Code No: RT21016 **R13** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2016
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1. a) Explain the effect of temperature on viscosity. (4M)
   b) Define and distinguish between (i) Steady and unsteady flow (ii) Rotational and irrotational flow. (4M)
   c) State the assumptions made while deriving equation for Euler's equation. (3M)
   d) What is magnus effect? Explain. (4M)
   e) Sketch the velocity distribution and shear stress distribution for a laminar flow between parallel plates when one plate moving and other at rest. (4M)
   f) What is a pitot tube? Explain its working with a sketch. (3M)

PART -B

2. a) If the equation of a velocity profile over a plate is $v = 2y^{2/3}$; in which v is the velocity in m/s at a distance of y meters above the plate. Determine the shear stress at y = 0, y = 0.05 and y = 0.075 m. Given dynamic viscosity as 0.85 N.s/m^2. (8M)
   b) State and prove Pascal's law. (8M)

3. a) An annular plate 3 m external diameter and 1.5 m internal diameter is immersed in water with its greatest and lowest depths below water surface as 4 m and 1.2 m respectively. Determine the total pressure and the position of the center of pressure on one face of the plate. (8M)
   b) Derive the expression for 3 Dimensional continuity equation. (8M)

4. a) A bend in pipeline conveying water gradually reduces from 0.6 m to 0.3 m diameter and deflects the flow through angle of 60^0. At the larger end the gauge pressure is 171.675 kN/m^2. Determine the magnitude and direction of the force exerted on the bend when there is no flow. (10M)
   b) Explain the importance and application of Navier – Stokes equation. (6M)

5. a) What is a boundary layer? Explain its formation along a long thin plate with neat sketch. (6M)
   b) Examine whether or not the following velocity profiles satisfy the essential boundary conditions for velocity distribution in the laminar boundary layer on a flat plate: (10M)
   i) $u/U = 1 + (y/\delta) - 3(y/\delta)^2$
   ii) $u/U = \sin(\pi y/2\delta)$ where U is the free stream velocity.
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6. a) Using Hagen-Poiseuille equation derive an expression for the head loss in a pipe of diameter D and length L in terms of Reynolds number and velocity head. (8M)
   b) A flow of 420 liters/min of oil (specific gravity = 0.91 and viscosity = 1.24 poise) is pumped through a pipeline 75 mm diameter having a length of 62 m and whose outlet is 3 m higher than its inlet. Estimate the power required for the pump if its efficiency is 60 %. (8M)

7. a) A rectangular channel 6 m wide carries 2800 liters per second at a depth of 0.9 m. What height of a broad crested rectangular weir must be installed to double the depth? Assume a weir coefficient of 0.86. (10M)
   b) What is the necessity of ventilation of weirs? Explain. (6M)

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Code No: RT21016 **R13** SET - 2

II B. Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2016
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1. a) Explain the importance of Pascal's law. (3M)
   b) Define and distinguish between stream line, path line and streak line. (4M)
   c) Explain the importance of momentum correction factor. (4M)
   d) Briefly explain the flow around submerged objects. (4M)
   e) Sketch the velocity distribution and shear stress distribution for a laminar flow between parallel plates when both plates at rest. (4M)
   f) A rectangular weir is 3 m long and has a head of 0.75 m. Find the discharge taking into account two end contractions. (3M)

PART -B

2. a) Calculate the capillary rise in a glass tube of 3 mm diameter when immersed in (i) Water, (ii) Mercury. Both the liquids being at 30 ^{0}C and the values of the surface tension for water and mercury at 30 ^{0}C in contact with air are respectively 0.0075 kgf/m and 0.052 kgf/m. (8M)
   b) Derive the expression for pressure difference in case of inverted U-tube manometer with neat sketch. (8M)

3. a) A square disc of side 1 m is immersed vertically in water so that an edge of the square makes an angle of 35^0 with the horizontal. If the highest corner of the disc is at a depth of 1.5 m below the free surface, find the total pressure on one face of the disc and the depth of centre of pressure. (12M)
   b) Classify and briefly explain different types of flow. (4M)

4. a) A bend in pipeline conveying water gradually reduces from 0.5 m to 0.2 m diameter and deflects the flow through angle of 60^0. At the larger end the gauge pressure is 171.675 kN/m^2. Determine the magnitude and direction of the force exerted on the bend when the flow is 876 litres/s. (12M)
   b) State the assumptions made while deriving equation for Bernoulli's equation. (4M)
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5. a) Explain the characteristics of a boundary layer. (4M)
   b) A plate 25 m long × 1.25 m wide is moving under water in the direction of its length. The drag force on the two sides of the plate is estimated to be 8500 N. Calculate: i) The velocity of the plate, ii) The boundary layer thickness at the trailing edges of the plate and iii) The distance x_c at which the laminar boundary layer existing at the leading edge transforms into turbulent boundary layer. Take for water: $\rho = 1000$ kg/m^3; $\nu = 1 \times 10^{-6}$ m^2/s. (12M)

