NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

OU CODE: PC403CE SUBJECT: FLUID MECHANICS PROGRAMME: UG

BRANCH: CIVIL

YEAR: II nd DOCUMENT No: NSAKCET/CE/01

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DATE:

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SIGN:
DESIGN:
DATE:

APPROVED BY (HOD):

1) NAME SYED FARRUKH ANWAR (ASSOC. PROF)
2) SIGN
3) DATE

1.1 Vision of Institute

To be a leading institute of world class quality technical education with strong ethical values, preparing students for leadership in their fields for the dynamic and global careers, developing breakthrough environment for professional education and research.

Mission of Institute

M1: To enable the students to develop into outstanding professionals with high ethical standards capable of creating developing and managing local and global engineering enterprises.

M2: To ensure quality assurance by fulfilling expectations of the society and industry with state of the art technology.

M3: To attract and retain knowledgeable, creative, motivated, and highly skilled individuals whose leadership and contributions uphold the college tenets of education through student–centric learning methodologies.

M4: To provide opportunities for deserving students of all communities.

M5: To promote all round personality development of the students through interactions with alumni and academia.

1.1 Availability of statements of the Department

Vision of the Civil Engineering Department

To develop technically strong civil engineers having ethics and human values by providing quality education, enabling them to be competent in facing any challenges that may arise during their service in particular to the society and in general to the nation.

Mission of the Civil Engineering Department

M1: To provide conceptually strong technical knowledge relating to all fields of civil engineering braced with professional ethics.

M2: To adopt the latest developments in civil engineering to provide conducive environment for better teaching learning process.

M3: To provide adequate soft skills and make the students prepare for industry ready to grab the opportunities in this field.

M4: To encourage students to participate in various technical events at research institutes, institutes of higher learning so that they develop the capabilities to serve the nation effectively

1.2 PEO's of Civil Engineering Department

PEO1: Graduates will be capable of handling the Civil Engineering projects independently in their future assignments

PEO2: Graduates will be able to apply technical skills in their chosen fields in an ethical manner.

PEO3: Graduates will be able to implement their core concept to obtain solution for real time problems.

FLUID MECHANICS

PC403 CE

Instruction: 3 periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Objectives:

The objectives of this course is to impart knowledge of:

- Concepts and principles of fluid mechanics–statics, kinematics and dynamics
- Properties of fluid pressure, pressure measurements and problems in fluid statics
- Fluid kinematics, including types of flows, fluid path lines and continuity equations

Outcomes:

After completing this course, the student will be able to:

- Classify the fluids based on their properties
- Solve problems on pressure calculations, hydrostatic forces on bodies and buoyancy
- Relate types of flows with the corresponding mathematical equations
- Apply Euler's, Bernoulli's and Momentum equation to solve fluid dynamic problems
- Apply principles of fluid dynamics to make flow measurement calculations

UNIT – I

Fluid Properties**:** Basic Concepts and Definitions: Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics: Fluid Pressure: Pressure at a point, Pascal's law, Piezometer, Manometer, Differential Manometer, Micromanometers. Pressure gauges, transducers.

UNIT – II

Fluid Kinematics: Classification of fluid flow-steady and unsteady flow, uniform and non-uniform flow, laminar and turbulent flow, rotational and irrotational flow, compressible and incompressible flow, ideal and real fluid flow,one,two-andthree-dimensionalflows.Streamline,pathline,streakline and stream tube.

Law of mass conservation: Continuity equation from control volume and system analysis. Definition and properties of Stream function, velocity potential function and uses of flownets.

UNIT – III

Fluid Dynamics: Convective and local acceleration. Surface and body forces. Euler's equations of motion.

Law of energy Conservation: Bernoulli's equation from Euler's equation. Application of Bernoulli's equation.

UNIT – III

Shear Stress in Beams: Derivation of equation of shear stresses, distribution across rectangular, circular, T and I section.

***Direct and Bending Stresses*:** Direct loading, Eccentric loading, limit of eccentricity, Core of sections, rectangular and circular, solid and hollow sections

UNIT – IV

***Compound Stresses*:** Stresses on oblique planes, principal stresses and planes. Mohr's circle of stress.

***Application to pressure vessels*:** Thin cylinders subjected to internal fluid pressure, volumetric change. Thick Cylinders: Lame's equations, stresses under internal and external fluid pressures, Compound cylinders, Shrink fit pressure.

UNIT – V

***Torsion*:** Theory of pure torsion in solid and hollow circular shafts, shear stress, angle of twist, strength and stiffness of shafts, Transmission of Power. Combined torsion and bending for determination of principal stresses and maximum shear stress. Equivalent bending moment and equivalent twisting moment.

***Springs*:** Close and open coiled helical springs under axial load and axial twist, Carriage springs.

Suggested Reading:

1. D.S. Prakash Rao, *Strength of Materials- A Practical Approach*, Universities Press, Hyderabad, 1999.
2. R. K. Bansal, *A Textbook of Strength of Materials (Mechanics of Solids – S.I. Units)*, Laxmi Publications Pvt. Ltd., 6th Edition, 2015
3. R.K. Rajput, *A Textbook of Strength of Materials*, S. Chand Publications, New Delhi, 2007.
4. R. Subramanian, *Strength of Materials*, Oxford University Press, New Delhi, 2016.
5. S. S. Bhavikatti, Strength of materials, Vikas Publishing House, Delhi, 2002.
6. Ferdinand P Beer, Johnston and De Wolf., *Mechanics of Materials*, Tata McGraw-Hill, Delhi, 2004.

Department of civil Engineering

Course Outcomes & CO-PO

Mapping

Course Name: Fluid Mechanics AY: 2020-21

Course Code: PC403CE Semester: III

Name of the faculty: Mohd Azheruddin

Course Outcomes

After completing this course the student will be able to:

CO No.	Course Outcome	Taxonomy Level
223.1	Understand the physical properties of fluid, concept of viscosity for kinematics and dynamics flow with effect of temperature, vapor pressure, surface tension, capillary rise and fall derivation of Pascal's law, Manometers (U-tube, differential, single column),	IV-Understanding
223.2	Remembering the classification of fluid flow, stream-streak line concept properties of it, continuity equation for 3-D flow, uses of flow nets.	I-Remembering
223.3	Remember the concept of Convective and local accelerations, applications of Bernoulli's equation ,concept of vortex flow.	III-Applications
223.4	Remember in Venturi meter, orifice meter and pitot tube, hot wire anemometer, discharge through notches and wiers, spillways, discharge through mouthpiece.	I-Remembering

Fluid Mechanics (PC403CE) A.Y:2020-21CO-PO/PSO mapping

Justification

CO1: Understand the physical properties of fluid, concept of viscosity for kinematics and dynamics flow with effect of temperature, vapor pressure, surface tension, capillary rise and fall derivation of Pascal's law, Manometers (U-tube, differential, single column),

	Mapping Level	Justification
P01	2	To derive an equation, it requires the basic knowledge and to solve the problems requires the same.
P02	1	Least relates with designing part of the fluid problems.
P03	1	Least relates with designing part of the fluid problems
P04	3	The basic knowledge of the fluid behavior will help to overcome the complex problems related with it.
P012	2	Principles of fluid flow is helping very much to understand the latest topics in Geotechnical, Ground water, waste water etc.

CO2: Remembering the classification of fluid flow, stream- streak line concept properties of it, continuity equation for 3-D flow, uses of flow nets.

	Mapping Level	Justification
PO1	2	Gathering the information related to fluid flowing in three different directions will help in measuring the forces with it.
PO2	2	Moderately deals with the calculations which will leads to design of the various complex problems in a very simple way.
PO3	1	Least relates with the different engineering fields in Civil Engineering.
PO4	2	Fairly relates the solutions to the complex problems with different dimensional flow.
PO12	2	Principles of fluid flow is helping very much to understand the latest topics in Geotechnical, Ground water, waste water etc.

CO3: Remember the concept of Convective and local accelerations, applications of Bernoulli's equation ,concept of vortex flow..

	Mapping Level	Justificatio n
PO1	3	Strongly co-relates with the mathematics involvement to solve problems for fluids.
PO3	1	Least related with designing problems.
PO4	2	The equations derived by Bernoulli's provides the base for the solutions for complex problems.
PO12	2	Derivations will always open the gates for future learning with different parameters with various conditions.
PSO1	1	Least relates with design process, executing the problems having complexity in solutions with very much ease.

CO4: Remember in Venturi meter, orifice meter and pitot tube, hot wire anemometer, discharge through notches and wiers, spillways, discharge through mouthpiece.

	Mapping Level	Justification
PO1	3	Strongly relates with applying the basic knowledge to carry out an experiment on different types of flow for knowing the Reynold's number, knowledge is the only way to visualize the Magnus effect and understanding the concept of important topics such as Boundary layer.
PO2	2	Moderately relates with the analysis problems for Venturi meter, orifice meter and pitot tube designing the pipe flow through Notches and Wiers of different shapes
PO3	2	Except solving the problems related with different types of flow and conducting an experiment on the behavior of fluids, it is least related with the public safety and environmental concerns.
PSO 1	2	Co-efficient will help in designing the problems for different types of flows.

