Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere – 577 004
Department of Civil Engineering

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Bapuji Institute of Engineering and Technology, Davangere-577004

CALENDER OF EVENTS - ODD SEMESTER: SEPTEMBER-JANUARY- 2020-21 (Tentative)

PARTICULARS	I sem BE/B.Tech	III, V BE/B.Tech	VII sem BE/B.Tech	III & V sem MCA	III sem MBA	III sem M.Tech
Commencement of ODD Sem	14-12-2020	01-09-2020	01-09-2020	01-09-2020	01-09-2020	01-09-2020
Last Working Day	25-03-2021	16-01-2021	16-01-2021	16-01-2021	16-01-2021	16-01-2021
1st CIE Series	-----	19-10-2020 To 24-10-2020	19-10-2020 To 24-10-2020	19-10-2020 To 24-10-2020	15-10-2020 To 17-10-2020	19-10-2020 To 24-10-2020
2nd CIE Series	-----	07-12-2020 To 09-12-2020	07-12-2020 To 09-12-2020	07-12-2020 To 09-12-2020	26-11-2020 To 28-11-2020	07-12-2020 To 09-12-2020
3rd CIE Series	-----	11-01-2021 To 13-01-2021	11-01-2021 To 13-01-2021	11-01-2021 To 13-01-2021	7-01-2021 To 9-01-2021	11-01-2021 To 13-01-2021
Practical Examination	29-03-2021 Onwards #	21-01-2021 Onwards #	21-01-2021 Onwards #	08-02-2021 Onwards #	-----	21-01-2021 Onwards #
Theory Examination	12-04-2021 To 30-04-2021	08-02-2021 To 27-03-2021	08-02-2021 To 27-03-2021	21-01-2021 To 06-02-2021	21-01-2021 To 19-02-2021	28-01-2021 To 13-02-2021
Internship	-----	-----	29-03-2021 To 10-04-2021	-----	-----	-----
Internship Viva-Voce	-----	-----	-----	-----	-----	15-02-2021 To 22-02-2021
Professional Training/Organization Study	-----	-----	-----	-----	22-02-2021 To 03-04-2021	-----
Commencement of Even Semester	03-05-2021	29-03-2021	12-04-2021	15-02-2021	05-04-2021	23-02-2021

Notification regarding the calendar of events relating to the conduct of University Examination will be issued by the Registrar (Evaluation) from time to time.

Principal

Revised Academic Calendar of VTU, Belagavi for ODD Semester of 2020-21 (Tentative)

	I Sem B. E. / B. Tech. / B. Arch./B.Plan	I sem M.Tech./MBA /MCA/M.Arch.	III, V B. E. /B. Tech./B.Plan/ B.Arch & VII sem BPlan /BArch & IX Sem B. Arch.	VII Sem B. E. /B. Tech	III & V Sem MCA	III Sem MBA	III Sem M. Tech.	III Sem M. Arch.
Commencement of ODD Semester	14.12.2020	Will be announced later	01.09.2020	01.09.2020	01.09.2020	01.09.2020	01.09.2020	01.09.2020
Last Working day of ODD Semester	25.03.2021		16.01.2021	16.01.2021	16.01.2021	16.01.2021	16.01.2021	16.01.2021
Practical Examinations	29.03.2021 Onwards#		21.01.2021 Onwards#	21.01.2021 Onwards#	08.02.2021 Onwards#	—	21.01.2021 Onwards#	—
Theory Examinations	12.04.2021 To 30.04.2021		08.02.2021 To 27.03.2021	08.02.2021 To 27.03.2021	21.01.2021 To [illegible].02.2021	21.01.2021 To 19.02.2021	28.01.2021 To 13.02.2021	21.01.2021 To 06.02.2021
Internship			—	29.03.2021 To 10.04.2021	—	—	—	—
Internship Viva-Voce			—	—	—	—	15.02.2021 To 22.02.2021	—
Professional training / Organization study			—	—	—	22.02.2021 To 03.04.2021	—	—
Commencement of EVEN Semester	03.05.2021		29.03.2021	12.04.2021	15.02.2021	05.04.2021	23.02.2021	08.02.2021