6. A pipe of diameter 20 cm and length 2000 m connects two reservoirs, having difference of water levels as 20 m. Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, find the increase in the discharge. Take f = 0.015 and neglect minor losses. (16M)

7. a) Explain broad crested weir with (i) Sharp corner at upstream end and (ii) Round corner at upstream end with sketch. (6M)
   b) 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 m^3/s. Find the pressure difference between the inlet and the throat. (10M)

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Code No: RT21016 **R13** SET - 3

II B. Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2016
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1. a) What is guage pressure and vaccum pressure? (3M)
   b) What is meant by 1D, 2D and 3D flows? Explain. (3M)
   c) Explain the importance of kinetic energy correction factor. (4M)
   d) Differentiate between laminar and turbulent boundary layers with a neat sketch. (4M)
   e) Explain total energy line and hydraulic gradient line with sketch. (4M)
   f) Explain the flow over triangular notch with a neat sketch. (4M)

PART -B

2. a) Calculate the capillary effect in mm in a glass tube 2 mm in diameter when immersed in (i) Water, (ii) Mercury. Both the liquids being at 20 ^{0}C and the values of the surface tension for water and mercury at 20 ^{0}C in contact with air are respectively 0.0736 N/m and 0.51 N/m. Contact angle for water = 0^0 and for mercury 130^0. (8M)
   b) Derive the expression for pressure difference in case of differential U-tube manometer with neat sketch. (8M)

3. a) Derive the expression for total pressure on inclined plane surface. (10M)
   b) A stream function in a two-dimensional flow is equal to 2xy. Show that the flow is irrotational and determine the corresponding velocity potential. (6M)

4. a) Water flows through a 0.9 m diameter pipe at the end of which there is a reducer connecting to a 0.6 m diameter pipe. If the gage pressure at the entrance to the reducer is 412.02 kN/m^2 and the velocity is 2 m/s, determine the resultant thrust on the reducer, assuming that the frictional loss of head in the reducer is 1.5 m. (12M)
   b) Briefly explain the applications of momentum equation. (4M)

5. a) Explain the separation of boundary layer and its preventive methods. (8M)
   b) A thin flat plate 0.3 m wide and 0.6 m long is suspended and exposed parallel to air flowing with a velocity of 3 m/sec. Calculate drag force on both sides of the plate when the 0.3 m edge is oriented parallel to free stream. Consider flow to be laminar and assume for air kinematic viscosity is 0.18 stokes and density is 1.2 kg/m^3. (8M)
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6. a) Determine the difference in the elevations between the water surfaces in the two tanks which are connected by horizontal pipe of diameter 300 mm and length 400 m. The rate of flow of water through the pipe is 300 liters/s. Consider all losses and take the value of f = 0.008. (8M)

   b) Derive an expression for mean velocity for laminar flow (8M)
   (i) through a pipe; (ii) between parallel plates.

7. a) Discuss the advantages of triangular weir over rectangular weir. (6M)

   b) A 150 mm x 75 mm Venturimeter with C_d = 0.98 is to be replaced by an orifice meter having a value of C_d = 0.6. If both the meters are to give the same differential mercury manometer reading for a discharge of 100 lps and the inlet dia. to remain 150 mm, what should be the diameter of orifice? (10M)

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Code No: RT21016 **R13** SET - 4

II B. Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2016
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1. a) Explain the terms surface tension and vapour pressure. (3M)
   b) Describe the use and limitation of flow nets. (3M)
   c) What are the different energies of a fluid? Explain each of them. (4M)
   d) Explain the importance of Vonkarmen momentum integral equation. (4M)
   e) What do you understand from Moody's Chart? Explain. (4M)
   f) What is an orifice? Give its classification. (4M)

PART -B

2. a) Derive the expression for capillary rise and fall with neat sketch. (8M)
   b) Derive the expression for pressure difference in case of micro manometer with neat sketch. (8M)

3. a) If the expression for the stream function is given by $x^3 - 3xy^2$, indicate whether the flow is rotational or irrotational. If the flow is irrotational determine the value of the velocity potential. (8M)
   b) A circular plate 3 m diameter is immersed in water with its greatest and lowest depths below water surface as 3 m and 1 m respectively. Determine the total pressure and the position of the center of pressure on one face of the plate. (8M)

4. The diameter of a pipe bend is 0.3 m at inlet and 0.15 m at outlet and the flow is turned through 120^0 in a vertical plane. The axis at inlet is horizontal and the center of the outlet section is 1.5 m below the center of the inlet section. The total volume of fluid contained in the bend is $0.085m^3$. Neglecting friction, calculate the magnitude and direction of the force exerted on the bend by the water flowing through it at 225 l/s when the inlet pressure is 137.34 kN/m^2. (16M)