Faculty sign

HoD

CO-PO Mapping before gaps:

PO / CO	P 01	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	3	-	-	-	-	-	-	-	2	-		-
C02	2	2	1	2	-	-	-	-	-	-	-	2	-	-	-
C03	3	1	2	2	-	-	-	-	-	-	-	2	1	2	-
C04	3	2	2	-	-	-	-	-	-	-	-	1	-	2	-
AVG	2.5	1.75	1.25	1.75	-	-	-	-	-	-	-	1.75	-	1	-

Signature of Faculty

Head of Department

PREREQUISITES: Things to be known prior to FLUID MECHANICS

Level	Credits	Periods/Week	**Pre requisites**
UG	3	3	Know where Fluid Mechanics is applied. This intrigues and drives you to know how is it applied.
			As FM includes a lot of physics, focus more on the equations and laws that govern the fluid flow. make a list of them. Understand the terms of the equations and be good at making proper rearrangements for the subjective of the formula.

1. Know where Fluid Mechanics is applied. This intrigues and drives you to know how is it applied.
2. Statics have a lot of formulas. Kinematics have many equations. Dynamics have complicated derivations. So, instead of worrying about memorizing it, be focused and try to know the point of its formulation. Keep yourself focused on Statics and Kinematics. Give a read and understand WHY does it happen?
3. Focus more on Boundary layer theory and Equations of continuity in different forms, Laminar - Turbulent flows and the equations associated, Velocity profiles on flat plates and conduit flows.
4. Solve a few simple numerical to feel confident enough.

NSAKCET, HYDERABAD

DEPARTMENT OF CIVIL ENGINEERING,

B.E-II year Name of Faculty: - MOHD AZHERUDDIN

SUB: - FLUID MECHANICS

Lesson schedule

SL.NO	TOPICS TO BE COVERED	NO. OF PERIODS	DATE
	UNIT-I		
1	Dimensions and units, physical properties of fluid.	2	15-03-2021
2	Newton's law of viscosity. problems on Newton's law of viscosity,	2	16-03-2021
3	Dynamic viscosity, Kinematic viscosity, velocity gradient, numerical.	2	22-03-2021
4	specific gravity, surface tension theory, Numerical	2	23-03-2021
5	Vapor pressure, Pascal's law	2	30-03-2021
6	Problems on Pascal's law, atmospheric gauge, vacuum pressure, pressure measurements.	2	05-04-2021
7	Problems on manometers, concept of manometers	2	06-04-2021
8	Differential u-tube manometer,	2	12-04-2021
9	Problems of differential manometer, inverted u-tube manometer.	2	13-04-2021
10	Problems on inverted u-tube manometer,	2	19-04-2021
11	Hydrostatics forces on submerged plane, horizontal	2	20-04-2021

12	Different types of numerical on it.	2	26-04-2021
13	vertical, inclined centre of pressure derivation and problems	2	27-04-2021
14	Pressure on curved surfaces,	2	03-05-2021
15	Numerical.	2	04-05-2021
	UNIT-II		
16	Introduction to buoyancy and floatation	2	10-05-2021
17	stability of bodies with different forces.	2	11-05-2021
18	meta centre liquids in relation equilibrium.	2	17-05-2021
19	Basic concept of fluid kinematics in brief.	2	18-05-2021
20	Numerical on fluid kinematic	2	24-05-2021
21	Solving previous year exam papers.	2	25-05-2021
22	Properties of stream function.	2	31-05-2021
23	stream line, path line, steam tube, numerical on properties of stream function	2	01-06-2021
24	Classification of flows, steady, unsteady, uniform, non-uniform	2	07-06-2021
25	turbulent, rotational and irrotational flow	2	08-06-2021
26	Equation of continuity for one two- and three-dimensional flows	2	14-06-2021
27	Problems on continuity equation	2	15-06-2021
28	Previous year question paper solution.	2	05-07-2021
29	Stream velocity potential functions	2	06-07-2021
30	Concept of circulation in fluid	2	12-07-2021

	mechanics.		
31	velocity flow net analysis	2	13-07-2021
	UNIT-III		
32	Fluid dynamics , convective and local acceleration	2	19-07-2021
	surface and body forces, Numerical on the body forces		20-07-2021
33	Euler's and Bernoulli's equation for flow along a stream line for 3-D flow	2	26-07-2021
34	Applications of Bernoulli's equation, Numerical on Bernoulli's equation. Vortex flow.	2	27-07-2021
	UNIT-IV		
35	Pitot tube, venturi meter, orifice meter, derivations and problems on the same	2	02-08-2021
36	Notches and weir derivation problems	2	03-08-2021
37	Mouth piece concept cylindrical and Borda's mouthpiece.	2	09-08-2021
	UNIT-V		
38	Compressibility of liquids and gases, energy equation for		10-08-2021
39	isothermal and adiabatic conditions,		16-08-2021
40	velocity of pressure wave, Mach number	2	17-08-2021
41	stagnation pressure, density and temperature.		19-08-2021

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING & TECHNOLOGY								
NEW MALAKPET, HYDERABAD - 500024.								
TIME TABLE FOR B.E II YEAR II SEMESTER 2020 - 2021 (ONLINE/OFFLINE MODE)								
DEPARTMENT OF CIVIL ENGINEERING								wef:31-8-2020
Branch	Civil II-B							
Days	9:30 TO 10:20	10:20 TO 11:10	11:10 TO 12:00	12:00 TO 12:50	12:50 TO 1:30	1:30 TO 2:20	2:20 TO 3:10	3:10 TO 4:00
MON	EOME		FM		L B	IC	MT&E	
TUE	MT&E		ETCE		U R	IC	FM	
WED	ETCE		MOM		N E	IC	M-III	
THUR	EOME		FA		C A	IC	M-III	
FRI	MOM		FA		H K	TUTORIALS		

THEORY:

ETCE : MS. SABIHA
FM : MR AZHER
M-III : IMRANA
MOM : MR IMTIYAZ
EOME : MR SHARJEEL
MT&E : MR HUZAIFA
FA : MS AZEEZA SHAHEEN
IC : MR HASEEB

HOD **PRINCIPAL**

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING & TECHNOLOGY								
NEW MALAKPET, HYDERABAD - 500024.								
TIME TABLE FOR B.E II YEAR II SEMESTER 2020 - 2021 (ONLINE/OFFLINE MODE)								
DEPARTMENT OF CIVIL ENGINEERING								wef:31-8-2020
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MON			FM		L B	IC		
TUE					U R	IC	FM	
WED					N E	IC		
THUR					C A	IC		
FRI					H K	TUTORIALS		

THEORY:

ETCE : MS. SABIHA
FM : MR AZHER
M-III : IMRANA
MOM : MR IMTIYAZ
EOME : MR SHARJEEL
MT&E : MR HUZAIFA
FA : MS AZEEZA SHAHEEN
IC : MR HASEEB

HOD **PRINCIPAL**

For reference:

1) A textbook of Fluid Mechanics and Hydraulic Machines by R.K Bansal.
2) A textbook of Fluid Mechanics by R.K Rajput
3) Google for some topics.
4) B.N Moodi in Hydraulics Machines.

Introduction :-

Fluid :- Any substance which can flow is called fluid.

Substance :- Any thing which is having finite mass, occupies some space & is tangible.

Flow :- Relative change of position of partial w.r.t time.

Mechanics :- It is the study of force & its effects.

Fluid mechanics can be defined as the study of effect of force on a fluid.

Fluid at rest we say its a (static fluid)

Fluid in motion we say fluid dynamics.

Fluids
All form of a matter.
(liquid & gases)

Liquids
Its a phase of matter prevailing to temperature & pressure.
(Only liquid)

~~87, 86, 88~~, 89,

Kinematic viscosity :- It is a measure of a fluid's internal resistance to flow under gravitational forces.

It is determined by measuring the time in seconds, required for a fixed volume of fluid to flow a known distance by gravity through a ~~f~~ capillary. within a calibrated viscometer at a closely controlled temperature.

It is expressed as the ratio of fluid dynamic viscosity to its density. (stokes)

Dynamic Viscosity :- (μ) It is expressed as the ratio of shear stress to shear strain. (poise).

It is the measurement of the fluid's internal resistance to flow.

Effects of temperature on viscosity :-

The viscosity of liquids decreases rapidly with an increase in temperature, & the viscosity of gases increases with an increase in temperature.

Thus upon heating, liquids flow more easily. whereas gases flow more sluggishly.

Difference b/w a fluid & solid

Fluids	Solids
Fluids have no shape	Solids have a definite shape.
Fluids cannot sustain a shear force, ie fluid is always in motion.	Solids can sustain a shear force, ie they remain static.
Stress is a function of the rate of strain, thus a fluid has a dynamic state.	Stress is a function of strain, thus a solid maintains a static or quasi-static state.
The static properties of a fluid cannot be extended to dynamic properties.	The static properties of a solid can be extended to dynamic properties.

4) The boiling point of a liquid varies according to the applied pressure, the normal boiling point is the temperature at which the vapour pressure is equal to the standard sea-level atmospheric pressure.

At sea level water boils at 100°c.

[illegible]

of fluid occupied by a unit mass or volume of fluid per unit mass of a fluid is called Specific Volume

$$S.V = \frac{\text{Volume of fluid}}{\text{Mass of fluid}}$$

Thus specific volume is the reciprocal of mass density

$$= \frac{1}{\frac{\text{mass of fluid}}{\text{Volume of fluid}}} = \frac{1}{\rho}$$

It is expressed as m^3/Kg.

<u>Specific gravity</u>: It is defined as the ratio of the weight density or (density) of a ~~given standard~~ fluid to the weight density or (density) of a standard fluid. for Liquids, The standard fluid is taken as water and for gases the standard fluid is taken as air.

It is also called as relative density.

