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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem. 2019-20 | **Date:** 30.09.2019

Course Code: MEC 203 | **Time:** 2:30PM to 3:30PM

Course Name: FLUID MECHANICS & MACHINES | **Max Marks:** 40

Program & Sem: B.Tech (MEC) & III | **Weightage:** 20%

Instructions:

(i) Illustrate with neat sketches wherever deemed necessary

(ii) All questions are compulsory

Part A (Memory Recall Questions)

Answer all the Questions. Each Questions carries three mark. (3Qx4M=12M)

1. Fill in the

   a. SI Unit of Surface tension is _____.

   b. Reciprocal of density is called as _____.

   c. Study of fluids at rest is called as _____.

   d. Suction pressure is also called as _____.

2. State and prove hydrostatic law. (C.O.NO.01) [Knowledge]

3. Explain in brief concept of surface tension. (C.O.NO.01) [Knowledge]

Part B (Thought Provoking Questions)

Answer all the Questions. Each Question carries six marks. (3Qx6M=18M)

4. A submarine is stationed at a depth of 250m below sea level. The submarine has a working depth of 500m. You being a submarine operator working in pressure management chamber kindly help the captain find the safe working pressure and also specify the current pressure. Illustrate with a sketch.

   (C.O.NO.01) [Comprehension]

5. An operator working on a hydraulic lift asks his supervisor to suggest the load value to be fed at the plunger end to lift an automobile. You being his supervisor what's the value you would suggest. Illustrate with a neat sketch (C.O.NO.01) [Comprehension]

   Known: i) Weight of automobile: 40kN
   ii) Diameter of plunger: 4.5 cm
   iii) Diameter of Ram: 40 cm

6. A milk packet from a production line was extracted for sample testing. Milk was subject to various property tests. Each bottle (cylindrical) had a height of 150mm and diameter of 8cm. Each bottle had 400gm of milk. Kindly help the personal to find its density, specific volume, weight density & specific gravity. Illustrate with a sketch.

   (C.O.NO.01) [Comprehension]

Part C [Problem Solving Questions]

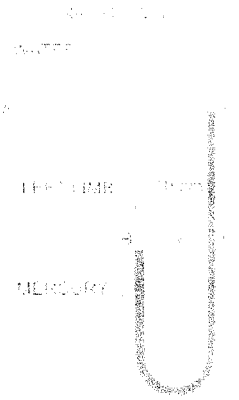
Answer all the Questions. Each Question carries five marks. (2Qx5M=10M)

7. A horizontal plate is pulled through a gap filled with oil. The gap was found to be 2.5cm. Find the force that must be applied to pull the plate horizontally when the plate is placed centrally with a velocity of 3m/s. Oil has a dynamic viscosity of 8.33×10^{-4} Ns/m^2. Area of the plate is 0.5mx0.5m. (C.O.NO.01) [Comprehension]

8. A differential manometer is as shown in the figure. Help the operator determine the absolute pressure within the pipe. (C.O.NO.01) [Comprehension]

   Given: Density of water: 1000 kg/m^3

   Density of Mercury: 13600 kg/m^3



SCHOOL OF ENGINEERING

Semester: 3rd

Course Code: MEC 203

Course Name: FLUID MECHANICS AND MACHINES

Date: 30-09-2019

Time: 1 hrs

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			A			
1(a)	1	Module 1: Introduction to Fluid Mechanics	0.5									0.5
1(b)	1	Module 1: Introduction to Fluid Mechanics	0.5									0.5
1(c)	2	Module 2: Fluid Statics	0.5									0.5
1(d)	2	Module 2: Fluid Statics	0.5									0.5
2	2	Module 2: Fluid Statics			4							4
3	1	Module 1: Introduction to		4								4

		Fluid Mechanics											
4	2	Module 2: Fluid Statics						6				6	
5	2	Module 2: Fluid Statics						6				6	
6	1	Module 1: Introduction to Fluid Mechanics				6						6	
7	1	Module 1: Introduction to Fluid Mechanics									5	5	
8	2	Module 2: Fluid Statics									5	5	
	Total Marks		4	4	4	6		12			10	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. Arun George]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: 3rd