NOTE:

- VII Semester B. E. / B. Tech. students shall have to undergo Internship as per circular of University VTU/Aca/2019-20/85, dated 12.05.2020.
- I Semester B. E/ B. Tech / B. Arch Students shall compulsorily undergo Induction Program for 01 Weeks.
- The classroom sessions for all the semesters would be in ONLINE mode/blended mode until further orders.
- The Institute needs to function for six days a week with additional hours (Saturday is a full working day).
- The faculty/staff shall be available to undertake any work assigned by the university.
- If any of the above dates are declared to be a holiday then the corresponding event will come into effect on the next working day.
- (#) Notification regarding the Calendar of Events relating to the conduct of University Examinations will be issued by the Registrar (Evaluation) from time to time.
- Academic Calendar may be modified based on guidelines/directions issued in the future by MHRD/UGC/AICTE/State Government.
- Revised Academic Calendar is also applicable for Autonomous Colleges.
- The MBA students are permitted to carry out project work in blended mode (ONLINE/OFFLINE). More emphasis on OFFLINE mode wherever feasible.

04-12-2020
REGISTRAR

Vision of BIET

To be a center of excellence recognized nationally and internationally, in distinctive areas of engineering education and research, based on a culture of innovation and invention.

Mission of BIET

BIET contributes to the growth and development of its students by imparting a broad based engineering education and empowering them to be successful in their chosen field by inculcating in them positive approach, leadership qualities and ethical values

VISION OF THE DEPARTMENT

To train the students to become Civil Engineers with leadership qualities, having ability to take up professional assignments and research with a focus on innovative approaches to cater to the needs of the society.

MISSION OF THE DEPARTMENT

1. To provide quality education through updated curriculum and conducive teaching learning environment for the students to excel in higher studies, competitive examinations and professional career.
2. To impart soft skills, leadership qualities and professional ethics among the graduates to handle the projects independently with confidence.
3. To deal with the contemporary issues and to cater to the socio-economic needs.
4. To build industry-institute interaction and to establish good rapport with alumni.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Core Competence: Graduates will be able to plan, analyse, design and construct sustainable Civil Engineering Infrastructure.

PEO 2: Professional Skills: Graduates will be professional engineers with a sense of ethics, creativity, leadership, self-confidence and independent thinking to cater to the needs of the society.

PEO 3: Societal Needs: Graduates will be able to contribute effectively for the development of industry and professional bodies.

PEO 4: Cognitive Intelligence: Graduates will be able to take up competitive examinations, higher studies and involve in research and entrepreneurship activities.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Students after the completion of the Program will be able to

1. Apply the fundamental concepts, software and codal provisions in the analysis, design and construction of sustainable civil engineering infrastructure.
2. Inculcate professional and leadership qualities, sense of ethics and confidence related to civil engineering.

Faculty will be able to

3. Contribute to the overall development of civil engineering community through the professional bodies and offer services to the society.

Name of the Faculty : Sri. Sharathraj R M

Time / Day	8 – 9	9 – 10	10.30 – 11.30	11.30 – 12.30	2 – 3	3 – 4	4 – 5
Mon	17CV53 – PS			18CV33 – A			
Tue	18CV33 – A			17CV53 – PS	18CVL57 – A2 (SRM + CTG)		
Wed							
Thu		17CV53 – PS					
Fri		17CV53 – PS			18CVL57 – B2 (SRM + VMK)		
Sat		18CVL37 – B3 (SH + SRM) ←→	18CV33 – A				

Time Table Coordinator HOD Principal

F 141.

B. E. CIVIL ENGINEERING Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - III			
FLUIDS MECHANICS			
Course Code	18CV33	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: The objectives of this course is to make students to learn:

1. The Fundamental properties of fluids and its applications.
2. Hydrostatic laws and application to solve practical problem.
3. Principles of Kinematics and Hydrodynamics for practical applications.
4. Basic design of pipes and pipe networks considering flow, pressure and its losses.
5. The basic flow rate measurements.

