Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem: Odd Sem 2019-20
Course Code: CIV 208
Course Name: FLUID MECHANICS
Program & Sem: B.Tech (CIV) & III

Date: 1.10.2019
Time: 11.00AM to 12.00PM
Max Marks: 40
Weightage: 20%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries four marks. **(3Qx4M=12M)**

1. Define Fluid and explain the effect of shear stress on solids and fluids

(C.O.NO.1)[Knowledge]

2. Define the relation between absolute pressure, atmospheric pressure and gauge pressure with neat diagram. (C.O.NO.1)[Knowledge]

3. State Archimedes' principle with example.

(C.O.NO.1)[Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries six marks. **(2Qx6M=12M)**

4. A Plate at a distance 0.0254 mm from a fixed plate moves at 0.61m/s and requires a force of 1.962 N/m^2 area of plate. Determine dynamic viscosity of liquid between the plates.

(C.O.NO.1) [Comprehension]

5. A 0.8- mm -diameter glass tube is inserted into kerosene at 20 ^{0}C. The contact angle of kerosene with a glass surface is 26°. Determine the capillary rise of kerosene in the tube. Take surface tension of Kerosene at 20 ^{0}C is 0.028 N/m and specific gravity of kerosene = 0.820. (C.O.NO.1) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

6. A 3.6 m by 1.5 m wide rectangular gate MN is vertical and is hinged at point 0.15 m below the center of gravity of the gate shown in Figure-1. The total depth of water is 5 m. What horizontal force must be applied at the bottom of the gate to keep the gate closed?

(C.O.NO.2)[Application]

7. Consider a double - fluid manometer attached to an air pipe shown in Figure-2. If the specific gravity of one fluid is 13.55, determine the specific gravity of the other fluid for the indicated absolute pressure of air. Take atmosphere pressure to be 100 kPa.

(C.O.NO.1)[Application]

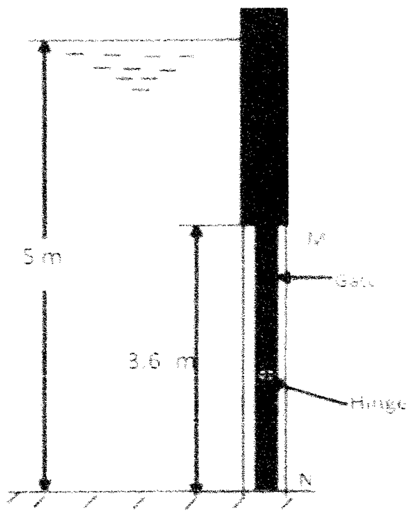


Figure-1

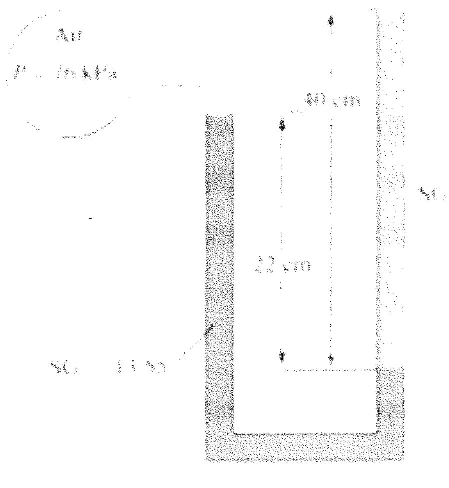


Figure-2

SCHOOL OF ENGINEERING

Semester: 3rd
Course Code: CIV 208
Course Name: Fluid Mechanics

Date 1/10/2019
Time. 11:00 to 12:00 PM
Max Marks: 40
Weightage. 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Module	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	1	Module-1	4			4
2	1	Module-1	4			4
3	1	Module-1	4			4
4	1	Module-1		6		6
5	1	Module-1		6		6
6	2	Module-2			8	8
7	1	Module-1			8	8
	Total Marks		12	12	16	40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines. Mr. Santhosh M B]

Reviewers' Comments

1. Figures should be made bold.

Annexure- II:

SCHOOL OF ENGINEERING

SOLUTION

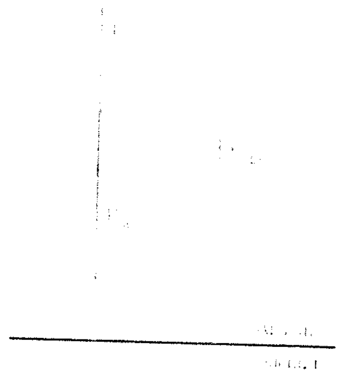
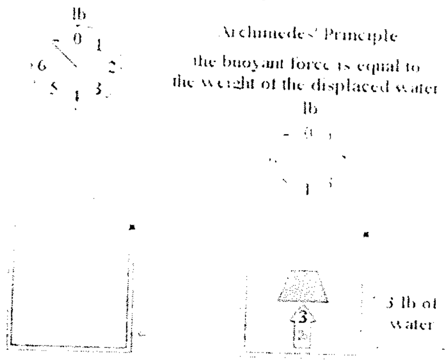
Semester: 3rd
Course Code: CIV 208
Course Name: Fluid Mechanics

Date 1/10/2019
Time: 11:00 t0 12:00 PM
Max Marks: 40
Weightage: 20%

Part A

(3Q x 4 M = 12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	By definition, a fluid is any material that is unable to withstand a static shear stress. A solid can resist an applied shear stress by deforming, whereas a fluid deforms continuously under the influence of shear stress, no matter however small is the stress. **Solid:** It can resist an applied shear by deforming Stress is proportional to strain **Fluid:** Deforms continuously under applied shear Stress is proportional to strain rate	Fluid definition **1 M** effect of shear stress on solids and fluids **3 M**	5 Minutes
2	**Relation between Absolute and Gage pressure** $P_{gage} = P_{abs} - P_{atm}$	Diagram 2 M Relation 2 M	5 Minutes

	 **Absolute pressure** The actual pressure at a given position is called the **absolute Pressure** and it is measured relative to absolute vacuum (i.e., absolute zero pressure). **Gauge pressure** is zero-referenced against ambient air pressure, so it is equal to absolute pressure minus atmospheric pressure.		
3	**Archimedes' principle**: The buoyant force acting on a body immersed in a fluid is equal to the weight of the fluid displaced by the body, and it acts upward through the centroid of the displaced volume.  	Statement 2 M Example 2 M	5 Minutes

Part B

(2Q x 6 M = 12 Marks)

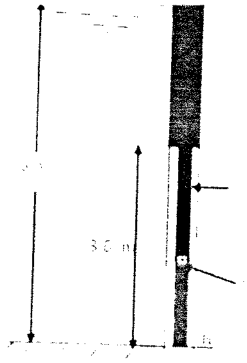
Q No	Solution	Scheme of Marking	Max. Time required for each Question
4		Formula 2 M Steps and unit 2 M Final answer 2M	5 Minutes

	$Y = 0.0254$ [illegible] $= 0.0254 \times$ [illegible] $\tau = 1.962\ N/m^2$ $\mu = ?$ Assuming linear velocity distribution $\tau = \mu \frac{U}{Y}$ $1.962 = \mu \times \frac{0.61}{0.0254 \times 10^{[illegible]}}$ $\mu = 8.17 \times 10^{[illegible]} \frac{NS}{m^2}$		
5	Capillary height is given by equation $h = \frac{[illegible]}{\gamma R}$ $\Theta = 26^0$ R = 0.4 mm σ = 0.028 N/m Υ of Kerosene = 0.820 X 1000 X 9.81 Capillary rise (h) = 16 mm	Formula 2 M Steps and unit 2 M Final answer 2 M	5 Minutes

Part C

(2Q x 8 M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

6	 **Total pressure acting on the plane surface of the gate is given by** P = ρgh̄ A P = 1000 X 9.81 X (5-1.8) X (3.6 X 1.5) P = 169.516 kN. **The depth of centre of pressure is given by** $h^{*} = \dfrac{I_G + A\bar{h}^2}{A\bar{h}} = \dfrac{I_G}{A\bar{h}} + \bar{h}$ h* = 5.832 /(3.6 X 1.5) 3.2 + 3.2 h* = 3.53 m Let F be the force required to be a applied at the bottom of the gate of keep it closed. By taking moments of all the forces about the hinge and equating to zero for equilibrium, we get F (1.8-0.15) – (169.516 X 1000)(0.33- 0.15) = 18.4 kN	Total pressure formula 1 M Total pressure 2 M Centre of pressure formula 1 M Centre of pressure 2M Force to be applied at the bottom 2 M	20 Minutes
7	**Properties:** The specific gravity of one fluid is given to be 13.55. We take the standard density of water to be 1000 kg/m³ **Analysis:** Starting with the pressure of air in the tank, and moving along the tube by adding (as we go down) or subtracting (as we go up) the ρgh terms until we reach the free surface where the oil tube is exposed to the atmosphere, and setting the result equal to Patm give:	Formula 2 M Analysis 2M Substitution 2 M Final answer 2 M	15 Minutes