It is denoted by symbol 'S'.

$$S \text{ for Liquids} = \frac{\text{weight density (density) of Liquid}}{\text{weight density (density) of water}}$$

$$S \text{ for gases} = \frac{\text{weight density (density) of gas}}{\text{weight density (density) of air}}$$

Thus wt density of Liquid $= S \times$ wt density of water

$= S \times 1000 \times 9.81 \; N/m^3$

density of Liquid $= S \times$ Density of water

$= S \times 1000 \; Kg/m^3$

1.2 Physical prop of fluids

(169)

Density

(i) Mass density: (ρ)

It is also known as density or specific mass. It is denoted by rho (ρ) kg/m³

The density of a Liquid may be defined as the ratio of mass per unit volume at a standard pressure & temp

$$\rho = \frac{\text{Mass of fluid}}{\text{Volume of fluid}} \qquad \boxed{\rho = \frac{m}{V}} \quad kg/m^3$$

The density of water is $1\ gm/cm^3$ or $1000\ kg/m^3$.

1.2.2 Specific weight or weight density: of a fluid is the ratio b/w the wt of fluid to its volume. Thus weight per unit volume of a fluid is called weight density & is denoted by the symbol ω.

$$\omega = \frac{\text{Wt of fluid}}{\text{Volume of fluid}} = \frac{\text{Mass of fluid} \times \text{Accelation due to gravity}}{\text{Volume of fluid}}$$

$$= \frac{\text{Mass of fluid} \times g}{\text{Volume of fluid}}$$

$$= \rho \times g$$

$$\boxed{\omega = \rho g}$$

The value of specific wt or weight density (ω) for water is 9.81×1000 (k) N/m^3.

dy

$$\tau = \mu \frac{du}{dy}$$

where μ is constant of proportionality & is known as the co-eff of dynamic viscosity.

$\frac{du}{dy}$ represents the rate of shear strain or rate of shear deformation or velocity gradient.

we have $\mu = \frac{\tau}{\left[\frac{du}{dy}\right]}$ units = $\frac{N-s}{m^2}$ (S.I) = Pa.s ($\frac{N}{m^2} = 1 Pa$)

Note: 1 poise = $\frac{1}{10}$ N.s/m^2

Thus viscosity is also defined as the shear stress required to produce unit rate of shear strain. 1 Poise = $\frac{1}{10}$ Pa.s

Kinematic viscosity:- It is defined as the ratio b/w the dynamic viscosity & density of fluid.

It is denoted by the Greek symbol (ν) called 'nu'

units: Stoke = $10^{-4} \frac{m^2}{sec}$

1 Stoke = 10^{-4} m^2/sec

$$\nu = \frac{\text{Viscosity}}{\text{Density}} = \frac{\mu}{\rho}$$

m^2/sec or stoke (c.g.s)

unit = m^2/sec (S.I)

Newtons Law of Viscosity:- It states that the shear stress (τ) on a fluid element layer directly proportional to the rate of shear strain. The constant of proportionality is called the co-eff of viscosity.

Mathematically It is expressed as given by Eqn

$$\boxed{\tau = \mu . \frac{du}{dy}}$$

τ = shear stress
μ = co-eff of viscosity
$\frac{du}{dy}$ = velocity gradient

~~Fluids~~ ~~which~~ fluids which obey the above relation are known as Newtonian fluids.

The " " do not obey " "

" " Non - Newtonian fluid.

Prob: Calculate the [illegible] of one litre of a Liquid which weights 7N.

Sol: Given

Volume $= 1$ litre $= \frac{1}{1000} m^3$ $\left[1 \text{ litre} = 1000 \text{ cm}^3 \text{ or } \frac{1}{1000} m^3 \right]$

Weight $= 7N$

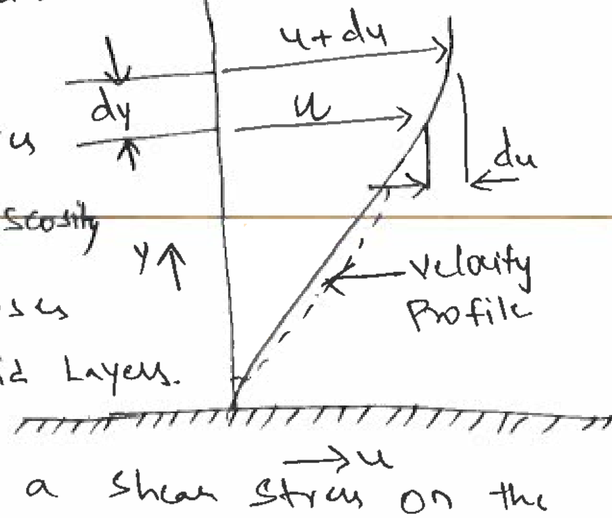
(i) Specific wt $= (w) = \frac{\text{Weight}}{\text{Volume}} = \frac{7N}{\left[\frac{1}{1000}\right] m^3} = 7000 \text{ N/m}^3$

(ii) Density $(\rho) = \frac{w}{g} = \frac{7000}{9.81} \text{ kg/m}^3 = 713.5 \text{ kg/m}^3$

(iii) Sp. ~~gravity~~ Volume $(v) = \frac{1}{\rho} = \frac{1}{713.5} = 0.00140 \text{ m}^3/\text{kg}$.

(iv) Sp. gravity $= (S) = \frac{\text{Density of Liquid}}{\text{Density of water}} = \frac{713.5}{1000} = 0.7135$ Ans/-

Viscosity:- It is defined as the property of a fluid which offers resistance to the movement of one layer of fluid over another adjacent layer of fluid. When two Layers of fluids a distance dy apart, move one over the other at different Velocities say u & u+du as shown in fig. The viscosity together with relative velocity causes a shear stress acting b/w the fluid Layers.



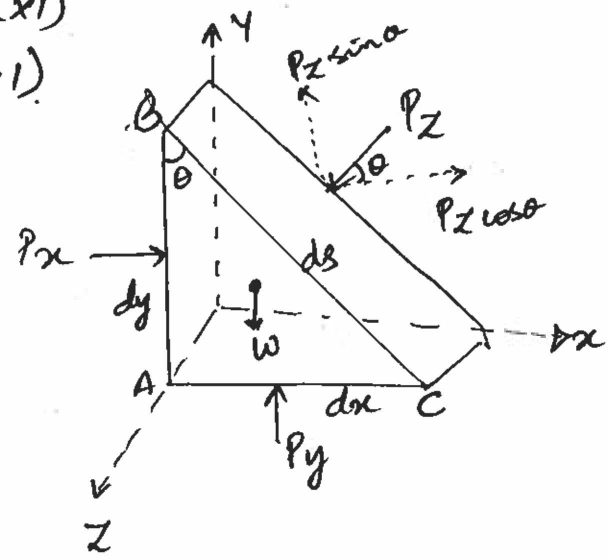
The top Layer causes a shear stress on the adjacent Lower Layer while the lower Layer causes a shear stress on the adjacent top layer. This shear stress is proportional to the rate of change of velocity ~~with~~ w.r.t y.

It is denoted by symbol τ (Tau)

Pressure force on face AB = $P_x \times (dy \times 1)$

AC = $P_y \times (dx \times 1)$

BC = $P_z \times (ds \times 1)$



Weight of the element $W = m \times g$

$= \rho \times v \times g$

but $\rho = \frac{m}{V}$

V = Area × width

$= \frac{1}{2} \times AB \times AC \times 1$

$= \frac{1}{2} AB \times AC$

$m = \rho \times V$

$W = \rho \times V \times g$

$W = \rho \times \frac{1}{2} \times AB \times AC \times g$

from fig $\angle ABC = \theta$

$\cos\theta = \frac{AB}{BC}$

$AB = BC \cos\theta$

$AB = ds \cos\theta$

$\sin\theta = \frac{AC}{BC}$

$AC = \sin\theta BC$ $\boxed{dy = ds \sin\theta}$

$AC = ds \sin\theta$

$\boxed{dx = ds \sin\theta}$

Algebraic sum of horizontal forces x-direction

$P_x (dy \times 1) - (P_z \cos\theta)(ds \times 1) = 0$

$P_x dy - P_z ds \cos\theta = 0$

$P_x\, dy = P_z\, dy$

$$\boxed{P_x = P_z} \rightarrow (1).$$

Resolve the forces in y-direction

$$P_y\,(dx \times 1) - P_z \sin\theta\,(ds \times 1) - \frac{1}{2} \times dx\, dy \times \rho g = 0.$$

Element is very small & hence weight can be neglected.

$P_y\, dx = P_z\, ds \sin\theta$

$P_y\, dx = P_z\, dx$

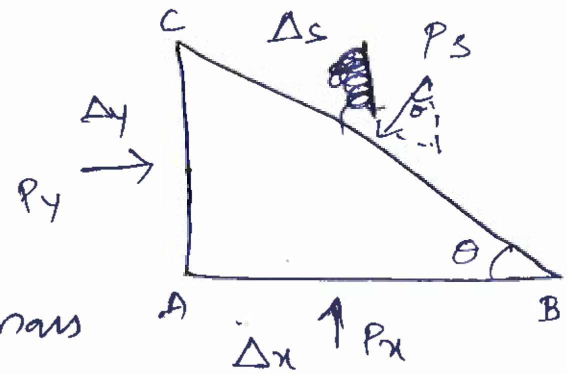
$$\boxed{P_y = P_z.} \rightarrow (2).$$

from eqn (1) & (2).

$$\boxed{P_x = P_y = P_z}$$

Hence proved.

