Code No: R09221802 | R09 | SET-1

B.Tech II Year - II Semester Examinations, April-May, 2012
MECHANICS OF FLUIDS
(Metallurgy and Material Technology)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1.a) Briefly explain the following terms:
i) Newton's law of viscosity ii) Surface tension.
b) What is stability of a floating body? Explain the stability of a floating body with reference to its metacentric height.
c) A circular plate of 1.5m diameter is submerged in water, with its greatest and least depths below the free surface being 2m and 0.75m respectively. Determine
i) The total pressure on the face of the plate
ii) The depth of the centre of pressure from the free surface. [5+3+7]

2.a) Differentiate between
i) steady flow and unsteady flow
ii) uniform flow and Non-uniform flow
iii) rotational and irrotational flows
iv) laminar and turbulent flows.
b) For a two-dimensional flow, the velocity components in x and y directions are expressed as $u = x/(x^2 + y^2)$, and $v = y/(x^2 + y^2)$, respectively. Determine the acceleration components in x and y directions a_x and a_y, and the angular velocity ω_z at the coordinate (1, 2). [8+7]

3.a) Derive three dimensional Bernoulli's equation, mentioning clearly the assumptions involved.
b) An open tank 5m long, 3m wide and 2m deep contains 1.5m water. What is the maximum horizontal acceleration that can be given to the tank without causing spill over, and what is the alignment of the tank with respect to the movement? [8+7]

4.a) Derive an expression for discharge through a rectangular notch. Explain how it is modified to take into account the effect of end contractions and velocity of approach.
b) A vertical venturimeter carries a liquid of relative density 0.8 and has inlet and throat diameters of 150 mm and 75 mm respectively. The pressure connection at the throat is 150mm above that at the inlet. If the actual rate of flow is 40 liters/sec and $C_d = 0.96$, calculate the pressure difference between inlet and throat in N/m^2. [8+7]

5.a) Explain the characteristics of laminar and turbulent boundary layer.
b) What are drag, lift, Magnus effect and circulation?
c) Discuss the phenomenon of separation of boundary layer. Also discuss the various methods of controlling it. [4+4+7]

6.a) Explain the terms hydraulic gradient and total energy lines with a neat sketch.

b) Obtain the condition for maximum efficiency in transmission of power through a pipeline.

d) Two pipes each 30m long are available for connecting to a reservoir from which a flow of 0.085 m^3/s is required. If the diameters of the two pipes are 0.3m and 0.15m respectively, determine the ratio of the head lost when the pipes are connected in series to the head lost when they are connected in parallel. Neglect minor losses. [4+4+7]

7.a) For a steady laminar flow through a circular pipe, prove that the velocity distribution across section is parabolic and the average velocity is half of the maximum velocity?

b) What is the significance of Moody' diagram?

c) If the relative roughness of a 15 cm diameter pipe, carrying water having kinematic viscosity of 0.009cm^2/s is 0.0005, what is the Renold's number up to which the pipe behaves as smooth? [8+3+4]

8.a) Explain subsonic, sonic and supersonic flows.

b) Explain Mach cone and Mach angle.

c) The air is flowing through a pipe whose diameter changes from 8cm to 4 cm at a particular position. The pressure and temperature of the air entering the pipe are 3bar (gauge) 280K. The pressure of the air in the lower diameter is 2 bar (gauge). Assuming the flow is isothermal, find the velocities of the air in hogher and lower diameter pipe sections. Take atmospheric pressure = 1bar, R(air)=287Nm/kg-k. [4+4+7]

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MECHANICS OF FLUIDS
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Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1.a) Prove that the pressure at a point is same in all directions in a static fluid.
b) Define the terms: viscosity, vapour pressure, metacentre and metacentric height.
c) A hydraulic lift consists of a 25 cm diameter ram which slides in a 25.015 cm diameter cylinder the annular space being filled with oil having a kinematic viscosity of 0.25 cm^2/sec and specific gravity of 0.85. If the rate of travel of the ram is 9.15 m/min, find the frictional resistance when 3.05 m of the ram is engaged in the cylinder. [4+4+7]

2.a) Derive the continuity equation for a three dimensional flow field.
b) Show that $u = -2xyz/(x^2 + y^2)$, $v = (x^2 - y^2) – z/(x^2 + y^2)^2$ and $w = y/(x^2 + y^2)$ are velocity components of a possible incompressible fluid motion. Verify that the motion is irrotational and find the velocity potential. [7+8]

3.a) What are the limitations of the Bernoulli's equation?
b) Water under a pressure of 415 kN/m^2 is flowing through a 23 cm diameter pipe at the rate of 0.30 m^3/s. If the pipe is bent by 135^0 in the horizontal plane, find the magnitude and direction of the resultant force on the bend.
c) Differentiate between free vortex and forced vortex. Give examples. [4+7+4]

4.a) Write short notes on:
i) Pitot-static tube; ii) Venturimeter;
iii) Cavitation; iv) Viscometer.
b) A rectangular notch is to be made to discharge 1.82×10^4 litres per minute with a head over the sill equal to half the width of the notch. Neglecting the velocity of approach and allowing for two end contractions; determine the width of the notch and the head of water above the sill. [8+7]