$P_{air} + \rho_1 g h_1 - \rho_2 g h_2 = P_{atm} \rightarrow P_{air} - P_{atm} = SG_2\, \rho_w g h_2 - SG_1\, \rho_w g h_1$

Rearranging and solving for SG_2,

$$SG_2 = SG_1 \frac{h_1}{h_2} + \frac{P_{air} - P_{atm}}{\rho_w g h_2} = 13.55\,\frac{0.22\text{ m}}{0.40\text{ m}} + \left(\frac{(76-100)\text{ kPa}}{(1000\frac{\text{kg}}{\text{m}^3})(9.81\frac{\text{m}}{\text{s}^2})(0.40\text{ m})}\right) * \left(\frac{1000\text{ kg m/s}^2}{1\text{ kPa m}^2}\right) =$$

Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20 **Date:** 19.11.2019

Course Code: CIV 208 **Time:** 11.00 AM to 12.00 PM

Course Name: FLUID MECHANICS **Max Marks:** 40

Program & Sem: B.Tech, (CIVIL) & III Sem **Weightage:** 20%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries four marks. (3Qx4M=12M)

1. Differentiate between steady flow and unsteady flow. (C.O.NO.3)[Knowledge]
2. State Bernoulli's theorem and what are the assumptions made in the Bernoulli's theorem? (C.O.NO.3)[Knowledge]
3. Define the following:
   a. Stream lines
   b. Stream tube
   c. Path line
   d. Streak (C.O.NO.3)[Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries six marks. (2Qx6M=12M)

4. Find the Reynold's number if a fluid of viscosity 0.5 Ns/m^2 and relative density of 980 kg/m^3 through a 30 mm pipe with a velocity of 2.8 m/s. (C.O.NO.3)[Comprehension]
5. A 0.3 m pipe carries water at a velocity of 24.4 m/s. At points A and B measurements of pressure and elevation were respectively 361 kN/m^2 and 288 kN/m^2 and 30.5 m and 33.5 m. For steady flow, find the loss of head between A and B. (C.O.NO.3)[Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each question carries eight marks. (2Qx8M=16M)

6. Derive Euler's equation of motion for a steady flow and deduce Bernoulli's equation.
(C.O.NO.3)[Comprehension]
7. An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Co-efficient of discharge for the orifice meter is given as 0.6. Compute the discharge of water through pipes.
(C.O.NO.3)[Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: III
Course Code: **CIV 208**
Course Name: Fluid Mechanics

Date: 19/11/2019
Time: 1 hour
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels				Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]				Total Marks
			K				C			C				
A1	3	Module 3	4											4
A2	3	Module 3	4											4
A3	3	Module 3	1	1	1	1								4
B1	3	Module 3					6							6
B2	3	Module 3					6							6
C1	3	Module 3								8				8
C2	3	Module 3								8				8
	Total Marks													40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

SCHOOL OF Engineering

SOLUTION

Semester: III

Course Code: CIV 208

Course Name: FLUID MECHANICS

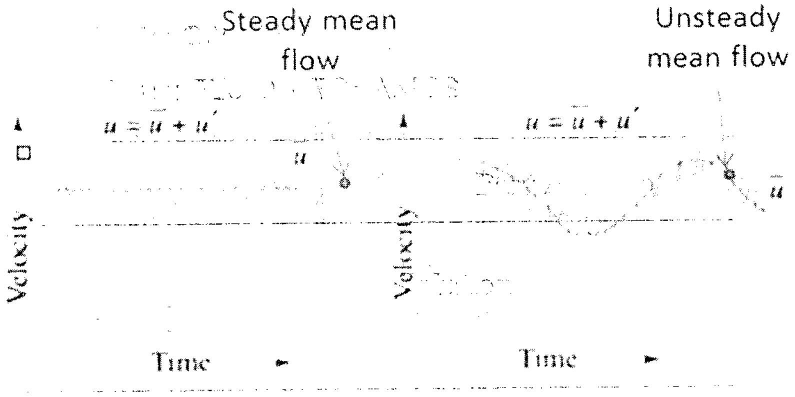
Date. 19/11/2019

Time: 1 HOUR

Max Marks: 40

Weightage: 20%

Part A (3Q x 4M =12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	The term steady flow implies no change of properties like velocity, temperature, etc., at a point with time. The unsteady flow implies change of properties like velocity, temperature with time.  (a) Steady (b) Unsteady	**2 M** **2 M**	**4 mins**
2	**Statement of Bernoulli's theorem:** In a steady, ideal flow of an incompressible fluid , the total energy at any section of a flowing fluid is always a constant. **Assumptions**	**2 M** **4x0.5= 2 M**	**4 mins**

