

II B.Tech II Semester Supplementary 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

1. (a) Write a note on viscosity and compressibility.
(b) Calculate the velocity gradient at distances of 0,10,15 cm from the boundary if the velocity profile is a parabola given by $u = Ay^2 + By + C$ and with the vertex 15cm from the boundary, where the velocity is 100 cm/sec. Also calculate the shear stress at these points if the fluid has a viscosity of 8.2 poise.
[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° with the x- axis.
[8+8]
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.
[8+8]
4. (a) Draw and explain the approximate flow pattern and the pressure distribution around a flat plate placed normal to a stream.
(b) A flat plate of 2.0 m width and 4.0 m length is kept parallel to air flowing at a velocity of 5 m/s. Determine the length of plate over which the boundary layer is laminar, shear at the location which boundary layer ceases to be laminar and total force on both sides on that portion of plate where the boundary layer is laminar. Take $\rho = 1.2 \text{ kg/m}^3$ and $\nu = 1.47 \times 10^{-5} \text{ m}^2/\text{s}$.
[8+8]
5. (a) What is the function of wind tunnel?
(b) What is meant by stagnation point. Explain
[8+8]
6. (a) Prove that in a steady uniform laminar flow, the pressure gradient in the direction of flow is equal to the shear stress gradient in the normal direction.
(b) In an experiment, the details of laminar flow of fluid are as follows. Determine the discharge in the pipe.
Specific gravity = 1.67
Viscosity = 1.56 poise

Diameter of pipe = 15 cm
Length of the pipe = 2000 m
Loss of head = 0.45 m

[8+8]

7. (a) How will you determine the loss of head due to friction in pipes using Darcy weisbach formula.
- (b) An oil pipe line 60cm in diameter and roughness height 0.00005m carries a flow of 0.55 cumecs across the country. The pumping stations are located at every 80km. If the pump efficiency is 85%, determine the power input required at each station when the kinematic viscosity and specific gravity of the oil are $2 \times 10^{-6} m^2/sec$ and 0.88 respectively. [8+8]
8. (a) Explain orifice meter in detail with diagram. Also derive an expression for finding out the actual discharge from a given orifice meter.
- (b) How will you find the discharge through or triangular notchv

II B.Tech II Semester Supplementary 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

1. (a) Write a note on viscosity and compressibility.
(b) Calculate the velocity gradient at distances of 0,10,15 cm from the boundary if the velocity profile is a parabola given by $u = Ay^2 + By + C$ and with the vertex 15cm from the boundary, where the velocity is 100 cm/sec. Also calculate the shear stress at these points if the fluid has a viscosity of 8.2 poise.
[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° with the x- axis.
[8+8]
3. (a) What are the body forces considered in fluid flow problems?
(b) A 15-cm diameter pipe is reduced to 7.5 cm diameter through a gradual contraction. The difference between the piezometric heads at the main and contracted section is 4 cm of mercury. By neglecting losses calculate the discharge of water.
[8+8]
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° to the horizontal. The string attached to the kite makes an angle of 45° to the horizontal and at the position the values of C_D and C_L are 0.6 and 0.8 respectively. Find the speed of the kite and tension of the string. Take unit weight of air = $12.5 \text{ N} / m^3$.
[8+8]
5. (a) What is the function of wind tunnel?
(b) What is meant by stagnation point. Explain
[8+8]
6. (a) Prove that in a steady uniform laminar flow, the pressure gradient in the direction of flow is equal to the shear stress gradient in the normal direction.
(b) In an experiment, the details of laminar flow of fluid are as follows. Determine the discharge in the pipe.
Specific gravity = 1.67
Viscosity = 1.56 poise

Diameter of pipe = 15 cm
Length of the pipe = 2000 m
Loss of head = 0.45 m

[8+8]

7. (a) Derive an expression for loss of head due to sudden contraction of a pipe. Sketch the flow pattern and show how the hydraulic gradient and total energy line vary as the flow takes place through the contraction.
- (b) Water flows through a 25cm diameter which is suddenly contracted to 10cm diameter. The flow through the pipe is 75lit/sec. If coefficient of contraction is 0.62, determine the head loss. The pressure of water before the contraction is 80Kpa. What is the pressure after contraction. [8+8]
8. (a) What is the purpose of a differential manometer, and what are the types of differential manometers
- (b) What are the devices to measure discharge in open channels. [8+8]