$\therefore$ Pressure at a Point in a static fluid is equal in all directions.



Forces on fluid element

The fluid element is of very small dimensions i.e P_x, P_y & P_s

Consider an arbitary fluid Element of wedge shape in a fluid mass at rest as shown in fig. Let the width of the element ⊥ar to the plane of paper is unity

and $P_x, P_y, \& P_s$ are the Pressure intensity of Pressure acting on face AB, AC. & BC resp. Let $\angle ABC = \theta$

~~then the forces acting on the element are~~

Then the forces acting on the element are

→ Pressure forces normal to the surfaces &

→ weight of Element in vertical directions

$\sin\theta = \frac{opp}{Hyp}$

$\cos\theta = \frac{adj}{Hyp}$

$\tan\theta = \frac{opp}{adj}$

Resolving forces in x-direction we have

$\sum F_x = 0$ $\quad P_y \cdot \Delta y - P_s \cdot \Delta s \cdot \sin\theta = 0$

As the Element of the liquid is at rest, therefore the sum of horizontal & Vertical Comp of the liquid Pressure must be equal to zero.

but $\sin\theta = \frac{\Delta y}{\Delta s}$ $\quad P_y \cdot \Delta y - P_s \cdot \Delta s \cdot \frac{\Delta y}{\Delta s} = 0$

$P_y \cdot \Delta y = P_s \cdot \Delta y$

$P_y = P_s$

Resolving forces in y-direction

$\Sigma f_y = 0$ $P_x \cdot \Delta x - P_s \cdot \Delta s \cos\theta = 0$

But $\cos\theta = \frac{\Delta x}{\Delta s}$ $P_x \cdot \Delta x - P_s \cdot \Delta s \frac{\Delta x}{\Delta s} = 0$

$P_x \cdot \Delta x = P_s \cdot \Delta x$

$P_x = P_s$

$$\therefore \boxed{P_x = P_y = P_s}$$

The above eqn states that the Pressure at any Point is equal.

Cavitation: It is the phenomenon of formation of Vapour bubbles of a flowing liquid in a region where the pressure of liquid falls below the Vapour pressure and sudden collapsing of these Vapour bubbles in of higher pressure. when the Vapour bubbles collapse, a very high pressure is created. The metallic surfaces above which the liquid is flowing, is subjected to these high pressures, which causes pitting action on the surface. Thus Cavities are formed on the metallic surface & hence known as Cavitation

$F_z \cos\alpha = F_y - W$ (W = wt of liquid element)

Since the element is very small, neglecting its wt

we have $F_z \cos\alpha = F_y$

$P_z \, LM \cos\alpha = P_y \cdot MN$

$P_y = P_z \cos\alpha \left(\frac{LM}{MN}\right)$

~~LM cosα = MN~~

$P_y = P_z \cos\alpha \frac{1}{\cos\alpha}$

$P_y = P_z$

$P_z = P_y$ —— ②

from ① & ② we get

$P_x = P_y = P_z$

which is independent of α.

Hence at any point in a fluid at rest the Intensity of pressure is exerted equally in all directions. which is called pascals Law.

Note: $\sin\theta = \frac{OPP}{HYP}$

$\cos\theta = \frac{adJ}{HYP}$

$\tan\theta = \frac{OPP}{adJ}$

Measurement of Pressure

- Manometers
  - Simple manometer
    - Piezometer
    - U-tube manometer
    - Single column Manometer
  - Diff Manometer
    - U-tube Diff manometer
    - Inverted U-tube Diff "
- Mechanical gauges
  - Diaphragm P.G
  - Bourdon tube P.G
  - Dead wt P.G
  - Bellows P.G

, 19, 27, 31, 59, 45, 48, 6, 28, 62, 51, 35, 60, 32, 25, 39, 37

57, 4, 20, 29, 38, 17, 13, 52, 15, 49, 42.

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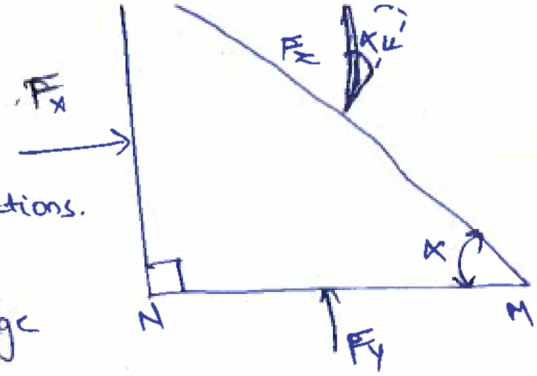
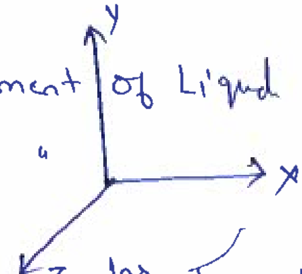
It states that the Intensity of pressure at any point in a Liquid at rest is same in all directions.



Proof: Let us consider a very small wedge shape element LMN of a liquid.



F_x = Intensity of horizontal pressure on the Element of Liquid

F_y = " " Vertical " " "

F_z = " " diagonal of the right angled Δlar element

α = Angle of element of the liquid

P_x = Total pressure on the vertical side LN of the Liquid

P_y = " " " horizonal side MN of "

P_z = " " diagonal LM "

Now $F_x = P_x \times LN$

$F_y = P_y \times MN$

$F_z = P_z \times LM$

As the element of the liquid is at rest, therefore the sum of horizontal & vertical components of the liquid pressure must be equal to zero

Resolving forces horizontally $P_x - P_z \sin\alpha = 0$

$-F_z \sin\alpha + f_x = 0$

$f_x = f_z \sin\alpha$

$P_x \times LN = P_z \times LM \sin\alpha$

$P_x = P_z \sin\alpha \left(\frac{LM}{LN}\right)$

$P_x = P_z \sin\alpha \operatorname{cosec}\alpha$ (1)

~~$P_x = P_z \sin\alpha$~~

~~$P_x LN = P_z \cdot LM \sin\alpha \; (LN/LM)$~~

~~$LN = LM \sin\alpha$~~ ... (1)

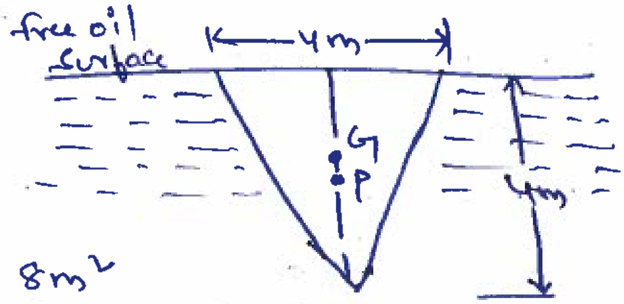
~~$P_x = P_z$~~

$\left(\frac{1}{\sin\alpha}\right)$

$\operatorname{cosec} = \frac{1}{\sin\alpha}$

plate of base 4m & altitude 4m when it is immersed Vertically in an oil of sp.gr 0.9 The base of the plate coincides with the free surface of oil.

Sol: Given:



base of plate $b = 4m$

Ht of plate $h = 4m$

Area $A = \frac{bh}{2} = \frac{4\times4}{2} = 8m^2$

Sp. gr of oil $S = 0.9$

Density of oil $\rho = 900 kg/m^3$

The dist of C.G from free surface of oil

$\bar{h} = \frac{h}{3} = \frac{4}{3} = 1.33m$

Total pressure $F = \rho g A\bar{h}$

$= 900\times9.81\times8\times1.33 = 93947.6N$

C.O.P h' from free surface of oil is given by

$h' = \frac{I_G}{A\bar{h}} + \bar{h}$

where I_G = M.O.I of Δlar section about its C.G

$I_G = \frac{bh^3}{36} = \frac{4\times4^3}{36} = 7.11m^4$

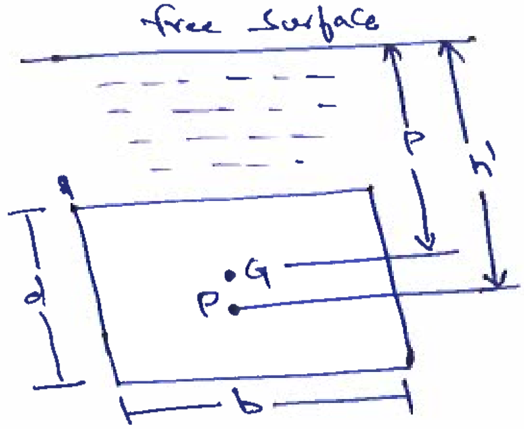
$h' = \frac{7.11}{8\times1.33} + 1.33$

$= 0.6667 + 1.33$

$= 1.99m$.