	1. The fluid is ideal. i.e. the viscosity is zero 2. The flow is steady 3. The flow is incompressible 4. The flow is irrational or the flow is along a stream line		
3	**Streamline:** A curve that is everywhere tangent to the instantaneous local velocity vector. **Stream tube:** consists of a bundle of streamlines much like a communication cable consists of a bundle of fiber-optic cables. **Path line:** The actual path traveled by an individual fluid particle over some time period. **Streak line:** The locus of fluid particles that have passed sequentially through a prescribed point in the flow.	**4x1M =4M**	**4 mins**

Part B (2Q x 6M =12 Marks)

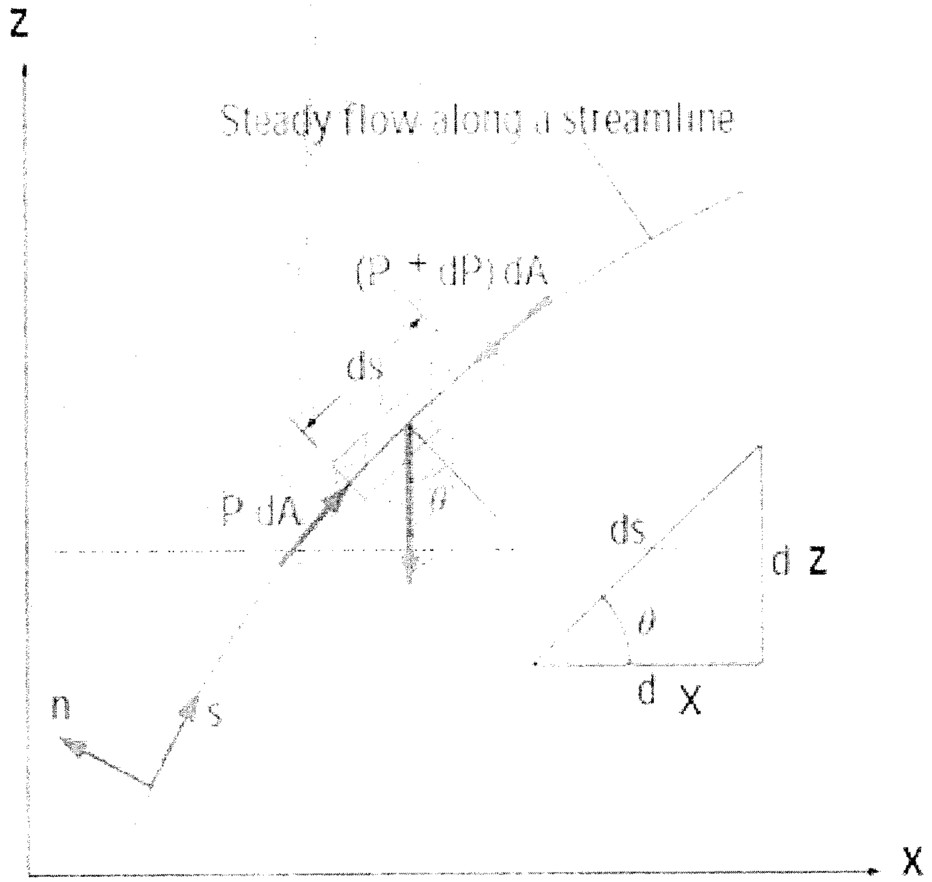
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	**Given,** v = 2.8 m/s **d** = 30 mm = 30×10^{-3} m $\rho = 980\ kg/m^3$ $\mu = 0.5\ Ns/m^2$ $R_e = ?$ **Reynold's number,** $R_e = \frac{\rho v d}{\mu}$ $R_e = \frac{980X2.8X30X10^{-3}}{0.5}$ $R_e = 164.64$ Since Reynold's number is 164.64 which is less than 2000, the flow is laminar.	3 M , formula 1 M 2 M	9 mins
2	Given, $P_A = 361\ kN/m^2 = 361 \times 10^3\ N/m^2$ $P_B = 288\ kN/m^2 = 288 \times 10^3\ N/m^2$	1 M	9 MINS

