Code No: R21014 **R10** SET - 1

II B. Tech I Semester Supplementary Examinations, September - 2014
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) What are manometers? Explain any two.
   b) Define gauge pressure, vacuum pressure and absolute pressure
   c) A square metal of bar 1.8m side and 1.8 mm thick weighing 60N is to be lifted through a vertical gap of 30 mm of infinite extent. The oil in the gap has specific gravity of 0.95 and viscosity of 3N-s/m^2. If the metal plate is said to be lifted at a constant speed of 0.12 m/sec find the force and power required. (4M+3M+8M)

2. a) State Pascal's law. Explain its significance.
   b) An opening of 1m depth and 3m width is provided in the vertical side of large tank. The water surface in the tank is 4m above the top of the opening. If the opening is closed by a plate which is held in place by 4 bolts place at corners, determine the force in each bolt. (6M+9M)

3. a) What is flow net? Enumerate the methods of drawing flow nets.
   b) Velocity components in a steady flow are:
   u= 2kx; v= 2ky; w= -4kz.
   What is the equation of stream line passing through the point (1, 0, 1)? (7M+8M)

4. a) Define drag and lift. Explain how boundary layer separation takes place.
   b) Discuss the Characteristics of boundary layer along a thin flat plate with neat sketch (9M+6M)

5. A 120^0 bend-cum reducer has 300mm diameter at the inlet and 200mm diameter at outlet. When the bend-cum reducer carries a discharge of 0.30 m^3/sec of water, pressure at the inlet section is 210 kN/m^2. Assume no energy loss in the bend and determine the components of force exerted by the bend on the flow. Assume the bend to be in a vertical plane and the weight of the bend and water is to be 1500N. (15M)
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6. A parallel plates kept 120mm apart have laminar flow of oil between them with a maximum velocity of 2 m/s. Calculate: i) discharge per meter width ii) shear stress at the plates iii) difference in pressure between 30 m apart iv) velocity gradient at the plates and v) velocity at 30mm from the plate. Assume viscosity of oil 24.5 poise. (15M)

7. a) Derive the expression for the loss of head due to friction in turbulent flow.
   b) Explain the Moody Chart and its significance in design of pipe flow problems
   c) Explain pipes in parallel. (8M+4M+3M)

8. a) Define coefficient of velocity, coefficient of discharge and coefficient of contraction and deduce the equation for coefficient of discharge
   b) A 150 mm×75 mm Venturimeter with a coefficient of discharge 0.98 is to be replaced by an orifice meter having a coefficient of discharge 0.6. If both the meters are to give the same differential mercury manometer reading for a discharge of 100 lit/sec and the inlet diameter is to remain 150mm, should be the diameter of the orifice. (7M+8M)

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1. a) What do you understand by viscosity and discuss its significance in fluid mechanics
   b) The space between two parallel plates is 6mm is filled with crude oil. A force of 3N is required to drag upper plate at a constant velocity of 1 m/s. The lower plate is stationary. The area of upper plate is 0.1 m^2. Determine: i) dynamic viscosity ii) kinematic viscosity of oil in stokes if the specific gravity of oil is 0.9. (6M+9M)

2. a) Derive an expression for the depth of center of pressure from free surface of liquid of an inclined Plane surface submerged in the liquid.
   b) A circular plate 3 m in diameter is submerged in water in such a way that the greatest and least depths of the surface, (below water surface) are 2m and 1m respectively. Calculate: i) total pressure on front face of the plate and ii) position of center of pressure. (8M+7M)

3. a) Define Stream line, path line, streak line.
   b) How the continuity equation related to law of conservation of mass. Derive the continuity equation in Cartesian coordinates. (6M+9M)