Course Code: MEC203

Course Name: Fluid Mechanics and Machines

Date: 30-09-2019

Time: 1hrs

Max Marks: 40

Weightage: 20%

Part A (3Q x4 M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	i) N/m ii) Specific Volume iii) Fluid Statics iv) Vacuum Pressure	1 1 1 1	5min
2	The pressure at any point in a fluid at rest is obtained by the Hydro static Law which states that the rate of increase of pressure in a vertically downward direction must be equal to the specific weight of the fluid at that point. This is proved as: Consider a small fluid element as shown in Fig. 2.2 Let ΔA = Cross-sectional area of element ΔZ = Height of fluid element p = Pressure on face AB Z = Distance of fluid element from free surface. The forces acting on the fluid element are :	1 1	10min

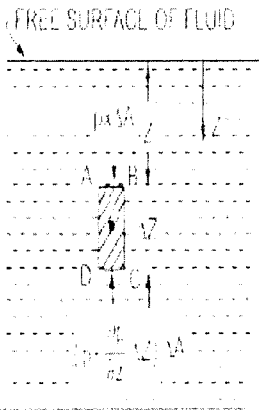


Fig. 2.2 *Forces on a fluid element.*

	1. Pressure force on the face $ABCD$ = Mass intensity p × Area of face $ABCD$ = $p \times \Delta A$	1	
	2. Pressure force on the face $EFGH$ = $p + \frac{\partial p}{\partial Z}\Delta Z \times \Delta A$ (The direction of this force is opposite to the direction of force mentioned in 1)		
	3. Weight of fluid element = Density × g × Volume = $\rho \times g \times \Delta A \times \Delta Z$		
	4. Pressure forces on surfaces $EFGH$ and $ABCD$ are equal and opposite. For equilibrium of the element we have		
	$$p\Delta A - \left(p + \frac{\partial p}{\partial Z}\Delta Z\right)\Delta A + \rho \times g \times \Delta A \times \Delta Z = 0$$		
	or $$p\Delta A - p\Delta A - \frac{\partial p}{\partial Z}\Delta Z\Delta A + \rho \times g \times \Delta A \times \Delta Z = 0$$	1	
	or $$-\frac{\partial p}{\partial Z}\Delta Z\Delta A + \rho \times g \times \Delta A\Delta Z = 0$$		
	or $$\frac{\partial p}{\partial Z}\Delta Z\Delta A = \rho \times g \times \Delta A\Delta Z$$ or $$\frac{\partial p}{\partial Z} = \rho \times g$$ [cancelling $\Delta A\Delta Z$ on both sides]		
	$$\therefore \frac{\partial p}{\partial Z} = \rho \times g = w \qquad \text{i.e., } p \times g = w \qquad (2.4)$$		
	where w = Weight density of fluid		
	Equation (2.4) states that rate of increase of pressure in a vertical direction is equal to weight density of the fluid at that point. This is **Hydrostatic Law**.		
	By integrating the above equation (2.4) for liquids, we get		
	$$dp = \rho g dZ$$		
	or $$p = \rho g Z \qquad (2.5)$$		
	where p is the pressure above atmospheric pressure and Z is the height of the point from free surfaces.		
	From equation (2.5), we have $$Z = \frac{p}{\rho \times g} \qquad (2.6)$$		
	Here Z is called **pressure head.**		
3	Surface tension is defined as the tensile force acting on the surface of a liquid in contact with a gas or on the surface between two immiscible liquids such that the contact surface behaves like a membrane under tension. The magnitude of this force per unit length of the free surface will have the same value as the surface energy per unit area. It is denoted by Greek letter σ (called sigma). In MKS units, it is expressed as kgf/m while in SI units as N/m.	2	**5min**
	The phenomenon of surface tension is explained by Fig. 1.10. Consider three molecules A, B, C of a liquid in a mass of liquid. The molecule A is attracted in all directions equally by the surrounding molecules of the liquid. Thus the resultant force acting on the molecule A is zero. But the molecule B, which is situated near the free surface, is acted upon by upward and downward forces which are unbalanced. Thus a net resultant force on molecule B is acting in the downward direction. The molecule C, situated on the free surface of liquid, does experience a resultant downward force. All the molecules on the free surface experience a downward force. Thus the free surface of the liquid acts like a very thin film under tension of the surface of the liquid act as though it is an elastic membrane under tension.	2	