	$\rho = 1000\ kg/m^3$		
	$V_A = V_B = 24.4$ m/s		
	$Z_A = 30.5$ m	1 M	
	$Z_B = 33.5$ m		
	$E_A = \frac{P_A}{\rho g} + \frac{V_A{}^2}{2\,g} + Z_A$		
	$E_A = \frac{361x10^3}{1000X9.81} + \frac{(24.4)^2}{2X9.81} + 30.5$	1 M	
	$E_A = 97.64\ N/m^2$	1 M	
	$E_B = \frac{P_B}{\rho g} + \frac{V_B{}^2}{2\,g} + Z_B$	1 M	
	$E_B = \frac{288X10^3}{1000X9.81} + \frac{(24.4)^2}{2X9.81} + 33.5$	1M	
	$E_B = 93.20\ N/m^2$		
	Loss of head = E_A - E_B	1 M	
	= 97.64 - 93.20		
	= 4.43 N/m^2		

Part C (2Q x 8M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Consider the motion of a fluid particle in a flow field in steady flow.		15 MINS

1 M for diagram



Applying Newton's second law (Which is referred as linear momentum equation in fluid mechanics) in the S – direction on a particle moving along a streamline gives

1 M

$$\sum F_s = m a_s \quad \textbf{Eqn -1}$$

In regions of flow where net frictional forces are negligible, there is no pump or turbine . and there is no heat transfer along the stream line , the significant forces acting in the S – direction are pressure (acting on the both sides) and component of weight of the particle in the S –direction Shown in figure. Therefore, Eqn -1 becomes

2 M

$$P\,dA - (P + dP)dA - W \sin\Theta = m V \frac{dV}{ds} \quad \textbf{Eqn -2}$$

where Θ is the angle between the normal of the streamline and the vertical Z-axis at that point, $m = \rho V = \rho\, dA\, ds$ is the mass, $W = mg = \rho g\, dA\, ds$ is the weight of the fluid particle, and $\sin\Theta = dz / ds$. Substituting,

1 M

	$-dP\,dA - \rho g\, dA\, ds \frac{dz}{ds} = \rho\, dA\, ds V \frac{dV}{ds}$ **Eqn -3** Canceling dA from each term and simplifying, $-dP - \rho g\, dZ = \rho V\, dV$ **Eqn -4** Noting that $V\,dV = \frac{1}{2}\, d(V^2)$ and dividing each term by ρ gives $\frac{dP}{\rho} + \frac{1}{2} d(V^2) + g\,dz = 0$ Integrating above equation **Steady flow:** $\int \frac{dP}{\rho} + \frac{V2}{2} + gz = Constant\ (along\ a\ streamline)$ **Steady, Incompressible flow:** $\frac{P}{\rho} + \frac{V2}{2} + gz = Constant\ (along\ a\ streamline)$ ρ is constant $\frac{p}{\rho g} + \frac{V^2}{2g} + z = Constant$	1 M 1 M 1 M	
2	Given, d = 10 cm = 0.1 m $A = \frac{\pi}{4} d^2 = \frac{\pi}{4}(0.1)^2 = 7.85 \times 10^{-3}\ m^2$ D = 20 cm = 0.2 m $P_1 = 19.62\ N/cm^2 = 19.62 \times 10^4\ N/m^2$ $P_2 = 9.81\ N/cm^2 = 9.81 \times 10^4\ N/m^2$ $C_d = 0.6$ Discharge equation of Orifice meter $$Q = AC_d \sqrt{\frac{2(P_1 - P_2)}{\rho(1-\beta^4)}}$$ $\beta = \frac{d}{D}$ $\beta = \frac{0.1}{0.2}$ $\beta = 0.5$	3 M 1 M 1 M	15 MINS

	$$Q = 7.85X10^{-3}\ X\ 0.6\sqrt{\frac{2(19.62X10^4 - 9.81X10^4)}{1000(1-0.5^4)}}$$	2 M	
	Q = 0.068 m^3/s Q = 68 litres/s	1 M	

Roll No

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: CIV 208
Course Name: FLUID MECHANICS
Program & Sem: B.Tech (CIV) & III