4. a) List the assumptions which are made of while deriving Bernoulli`s equation.
   b) What are the limitation of the Bernoulli`s equation.
   c) An inclined water supply line changes its diameter gradually from 20 cm to 50 cm in a vertical height of 3m where as pressure changes from 0.8 kgf/cm^2 and 0.6 kgf/cm^2 respectively. If the flow is 200 liters/ second find: i) direction of flow and ii) the head lost in friction between the two section. (4M+4M+7M)

5. a) Define displacement thickness, energy thickness and momentum thickness.
   b) Experiments were conducted in a wind tunnel at 50 kmph on a plate of size 2m×1m. The specific weight of air is 11.28 N/m^3. The pate is kept at such an angle that the co-efficient of lift and drag are 0.75 and 0.15 respectively. Determine lift force, drag force, resulting force and power exerted by air stream on plane. (8M+7M)
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6. a) Write the characteristics of Laminar and Turbulent flows.
   b) Two parallel plates kept 10cm apart have laminar flow of oil between them with a maximum velocity of 1.25 m/s. Calculate the discharge per meter width, the shear at the plates, the difference in pressure in pascals between two points 15m apart, the velocity gradient at the plates and velocity at 0.02m from the plate. Take viscosity of oil to be 2.5 N.s/m2.(7M+8M)

7. a) Discuss the various losses in flow through pipes.
   b) What do you meant by pipes in series and pipes in parallel?
   c) A 2500m long pipeline is used for transmission of power. 120 kW power is to be transmitted through the pipe in which water having a pressure of 4000 kN/m^2 at inlet is flowing. If the pressure drop over the length of pipe is 800 kN/m^2 and f=0.006, find: i) diameter of the pipe ii) efficiency of transmission. (4M+4M+7M)

8. a) Water flows over a rectangular sharp-crested weir 1 m long, the head over the sill of the weir being 0.66 m. The approach channel is 14 m wide and depth of flow in the channel is 1.2 m. Determine the rate of discharge over the weir. Calculate also the velocity of approach and the effect of end contraction. Take the co-efficient of discharge for the weir as 0.6.
   b) A rectangular channel 6 m wide carries 2800 liters per second at a depth of 0.9 m. What height of broad crested rectangular weir must be installed to double the depth? Assume a weir coefficient of 0.86. (8M+7M)

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1. a) What do you understand by Pascal's Law and discuss its applications in fluid mechanics
   b) How is pressure similar to shear stress? How does pressure differ from shear stress?
   c) What are the most units for pressure? A diver in the ocean (S=1.03) records a pressure of 1520 mm-Hg on her depth gauge. How deep is she? (5M+5M+5M)

2. a) For hydrostatic conditions, what do typical pressure distributions on plane surface look like? Sketch two examples that corresponds to different situations.
   b) A cylindrical vessel of 1 m diameter has water in it to a height of 2 m. Oil of specific gravity 0.75 is kept over water column for another 1m. Above the oil, a dead weight of 5000N, base diameter 1 m, is kept. Estimate the total hydrostatic force and center of pressure on a gate 30 cm in diameter placed along the vertical surface of the vessel. The lowest point of the gate is on the base of the vessel. (5M+10M)

3. a) Define Steady and Unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational flows.
   b) An incompressible fluid flows past a solid plate. The x and y coordinates are measured respectively from the leading edge and the surface of the plate. If the x component of the fluid velocity is given by $u = x^2y^2 + 2xy$, obtain the velocity field, and the acceleration at a point (2, 1). (8M+7M)

4. a) Derive Euler's equation of motion.
   b) A tapering pipe with a 30^0 bend is laid on a horizontal plane. The inlet and outlet diameters are 30 cm and 20 cm, pressures are 5 and 2 bar absolute, when the inlet water velocity is 12 m/sec. Considering atmospheric pressure to be 1 bar, estimate the magnitude and direction of the resultant force acting on water, and of those who required to hold the bend stationary. (7M+8M)
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5. a) Discuss the development of boundary layer over a thin flat plate with a neat diagram.
   b) The velocity distribution in the boundary layer is given by $\frac{u}{U} = \left(\frac{y}{\delta}\right)^{1/7}$ calculate the following: i) Displacement thickness ii) Momentum thickness iii) Energy thickness. (8M+7M)