5. a) Explain different types of thickness of a boundary layer and give their corresponding expressions. (6M)
   b) Water is flowing over a thin smooth plate of length 4.5 m and width 2.5 m at a velocity of 0.9 m/s. If the boundary layer flow changes from laminar to turbulent at a Reynolds number 5×10^5, find: (10M)
   i) The distance from the leading edge up to which the boundary layer is laminar
   ii) Thickness of the boundary layer at the transition point and
   iii) the drag forces on one side of the plate. Take viscosity of water as 0.01 poise.
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6. Three pipes of 500 mm, 300 mm and 400 mm diameters have lengths of 300 m, 100 m and 200 m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 20 m. If co-efficient of friction for these pipes is same and equal to 0.006, determine the discharge through the compound pipe neglecting first the minor losses and then including them. (16M)

7. a) Explain the flow over steeped notch with a neat sketch. (4M)
   b) Explain orifice meter in detail with diagram. Also derive an expression for finding out the actual discharge from a given orifice meter. (12M)

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Code No: RT21016 **R13** SET - 1

II B. Tech I Semester Regular Examinations, Dec - 2015
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(Civil Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1. a) What is viscosity? Why the viscosity of liquids usually decreases as the temperature increases?
   b) What is centre of pressure? Why its position is always different from the position of center of gravity in case of submerged surfaces?
   c) Write the Bernoulli's equation for steady flow and state the necessary conditions that need to be satisfied.
   d) What is Reynolds number? Explain the affect of various parameters on Reynolds number.
   e) Name and explain four important characteristics of turbulent flow.
   f) Define coefficient of discharge for a venturimeter. Why it is always less than unity?

PART –B

2. a) Define Pascal's law.
   b) A differential manometer is connected to two pipes whose centres are at 3 m difference in height. Higher level pipe is carrying liquid of specific gravity of 0.9 at a pressure of 1.8 bar and another pipe is carrying liquid at specific gravity of 1.5 at a pressure of 1 bar. The centre of pipe carrying low pressure liquid is 2 m above the higher level of the mercury in the manometer. Find out the difference in mercury level in the manometer in cm.

3. A right angled triangular plate is held in water in the vertical plane. Find out the total pressure acting on the plate and the position of its centre of pressure from both axis X and Y.

4. Discuss the application of Bernoulli's equation for the following:
   (i) Inclined Manometer (ii) Orifice Meter

5. a) Write the Prandtl's boundary layer equations and state their significance.
   b) How the separation of the boundary layer is controlled.

6. Three pipes of 40 cm in diameter, 300 m long, 20 cm in diameter, 400 m long and 30 cm in diameter, 200 m long are connected in series and the ends are connected to two tanks whose water level difference is 20 m. find the discharge through the compound pipe, (i) considering only frictional losses (ii) frictional and all other minor losses. Assume friction factor as 0.005

7. What is venture meter? Derive an expression for the volume flow rate in terms of coefficient of discharge and pressure difference.
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Code No: RT21016 **R13** SET - 2

II B. Tech I Semester Regular Examinations, Dec - 2015
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1. a) What is surface tension? How temperatures influence surface tension?
   b) What is stream line? Write the differential equation for it in Cartesian coordinate system.
   c) Write the Euler's equation of motion along a streamline. Show the forces acting on the fluid element along the streamline.
   d) Write four forms of velocity distributions for laminar boundary layer development.
   e) Show the Moody's chart schematically and explain its significance.
   f) Briefly explain the process of calibration of an orificemeter.

PART –B

2. a) Define Hydrostatic law.
   b) In a hydraulic jack, the diameter of small and large pistons is 2 cm and 10 cm respectively. If the force applied on small piston is 1000 N, find the load lifted by the large piston when (i) Both pistons are at same level (ii) Smaller piston is 50 cm above the large piston. The specific gravity of oil is 0.8.

3. A Circular plate 4 m in diameter is placed in such a way that it top vertex is at 2 m below free water surface and bottom vertex is 5 m below the free water surface. Find out the total pressure acting on the plate.

4. a) Derive the Euler's equations of motion for three dimensional steady state incompressible non viscous flow.
   b) Write the Navier-Stokes equation and explain the terms.