Date: 27 December 2019
Time: 1.00 PM to 4.00 PM
Max Marks: 80
Weightage: 40%

Instructions:

(i) Read the all questions carefully and answer accordingly.
(ii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 4 marks. (5Qx4M=20M)

1. Distinguish uniform and non-uniform flow (C.O.No.1) [Knowledge]
2. State Bernoulli's equation and list assumptions made for derivation of Bernoulli's equation (C.O.No.3) [Knowledge]
3. State and Explain Pascal's Law (C.O.No.2) [Knowledge]
4. Write the classification of losses in pipes (C.O.No.4) [Knowledge]
5. With neat diagram explain the working principle of orifice meter (C.O.No.3) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 8 marks. (3Qx8M=24M)

6. A 0.25m diameter pipe carries oil of specific gravity 0.8 at the rate of 120 litres per second and the pressure at a point A is 19.62 kN/m^2 (gauge). If the point A is 3.5 m above the datum line, calculate the total energy at point A in meters of oil. (C.O.No.4) [Comprehension]

7. A main pipe divides in to two parallel pipes which again forms one pipe as shown in Figure -1 The length and diameter for the first parallel pipe are 2500 m and 1.0 m respectively, while the length and diameter of 2nd parallel pipe are 2500 m and 0.8 m. Find the rate of flow in each parallel pipe, if total flow in the main is 4.0 m^3/s. The co-efficient of friction for each parallel pipe is same and equal to 0.005.

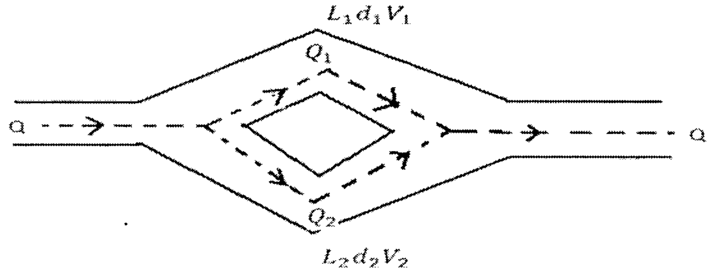


Figure -1 (C.O.No.4) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

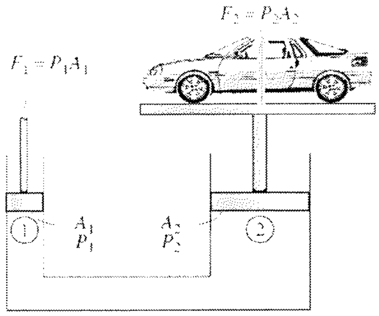
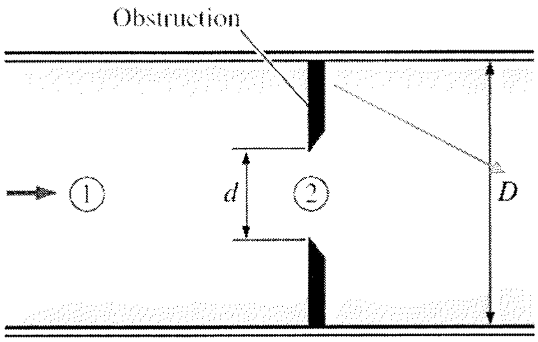
Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	1	1	4			4
2	3	3	4			4
3	2	2	4			4
4	1	1	4			4
5	3	3	4			4
6	4	4		8		8
7	3	3		8		8
8	3	3		8		8
9	4	4			12	12
10	4	4			12	12
11	4	4			12	12
	Total Marks		20	24	36	80

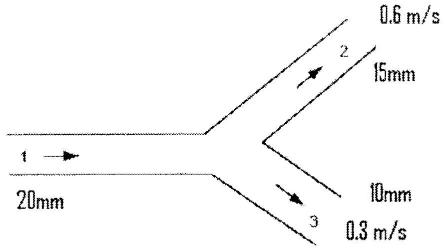
K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

