CODE NO: R09221802 | R09 | SET No - 1

II B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
MECHANICS OF FLUIDS
(METALLURGY AND MATERIAL TECHNOLOGY)

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

Answer any FIVE questions
All Questions Carry Equal Marks

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1.a) A painter is painting a wall 3m×4m with a brush 0.1m wide and 0.0125m thick, the thickness of one coat of paint is 7×10^{-3}m and the viscosity of the paint is 2Pa-S. Calculate the total work required for painting one side of the wall. Assume the variation of velocity as linear. [15]

2.a) What is a stream tube? What are its characteristics?
b) Prove that the following Stream function represents a rotational flow. $\psi = x^3y$. Calculate the velocity and acceleration at point (1,2). [4+11]

3. A pipe carrying crude oil of specific gravity 0.84 is of 25 cm diameter at section (1) and 50 cm diameter at section (2). The rate of flow is 450 lps. Section (1) is at an elevation of 25 m above section B. If the pressures of fluid at the two sections are 55 KPa at (1) and 320 KPa at (2), find the direction of flow and the head lost between the sections. [15]

4.a) Why is it necessary to use distorted models ? List out the merits and limitations of distorted models?
b) In a reservoir model built to a scale of 1:200. The rate of flow through the sluice in to the canal is 2 lpm and it takes 28.6 hours to drain the reservoir. Predict the prototype discharge and the time of emptying of the reservoir? [7+8]

5. A thin flat plate measuring 75 cm by 25 cm is exposed parallel to a stream of water of uniform velocity 1.2 m/sec. The flow takes place parallel to the 25 cm side of the plate. If the kinematic viscosity of water is 1.1 centistokes, determine the maximum boundary layer thickness, shear stress at the tailing edge and the drag on both sides of the plate. [15]

6. Water flows through a 10 cm diameter, 30 cm long pipe at a rate of 1400 lpm. What percent of head would be gained by replacing the central one third length of pipe of 20 cm diameter? Assume that the changes in section are abrupt and f = 0.008 for all pipes. Neglect entrance and exit losses but consider all other losses. [15]

7. An oil of specific gravity 0.82 and viscosity 1.1 poise flows between two horizontal parallel plates 6 cm apart. One plate is stationary while the other moves horizontally with a velocity of 75 cm/sec. The rate of flow of oil is 0.046 m3/s/metre width. Calculate the average velocity, velocity mid way between the plates, pressure gradient, shear stress at the stationary plate and Reynolds number. [15]

8. A 2 cm diameter orifice is fitted in a 5 cm diameter pipe through which air flows at an absolute pressure and temperature of 4.5 bars and 290^0K respectively. A differential manometer containing mercury connected between the two sections of the pipe just before the orifice and after the orifice gives a deflection of 75 cm. If C_d = 0.62, find the rate of flow of air in N/min. Assume R = 287 j/kg-k and γ= 1.4. [15]

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

Answer any FIVE questions
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1. The work done in forming a soap bubble is 0.007N-m. Determine the size of the bubble formed if surface tension of soap solution to air is 0.08 N/m .Also calculate the force required to separate the bubble into two identical halves and the pressure in side the bubble. [15]

2.a) Distinguish between the following types of flow giving examples.
i) Steady and unsteady ii) Uniform and non uniform flow.
b) Derive 3-Dimensional continuity equation and explain its significance. [4+11]

3. A liquid of specific gravity 1.52 is discharged from a tank through a siphon whose summit point is 2.2 m above the liquid level in the tank. The siphon has a uniform diameter of 10 cm and it discharges the liquid in to atmosphere whose pressure is 101 KPa. If the Vapour pressure of the liquid is 28 KPa (abs), how far below the liquid level in the tank can the outlet be safely located? What is the maximum discharge? Neglect all losses of head. [15]

4.a) Why is divergence more gradual than convergence in a venturimeter?
b) Fluid oil of specific gravity 0.95 flows through a 30cm diameter by 10 cm diameter venturimeter. The pressures of fluid at inlet and throat sections are 1.45 bars(gauge) and 30 cm of mercury (vac) respectively. The head lost in the venturimeter is equal to 3 percent of the differential head of the meter. Determine the discharge of the fluid. [4+11]

5. A cargo truck of width 3.3m, height 3.5m and length 14m travels at 90 Kmph in air of kinematic viscosity 0.138sq.cm/sec and density 1.196 kg/m3. Determine the power required to overcome the air resistance over the top and sides of the truck. Find the boundary layer thickness at the rear end and the shear stress at mid-length of the truck. Assume that the front end of the truck is rough enough to make the boundary layer turbulent. [15]