5. What is Magnus effect? Derive an expression for the stream function for flow past a cylinder with circulation.

6. A pipe line 30 cm in diameter 1500 m long is used to connect two tanks and has a slope of 1 in 100. The water level in the first tank is 10 m above inlet of the pipe and water level in the second tank is 2 m above the outlet of the pipe. Considering only frictional losses, find the flow rate through the pipe. Also draw TEL and HGL lines. Take friction factor as 0.005

7. a) Give the classification for notches and weirs.
   b) Derive an expression for discharge over a broad crested weir.
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2. Answer **ALL** the question in **Part-A**
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PART –A

1. a) What is inverted manometer? Where it is used?
   b) What is stream function? Write an equation for streamline in terms of stream function.
   c) Write the Navier-Stokes equation in Cartesian coordinates along x-direction. State the Unknowns of the equation.
   d) Define thickness of the boundary layer for flow over a flat plate. Write an expression for it according to Blausius.
   e) With the help of schematic diagram, show the flow pattern through abrupt but finite enlargement.
   f) Briefly explain the working principle of Pitot static tube.

PART –B

2. a) Define specific gravity & Viscosity of fluid.
   b) A U-tube mercury manometer is used to measure the pressure of oil flowing through a pipe whose specific gravity is 0.85. The centre of the pipe is 15 cm below the level of mercury. The mercury level difference in the manometer is 25 cm, determine the absolute pressure of the oil flowing through the pipe. Atmospheric pressure = 750 mm of Hg.

3. A triangular plate with base 2 m and height of 4 m is immersed in water and the plane of the plate makes an angle 30^0 with the free surface of water. The base is parallel to water surface and 2 m below the free water surface. Find out the total pressure acting on the plate and the centre of pressure from free surface of water.

4. A Pipe carrying air (ρ = 1.2 Kg/m^3) has cross-sectional area of 1 m^2 has been provided a bend whose cross-sectional area is gradually reduced from 1 m^2 to 0.5 m^2 area. The bend angle is 45^0 to the horizontal in anticlockwise direction. The air enters the pipe with a velocity of 10 m/s and 30 KPa pressure. Find the magnitude and direction of the force required to hold the pipe in position.

5. a) Compare the velocity profiles in a pipe for (i) laminar and (ii) turbulent flow.
   b) Derive an expression for the lift force for flow past a rotating cylinder.

6. a) Write Darcy's equation and explain its significance.
   b) A pipe system consists of three pipes connected in series i) 300 m long, 150 mm in diameter ii) 150 m long, 100 mm in diameter and iii) 250 m long, 200 mm in diameter. Find the Equivalent length of a 125 mm diameter pipe. Assume friction factor as 0.02 and coefficient of contraction as 0.6

7. Water flows through a 300 mm X 150 mm venturimeter at the rate of 0.037 m^3/s and the differential gauge is deflected 1 m. specific gravity of the gauge liquid is 1.25. Find the coefficient of discharge of the meter.
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PART –A

1. a) What is inclined tube manometer? For what purpose it is used?
   b) Show that equipotential lines and stream lines are orthogonal to each other except at Stagnation point.
   c) Describe the losses in pipe bends.
   d) Define favorable and adverse pressure gradients. How they influence the boundary layer Separation.
   e) State the four principles for flow through branched pipes.
   f) Give the classification of notches.

PART –B

2. a) Define Gauge & Vacuum Pressure.
   b) Describe a micro manometer & derive an expression for the same.

3. In an incompressible flow field, the velocity vector is given by **V** = (6xt+yz^2) **i** + (3t+xy^2) **j** + (xy-2xyz – 6tz) **k**.Verify whether the flow exists or not? If so, then find the acceleration vector at a point P (1,2,3) at t = 2.

4. A 45^0 reducing bend is connected to a pipe line whose inlet and outlet diameters are 60 cm and 30 cm respectively. The water flow through the pipe is 0.6 m^3/s. The pressure of the water at the inlet of the bend is 90 KN/m^2. Find the total force exerted on the bend. The pipe line rests on the ground.

5. a) Represent the development of boundary layer on a flat plate.
   b) Water at 15^{0}c flows over a flat plate at a speed of 1.2 m/s. The plate is 0.3 m long and 2 m wide. The boundary layer on each surface of the plate is laminar. Assume the velocity profile to be a linear expression with $\frac{\delta}{x} = \frac{3.46}{\sqrt{Re_x}}$. Find the drag force on the plate. Take ν for water as 1.1 X $10^{-6}\, m^2/s$ & $\rho = 1000\ kg/m^3$.

6. The total head at inlet to a pipe network system is 20m of water more than that at its outlet. Compare the rate of discharge of water, if the network system consists of (i) three pipes each 700 m long but of diameters 450 mm, 300 mm and 600 mm respectively in the order from inlet to outlet. (ii) the same three pipes in parallel. Assume friction factor for all the pipes to be 0.01 and the coefficient of contraction to be 0.6

7. Two orifices are fitted on the same side of the tank which is filled with water to a height of H. one orifice is located at a depth Z from the free surface of water and the other is located at the height Z from the bottom of the tank. Assuming same coefficient of velocity for both orifices, show that the jet will strike the ground at same horizontal distance from the tank. If H=5 m and Z=2 m, find the horizontal distance with velocity coefficient is 0.96.
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