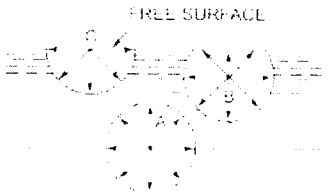


Fig. 1.10 *Surface tension.*

Part B

(3Q x 6M = 18 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	Figure Data Given P_{250} = 24.525 bar P_{600} = 58.86 bar Suggestion: Submarine must operate upto a depth corresponding to 58bar anything above this value would cause hull to crush(Damage to submarine)	1 1 1.5 1.5 1	10mins

5	Figure	2	10mins
	Data Given	1	
	Formulae : $\frac{Fr}{Ar} = \frac{Fp}{Ap}$	1	
		1	
	Steps	1	
	Force at plunger end: 506.25N		
6	Figure	1	5mins
	Data Given	1	
	Formulae		
	Density = 530.78 kg/m^3	1	
	Specific Volume = 0.001884 m^3/kg	1	
	Weight Density = 5206.918 N/m^3	1	
	Specific Gravity = 0.53078	1	

Part C

(2Q x 5M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
7	Figure	1	10
	Data Given	1	
	Formulae	1	
	Steps	1	
	Total Force = 2 x F = 2 x 0.04998 = 0.09996 N	1	
8	Figure	1	5
	Steps		

Solution. Given :

Difference of mercury = 10 cm = 0.1 m

The arrangement is shown in Fig. 2.11 (*a*)

Ist Part

Let p_A = (pressure of water in pipe line (i.e., at point *A*)

The points *B* and *C* lie on the same horizontal line. Hence pressure at *B* should be equal to pressure at *C*. But pressure at *B*

= Pressure at *A* + Pressure due to 10 cm (or 0.1 m) of water

$= p_A + \rho g h$

where ρ = 1000 kg/m^3 and h = 0.1 m

$= p_A + 1000 \times 9.81 \times 0.1$

$= p_A + 981$ N/m^2 ...(*i*)

Pressure at *C* = Pressure at *D* + Pressure due to 10 cm of mercury

$= 0 + \rho_m \times g \times h_m$

where ρ_m for mercury = 13.6 × 1000 kg/m^3

and h_m = 10 cm = 0.1 m

$\therefore$ Pressure at *C* = 0 + 13.6 × 1000 × 9.81 × 0.1

= 13341.6 N ...(*ii*)

But pressure at *B* is equal to pressure at *C*. Hence equating the equations (*i*) and (*ii*), we get

$p_A + 981 = 13341.6$

$\therefore$ $p_A = 13341.6 - 981$

$= 12360.6 \frac{N}{m^2}$ Ans.

Fig. 2.11 (*a*)

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SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20 | **Date**: 18.11.2019

Course Code: MEC 203 | **Time**: 2.30 PM to 3.30 PM

Course Name: FLUID MECHANICS AND MACHINES | **Max Marks**: 40

Program & Sem: B.Tech. (MECH) & III Sem | **Weightage**: 20%

Instructions:

(i) The question paper consists of 3 Parts.

(ii) All Questions are compulsory.

Part A [Memory Recall Questions]

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

1. Name four different types of fluid flows and describe them in brief. (C.O.NO.3)[Comprehension]
2. Write expression for mass flow rate and volume flow rate with correct nomenclature and S.I. units. (C.O.NO.4)[Comprehension]
3. Define velocity potential function and write velocity components in terms of potential function (ϕ) for steady flow. (C.O.NO.3)[Comprehension]

Part B [Thought Provoking Questions]