3	**Pascal's law**: The pressure applied to a confined fluid increases the pressure throughout by the same amount. Or The pressure at a point in a fluid is same in all the directions P1 = P2 F1/A1 = F2/A2 Or F2/F1 = A2/A1  	Statement **2 M** Expression **2 M**	15 minutes
4	**<u>Classification</u>** **1. Major losses** • It is due to friction **2.Minor losses** • Sudden expansion of pipe • Sudden contraction of pipe • Bend in pipe • Pipe fittings • An obstruction in pipe	Major losses **2M** Minor losses **2M**	10 minutes
5	Orifice meter is a device used for measuring the rate of flow of a fluid flowing through a pipe. It consists of flat circular plate which has a circular hole, in concentric with the pipe. This is called orifice. **Construction and Working** The orifice plate inserted in the pipeline causes an increase in flow velocity and a corresponding decrease in pressure. The flow pattern shows an effective decrease in cross section beyond the orifice plate, with a maximum velocity and minimum pressure at the vena contracta.  	Working principle **2M** Sketch **2M**	10 minutes

8	 Given Q_1 =? cm^3/s V_1 =? m/s D_1 = 20 mm V_2 = 0.6 m/s D_2 = 15 mm V_3 = 0.3 m/s D_3 = 10 mm Apply continuity equation (mass conservation law) $Q_1 = Q_2 + Q_3$ $A_1V_1 = A_2V_2 + A_3V_3$ $\pi/4\ 0.02^2 \text{ X } V_1 = \pi/4 * 0.015^2 \text{ X } 0.6 + \pi/4 * 0.01^2 \text{ X } 0.3$ V_1 = 0.412 m/s $Q_1 = A_1 * V_1 = 1.29 * 10^{-4}$ = 129 cm^3/s	$Q_1 = Q_2 + Q_3$ **2M** $A_1V_1 = A_2V_2 + A_3V_3$ **2M** V_1 = 0.412 m/s **2M** $Q_1 = A_1 * V_1 = 1.29 * 10^{-4}$ = 129 cm^3/s **2M**	15 minutes

Part C (3Q x 12M = 36Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
9	Given Dia of pipe (d) = 500 mm = 0.5m Length of pipe (L) = 80 m Velocity of flow (V) = 2 m/s Chezy's constant (C) = 60 Kinematic viscosity (v) = 0.01 cm^2/s **Darcy's formula is given by** $$h_f = \frac{4.f.L.V^2}{d.2g}$$ f is coefficient of friction is a function of Reynold's number Reynold's number is given by	Darcy formula **2 M** Chezy's formula **2M** Reynold's number **2M** hf =0.324 m (Darcy's formula) **2M** hf =0.704 m (Chezy's formula) **2M** Steps **2 M**	25 minutes

	CASE 2 $$h_f = h_{f1} + h_{f2} + h_{f3} = \frac{4fl_1}{d_1}.\frac{v_1^2}{2g} + \frac{4fl_2}{d_2}.\frac{v_2^2}{2g} + \frac{4fl_3}{d_3}.\frac{v_3^2}{2g}$$ V1 = 1.445 m/s Q = A1V1 = π/4 $(0.3)^2$ X 1.445 = **0.1021 m^3/s = 102.1 ltr/sec**		
11	Given Dia of larger pipe, D1 = 600 mm = 0.6 m Area A1 = 0.2827 m^2 Dia of smaller pipe, D2 = 300 mm = 0.3 m Area A2 = 0.0707 m^2 Pressure in large pipe = 12.5 X 10^4 N/m^2 Pressure in smaller pipe = 9.75 X 10^4 N/m^2 Cc = 0.62 Head loss due to contraction $$h_L = K_L \frac{V_2^2}{2g}$$ $$K_L = [\frac{1}{Cc} - 1]^2$$ $h_L = 0.375V_2^2/2g$ From continuity equation A1V1 = A2V2 V1 = V2/4 Applying Bernoulli's equation before and after contraction $$\frac{p_A}{\gamma} + \frac{V_A^2}{2g} + Z_A = \frac{p_B}{\gamma} + \frac{V_B^2}{2g} + Z_B + h_L$$ Pipe is horizontal Z1 = Z2 $h_L = 0.375V_2^2/2g$ V1 = V2/4 Substituting these values in the above equation we get V2 = 6.185 m/s Q = A2V2 = **0.4372 m^3/s = 437.2 lit/s** Head loss due to sudden contraction = $h_L = 0.375(6.185)^2/2g$ **= 0.731 m**	$h_L = K_L \frac{V_2^2}{2g}$ **2M** $h_L = 0.375V_2^2/2g$ **2M** V1 = V2/4 **2M** Applying Bernoulli's equation before and after contraction **2M** V2 = 6.185 m/s **1M** Q = 0.4372m^3/s = 437.2 lit/s **1 M** h_L= 0.731 m **2M**	25 minutes