Module-1

Fluids & Their Properties: Concept of fluid, Systems of units. Properties of fluid; Mass density, Specific weight, Specific gravity, Specific volume, Viscosity, Newton's law of viscosity (theory & problems), Cohesion, Adhesion, Surface tension, Pressure inside a water droplet, soap bubble and liquid jet. Numerical problems,& Capillarity. Capillary rise in a vertical tube and between two plane surfaces (theory & problems). Vapor pressure of liquid, compressibility and bulk modulus, Fluid as a continuum,

Fluid Pressure and Its Measurements: Definition of pressure, Pressure at a point, Pascal's law, Variation of pressure with depth. Types of pressure. Measurement of pressure using simple, differential & inclined manometers (theory & problems). Introduction to Mechanical and electronic pressure measuring devices.

Module-2

Hydrostatic forces on Surfaces: Definition, Total pressure, centre of pressure, total pressure on horizontal, vertical and inclined plane surface, total pressure on curved surfaces, water pressure on gravity dams, Lock gates. Numerical Problems.

Fundamentals of fluid flow (Kinematics): Introduction. Methods of describing fluid motion. Velocity and Total acceleration of a fluid particle. Types of fluid flow, Description of flow pattern. Basic principles of fluid flow, three- dimensional continuity equation in Cartesian coordinate system. Derivation for Rotational and irrational motion. Potential function, stream function, orthogonality of streamlines and equipotential lines. Numerical problems on Stream function and velocity potential. Introduction to flow net.

Module-3

Fluid Dynamics: Introduction. Forces acting on fluid in motion. Euler's equation of motion along a streamline and Bernoulli's equation. Assumptions and limitations of Bernoulli's equation. Modified Bernoulli's equation. Problems on applications of Bernoulli's equation (with and without losses). Momentum equation problems on pipe bends.

Applications: Introduction. Venturi meter, Orifice meter, Pitot tube. Numerical Problems.

Module-4

Orifice and Mouth piece: Introduction, classification, flow through orifice, hydraulic coefficients and Numerical problems. Mouthpiece, classification, Borda's Mouthpiece (No problems).

Notches and Weirs: Introduction. Classification, discharge over rectangular, triangular, trapezoidal notches, Cippoletti notch, broad crested weirs. Numerical problems. Ventilation of weirs, submerged weirs.

Module-5

Flow through Pipes: Introduction. Major and minor losses in pipe flow. Darcy- Weis bach equation for head loss due to friction in a pipe. Pipes in series, pipes in parallel, equivalent pipe-problems. Minor losses in pipe flow, equation for head loss due to sudden expansion. Numerical problems. Hydraulic gradient line, energy gradient line. Numerical problems, .Pipe Networks, Hardy Cross method (No problems on pipe networks),

Surge Analysis in Pipes: Water hammer in pipes, equations for pressure rise due to gradual valve closure and sudden closure for rigid and elastic pipes. Problems.

Course outcomes: After successful completion of the course, the student will be able to:

1. Possess a sound knowledge of fundamental properties of fluids and fluid Continuum
2. Compute and solve problems on hydrostatics, including practical applications
3. Apply principles of mathematics to represent kinematic concepts related to fluid flow
4. Apply fundamental laws of fluid mechanics and the Bernoulli's principle for practical applications
5. Compute the discharge through pipes and over notches and weirs

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. P N Modi and S M Seth, "Hydraulics and Fluid Mechanics, including Hydraulic Machines", 20th edition, 2015, Standard Book House, New Delhi
2. R.K. Bansal, "A Text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi
3. S K SOM and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, New Delhi

Reference Books:

1. Victor L Streeter, Benjamin Wylie E and Keith W Bedford, "Fluid Mechanics", Tata McGraw Hill Publishing Co Ltd., New Delhi, 2008(Ed).
2. K Subramanya, "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Co. Ltd.
3. K Subramanya, "Fluid Mechanics and Hydraulic Machines-problems and solutions", Tata McGraw Hill Publishing Co. Ltd.
4. J. F. Douglas, J. M. Gasoriek, John Swaffield, Lynne Jack, "Fluid Mechanics", Pearson, Fifth Edition.
5. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press.