6. Two reservoirs whose water surface elevations differ by 60 m are connected by a 0.3 m diameter pipe 4000m long. In order to increase the rate of flow by 25 percent, another is laid parallel to the original pipe over the first half of its length. Compute the diameter of the additional pipe. Neglect minor losses and assume f = 0.008 for all pipes. [15]

7. Derive Navier-Stokes equations of motion for the steady flow of an incompressible, constant viscosity fluid. [15]

8. A jet aircraft flies at 1000 kmph in air at 100C.Calculate the Mach number of flight. What are the temperature, pressure and density of air at the nose of the fuselage? Assume the pressure of ambient air = 1 bar. Take R = 287 j/kg-k and γ =1.4. (15) M

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II B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
MECHANICS OF FLUIDS
(METALLURGY AND MATERIAL TECHNOLOGY)

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

Answer any FIVE questions
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1. A hydraulic lift consists of a 25cm diameter ram which slides in a 25.015cm diameter cylinder, the annular space being filled with oil having a kinematic viscosity of 0.025 cm^2/s and specific gravity 0.85.If the rate of travel of the ram is 9.15m/min, find the frictional resistance when 3.05m of the ram is engaged in the cylinder. [15]

2.a) Distinguish between
i) Convective and local accelerations
ii) Tangential and normal accelerations.
b) Given the Stream function $\psi = 9x^2y^2 - x^4 - y^4$, Find the Velocity potential function. [6+9]

3. Determine the hydrodynamic force on a uniform 90-degree pipe elbow of 15 cm diameter through which water flows at a constant velocity of 8.4 m/s and constant pressure of 116 KPa (gauge). Assume the elbow to be in horizontal plane. [15]

4. Determine the hydrodynamic force on a uniform 90-degree pipe elbow of 15 cm diameter through which water flows at a constant velocity of 8.4 m/s and constant pressure of 116 KPa (gauge). Assume the elbow to be in horizontal plane. [15]

5.a) Explain the phenomenon of boundary layer separation and its influence on drag of an immersed body?
b) Calculate the Reynolds number and the overturning moment at the base of a smoke chimney of height 25 m and diameter 1.5 m in a gale of speed 200 Kmph. C_D =0.34. Specific weight of air = 11.8 N/m^3 and viscosity of air = 0.00018 poise. [7+8]

6. Derive the Darcy-Weisbach for friction head loss in a pipe. [15]

7. Derive from first principles an expression for the average velocity in couette flow with a pressure gradient. [15]

8. Derive expressions for the pressure, temperature and density of a compressible fluid at a stagnation point. [15]

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

Answer any FIVE questions
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1. A cylinder 0.1m diameter rotates in an annular sleeve 0.102m internal diameter at 100r.p.m.The cylinder is 0.2m long. If the dynamic viscosity of the lubricant between cylinders is 1.0 Poise, find the torque needed to drive the cylinder against viscous resistance. Assume that Newton's law of viscosity is applicable and the velocity profile is linear. [15]

2.a) Define flow net? Draw a typical flow net and explain its applications.
b) In a two-dimensional flow, the velocity components are: $u = 2xy + t^2 + 4$ and $v = -xy^2 - 5t$. The linear parameters are in meters and the time is in seconds. Estimate the acceleration in magnitude and direction at point (2, 1) when t = 2 seconds. [7+8]

3. An oil of specific gravity 0.8 flows through a 30 cm diameter by 20 cm diameter reducing bends, which turns the flow through 60^0. The rate of flow is 0.45 m^3/s and the pressure at the inlet which is the 30 cm diameter section is 122 KPa. Find the force required to keep the bend in position. Neglect loss of energy. [15]

4.a) Define and classify the Notches and Weirs?
b) A sharp-edged rectangular suppressed weir is placed across a channel of width 1.8 m. The height of the weir is 0.6 m and the head over it is 0.6m. Assuming Cd is 0.63 and considering the velocity of approach, compute the rate of flow? [6+9]

5.a) What is a boundary layer? Explain with a sketch the development of boundary layer over a smooth flat plate.
b) What is the drag of an advertising sign 1.5 m wide and 1.2 m high mounted in front of a truck moving in air at 75 Kmph? C_D=1.4.Air density = 1.208 kg/m^3. [7+8]

6. Derive an expression for the loss of head in a sudden contraction in 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. [15]

7. Two horizontal plates are 2 cm apart and one plate moves horizontally at 1 m/s. The space between the plates is filled with an oil of viscosity 1.5 poise. The pressure difference is 12.5 KPa per 10 m length. Compute the rate of flow, average and maximum velocities and the two boundary shear stresses. Sketch the velocity and shear stress distribution. [15]

8.a) Explain the terms Mach angle, Mach line and Mach cone.
b) Describe the energy equation for a compressible fluid flow, if the system is
i) Isothermal
ii) Adiabatic. [5+10]

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