II B.Tech II Semester Supplementary 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

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) 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 $1.2\text{ m}^3/\text{s}$ 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. [8+8]
3. (a) Define the terms (i) Forced vortex flow (ii) Free vortex flow. Give suitable examples.
(b) A rectangular duct of width 25 cm has a two dimensional irrotational flow. It has an elbow made up of circular arcs of radius 40 cm and 65 cm for the inner and outer walls respectively. Calculate the discharge per unit width of the duct when the difference in pressure between outer and inner walls in the elbow is 30 kPa. [8+8]
4. (a) State stokes law. Prove that the drag coefficient for sphere for Reynolds number up to 0.2 is given by $C_D = 24/R$
(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. Take $C_D = 0.35$ and $\rho_{air} = 1.25 \text{ kg / m}^3$. [6+4+6]
5. (a) Derive an expression for mass flow rate through a venturimeter
(b) An aero plane is flying at an height of 20 Km where the temperature is -40°C . The speed of plane is corresponding to $M = 1.8$. Find the speed of the plane. [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) Explain the concept of flow through a long pipe along with a neat sketch.
- (b) A main pipe divides into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000 m and 1.0 m respectively, while the length and diameter of second parallel pipe are 2000 m and 0.8 m. Find the rate of flow in each parallel pipe if total flow in the main is 3.0 cumecs. the coefficient of friction for each parallel pipe is same and equal to 0.006. [8+8]
8. (a) What is Manometry. Explain with a neat sketch the working of single column vertical Manometer.
- (b) Explain how you use U-tube manometer to find pressure difference between two points in fluid flow. [8+8]

II B.Tech II Semester Supplementary 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

1. (a) Give an example each where air can be treated as an incompressible fluid and water has to be treated as compressible fluid. Explain.
(b) The bulk modulus of water is 210 KN/cm^2 . What pressure is required to reduce its volume by 2%? Also prove that the increase in the mass density will be 2% only. [8+8]
2. (a) Derive the continuity equation for 3-D fluid flow.
(b) A fluid flow field is given by
 $V = xyi + 2yzj - (yz + z^2)k$
Determine whether this is a possible steady incompressible fluid flow. If so, determine the value of rotation at the point P (1,2,3). [8+8]
3. (a) Define the terms (i) Forced vortex flow (ii) Free vortex flow. Give suitable examples.
(b) A rectangular duct of width 25 cm has a two dimensional irrotational flow. It has an elbow made up of circular arcs of radius 40 cm and 65 cm for the inner and outer walls respectively. Calculate the discharge per unit width of the duct when the difference in pressure between outer and inner walls in the elbow is 30 kPa. [8+8]
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 1 m^2 . Compare the drag force in water and in air when travelling at a speed of 30 km/hr. [8+8]
5. (a) Derive an expression for mass flow rate through a venturimeter
(b) An aero plane is flying at an height of 20 Km where the temperature is -40°C . The speed of plane is corresponding to $M = 1.8$. Find the speed of the plane. [8+8]
6. (a) Derive Hazen-poiseuille equation for laminar flow in circular pipes.
(b) Explain in detail how the flow is demonstrated using Reynold's experiment. [8+8]
7. (a) Derive Darcy Weisbach equation for friction head loss in pipes.

- (b) Smooth pipe carries 6.5lit/sec of water at 20°C with kinematic viscosity of $10^{-6}\text{m}^2/\text{sec}$ and with a head loss of 7.5cm per 10m length. Determine the diameter of the pipe. Use the equation $f = 0.316/(R)^{1/4}$ to evaluate f. Where R is Reynolds number. [8+8]
8. (a) A venturimeter has its axis vertical, the inlet and throat diameters being 150 mm and 75 mm respectively. The throat is 225 mm above inlet and $k = 0.96$, petrol of specific gravity 0.78 flows up through the meter at a rate of $0.029\text{m}^3/\text{s}$. Find the pressure difference between the inlet and the throat.
- (b) Explain the working procedure of Bourdon pressure gauge. [8+8]