Course Title	Fluid Mechanics (18CV33)
CO	**Statement**
18CV33.1	**Explain** the fundamental properties of fluids
18CV33.2	**Explain** the concept of fluid pressure and equipment for its measurement
18CV33.3	**Calculate** the hydrostatic forces acting on surfaces and **explain** the kinematic concepts of fluid flow
18CV33.4	**Apply** Euler's equation and Bernoulli's principle for the practical applications of fluid flow
18CV33.5	**Compute** the discharge through channels and pipes
18CV33.6	**Explain** the losses in pipe flow and effect of water hammer in pipe flow

Course Title	Fluid Mechanics											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
18CV33.1	2	2	-	1	-	-	-	-	-	-	-	2
15CV33.2	2	2	-	1	-	-	-	-	-	-	-	2
15CV33.3	2	2	-	1	-	-	-	-	-	-	-	2
15CV33.4	2	2	-	1	-	-	-	-	-	-	-	2
15CV33.5	2	2	-	1	-	-	-	-	-	-	-	2
15CV33.6	2	2	-	1	-	-	-	-	-	-	-	2
Average	2	2		1								2

CO	PSO1	PSO2
18CV33.1	2	2
15CV33.2	2	2
15CV33.3	2	2
15CV33.4	2	2
15CV33.5	2	2
15CV33.6	2	2
Average	2	2

LESSON PLAN

Subject : FLUID MECHANICS Subject Code : 18CV33 Class : III A. CV

Period	Date	Topics Planned	Date	Topics Covered	Remarks
1	1/9/2020	Module-1 Concept of fluid. System of units, Properties of fluid	6/10/20	Concept of fluid. System of units properties of fluid.	
2	5/09	Mass density, Sp weight Sp. gravity, Sp. volume viscosity, Newtons law of viscosity	7/10/20	Mass density, specific weight, specific gravity viscosity	
3	7/09	Cohesion, Adhesion surface tension pressure inside a water droplet	8/10/20	Cohesion, Adhesion surface tension, pressure inside water droplet	
4	8/09	Soap bubble, liquid jet capillarity, capillary rise in a vertical tube.	13/10/20	Soap bubble, liquid jet, capilarity rise in a vertical tube.	
5	12/09	Vapour pressure of liquid, compressibility and bulk modulus.	14/10	Vapour pressure of liquid, compressibility and bulk modulus	
6	14/09	Pressure, Pascals law Variation of pressure with depth, types of pressure	15/10	problems	
7	15/09	Measurement using simple, differential and Inclined Manometer	20/10	pressure & its measurements	
8	19/09	Mechanical and Electrical pressure measuring devices.	28/10	problems.	
9	21/9/2020	Module-2 Total pressure, Centre of pressure, TP on Horizontal surface.	7/11/2020	Module-2 total pressure & centre of pressure.	
10	22/9	Vertical and Inclined surface, total pressure on curved surfaces.	9/11/2020	Horizontal, Vertical Inclined, curved surfaces	
11	26/9	Water pressure on gravity dams, Lockgates Methods of fluid Motion	10/11/2020	Water pressure on gravity dams, lockgates methods of fluid motion	
12	23/09/2020	Velocity and total accn of a fluid particle, Type of fluid flow, flow pattern	12/11	velocity & total acceleration of fluid particle, type of flow	
13	29/09	Basic principles of fluid flow 3Dimensional continuity equation in Cartisian co-system	17/11	Basic principles of fluid flow in 3D continuity equation.	
14	03/10/2020	Derivation for Rotational and Irrotational motion Potential function.	21/11	Derivation for rotation and Irrotational motion, potential function.	
15	5/10	Stream function, orthogonality of streamlines	23/11	Stream function, orthogonality of	