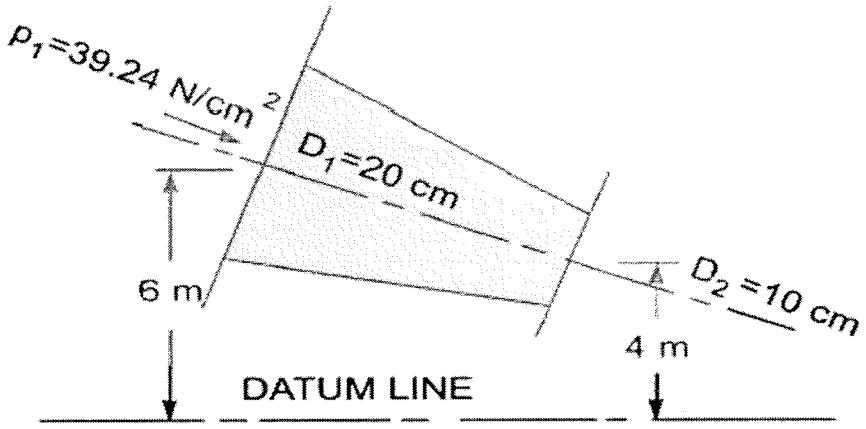
Answer all the Questions. Each question carries six marks. (3Qx6M=18M)

4. The diameters of pipe at inlet and outlet are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at inlet is 5m/s. Also determine the velocity at outlet. (C.O.NO.3)[Application]
5. A flow field is given by $\mathbf{V} = x^2y\,\mathbf{i} + y^2z\,\mathbf{j} - (2xyz+yz^2)\,\mathbf{k}$. Calculate the velocity and acceleration at the point (2, 1, 3). (C.O.NO.3)[Application]
6. Write an expression for discharge through venturimeter and orifice meter with usual notations. (C.O.NO.4)[Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The question carries ten marks. **(1Qx10M=10M)**

7. The water is flowing through a pipe having diameters 20 cm and 10 cm at section 1 and 2 respectively. The rate of flow through a pipe is 35 lts/s. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.29 N/cm^2. Find pressure at section 2. (C.O.NO.4)[Application]



SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: III

Course Code: MEC 203

Course Name: FM & M

Date: 18/11/2019

Time: 2.30 p.m.-3.30 p.m.

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			A			
1	3	3					C					4
2	4	4					C					4
3	3	3					C					4
4	3	3								A		6
5	3	3								A		6
6	4	4					c					6
7	4	4								A		10
	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

Semester: III
Course Code: MEC 203
Course Name: FM & M

Date: 18/11/2019
Time: 2.30 p.m.-3.30 p.m.
Max Marks: 40
Weightage: 20%

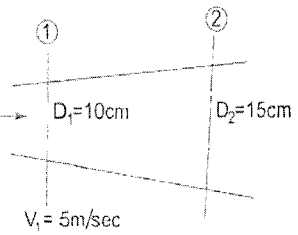
Part A (Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	The fluid flow is classified as : (*i*) Steady and unsteady flows ; (*ii*) Uniform and non-uniform flows ; (*iii*) Laminar and turbulent flows ; (*iv*) Compressible and incompressible flows ; (*v*) Rotational and irrotational flows ; and (*vi*) One, two and three-dimensional flows. **Any four from above classidication.**	**One mark for each correct classification.**	**5 min.**
2.	**Volume flow rate= A*V m^3/s** **Mass flow rate === ζ*A*V kg/s**	**2 marks for each correct expression and units**	**2 min**

3.	**5.8.1 Velocity Potential Function.** It is defined as a scalar function of space and time such that its negative derivative with respect to any direction gives the fluid velocity in that direction. It is defined by ϕ (Phi). Mathematically, the velocity, potential is defined as $\phi = f(x, y, z)$ for steady flow such that $$u = -\frac{\partial \phi}{\partial x}, \quad v = -\frac{\partial \phi}{\partial y}, \quad w = -\frac{\partial \phi}{\partial z} \qquad \ldots(5.9)$$ where u, v and w are the components of velocity in x, y and z directions respectively.	**2 marks each for correct definition and 2 Marks for EXPRESSION**	**7 min.**

