Code No: R1621016 **R16** SET - 1

**II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2018**
**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 **FOUR** Questions from **Part-B**

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## PART –A

1. a) What is the importance of vapour pressure (3M)
   b) List out the applications of flow net (3M)
   c) What are the different types of forces involved in Euler's equation (2M)
   d) What is an equivalent pipe? Why the equivalent pipe is necessary in pipe network? (2M)
   e) Differentiate the small orifice and large orifice (2M)
   f) Define the terms drag and lift (2M)

## PART –B

2. a) A U-tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. Its left end is connected to the pipe and the right limb is open to the atmosphere. The centre of the pipe is open to the atmosphere. The centre of the pipe is 100mm below the level of mercury (specific gravity=13.6) in the right limb. If the difference of mercury level in the two limbs is 160mm, determine the absolute pressure of the oil in the pipe (7M)
   b) State and explain the Newton's law of viscosity. Deduce the expression for the dynamic viscosity. (7M)

3. Derive an expression for the centre of pressure for a plane immersed in water and inclined by an angle θ to the free surface of water (14M)

4. The diameters of pipe bend at the inlet and outlet are 30 cm and 15 cm and turned through $120^0$ right in the vertical plane. The axis at the inlet is horizontal. The outlet is 1.5 cm below the inlet. The volume of water in the bend is 900 liters. Find the force acting on the bend when the water flow is 250 liters/second. And inlet pressure is 1.5 bar (14M)

5. a) Mention the different characteristics of laminar and turbulent flows (7M)
   b) A crude oil of viscosity 0.9 poise and relative density 0.9 is flowing through a horizontal pipe of diameter120 mm and length 12m.Calculate the difference of pressure at the two ends of the pipe, if 785 N of the oil is collected in a tank in 25 seconds. (7M)
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6. a) Deduce an expression for discharge over a triangular Notch (7M)

   b) A rectangular notch 400 mm long is used for measuring a discharge of $0.003 m^3/s$. An error of 1.5 mm was made, while measuring the head over the notch. Calculate the percentage error in the discharge. Assume $C_d = 0.6$ (7M)

7. a) A plate 300mmx 100mm is immersed in a liquid of density 998 $kg/m^3$ and kinematic viscosity $1x\ 10^{-6}\ m^2/s$. The water is moving with a velocity of 15.0 m/s parallel to it. Calculate (14M)
   (i) Drag force on that portion of the plate over which the boundary layer is laminar.
   (ii) Total drag force on both sides of plate

Code No: R1621016 **R16** SET - 2

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**FLUID MECHANICS**
(Civil Engineering)

Time: 3 hours Max. Marks: 70

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## PART –A

1. a) Why the dynamic viscosity decreases with increase in temperature (2M)
   b) What is the importance of path line (2M)
   c) Explain briefly (i) Potential head (ii) Velocity head (iii) Datum head (3M)
   d) List out the examples of laminar flow. What is the need of Moody's chart (3M)
   e) Explain the working principle involved in pitot tube (2M)
   f) Explain the significance of Magnus effect (2M)

## PART –B

2. a) Show that the rate of increase of pressure in a vertical direction in a fluid at rest is equal to the weight density of the fluid at that point. (7M)
   b) A vertical cylinder of diameter 180 mm rotates concentrically inside another cylinder of diameter 181.2 mm. The space between the cylinder is filled with the oil whose viscosity is 8 poise. Find out the power required to rotate the cylinder at 100 rpm (7M)

3. Derive the expressions to determine the horizontal and vertical components of the resultant pressure on a submerged curved surface. (14M)

4. a) Develop the Bernoulli's equation of motion along a stream line and list out limitations of Bernoulli's equation? (7M)
   b) The water is flowing through a pipe having diameters 20 cm and 15 cm at sections 1 and 2 respectively, The rate of flow through pipe is 40 litres/s. The section 1 is 6 m above datum line and section 2 is 3 m above the datum. If the pressure at section 1 is 29.43 N/cm$^2$,find the intensity of pressure at section 2 (7M)

5. a) What factors account for the loss of energy in laminar flow? How does the energy loss vary with velocity of flow? (7M)
   b) A liquid with a specific gravity 2.8 and a viscosity 0.8 poise flows through a smooth pipe of unknown diameter, resulting in a pressure drop of 800 N/m$^2$ in 2 km length of the pipe. What is the pipe diameter if the mass flow rate is 2500 kg/hr (7M)
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6. a) List out the applications of stepped notch. Derive an expression for the measurement of discharge by stepped notch (4M)
   b) Find the discharge through a trapezoidal notch which is 1.2 m wide at the top and 0.5 m at the bottom and is 0.4 m in height. The head of water on the notch is 0.3 m. Assume $C_d$ for rectangular portion =0.62,while for triangular portion 0.60 (10M)

7. a) Derive the expressions for the displacement thickness and momentum thickness of the boundary layer. Explain their significances in the boundary layer theory (7M)
   b) Why is it necessary to control the growth of boundary layer on most of the bodies? What methods are used for such a control (7M)

Code No: R1621016 **R16** SET - 3

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**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 **FOUR** Questions from **Part-B**

