/s. Calculate the drag force:
   (a) When the plate is equidistant from both the planes and
   (b) When the thin plate is at a distance of 4mm from one of the plane surfaces. [16]

3. (a) Sketch the Reynolds apparatus and explain how the laminar flow can be demonstrated with the help of this apparatus?
   (b) Oil of absolute viscosity 1.5 poise and relative density 0.85 flows through a 30cm diameter pipe .If the head losses in a 3000M length of a pipe is 20M.estimate the friction factor by assuming the flow to be laminar. [8+8]

4. (a) Velocity for a two dimensional flow field is given by
   V = (3+2xy+4 t^2)i+(x y^2+3t)j
   Find the velocity and acceleration at a point(1,2) after 2 sec
   (b) Define tangential and local accelerations [10+6]

5. (a) What is a compound pipe? How would you determine the equivalent size of a compound pipe?
   (b) Two pipes each 120 m long, one of diameter 120 mm and other of diameter 90 mm are provided in parallel connecting two tanks, the difference of water levels of which is 18 m. Find the discharge to the lower tank. If however a single pipe 120 m long is provided connecting the two tanks and the discharge to the lower tank is to be increased by 30%, find the diameter of this pipe. For all pipes take 4f = 0.032 and ignore minor losses. [8+8]

6. (a) Explain and differentiate between Pitot tube and Pitot Static Tube.

(b) Water flows through a rectangular channel 1m wide and 0.5m deep and then over a sharp crested cipolletti weir of crust length 0.6m. If the water level in the channel is 0.225m above the weir crest. Calculate the discharge over the weir. Take Cd = 0.6 and make correction for the velocity of approach. [7+9]

7. 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 γ=1.4. [16]

8. Water of kinematic viscosity 1.02 $\times 10^{-6} m^2$/sec is steadily flowing over a smooth flat plate at zero angle of attack with a velocity 1.6 m/sec. The length of the plate is 0.3m. Calculate

   (a) The thickness of boundary layer at 15 cm from the leading edge and

   (b) Shear stress at trailing edge of the plate.
   Assume a parabolic profile. Take density = 1000 kg/m^3 [16]

⋆ ⋆ ⋆ ⋆ ⋆