Part B

(Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time require for eac Questi
4	**Solution.** Given : At section 1, $D_1 = 10$ cm $= 0.1$ m $A_1 = \frac{\pi}{4}(D_1^2) = \frac{\pi}{4}(.1)^2 = 0.007854$ m^2 $V_1 = 5$ m/s. At section 2, $D_2 = 15$ cm $= 0.15$ m $A_2 = \frac{\pi}{4}(.15)^2 = 0.01767$ m^2  Fig. 5.2 (*i*) Discharge through pipe is given by equation (5.1) or $Q = A_1 \times V_1$ $= 0.007854 \times 5 =$ **0.03927 m^3/s. Ans.** Using equation (5.3), we have $A_1V_1 = A_2V_2$ (*ii*) $\therefore$ $V_2 = \frac{A_1V_1}{A_2} = \frac{0.007854}{0.01767} \times 5.0 =$ **2.22 m/s. Ans.**	6 marks for correct solution	10

2	Substituting these values in acceleration components, we get acceleration at (2, 1, 3) $a_x = x^2y\,(2xy) + y^2z\,(x)^2 - (2xyz + yz^2)\,(0)$ $= 2x^3y^2 + x^2y^2z$ $= 2\,(2)^3 1^2 + 2^2 \times 1^2 \times 3 = 2 \times 8 + 12$ $= 16 + 12 = 28$ units $a_y = x^2y\,(0) + y^2z\,(2yz) - (2xyz + yz^2)\,(y^2)$ $= 2y^3z^2 - 2xy^3z - y^3z^2$ $= 2 \times 1^3 \times 3^2 - 2 \times 2 \times 1^3 \times 3 - 1^3 \times 3^2 = 18 - 12 - 9 = -3$ units $a_z = x^2y\,(-2yz) + y^2z\,(-2xz - z^2) - (2xyz + yz^2)\,(-2xy - 2yz)$ $= -2x^2y^2z - 2xy^2z^2 - y^2z^3 + [4x^2y^2z + 2xy^2z^2 + 4xy^2z^2 + 2y^2z^3]$ $= -2 \times 2^2 \times 1^2 \times 3 - 2 \times 2 \times 1^2 \times 3^2 - 1^2 \times 3^3$ $+ [4 \times 2^2 \times 1^2 \times 3 + 2 \times 2 \times 1^2 \times 3^2 + 4 \times 2 \times 1^2 \times 3^2 + 2 \times 1^2 \times 3^3]$ $= -24 - 36 - 27 + [48 + 36 + 72 + 54]$ $= -24 - 36 - 27 + 48 + 36 + 72 + 54 = 123$ ∴ Acceleration $= a_x i + a_y j + a_z k = \mathbf{28i - 3j + 123k}$. Ans.	4 marks for correct solution and 2 marks correct answer	10
	Substituting the values $x = 2$, $y = 1$ and $z = 3$ in velocity field, we get $V = x^2yi + y^2zj - (2xyz + yz^2)\,k$ $= 2^2 \times 1i + 1^2 \times 3j - (2 \times 2 \times 1 \times 3 + 1 \times 3^2)\,k$ $= \mathbf{4i + 3j - 21k}$. Ans. id Resultant velocity $= \sqrt{4^2 + 3^2 + (-21)^2} = \sqrt{16 + 9 + 441} = \sqrt{466} = \mathbf{21.587}$ units. Ans. **cceleration at (2, 1, 3)** The acceleration components a_x, a_y and a_z for steady flow are $a_x = u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z}$ $a_y = u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z}$ $a_z = u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z}$ $u = x^2y, \frac{\partial u}{\partial x} = 2xy, \frac{\partial u}{\partial y} = x^2$ and $\frac{\partial u}{\partial z} = 0$ $v = y^2z, \frac{\partial v}{\partial x} = 0, \frac{\partial v}{\partial y} = 2yz, \frac{\partial v}{\partial z} = y^2$		
3	VENTURIMETER $Q_{act} = C_d \times \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$ ORIFICE METER	3 marks for correct Vnturimeter and orifice meter and 2 marks correct answer	10

$$Q = a_0 \times C_d \frac{\sqrt{1-\left(\frac{a_0}{a_1}\right)^2 C_c^2}}{\sqrt{1-\left(\frac{a_0}{a_1}\right)^2}} \times \frac{\sqrt{2gh}}{\sqrt{1-\left(\frac{a_0}{a_1}\right)^2 C_c^2}}$$

$$= \frac{C_d a_0 \sqrt{2gh}}{\sqrt{1-\left(\frac{a_0}{a_1}\right)^2}} = \frac{C_d a_0 a_1 \sqrt{2gh}}{\sqrt{a_1^2 - a_0^2}}.$$