6. a) Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic.
   b) Define Reynolds number. What do you understand by critical Reynolds number?
   c) Explain the characteristics of Laminar & Turbulent flows. (8M+3M+4M)

7. a) Explain what do you understand by Hydraulic Grade Line and Total Energy Line. Discuss its practical significance in analysis of fluid flow problems.
   b) Two pipes each 300 m 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 300mm and150mm respectively. Determine the ratio of head lost when the pipes are connected in series to the head lost when they are connected in parallel. Neglect minor losses. (7M+8M)

8. a) Differentiate between Venturimeter and Orifice meter with respect to application and energy loss.
   b) An engineer is designing a triangular weir for measuring the flow rate of a stream of water that has a discharge of $0.3 m^3/min$. The weir has an included angle of 45^0 and coefficient of discharge is 0.6. Find the head over the weir. (8M+7M)

Code No: R21014 **R10** SET - 4

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1. a) Write short notes on pressure gauges and manometers.
   b) A 400 mm diameter shaft is rotating at 200 r.p.m in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 n-s/m^2. Determine:
   i) Torque recurred to overcome friction in bearing
   ii) Power utilized in overcoming viscous resistance. Assume linear profile velocity
   (6M+9M)

2. a) Prove that center of pressure lies always below the center of gravity for submerged lamina.
   b) A rectangular gate in the vertical side of a reservoir can turn freely about its upper edge which is horizontal and is fastened at its two lower corners. The gate is 1.0m wide and 2.0m high and its upper edge is 2.0m below the water level. Determine the reactions at the lower corners assuming them to be equal. (7M+8M)

3. a) Discuss the different types of fluid flows.
   b) In three dimensional incompressible fluid flow; velocity components in x and y-directions are:
   $u = x^2+y^2z^3$; $u = -(xy + yz +zx)$
   Use continuing equation to evaluate an expression for the velocity component w in the z-direction. (8M+7M)

4. a) State and derive the Bernoulli`s equation mentioning the assumptions made from Euler`s equation of motion. List the application of Bernoulli`s equation.
   b) A bend in pipeline conveying water gradually reduces from 0.6m to 0.3m diameter and defects the flow through angle of 60^0. At the larger end the gauge pressure is 172 kN/m^2. Determine the magnitude and direction of the force exerted on the bend i) when there is no flow. (9M+6M)
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R10

SET - 4

5. a) Write a short notes on displacement thickness, momentum thickness and energy thickness.
   b) A kite is weighing 7.85 N has an effective area of 0.8 m^2. It is maintained in air at an angle of 10^0 to the horizontal. The string attached to kite makes an angle of 45^0 to the horizontal and at this position the values of coefficients of drag and lift are 0.6 and 0.8 respectively. Determine: i) The speed of wind, and ii) the tension in the string. Take density of air as 1.25 kg/m^3. (7M+8M)

6. a) Derive an expression for the velocity distribution for turbulent flow in smooth pipes.
   b) Show that velocity distribution for turbulent flow through rough pipes is given as
   $\frac{u}{u_f} = 5.7 \log_{10}(y/K) + 8.5.$ (8M+7M)

7. a) What are the different losses in pipe flow? Derive the equation for head loss due to friction in circular pipes.
   b) Tow pipes each 300 m long are connected to a reservoir from which a flow of $0.085m^3/sec$ is discharged. If the diameters of the two pipes are 300 mm and 150 mm respectively, determine the ratio of head lost when the pipes are connected in series to the head lost when they are connected in parallel. Neglect minor losses. (7M+8M)

8. a) Derive an expression for the maximum discharge over a broad-crested weir.
   b) Differentiate between i) Venturimeter and orifice meter ii) small orifices and mouth pieces. (8M+7M)