Prob: A rectangular sluice ...

wall of a lock. The vertical side of the sluice is 'd' meters in length & depth of centroid of the area is 'p' m below the water surface. P.T the depth of pressure is equal to $\left(p + \frac{d^2}{12p}\right)$



Sol: Given

Depth of vertical gate $= d\,m$

Let the ~~length~~ width of gate $= b\,m$

Area $A = b \times d\ m^2$

Depth of C.G from free surface

$\bar{h} = p$ meters

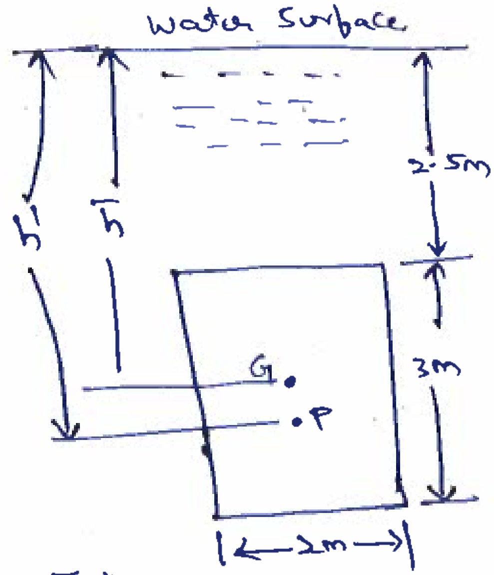
Let h' is the depth of C.O.P from free surface which is given by eqn $h' = \frac{I_G}{A\bar{h}} + \bar{h}$ where $I_G = \frac{bd^3}{12}$

$$h' = \left[\frac{bd^3}{12} \Big/ b \times d \times p\right] + p$$

$$= \frac{d^2}{12p} + p$$

i.e. $$h' = p + \frac{d^2}{12p}$$

D) 2.5mts below the free water surface:



$\bar{h}$ = dist of C.G from free surface of water.

$\bar{h} = 2.5 + \frac{3}{2} = 4.0m$

$F = \rho g A \bar{h}$

$= 1000 \times 9.81 \times 6 \times 4$

$F = 235440$ N.

Centre of pressure is given by

$h' = \frac{I_G}{A\bar{h}} + \bar{h}$

$I_G = 4.5m^4$

$A = 6m$

$\bar{h} = 4m$

$h' = \frac{4.5}{6 \times 4} + 4$

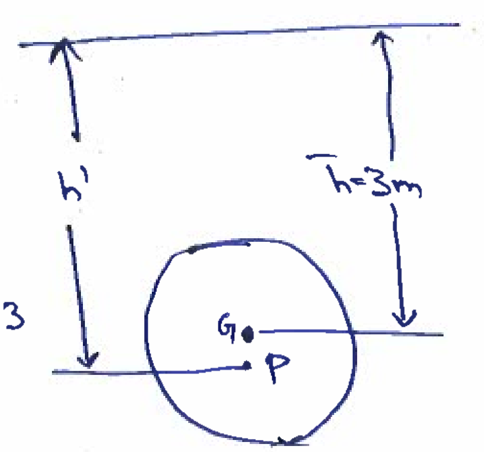
$= 4.1875$ m.

Prob Det the total pressure on a circular plate of Ø 1.5m which is placed vertically in water in such a way that the centre of plate is 3m. below the free surface of water. find the position of centre of pressure also.

Sol Ø of plate $d = 1.5m$

$A = \frac{\pi}{4}(1.5)^2 = 1.767m^2$

$\bar{h} = 3m$



Total pressure is given by

$F = \rho g A \bar{h}$

$= 1000 \times 9.81 \times 1.767 \times 3$

$= 52002.8$ N

Position of c.o.p h' is given by

$I_G = \frac{\pi d^4}{64} = \frac{\pi \times 1.5^4}{64} = 0.2485$

$h' = \frac{I_G}{A\bar{h}} + \bar{h}$

$= \frac{0.2485}{1.767 \times 3} + 3$

$= 3.0468$ ma.

Problem

1) A rect plane surface is 2mts wide & 3mt deep it lies in vertical plane in water, det the total pressure & position of C.O.P on the plane surface when its upper edge is horizontal &.

(i) coincide with water surface

(ii) 2.5mts below free water surface

Sol: Given

width of plane surface = 2m

depth of plane surface = 3m

Case (i) Coincide with water surface:

The total pressure is given by eqn

$$F = \rho g A \bar{h}$$

$$F = 1000 \times 9.81 \times 6 \times 1.5$$

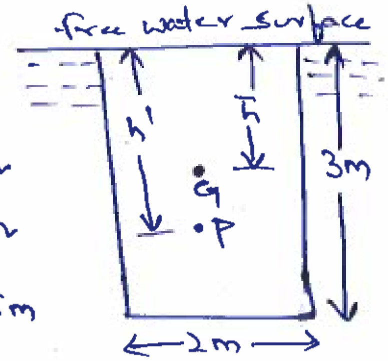
$$F = 88290\ N$$

$\rho = 1000\ kg/m^3$

$g = 9.81\ m/sec^2$

$A = 2 \times 3 = 6\ m^2$

$\bar{h} = \frac{1}{2} \times 3 = 1.5\ m$



Depth of centre of pressure is given by eqn

$$h' = \frac{I_G}{A\bar{h}} + \bar{h}$$

where I_G = M.O.I of horizontal surface about C.G

$$I_G = \frac{bd^3}{12} = \frac{2 \times 3^3}{12} = 4.5\ m^4$$

∴ dist of centre of pressure from the free surface of liquid is given by

$$h' = \frac{I_G}{A\bar{h}} + \bar{h}$$

$$= \frac{4.5}{6 \times 1.5} + 1.5$$

$$= 2\ mts.$$

i.e. c.o.p from free surface of liquid $h' = 2\ mts$

from the parallel Axis theorem

we have $I_0 = I_G + A\bar{h}^2$

where I_G = M.O.I of area about an axis passing through the centre of gravity of the area & parallel to the free surface of the liquid

Substituting I_0 in eq ③

$$h' = \frac{I_0}{A\bar{h}}$$

$$h' = \frac{I_G + A\bar{h}^2}{A\bar{h}}$$

$$= \frac{I_G}{A\bar{h}} + \frac{A\bar{h}^2}{A\bar{h}}$$

$$\boxed{h' = \frac{I_G}{A\bar{h}} + \bar{h}} \quad \text{--- (4)}$$

From the above Eqn it is clear that

(i) The dist of centre of pr from the free surface of liquid is independent of density of liquid

(ii) Centre of pressure "h'" lies below the centre of gravity ($\bar{h}$) of the vertical surface.

Moment of total force $= F \times h'$ —— (1)

moment of dF $= dF \times h$ $\quad \{dF = \rho g h \times b \times dh\}$

$= \rho g h \times b \times dh \times h$

Sum of moments of all such forces of free surface of liquid

$= \int \rho g h \times b \times dh \times h$

$= \rho g \int h \times b \times h dh$

$= \rho g \int b h^2 dh$ $\quad \{b dh = dA\}$

$= \rho g \int h^2 dA$

$\because dA \times h^2 =$ M.O.I of the elemental strip about the free surface of the liquid.

$\because \int dA \times h^2 =$ M.O.I of the total surface about the free surface of the liquid $= I_0$

$\therefore$ Sum of moments about the free surface

$= \rho g \int dA \times h^2$

$= \rho g I_0$ —— (2)

Equating (1) & (2)

$F \times h' = \rho g I_0$

we know that $F = \rho g . A\bar{h}$

$\rho g A\bar{h} \times h' = \rho g I_0$

$A\bar{h} \times h' = I_0$

$$\therefore \boxed{h' = \frac{I_0}{A\bar{h}}} \quad \text{—— (3)}$$

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NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY, OSMANIA UNIVERSITY, Hyderabad
DEPARTMENT OF CIVIL ENGINEERING

B.E. II YEAR, IV SEM - ATTAINMENT CALCULATIONS - Academic Year: 2020-21

Subject: FLUID MECHANICS **Subject Code:** PC403CE **Faculty:** Mr.Mohd Azheruddin

S.No.	Hall Ticket No.	CIE-1 ASG-1 (5M) CO1	CIE-1 ASG-2 (5 M) CO2	CIE-1 Part-1 Q1-abcd (6 M) CO1	CIE-1 Part-1 Q1-abcd (6 M) CO2	CIE-1 Q 2 (7 M) CO1	CIE-1 Q 3 (7 M) CO1	CIE-1 BEST OF Q2&Q3 CO1	CIE-1 Q 4 (7 M) CO2	CIE-1 Q 5 (7 M) CO2	CIE-1 BEST OF Q4&Q5 CO2	CIE-1 TOTAL (30 M)	CIE-2 ASG-1 (5M) CO3	CIE-2 ASG-2 (5 M) CO4	CIE-2 Part-1 Q1abcd (6 M) CO3	CIE-2 Part-1 Q1abcd (6 M) CO4	CIE-2 Q 2 (7 M) CO3	CIE-2 Q 3 (7 M) CO3	CIE-2 BEST OF Q2&Q3 CO3	CIE-2 Q 4 (7 M) CO4	CIE-2 Q 5 (7 M) CO4	CIE-2 BEST OF Q4&Q5 CO4	CIE-2 TOTAL (30 M)	CIE Average CIE (30 M)	TOTAL Marks (100 M)	SEE End Exam (70 M)
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CO2	2	2	1	2	-	-	-	-	-	-	-	2	-	-		3
CO3	3	1	2	2	-	-	-	-	-	-	-	2	1	2		3
CO4	3	2	2	-	-	-	-	-	-	-	-	1	-	2		3
Average	2.5	1.5	1.5	2.3333	0	0	0	0	0	0	0	1.75	1	2		3

CO2 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)
CO3 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)
CO4 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)

Course PO Attainments

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
Direct Attainment	2.50	1.50	1.50	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.75	1.00	2.00	

PO ATTAINMENTS
DIRECT ATTAINMENT (PO1)= (Average of PO1*Average of CO Direct Attainment)/3
Similar for PO2 TO PO12 & PSO1 TO PSO3

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY						
DEPARTMENT OF CIVIL ENGINEERING						
CO Feedback form						
Academic Year 2020-2021						
Course Name with Code	FM & C 222					
Class	BE Civil - IV Semester					
Faculty Name						
CO Attainment	Internal Attainment	External Attainment	DIRECT ATTAINMENT LEVEL	Indirect Attainment	Overall Attainment	COPO MAPPING
CO 1	3	3	3.00	2.38	3	1.76
CO 2	3	3	3.00	2.38	3	1.76
CO 3	3	3	3.00	2.35	3	1.69
CO 4	3	3	3.00	2.40	3	1.80
Overall Course Attainment			3.00	2.38	**3.00**	**1.75**
Set Target for the course						
Course Attainment						
Status(Yes/No)						**YES**

Percentage of students attained CO	CO attainment rubric
%CO ≥ 80	3
65 ≤ %CO < 80	2
%CO < 65	1

H.O.D

Action taken for course outcome attainment feedback:

- Student performance can be enhanced further by involving them to prepare a model for innovation in teaching and learning programme under the institute.
- Taking much longer time than the usual for the assessment and evaluation, for about three to five years roughly.