Part C (Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1		10 marks for correct solution	20 min

Fig. 6

At section 1, $D_1 = 20 \text{ cm} = 0.2 \text{ m}$

$$A_1 = \frac{\pi}{4}(.2)^2 = .0314 \text{ m}^2$$

$$p_1 = 39.24 \text{ N/cm}^2$$
$$= 39.24 \times 10^4 \text{ N/m}^2$$

$$z_1 = 6.0 \text{ m}$$

At section 2, $D_2 = 0.10 \text{ m}$

$$A_2 = \frac{\pi}{4}(0.1)^2 = .00785 \text{ m}^2$$

$$z_2 = 4 \text{ m}$$

$$p_2 = ?$$

Rate of flow, $$Q = 35 \text{ lit/s} = \frac{35}{1000} = .035 \text{ m}^3/\text{s}$$

Now $$Q = A_1V_1 = A_2V_2$$

$\therefore$ $$V_1 = \frac{Q}{A_1} = \frac{.035}{.0314} = 1.114 \text{ m/s}$$

and $$V_2 = \frac{Q}{A_2} = \frac{.035}{.00785} = 4.456 \text{ m/s}$$

Applying Bernoulli's equation at sections 1 and 2, we get

Applying Bernoulli's equation at sections 1 and 2, we get

$$\frac{p_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\rho g} + \frac{V_2^2}{2g} + z_2$$

or $$\frac{39.24 \times 10^4}{1000 \times 9.81} + \frac{(1.114)^2}{2 \times 9.81} + 6.0 = \frac{p_2}{1000 \times 9.81} + \frac{(4.456)^2}{2 \times 9.81} + 4.0$$

or $$40 + 0.063 + 6.0 = \frac{p_2}{9810} + 1.012 + 4.0$$

or $$46.063 = \frac{p_2}{9810} + 5.012$$

$\therefore$ $$\frac{p_2}{9810} = 46.063 - 5.012 = 41.051$$

$\therefore$ $$p_2 = 41.051 \times 9810 \text{ N/m}^2$$

$$= \frac{41.051 \times 9810}{10^4} \text{ N/cm}^2 = \mathbf{40.27 \text{ N/cm}^2}. \text{ Ans.}$$

Equating the two pressure, we get

$$13.6 \times 1000 \times 9.81h + 7500 \times 9.81 + 9.81 \times 10^4 = 900 \times 9.81 \times (h + 2) + 1.8 \times 10^4 \times 9.81$$

Dividing by 1000×9.81, we get

$$13.6h + 7.5 + 10 = (h + 2.0) \times .9 + 18$$

$$13.6h + 17.5 = 0.9h + 1.8 + 18 = 0.9h + 19.8$$

$$(13.6 - 0.9)h = 19.8 - 17.5 \text{ or } 12.7h = 2.3$$

$\therefore$ $$h = \frac{2.3}{12.7} = 0.181 \text{ m} = \mathbf{18.1 \text{ cm}}. \text{ Ans.}$$

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
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SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20 | **Date**: 26 December 2019

Course Code: MEC 203 | **Time**: 1:00 PM TO 4:00 PM

Course Name: FLUID MECHANICS AND MACHINES | **Max Marks**: 80

Program & Sem: B.Tech (MEC) & III | **Weightage**: 40%

Instructions:

(i) Read the all questions carefully and answer accordingly.
(ii) Question paper consists of three parts
(iii) Scientific and non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 2 marks. **(10Qx2M=20M)**

1.