LESSON PLAN

Subject : Fluid Mechanics Subject Code : 18CV33 Class : III . A . CV

Period	Date	Topics Planned	Date	Topics Covered	Remarks
18	12/10	Bernoulli's equation, Assumpt and limitations. Modified Bernoulis equation.	30/11	Bernoulis equation, Assumptions, limitation modified Bernoulis eqn	
19	13/10	problems on application of Bernoulis eqn with losses	01/12/20	problems	
20	17/10	problems on application of Bernoulli's eqn without losses.	05/12	problems	
21	19/10	Momentum equation problems on pipe bends	08/12	momentum equation problems.	
22	20/10	Applications: Introduction, Venturimeter	12/12	Applications of Bernoulis equation venturimeter.	
23	24/10	orifice meter, pitot tube, problems	14/12	problems on Venturimeter.	
24	27/10	problems.	15/12	problems.	
25	2/11/2020	Module - 4. Orifice and mouthpiece classification, flow through orifice	19/12	Module - 4. orifice and mouthpiece, classification,	
26	3/11	Hydraulic co-efficient. problems.	21/12	Hydraulic co-efficients Cd, Cv, Cc, Cr.	
27	7/11	Mouthpiece, classification Borda's mouthpiece	22/12	Mouthpiece, types Borda's mouthpiece,	
28	9/11	Notches & Weirs: types discharge over Rectangular notch.	26/12	Notches & weirs, types,	
29	10/11	triangular, trapezoidal, Cipolletti notch.	28/12	Derivation of Q over Rectangular, triangular trapezoidal Notch	
30	17/11	broad crested weirs problems.	29/12	Broad crested weirs problems.	
31	21/11	problems.	02/01/21	problems.	
32	23/11	Ventilation of weirs, submerged weirs.	05/01	ventilation of weirs submerged weirs	
33	24/11	Module :- 5 flow through pipes. Introduction, major & minor losses in pipe flow	09/01	Module 5. Flow through pipes. Losses in pipe flow	
		Darcy-Weis bach equation			

LESSON PLAN

Subject : Subject Code : Class :

S.No	Date	Topics Planned	Date	Topics Covered	Remarks
35	30/11	pipes in parallel, equivalent pipe problems, minor loss in pipeflow, eqn of head loss due to sudden expansion	11/01	pipe in parallel, equivalent pipe problems, minor loss in pipeflow.	
36	1/12/2020	problems.	16/01	problems	
37	5/12	Hydraulic gradient line. energy gradient line. problems.	18/01	Hydraulic gradient line, energy gradient line	
38	7/12	pipe network, Hardy cross method. Surge Analysis in pipes.	23/01	problems	
39	8/12	water hammer in pipes equation for pressure rise due to gradual valve closure.	30/01	pipe networks, surge analysis in pipe, water hammer in pipes	
40	12/12	Sudden closure for rigid and elastic pipes. problems.	08/02/21	Sudden closure for rigid & elastic pipe problems,	

Text Books :

1. P. N. Modi and S M Seth, " Hydraulics & Fluid mechanics including Hydraulic machines", 20th edition

2. R. K. Bansal " Fluid Mechanics and Hydraulic Machines" Laxmi publications.

Reference Books :

1. Victor L Streeter, Benjamin Wylie E and Keith " Fluid Mechanics" Tata McGraw publishing Co. Ltd.

2. K. Subramanya " Fluid Mechanics and Hydraulic Machines" Tata Mc. Graw Hill publishing Co. Ltd.

3. K. Subramanya " Fluid Mechanics & Hydraulic Machines problems and solutions" Tata M.C. Graw Hill P.Co

4. J. F. Doughas, J. M Gasarick, John Swaffield, Lynne Jack " Fluid Mechanics" Pearson. 5th edition

5. Mohd. Kaleem Khan " Fluid Mechanics and Machinery" Oxford University press.

Class : III A . CV   Subject Code : 18CV33   Subject : FLUID MECHANICS   Total No. of Classes : 40