Code No. : **5416/N**

FACULTY OF ENGINEERING

B.E. 2/4 (Civil) II Semester (New) (Main) Examination, May/June 2012

FLUID MECHANICS – I

Time : 3 Hours] [Max. Marks : 75

Note : *Answer* ***all*** *questions from Part* ***A****, answer* ***any five*** *questions from Part* ***B****.*

PART – A **(25 Marks)**

1. Define Newton's law of viscosity. **2**
2. Define surface tension. Prove the relationship between surface tension and pressure inside drop let of liquid is given by $p = \frac{4\sigma}{d}$. **2**
3. Explain the terms path line and streak line. **2**
4. Differentiate between forced vortex and free vortex flow. **2**
5. The stream function for a two-dimensional flow is given $\psi = 2xy$. Calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ. **3**
6. What is difference between momentum equation and impulse equations ? **2**
7. Prove that the error in discharge due to the error in the measurement of head over a rectangular notch is given by $\frac{dQ}{Q} = \frac{3dH}{2H}$. **3**

   when Q = discharge through rectangular notch and H = head over the rectangular notch.
8. State the Bernoulli's theorem for compressible flow. **3**
9. Define Mach number. What is significance of mach number in compressible fluid flow ? **3**
10. Define the term momentum correction factor. **3**

(This paper contains 2 pages)

P.T.O.

PART – B

(50 Marks)

11. a) Define the continuity equation and obtain an expression for a three dimensional flow. 6

b) The velocity potential function ϕ is given by $\phi = x^2 - y^2$. Find the velocity components in x and y direction. Also show that ϕ represents a possible case of fluid flow. 4

12. a) Starting with Euler's equation of motion along a stream line, obtain Bernoulli's equation by its integration. List all the assumptions made. 5

b) Water is flowing through a pipe having diameters 30 cm and 15 cm at the button and upper end respectively. The intensity of pressure at the bottom end is 14.715 N/cm². Determine the difference in datum head if the rate of flow through pipe is 50 liters/sec. 5

13. a) A rectangular channel is 15 m wide has a discharge of 200 liters per second which is measured by a right angled V-notch Weir. Find the position of the apex of the notch from the bed of the channel with maximum depth of water not to exceed 1 m. Take $C_d = 0.62$. 6

b) Explain the principle of venturimeter with a neat sketch. Prove the expression for the rate of flow of fluid through it. 4

14. a) What do you understand by stagnation pressure ? Obtain an expression for stagnation pressure of a compressible fluid in terms of approaching mach number and pressure. 6

b) Find the mach number when an aeroplane is flying at 1000 km/hour through still air having pressure of 7 N/cm² and temperature of –5°C. Take R = 287.14 J/kg K. Calculate the pressure and temperature of air at stagnation point. Take K = 14. 4

15. a) What for Hagen Poiseuille's formula is helpful ? Derive an expression for Hagen Poiseuille's formula. 6

b) A liquid is pumped through a 15 cm diameter and 300 m long pipe at the rate of 20 tonnes per hour the density of liquid is 910 kg/m³ and Kinematic viscosity = 0.002 m²/s. Determine Reynold's number. 4

16. a) State the significance of Mody's diagram in flow through pressure conduits. 5

b) Derive an expression for Bernoulli's equations when process is adiabatic. 5

17. Write the short notes of following :

a) Elbowmeter. 3

b) Mach cone 3

c) Reynolds experiment. 4

1,000

Code No. : **5416/N**

FACULTY OF ENGINEERING

B.E. 2/4 (Civil) II Semester (New) (Main) Examination, May/June 2012

FLUID MECHANICS – I

Time : 3 Hours] [Max. Marks : 75

Note : *Answer **all** questions from Part **A**, answer **any five** questions from Part **B**.*

PART – A **(25 Marks)**

1. Define Newton's law of viscosity. **2**
2. Define surface tension. Prove the relationship between surface tension and pressure inside drop let of liquid is given by $p = \frac{4\sigma}{d}$. **2**
3. Explain the terms path line and streak line. **2**
4. Differentiate between forced vortex and free vortex flow. **2**
5. The stream function for a two-dimensional flow is given $\psi = 2xy$. Calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ. **3**
6. What is difference between momentum equation and impulse equations ? **2**
7. Prove that the error in discharge due to the error in the measurement of head over a rectangular notch is given by $\frac{dQ}{Q} = \frac{3dH}{2H}$. **3**

   when Q = discharge through rectangular notch and H = head over the rectangular notch.
8. State the Bernoulli's theorem for compressible flow. **3**
9. Define Mach number. What is significance of mach number in compressible fluid flow ? **3**
10. Define the term momentum correction factor. **3**

(This paper contains 2 pages)

P.T.O.

PART – B

(50 Marks)

11. a) Define the continuity equation and obtain an expression for a three dimensional flow. 6

b) The velocity potential function ϕ is given by $\phi = x^2 - y^2$. Find the velocity components in x and y direction. Also show that ϕ represents a possible case of fluid flow. 4

12. a) Starting with Euler's equation of motion along a stream line, obtain Bernoulli's equation by its integration. List all the assumptions made. 5

b) Water is flowing through a pipe having diameters 30 cm and 15 cm at the button and upper end respectively. The intensity of pressure at the bottom end is 14.715 N/cm². Determine the difference in datum head if the rate of flow through pipe is 50 liters/sec. 5

13. a) A rectangular channel is 15 m wide has a discharge of 200 liters per second which is measured by a right angled V-notch Weir. Find the position of the apex of the notch from the bed of the channel with maximum depth of water not to exceed 1 m. Take $C_d = 0.62$. 6

b) Explain the principle of venturimeter with a neat sketch. Prove the expression for the rate of flow of fluid through it. 4

14. a) What do you understand by stagnation pressure ? Obtain an expression for stagnation pressure of a compressible fluid in terms of approaching mach number and pressure. 6

b) Find the mach number when an aeroplane is flying at 1000 km/hour through still air having pressure of 7 N/cm² and temperature of – 5°C. Take R = 287.14 J/kg K. Calculate the pressure and temperature of air at stagnation point. Take K = 14. 4

15. a) What for Hagen Poiseuille's formula is helpful ? Derive an expression for Hagen Poiseuille's formula. 6

b) A liquid is pumped through a 15 cm diameter and 300 m long pipe at the rate of 20 tonnes per hour the density of liquid is 910 kg/m³ and Kinematic viscosity = 0.002 m²/s. Determine Reynold's number. 4

16. a) State the significance of Mody's diagram in flow through pressure conduits. 5

b) Derive an expression for Bernoulli's equations when process is adiabatic. 5

17. Write the short notes of following :

a) Elbowmeter. 3

b) Mach cone 3

c) Reynolds experiment. 4

1,000

FACULTY OF ENGINEERING

B.E. 2/4 (Civil) II-Semester (Main) Examination, April / May 2013

Subject : Fluid Mechanics - I

Time : 3 Hours **Max. Marks: 75**

Note: Answer all questions of Part - A and answer any five questions from Part-B.