(a). Write a brief note on Macroscopic and Microscopic approach of fluid. (C.O.No.1) [comprehension]

(b). What do you mean by momentum in fluids? (C.O.No.1) [comprehension]

(c). Define Pascal's law? Write its applications. (C.O.No.2) [Application]

(d). Write the relationship between different types of pressure. (C.O.No.2) [Application]

(e). Define continuum in fluid mechanics. (C.O.No.3) [Application]

(f). Write the relation between stream function and velocity potential function. (C.O.No.3) [Application]

(g). Write the continuity equation in 3-d with respect to steady state. (C.O.No.4) [Application]

(h). Define local and convective acceleration. (C.O.No.4) [Application]

(j). Elucidate the difference between measurement of discharge in venturimeter and orifice meter. (C.O.No.5) [Application]

(j). What are causes of head loses in pipe flow. (C.O.No.5) [Application]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks. (4Qx10M=40M)

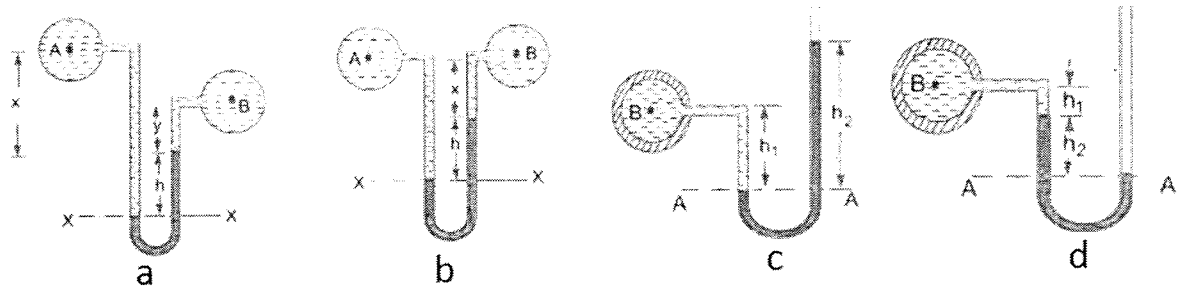
2. (a) Define Capillarity with a neat sketch and write the equation for capillary rise and fall. [4M]

   (b) Derive the compressibility and Bulk modulus equation with a neat sketch. [6M]

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

3. Find the pressure at point B in all cases, assuming mercury in the manometer.

Given: x=8cm, y=3cm, h=4cm, h_1=5cm, h_2=6cm, ρ_A= 900kg/m^3, ρ_B = 1300kg/m^3, and P_A=14kgf/cm^2. (C.O.No.2) [Application]



4. Derive the Pascal's law with suitable assumptions. (C.O.No 2.) [Application]

5. The velocity vector in a fluid flow is given by $\mathbf{V=9x^4i - 5x^3yj + 3t^2k}$. Find the velocity and acceleration of the fluid particle at (3,1,4) at time t=2. (C.O.No.3) [Application]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 5 marks. (4Qx5M=20M)

6. A horizontal venturimeter with inlet and throat diameter 30cm and 15cm respectively is used to measure the flow of water. The reading of differential manometer shows 20cm of Hg. Determine the rate of flow taking Cd=0.87 (C.O.No 3 and 4) [Application]

7. An orifice meter with orifice diameter 15cm is inserted in a pipe of 30cm diameter. The pressure difference measured is 40cm of Hg. Find the discharge of oil of sp. Gravity 0.9 when Cd is 0.64. (C.O.No 3 and 4) [Application]

8. Find the head loss due to friction in a pipe of diameter 300 mm and length 20cm, through which water is flowing at a velocity of 3m/s using Darcy and Cheyz's formula. Take C =40 and v=0.01stoke. (C.O.No 5) [Application]

9. At a sudden enlargement of water pipe from 300mm to 600mm diameter. The hydraulic gradient rises by 10mm. Estimate the rate of flow. (C.O.No 5) [Application]