Sl No.	USN	NAME	06/10	07/10	08/10	13/10	14/10	15/10	20/10	28/10	7/11	9/11	10/11
1	4BD19CV001	Aban Sharief	A	A	A	A	A	A	A	A	A	A	A
2	4BD19CV003	Afzal Noorsabnavar	A	1	2	3	4	5	6	7	A	8	9
3	4BD19CV005	Akashdeep R Andanur	1	2	A	3	A	4	5	6	7	8	9
4	4BD19CV006	Akhila C Akula	1	2	3	4	5	6	7	8	9	10	11
5	4BD19CV007	Akshatha Ashoka Pudalekara	1	2	3	4	5	6	7	8	9	A	10
6	4BD19CV009	Akshaya Kumara L M	A	1	A	A	2	A	A	A	A	A	A
7	4BD19CV011	Amith K M	1	A	2	A	A	A	A	A	A	A	3
8	4BD19CV013	Arpitha Basanagouda Patil	A	1	A	2	3	A	4	5	A	6	A
9	4BD19CV015	Basavaraj S Patil	1	A	A	A	2	3	4	A	A	A	A
10	4BD19CV017	Bhumika P	1	2	A	3	4	A	5	6	7	8	A
11	4BD19CV019	Chinmayee K	1	2	A	3	4	A	5	6	7	8	9
12	4BD19CV021	Darshan V N	1	A	A	A	A	A	A	A	A	A	A
13	4BD19CV023	Ganesh U Shirigeri	A	1	2	3	.	4	5	6	7	8	9
14	4BD19CV025	Hemanth Kumar D V	A	1	2	3	4	5	6	7	8	9	10
15	4BD19CV027	Jhanavi R	1	2	3	A	4	5	6	A	7	8	9
16	4BD19CV029	Kruthik S P	1	2	3	A	4	5	6	7	8	9	10
17	4BD19CV031	M Syed Anwar	A	A	A	A	A	A	A	A	A	A	A
18	4BD19CV033	Manjunatha M	1	2	3	4	5	6	7	8	9	10	11
19	4BD19CV035	Mithun Y	1	A	A	A	A	A	A	A	A	A	A
20	4BD19CV037	Mohammed Faizan Makandar	1	2	A	3	4	5	6	7	A	8	9
21	4BD19CV039	Nadeem Sha A Z	A	A	A	A	A	1	2	3	4	5	6
22	4BD19CV041	Nanda K B	1	2	3	A	4	5	6	7	8	9	10
23	4BD19CV043	Niranjan G M	1	2	A	A	A	A	A	A	3	A	A
24	4BD19CV047	Pooja P	A	A	A	1	2	3	4	5	6	7	8
25	4BD19CV049	Pradeep P N	A	A	A	A	A	A	A	A	A	A	A
26	4BD19CV051	Prashanth N R	A	A	A	1	A	A	A	A	A	A	A
27	4BD19CV053	Raghavendra Vaditha	A	A	A	A	A	A	A	A	A	A	A
28	4BD19CV055	Rakesh H N	A	A	A	A	A	A	A	A	1	A	A
29	4BD19CV057	Sambhram S Patil	1	A	2	3	4	5	6	A	7	8	9
30	4BD19CV059	Sevanth B M	A	A	A	A	A	A	A	A	A	A	A