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## PART –A

1. a) What is the working principle of manometer (2M)
   b) List out the applications of flow net analysis (2M)
   c) List out the assumptions which are made while deriving Bernoulli's equation (3M)
   d) What do you understand by Total energy line (3M)
   e) Define the terms of coefficient of discharge and coefficient of contraction (2M)
   f) Explain the characteristics of turbulent boundary layer (2M)

## PART –B

2. a) Explain the working of Micro manometers with neat sketch (7M)
   b) A differential manometer is connected to two pipes whose centers are at 3m 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 2m above the higher level of the mercury in the manometer. Find out the difference in mercury level in the manometer in cm (7M)

3. a) Classify the different types of flows. Explain in brief (i) laminar and turbulent flows (ii) rotational and irrotational flows (iii)Uniform and non Uniform flows (7M)
   b) In a particular steady state, incompressible flow field, the velocity components are given as u =2xy and v= $x^2$-$y^2$+$C^{2.}$ (7M)
   Find out the stream function to represent this flow

4. A 330 mm diameter $120^0$ bend discharges 0.4 $m^3$/s of water in the atmosphere. If the pressure of water entering the bend is 160 kN/$m^2$(guage), determine the force required to hold the bend in place. Assume the bend to be in horizontal plane. (14M)

5. A pipeline of 600 mm diameter and a 4km length connects two reservoirs. The difference of water levels in the reservoirs is 20 m. At a distance of 1 km from the upper reservoir, a small pipe is connected to the pipelines. The water can be taken from the small pipe. Find the discharge to the lower reservoir if (i) No water is taken from the small pipe, and (ii) 0.1 $m^3$/s of water is taken from small pipe. (14M)
   Take coefficient of friction =0.005 and neglect minor losses.
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6. a) Explain the working of orifice meter with the neat sketch. List out the differences of Orifice meter and Venturimeter. (7M)
   b) A horizontal venturimeter with inlet and throat diameters 160 mm and 60 mm respectively is used to measure the flow of an oil of specific gravity 0.8.If the discharge of oil is 0.005 $m^3/s$, find the deflection of oil mercury gauge. Take venturimeter constant =1 (7M)

7. Explain the concept of boundary layer? What is the importance of boundary layer in fluid flow problems? Derive Von Karman momentum integral equation (14M)

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Time: 3 hours Max. Marks: 70

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

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## PART –A

1. a) List out the applications of surface tension (3M)
   b) Define the terms: Total Pressure and Center of Pressure (2M)
   c) What is an impulse- momentum equation? (2M)
   d) What do you understand by Hydraulic gradient line (3M)
   e) Where do we find out the usage of notches for measuring the discharge (2M)
   f) Which factors affect the thickness of boundary layer (2M)

## PART –B

2. a) Explain the Pascal's law. Prove that pressure acting on wedge submerged in fluid is equal in all directions (7M)
   b) A body of weight 500N having surface area of 0.2 $m^2$ slides down a lubricated inclined plane making an angle $30^0$ with the horizontal. The oil has viscosity of 10 poise and a body speed of 1 m/s, determine the film thickness of the oil required (7M)

3. a) The following given stream function represents a two-dimensional steady state flow. (7M)
   $\Psi = 4(x^2-y^2)$
   Check whether the flow is irrotational or not?.If it is irrotational, then find out the corresponding velocity potential function.
   b) Define velocity potential function and stream function and list out its properties. What is the relationship between the stream function and velocity potential function (7M)

4. a) Develop the Euler's equation of motion along a stream line and list out some practical applications of Euler's equation (7M)
   b) A pipe 250mm long slopes down at 1 in 100 and tapers from 625 mm diameter at the higher end to 350 mm diameter at the lower end, and carries 150 liters/s of oil (sp.gravity 0.7).If the pressure gauge at the higher end reads 65 $KN/m^2$, determine: (i) velocities at the two ends (ii) Pressure at the lower end. Neglect all the losses. (7M)
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5. A pipeline of 500 mm diameter and 4.5 km length connects two reservoirs whose constant difference of water level is 12m.A branch pipe 1.25 km long and taken from a point distant 1.5 km from the reservoir, leads to the reservoir C whose water level is 15 m below that of reservoir A. Find the diameter of the branch pipe, so that the flow into both the reservoirs is same. Assume co-efficient of friction for each pipe , f= 0.0075. (14M)

6. a) Explain the working of Pitot tube. Derive an expression for measurement of velocity by Pitot tube (7M)
   b) Petroleum oil(sp.gr 0.93 and viscosity =13cP) Flows isothermally through a horizontal 5 cm pipe. A Pitot tube is inserted at the centre of a pipe and it leads are filled with the same oil and attached to a U-tube containing water. The reading on the manometer is 10 cm. Calculate the volumetric flow of oil in $m^3/s$. The coefficient of Pitot is 0.98 (7M)

7. a) A 2m wide and 5.0 m long plate when towed through water at $20^0$ C experiences a drag of 30.38 N on both the sides. Determine the velocity of the plate and the length over which the boundary layer is laminar (7M)
   b) How will you find the drag on a flat plate due to laminar and turbulent boundary layers? (7M)