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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	
PART A Q. NO1	CO 01 CO 02 CO 03 CO 04 CO 05	All the 5 modules	20			20
PART B Q.NO .2	CO 01	MODULE 01 PROPERTIES OF FLUIDS	-	10	-	10
PART B Q.NO .3	CO 02	MODULE 02 FLUID STATICS	-	10	-	10
PART B Q.NO .4	CO 02	MODULE 03 FLUID STATICS	-	10	-	10
PART B Q.NO .5	CO 03	MODULE 04 FLUID KINEMATICS	-	10	-	10

PART B Q.NO.6	CO 03 and 04	MODULE 03 FLUID KINEMATICS	-		-5	-5
PART B Q.NO.7	CO 03 and 04	MODULE 04 FLUID KINEMATICS	-		-5	-5
PART B Q.NO.8	CO 05	MODULE 05 LOSSES IN PIPE FLOW	-		-5	-5
PART B Q.NO.9	CO 05	MODULE 05 LOSSES IN PIPE FLOW	-		-5	-5
	Total Marks		20	40	20	~~100~~ 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.

Faculty Signature: Prasad.P 12/12/19

Reviewer Commend:

SCHOOL OF ENGINEERING

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SOLUTION

Semester : Odd Semester: 2019 - 20
Course Code: MEC 203
Course Name: Fluid mechanics and machines
Program & Sem: B. Tech 3rd sem

Date: 26 Dec 2019
Time: 13 hrs to 16hrs
Max Marks: 80
Weightage: 40 %

Part A (10Q x 2M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
a	The fluid motion is described by two methods. They are – (*i*) Lagrangian Method, and (*ii*) Eulerian Method. In the Lagrangian method, a **single fluid particle** is followed during its motion and its velocity, acceleration, density, etc., are described. In case of Eulerian method, the velocity, acceleration, pressure, density etc., are described **at a point** in flow field. The Eulerian method is commonly used in fluid mechanics.	2	3minutes each
b	**Momentum.** In simple terms, momentum is considered to be a quantity of motion. This quantity is measurable because if an object is moving and has mass, then it has momentum. Something that has a large mass has a large momentum or something that is moving very fast has a large momentum.	2	
C	Pressure Applied pressure in contained liquid is equal in all directions	2	
D	Mathematically : (*i*) Absolute pressure = Atmospheric pressure + Gauge pressure $P_{ab} = P_{atm} + P_{gauge}$ (*ii*) Vacuum pressure = Atmospheric pressure – Absolute pressure.	2	
E	**A continuum is an area that can keep being divided and divided infinitely. It is a simplification that makes it possible to investigate the movement of matter on scales larger than the distances between particles.**	2	

F	$\frac{\partial \psi}{\partial x} = -\frac{\partial \psi}{\partial y}$ $\frac{\partial \psi}{\partial y} = -\frac{\partial \psi}{\partial x}$	2
G	$\frac{\partial}{\partial x}(\rho u) + \frac{\partial}{\partial y}(\rho v) + \frac{\partial}{\partial z}(\rho w) = 0$	2
H	**Local Acceleration:** It is defined as the rate of increase of velocity with respect to time at a given point in a flow field $\frac{\partial u}{\partial t}, \frac{\partial v}{\partial t}, \frac{\partial w}{\partial t}$ are called as local acceleration. **Convective Acceleration:** It is defined as the rate of change of velocity due to change of position of fluid particles in a fluid flow.	2
I	Discharge in venture and orifice difference	2
J	Major and minor losses explaination	2

Part B (4Q x 10M = 40 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
2	1.6.4 **Capillarity.** Capillarity is defined as a phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid. The rise of liquid surface is known as capillary rise while the fall of the liquid surface is known as capillary depression. It is expressed in terms of cm or mm of liquid. Its value depends upon the specific weight of the liquid, diameter of the tube and surface tension of the liquid.	10	20min each
3	20 pa, 15pa, 16 pa, and 40 pa	10	
4	Pascals law derivation	10	
5	V=20units A=40units	10	

Part C (4Q x 5M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	Q=34.33m^3/s	5	15min each
7	Q=134.45m^3/s	5	

8	f= 0.0009, f=3.04	5	
9	$Q=35m^3/s$	5	