Sl No.	10/11	12/11	17/11	21/11	23/11	24/11	28/11	30/11	01/12	05/12	08/12	12/12	14/12	15/12	19/12	21/12	22/12
1	1	2	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2	A	A	A	A	A	A	A	A	A	A	A	A	A	A	10	A	A
3	A	A	10	A	11	12	13	A	A	14	A	15	16	17	18	19	20
4	A	A	12	A	13	14	15	16	17	18	A	19	20	21	22	23	24
5	A	A	11	12	13	14	15	16	A	A	A	17	A	18	19	20	21
6	A	A	A	3	A	A	A	A	4	5	A	A	A	A	6	7	8
7	A	A	A	A	A	A	4	A	5	A	A	A	A	A	A	A	A
8	A	A	A	A	A	7	8	A	A	9	A	10	A	A	11	A	12
9	5	6	7	A	A	A	8	A	9	A	A	10	A	11	12	13	14
10	9	10	11	12	13	A	A	14	15	16	A	17	18	19	20	21	22
11	10	11	12	A	13	14	15	16	17	A	A	18	19	20	21	22	23
12	A	A	A	A	A	A	A	A	A	A	A	1	A	A	2	A	3
13	10	11	12	13	14	15	.	17	18	19		20	21	22	23	A	24
14	11	A	12	A	13	A	A	18	19	20	A	A	A	21	22	A	A
15	10	11	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
16	A	A	A	A	11	12	13	A	A	A	A	14	A	A	15	16	A
17	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
18	12	13	14	15	16	17	18	19	20	21	A	22	23	24	25	26	27
19	A	A	A	A	A	2	3	A	A	A	A	4	5	A	6	7	8
20	10	11	12	A	A	13	A	A	14	15	A	16	A	A	18	19	20
21	7	8	9	10	11	A	A	A	A	A	A	11	12	13	14	15	16
22	A	11	A	A	12	13	A	14	A	A	15	16	A	A	A		18
23	A	A	4	A	A	5	A	A	6	A	A	A	A	A	A	A	A
24	9	10	A	A	A	A	11	A	A	A	A	A	12	A	13	A	K
25	A	A	A	A	A	1	2	A	A	3	A	4	A	A	A	A	A
26	A	A	A	A	A	2	A	A	A	3	A	4	5	A	6	A	A
27	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
28	A	A	A	A	A	1	2	A	A	A	A	2	3	A	4	5	6
29	A	A	10	11	A	12	13	A	A	A	A	14	15	16	17	18	19
30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Sl No.	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average (10)	Remarks (40)
1	32	84	28	28	4	9	29.
2	30	92	29	22	13	7	29.
3	27	80	28	29	29	10	39.
4	31	81	27	28	26	10	37.
5	35	88	30	30	18	10	36.
6	35	88	30	28	14	10	34.
7	38	88	29	28	17	10	35.
8	34	84	28	30	28	10	39.
9	29	75	26	26	15	10	31.
10	36	86	30	30	29	10	40.
11	37	88	29	30	24	10	38.
12	36	75	28	30	19	9	35.
13	34	84	30	30	20	10	39.
14	34	82	28	30	7	9	28.
15	A	A	A	A	A	A	course left
16	29	80	25	30	26	10	37.
17	A	A	A	A	A	0	course left
18	36	89	30	30	22	10	38.
19	17	49	20	30	7	7	26.
20	28	80	30	28	24	10	38.
21	35	88	29	24	15	10	37.
22	31	81	30	30	21	10	37.
23	27	69	28	22	23	7	32.
24	29	80	30	30	1	10	32.
25	16	42	22	29	9	10	30.
26	30	80	27	30	21	10	36.
27	20	80	27	29	08	10	32.
28	27	77	28	30	20	10	36.
29	34	84	29	30	15	9	34.
30	31	84	29	30	25	09	37.

Initials of Teacher

Class : III . A . CV Subject Code : 18CV33 Subject : FLUID MECHANICS Total No. of Classes : 44