5.a) Define boundary layer thickness, displacement thickness and momentum thickness.
b) Write short notes on boundary layer separation.
c) Air flows over a flat plate 1m long at a velocity of 6m/sec. Determine
i) The boundary layer thickness at the end of the plate
ii) Shear stress at the middle of the plate
iii) Total drag per unit length on the sides of the plate.
Take $\rho = 1.226$ kg/m^3 and $\upsilon = 0.15 \times 10^{-4}$ m^2 /sec for air. [3+4+8]

6.a) Distinguish between laminar flow and turbulent flow in pipes.
b) What is a compound pipe? How would you determine the equivalent size of a compound pipe?
c) Two reservoirs are connected by s pipe 2250 m long and 0.225 m in diameter, the difference in water levels being 7.5 m. Determine the flow through the pipe in litres per minute taking friction factor as 0.03. Also find the percentage increase in the discharge if for the last 600 m a second pipe of the same diameter is laid alongside the first. [4+4+7]

7.a) Two parallel plates kept 0.1m apart have laminar flow of oil between them with a maximum velocity of 1.5 m/sec. Calculate discharge per meter width, shear stress at the plates, pressure difference between two points 20m apart, velocity gradient at the plates and velocity at 0.02m from the plate. Take viscosity of oil as 2.453 N.s/m^2.

b) What do you understand by hydro dynamically smooth and hydro dynamically rough pipes?

c) Differentiate between Couette's flow and Poiseuille flow? [7+4+4]

8.a) State the continuity equation and energy equation for flow of gas.

b) A gas at 5 bar absolute pressure and 300K is flowing through a pipe of 10cm which changes to 5 cm where the pressure falls to 4 bar absolute. Assuming the flow is isothermal, find the velocities of gas in both sections. The mass flow rate through the pipe = 50 kg/min. Take R=292 Nm/kg-K for the gas.

c) What is Mach number? What is the importance of Mach number in the flow of compressible fluids? [4+7+4]

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Code No: R09221802 | R09 | SET-3

B.Tech II Year - II Semester Examinations, April-May, 2012
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Time: 3 hours **Max. Marks: 75**

Answer any five questions
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1.a) Distinguish between ideal and real fluids and classify the real fluids based on viscosity.
b) What is Pascal's law? Prove it. [15]

2.a) How do you classify fluid flows? Explain.
b) Derive Laplace equation of velocity potential and prove it for a continuous flow. [15]

3.a) Derive Euler's equation of motion and compare the same with Navier-Stokes equation in Cartesian coordinates.
b) Define free vortex and forced vortex motions and discuss any case of their combination. [15]

4.a) What is distorted model? When it is needed to have distorted models?
b) Explain hotwire anemometer with a neat sketch and list out its uses and limitations. [15]

5.a) Discuss boundary layer theory and define nominal thickness, displacement and momentum thickness and derive the relation among them.
b) Write Prandtl's boundary layer equations in Cartesian coordinates and explain how it can be derived from Navier Stokes equation. [15]

6.a) Explain Reynolds experiment to classify flow into laminar and turbulent for circular closed conduit.
b) Give a neat sketch of sudden contraction in a pipe and explain how the expression for loss of head is derived. [15]

7.a) Derive plane Poissuelle flow equation between parallel planes.
b) Distinguish between velocity distribution of laminar flow and turbulent flow in a pipe. [15]

8.a) What is adiabatic process? Explain.
b) Define Mach number and its applications. [15]

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Code No: R09221802 | R09 | SET-4

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Time: 3 hours **Max. Marks: 75**

Answer any five questions
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1.a) Define specific gravity and explain its significance in fluid mechanics.
b) Draw a neat sketch of a differential U tube manometer and derive the expression for differential pressure in a closed conduit. [15]

2.a) Differentiate between stream line and path line and explain the characteristics of stream line.
b) Deduce continuity equation for a steady 3-D flow of an incompressible fluid. [15]

3.a) Derive Bernoulli's equation for the flow along a stream line.
b) Explain the variation of velocity in a free vortex flow far from centre and at centre. [15]

4.a) Explain Fourier's principle of homogeneity and discuss the use of dimensionless parameters for dynamic similarity between model and prototype.
b) Why energy loss is higher in orifice meter when compared to venture meter? Explain with a neat sketch. [15]

5.a) a) Explain any approximate solution of Navier Stokes equations.
b) Discuss boundary layer over a flat plate at zero angle of incidence with a neat sketch and write the equations for boundary layer growth for laminar and boundary layers. [15]

6.a) a) How the resistance to flow in a closed conduit is measured? Explain for both laminar and turbulent flow conditions.
b) Derive the expression for loss of head due to sudden expansion in a circular pipe. [15]

7.a) Derive the equation of plane coquette flow using Navier Stokes equation.
b) Discuss Moody's chart and its use. [15]

8.a) What is isothermal process? Explain.
b) Define Mach number and its applications. [15]

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