PART – A (25 Marks)

1. Differentiate between notch and weir. (2)
2. What is hydrostatic variation of pressure force? (2)
3. Define momentum correction factor. (2)
4. What do you mean by velocity of approach in a notch? (2)
5. Define temporal acceleration. (2)
6. Darcy-Weisbach equation can be used only for turbulent flows-yourcomment. (3)
7. What is meant by lower critical Reynolds number in pipe flows? (3)
8. Define Stream function and velocity potential. (3)
9. What is Mach cone? (3)
10. What is an equivalent pipe? (3)

PART – B (5x10=50 Marks)

11.(a) Derive the expression for variation of pressure in a static fluid. (5)
(b) A hydraulic lift consists of a 28cm diameter ram which slides in a 28.015cm diameter cylinder, the annular space being filled with oil having kinematic viscosity of 0.025 cm^2/s and specific gravity 0.85. If the rate of travel of the ram is 10.15 m/min, find the frictional resistance when 3.25m of the ram is engaged in the cylinder. (5)

12.(a) Derive Bernoulli's equation from Euler's equation of motion clearly stating the assumptions involved. (5)
(b) A pipe bend tapers in the direction of flow from a diameter of 500mm to a diameter of 250mm and turns through 450 in the horizontal plane. The pressure at inlet is 40 kPa. If the pipe is conveying oil of specific gravity of 0.85, find the magnitude and direction of the resultant force on the bed when the oil flows at a rate of 150 litres / s. (5)

13.(a) Derive the expression for discharge through a Venturimeter fitted to an inclined pipe line. (5)
(b) In an experiment on a 90° V-notch the flow is collected in vertical cylindrical tank 0.9m diameter. It is found that the depth of water in the tank increases by 0.65 m in 16.8 s when the head over the notch is 0.2m. Determine the coefficient of discharge through the notch. (5)

14.(a) Derive the equation for velocity of pressure wave or elastic wave in a compressible fluid. (5)

(b) Air is flowing through a pipe with a velocity of 285m/s where its pressure temperature are 0.6 bar (absolute) and 300K. The pipe along the flow changes in diameter and its pressure at that section is 0.9 bar (absolute). Taking Y as 1.4 and R as 287Nm/kg0K, and assuming the adiabatic flow, find the velocity of flow at this section. (5)

15.(a) Explain the concept of equivalent pipe and generate the relevant expression. (5)

(b) Oil of viscosity 0.1 Pa-s and specific gravity 0.9, flows through a horizontal pipe of 25 mm diameter. If the pressure drop per metre length of the pipe is 12kPa, determine (i) the rate of flow in N/min (ii) the shear stress at the pipe wall (iii) the Reynolds number of the flow (iv) the power required per 50m length of pipe to maintain flow. (5)

16.(a) Derive the expression for loss of energy due to sudden contraction in a circular pipe. (5)

(b) Oil of specific gravity 0.9 flows in a 300mm diameter at the rate of 120 litres per second and the pressure at a point A is 24.525 kPa. If the point A is 5.2 m above the datum line, calculate the total energy at point A in terms of meters of oil. (5)

17. Write short notes on the following:

(a) Rotameter (3)

(b) Pascal's Law (3)

(c) Vapour pressure (4)

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Code No. 463/CBCS

FACULTY OF ENGINEERING

B.E. (Civil) IV - Semester (CBCS) (Main) Examination, May/June 2018

Subject : Fluid Mechanics - II

Time : 3 Hours **Max. Marks: 70**

Note: Answer all questions from Part-A & any five questions from Part-B.

PART – A (20 Marks)

1 Write the significance of Reynolds number. 2
2 Find the diameter of a single pipe of length 1500m to replace three pipes of length 600m, 500m and 300m and diameters 300mm, 200mm and 100mm. 2
3 Explain the terms hydraulic gradient line and total energy line. 2
4 Define water hammer phenomenon. 2
5 Differentiate between friction drag and pressure drag. 2
6 Define laminar sublayer. 2
7 Define specific energy and critical depth. 2
8 State the Froude number values for critical, subcritical and supercritical states of flow. 2
9 List the different surface profiles. 2
10 If a hydraulic jump occurs at a point where the upstream depth is 0.25m, what would be the depth after the hydraulic jump, if the discharge per unit width q=0.625 m^3/s per metre width. 2

PART - B (50 Marks)

11 (a) Derive Hagen Poisuille's equation for laminar flow through circular pipes. 5
(b) A pipe 200mm in diameter and 45m long conveys water at a velocity of 2.5 m/s. Find the head lost in friction. Take f= 0.006. 5

12 (a) Explain different types of pipes, based on pipe materials. 5
(b) Water flowing in a long pipe of diameter 150mm and thickness 6mm is suddenly stopped by closing the valve at the discharge end. The quantity of water flowing is 18 litres/sec. Find the rise in pressure, taking the modulus of elasticity of pipe material as 1.962×10^5 N/mm^2 and bulk modulus of water as 1.962×10^3 N/mm^2. 5

13 (a) Explain the drag on a flat plate, held perpendicular to the direction of flow of fluid. 5
(b) If the velocity distribution in the boundary layer is given by $\frac{u}{U}=\frac{y}{\delta}$, determine the displacement thickness, momentum thickness and energy thickness. 5

14 (a) Derive Chezy's equation for uniform flow. 5
(b) A channel of trapezoidal section has sides sloping at 60^0 with the horizontal and a bed slope of 1 in 800 and conveys a discharge of 12m^3/s. Find the bottom width and depth of flow for most economical section. Take Chezy's constant C=70. 5

15 (a) Explain specific energy diagram and determine the expression for critical depth. 5

(b) A rectangular channel 7.5m wide has a uniform depth of flow of 2m and has a bed slope of 1 in 3000. If due to weir constructed at the downstream end of the channel, water surface at a section is raised by 0.75m, determine the water surface slope with respect to the horizontal at this section. Take n=0.02. 5

16 (a) Derive an expression for the celerity of a positive surge. 5

(b) Calculate the total drag, shear drag and pressure drag exerted on 1m length of an infinite circular cylinder which has a diameter equal to 30mm, air of density 1.236 Kg/m^3 flowing past the cylinder with velocity 3.6 m/min. Take total drag coefficient equal to 1.4 and shear drag coefficient equal to 0.185. 5

17 Write short notes on 10

(i) Momentum thickness

(ii) Separation of Boundary layer.

(iii) Hydraulic jump.

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ASSIGNMENT QUESTIONS

1.	a) Explain briefly the physical properties of fluid ie Mass density, Weight density, Specific gravity and also explain the concept of capillary rise and fall in a fluid. b) What is Pascal's law? Derive the equation of Pascal's law ie,(Px = Py= Pz).	CO1
2.	a) Derive the continuity equation for 3-Dimensional. b) The velocity potential function **$\emptyset=(-xy^3-x^2+x^3y+y^2)$** find i)The velocity component in X and Y direction. ii) Show that **$\emptyset$** represents a possible case of flow.	CO2
3.	A 40cm diameter pipe conveying water, branches into two pipes of diameter 30cm and 20cm respectively. If the average velocity in the 40cm diameter pipe is 3m/sec. Find the discharge in this pipe. Also determine the velocity in 20cm pipe if the average velocity in 30cm diameter pipe is 2m/sec.	CO2
4.	Derive the Euler's equation of motion.	CO3

ASSIGNMENT QUESTIONS

1.	Explain briefly about convective and local acceleration also with surface and body forces.	CO3
2.	Definition and types of free and forced vortex flow.	CO3
3.	Measurement of discharge through different Notches and Weir.	CO3
4.	Discharge through an orifice meter, Bernoulli's equation for adiabatic and isothermal conditions.	CO4

2nd YEAR CIVIL ENGG STUDENT LIST			
1	161019732001	73	161019732085
2	161019732002	74	161019732086
3	161019732003	75	161019732087
4	161019732004	76	161019732088
5	161019732006	77	161019732089
6	161019732007	78	161019732090
7	161019732008	79	161019732091
8	161019732009	80	161019732092
9	161019732010	81	161019732093
10	161019732011	82	161019732095
11	161019732013	83	161019732096
12	161019732014	84	161019732097
13	161019732016	85	161019732098
14	161019732017	86	161019732099
15	161019732018	87	161019732301
16	161019732019	88	161019732302
17	161019732020	89	161019732303
18	161019732021	90	161019732304
19	161019732022	91	161019732305
20	161019732023	92	161019732306
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27	161019732030	99	161019732313
28	161019732031	100	161019732314
29	161019732032	101	161019732315
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31	161019732034	103	161019732317
32	161019732036	104	161019732318
33	161019732038	105	161019732319
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35	161019732040	107	161019732321
36	161019732041	108	161019732322
37	161019732042	109	161019732323
38	161019732043	110	161019732324
39	161019732044	111	161019732325
40	161019732045	112	161019732326
41	161019732046	113	161019732327

42	161019732047	114	161019732328
43	161019732050	115	161019732329
44	161019732051	116	161019732330
45	161019732052	117	161019732331
46	161019732054	118	161019732332
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49	161019732057	121	161019732335
50	161019732058	122	161019732336
51	161019732059	123	161019732337
52	161019732061	124	161019732338
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55	161019732064	127	161019732341
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70	161019732082	142	161019732357
71	161019732083	143	161019732357
72	161019732084		

ADVANCE LEARNER LIST			
1	161019732001	73	161019732085
2	161019732002	74	161019732086
3	161019732003	75	161019732087
4	161019732004	76	161019732088
5	161019732006	77	161019732089
6	161019732007	78	161019732090
7	161019732008	79	161019732091
8	161019732009	80	161019732092
9	161019732010	81	161019732093
10	161019732011	82	161019732095
11	161019732013	83	161019732096
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13	161019732016	85	161019732098
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18	161019732021	90	161019732304
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69	161019732081	141	161019732356
70	161019732082	142	161019732357
71	161019732083	143	161019732357
72	161019732084		

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY, OSMANIA UNIVERSITY, Hyderabad

DEPARTMENT OF CIVIL ENGINEERING

B.E. II YEAR, IV SEM - ATTAINMENT CALCULATIONS - Academic Year: 2020-21

Subject: FLUID MECHANICS **Subject Code:** PC403CE **Faculty:** Mr.Mohd Azheruddin

S.No.	Hall Ticket No.	CIE - 1											CIE - 2											CIE		SEE
		ASG-1 (5M)	ASG-2 (5 M)	Part-1 Q1-abcd (6 M)		Q 2 (7 M)	Q 3 (7 M)	BEST OF Q2&Q3	Q 4 (7 M)	Q 5 (7 M)	BEST OF Q4&Q5	CIE-1 TOTAL (30 M)	ASG-1 (5M)	ASG-2 (5 M)	Part-1 Q1abcd (6 M)		Q 2 (7 M)	Q 3 (7 M)	BEST OF Q2&Q3	Q 4 (7 M)	Q 5 (7 M)	BEST OF Q4&Q5	CIE-2 TOTAL (30 M)	Average CIE	TOTAL Marks	End Exam
		CO1	CO2	CO1	CO2	CO1	CO1	CO1	CO2	CO2	CO2		CO3	CO4	CO3	CO4	CO3	CO3	CO3	CO4	CO4	CO4		(30 M)	(100 M)	(70 M)
1	161019732001	5	5	3	2	4		4	.		0	19	5	5	2	2	5		5	4		4	23	21	56	35
2	161019732002	5	5	2	3	4		4	6		6	25	5	5	2	2	4		4	3		3	21	23	72	49
3	161019732003	5	5	3	2	4		4	7		7	26	5	5	2	2	5		5		5	5	24	25	74	49
4	161019732004	5	5	3	2	4		4	7		7	26	5	5	2	2	5		5		7	7	26	26	68	42
5	161019732006	5	5	3	2	4		4		7	7	26	5	5	2	2		4	4	5		5	23	25	53	28
6	161019732007	5	5	3	2	4		4	7		7	26	5	5	2	2		4	4	6		6	24	25	74	49
7	161019732008	5	5	3	2	4		4		7	7	26	5	5	2	2		5	5	7		7	26	26	54	28
8	161019732009	5	5	3	2		4	4	7		7	26	5	5	2	2	5		5	7		7	26	26	82	56
9	161019732010	5	5	3	2		4	4	7		7	26	5	5	2	2	5		5	6		6	25	26	54	28
10	161019732011	5	5	3	2	4		4	7		7	26	5	5	2	2	5		5	7		7	26	26	61	35
11	161019732013	5	5	3	2	4		4		7	7	26	5	5	2	2	6		6	7		7	27	27	90	63
12	161019732014	5	5	3	2	6		6	7		7	28	5	5	2	2	6		6	7		7	27	28	56	28
13	161019732016	5	5	3	2		4	4	7		7	26	5	5	2	2	7		7	7		7	28	27	76	49
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25	161019732028	5	5	3	2	4		4	5		5	24	5	5	2	2	5		5	5		5	24	24	66	42
26	161019732029	5	5	3	2	4		4	7		7	26	5	5	2	2	7		7	7		7	28	27	76	49
27	161019732030	5	3	3	2		3	3	4		4	20	3	3	2	2	3		3	4		4	17	19	47	28
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31	161019732034	5	5	3	2		5	5	7		7	27	5	5	2	2	7		7	7		7	28	28	63	35
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35	161019732040	5	5	3	2	5		5	7		7	27	5	5	2	2	7		7	7		7	28	28	70	42
36	161019732041	5	5	3	2	4		4	7		7	26	5	5	4	2		7	7	7		7	30	28	70	42
37	161019732042	5	5	3	2		4	4	7		7	26	5	3	2	2	3		3	3		3	18	22	57	35
38	161019732043	5	5	3	2	4		4	7		7	26	5	5	2	2	7		7	7		7	28	27	83	56
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40	161019732045	5	5	3	2		4	4	7		7	26	5	5	2	2	5		5	5		5	24	25	74	49
41	161019732046	5	5	3	2		4	4	7		7	26	5	5	2	2	7		7		7	7	28	27	55	28
42	161019732047	5	5	3	2	4		4	7		7	26	5	5	2	2		5	5	5		5	24	25	60	35
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44	161019732051	5	5	3	2	4		4	7		7	26	5	5	2	2	3		3	5		5	22	24	66	42
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47	161019732055	5	5	3	2	4		4	7		7	26	5	5	4	2	6		6	7		7	29	28	56	28
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75	161019732087	5	4	3	2	4		4	5		5	23	3	3	2	2	4		4		5	5	19	21	77	56
76	161019732088	5	5	3	2	6		6	7		7	28	5	5	2	3		5	5		7	7	27	28	77	49
77	161019732089	5	5	3	2	4		4	7		7	26	5	5	2	4		6	6		7	7	29	28	84	56
78	161019732090	5	5	3	2	5		5		7	7	27	5	5	3	3		5	5	7		7	28	28	56	28
79	161019732091	5	5	3	2	4		4	7		7	26	5	5	2	2	5		5	7		7	26	26	68	42
80	161019732092	5	5	3	2	4		4		7	7	26	5	5	4	3	6		6	7		7	30	28	56	28
81	161019732093	5	5	3	2	6		6	7		7	28	5	5	2	3	6		6	7		7	28	28	63	35
82	161019732095	5	5	3	2	4		4	7		7	26	5	5	2	2	5		5		5	5	24	25	53	28
83	161019732096	5	5	3	2		4	4	7		7	26	5	5	2	2	5		5		5	5	24	25	53	28
84	161019732097	5	5	3	2		4	4	7		7	26	5	5	2	2	5		5		7	7	26	26	61	35
85	161019732098	5	5	3	2	4		4	7		7	26	5	5	2	2	5		5	5		5	24	25	67	42
86	161019732099	5	5	3	2	4		4	7		7	26	5	5	2	2	5		5	7		7	26	26	54	28
87	161019732301	5	5	3	2	6		6		7	7	28	5	5	2	3		6	6		5	5	26	27	90	63
88	161019732302	5	5	3	2	4		4		7	7	26	5	5	2	2		5	5	7		7	26	26	61	35
89	161019732303	5	5	3	2	4		4	7		7	26	5	4	2	2	4		4		5	5	22	24	66	42
90	161019732304	5	5	3	4	6		6	6		6	29	5	5	3	3	5		5	4		4	25	27	62	35
91	161019732305	5	5	3	2	4		4	7		7	26	5	3	2	2	3		3	4		4	19	23	58	35
92	161019732306	5	5	3	2	4		4	7		7	26	5	4	2	2	3		3	5		5	21	24	73	49
93	161019732307	5	5	3	2	4		4		7	7	26	5	5	3	3	5		5		7	7	28	27	62	35
94	161019732308	5	5	3	2	4		4	7		7	26	5	5	2	3	6		6	7		7	28	27	62	35
95	161019732309	5	4	3	2	4		4		5	5	23	5	3	2	2	3		3	4		4	19	21	63	42
96	161019732310	5	5	3	2	4		4	7		7	26	5	5	3	3	5		5	7		7	28	27	69	42
97	161019732311	5	5	3	2	4		4	7		7	26	5	5	2	2	5		5	5		5	24	25	88	63
98	161019732312	5	5	3	2		5	5	7		7	27	5	5	3	3	5		5			0	21	24	24	0
99	161019732313	5	5	3	2		4	4	7		7	26	5	5	2	2		5	5	5	7	7	26	26	61	35
100	161019732314	5	5	3	2	4		4	7		7	26	5	5	2	2		5	5	7		7	26	26	68	42
101	161019732315	5	5	3	2		4	4	7		7	26	5	5	2	2	5		5	5		5	24	25	67	42
102	161019732316	5	5	3	2	4		4	7		7	26	5	5	3	3	5		5	7		7	28	27	69	42
103	161019732317	5	5	3	2	4		4		7	7	26	5	5	2	2	5		5	5		5	24	25	81	56
104	161019732318	4	4	3	2	4		4		6	6	23	4	3	2	2	3		3	5		5	19	21	56	35
105	161019732319	5	5	4	2	5		5		7	7	28	5	5	3	3	5		5	6		6	27	28	56	28
106	161019732320	5	3	3	2	4		4	6		6	23	4	3	2	2	3		3	4		4	18	21	56	35
107	161019732321	5	4	3	2	4		4	5		5	23	3	3	2	2	3		3	4		4	17	20	62	42

CO2	2	2	1	2	-	-	-	-	-	-	-	2	-	-		3
CO3	3	1	2	2	-	-	-	-	-	-	-	2	1	2		3
CO4	3	2	2	-	-	-	-	-	-	-	-	1	-	2		3
Average	2.5	1.5	1.5	2.3333	0	0	0	0	0	0	0	1.75	1	2		3

C02 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)
C03 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)
C04 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)

Course PO Attainments

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
Direct Attainment	2.50	1.50	1.50	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.75	1.00	2.00	

PO ATTAINMENTS
DIRECT ATTAINMENT (PO1)= (Average of PO1*Average of CO Direct Attainment)/3
Similar for PO2 TO PO12 & PSO1 TO PSO3

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY	
DEPARTMENT OF CIVIL ENGINEERING	
CO Feedback form	
Academic Year 2020-2021	
Course Name with Code	FM & C 222
Class	BE Civil - IV Semester
Faculty Name	

CO Attainment	Internal Attainment	External Attainment	DIRECT ATTAINMENT LEVEL	Indirect Attainment	Overall Attainment	COPO MAPPING
CO 1	3	3	3.00	2.38	3	1.76
CO 2	3	3	3.00	2.38	3	1.76
CO 3	3	3	3.00	2.35	3	1.69
CO 4	3	3	3.00	2.40	3	1.80
Overall Course Attainment			3.00	2.38	**3.00**	**1.75**
Set Target for the course						
Course Attainment						
Status(Yes/No)						**YES**

Percentage of students attained CO	CO attainment rubric
$\%CO \geq 80$	3
$65 \leq \%CO < 80$	2
$\%CO < 65$	1

H.O.D

Action taken for course outcome attainment feedback:

- Student performance can be enhanced further by involving them to prepare a model for innovation in teaching and learning programme under the institute.
- Taking much longer time than the usual for the assessment and evaluation, for about three to five years roughly.