Sl No.	USN	NAME	6/10/2022	7/10	8/10	13/10	14/10	15/10	20/10	28/10	07/11/2022	9/11	10/11
31	4BD19CV061	Shreya D K	1	2	3	4	5	6	7	8	9	10	11
32	4BD19CV 063	Soundarya N M	1	2	3	4	5	6	7	8	9	A	10
33	4BD19CV 065	Swathi V Kote	1	2	3	4	5	6	7	8	9	10	11
34	4BD19CV 067	U . Madhushree	A	A	1	2	3	4	5	6	7	8	9
35	4BD19CV 069	Vaishnavi. V	A	A	1	2	3	4	5	6	7	A	A
36	4BD19CV 071	Veeresh. K. K	1	2	3	4	5	6	7	8	9	10	A
37	4BD19CV 073	Vijayalakshmi R Telkar	1	2	3	4	5	6	7	8	9	10	11
38	4BD19CV 075	Vikas .S.M	A	A	A	A	1	2	3	A	A	A	A
39	4BD19CV077	Vivekananda H M	1	2	A	3	4	5	6	7	A	8	9
40	4BD19CV079	Yugh B Jain	A	1	2	3	4	5	6	7	8	9	10
41	4BD18CV099	Vinay Kumar M	A	1	2	3	4	5	6	7	8	9	10
42	4BD17CV052	Mohammed Azhar Basith	A	1	2	A	3	4	5	6	7	8	9
43	4BD20CV443	Trupthi S.R	A	A	A	A	A	A	A	A	A	A	A
44	4BD18CV027	Harshith N	A	A	1	2	A	A	A	3	A	A	A
45	4BD20CV406	Channesh H Patil	A	A	A	A	A	1	A	2	A	A	A
46	4BD18CV076	Shivaraj K.H	A	A	A	1	2	3	4	5	6	7	8
47	4BD20CV404	Bharath reddy N	A	A	A	A	A	A	1	2	3	4	5
48	4BD20CV423	Mohammed Khadir	1	2	3	4	5	6	7	8	9	10	11
49	4BD20CV400	Abhilash S.V	1	2	3	4	5	6	7	8	9	10	11
50	4BD20CV412	Dhanush . R	1	2	3	4	5	6	7	A	8	9	10
51	4BD20CV439	Surabhi S Bharadwaj	1	2	3	4	5	6	7	8	9	10	11
52	4BD20CV 407	Chetan Kotraiah.	A	A	A	A	A	A	A	A	A	A	A
53	4BD20CV448	Vinod Kumar Budhihal	A	A	A	A	A	A	A	A	A	A	A
54	4BD20CV 429	Nandesh m. mathad	A	A	A	A	A	A	A	A	A	A	A
55	4BD19CV082	Santhosh S Bagoor	A	A	A	A	A	A	A	A	A	A	A
56	Left course	Sujith R	A	A	A	A	A	A	A	A	A	A	A
57	4BD20CV431	Rohith A	A	A	A	A	A	A	A	A	A	A	A
58	4BD19CV081	Kiran M.M.	A	A	A	A	A	A	A	A	A	A	A
59	4BD20CV440	Suraj N Raikar	A	A	A	A	A	A	A	A	A	A	A
60	4BD20CV428	Murugharajendra HV	A	A	A	A	A	A	A	A	A	A	A
61	4BD20CV427	Shree Harsha T.R	A	A	A	A	A	A	A	A	A	A	A

Sl No.	10/11	12/11	17/11	21/11	23/11	24/11	28/11	30/11	01/12/2022	05/12	08/12 (IA)	12/12	14/12	15/12	19/12	21/12	22/12	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
31	12	A	13	14	15	16	17	A	18	19	A	20	21	22	23	24	25	35	95	30	30	12	10	34
32	12	12	13	14	15	16	17	18	19	A	A	A	20	21	22	23	24	38	95	29	30	30	10	40
33	12	13	14	15	16	17	18	19	20	21	A	22	23	24	25	26	27	40	100	30	30	29	10	40
34	10	11	12	13	14	15	16	17	18	19	A	A	20	21	22	23	24	40	100	30	30	30	10	40
35	9	10	11	12	A	13	14	15	16	17	A	A	18	19	20	21	22	37	92	29	30	30	10	40
36	11	12	13	14	15	16	17	18	19	20	21	22	A	A	A	A	A	38	95	30	30	18	9	35
37	A	A	A	11	12	13	14	15	17	18	A	A	19	20	21	22	23	40	100	30	30	29	10	40
38	4	5	A	A	A	A	6	7	8	9	10	11	12	13	14	15	16	33	83	26	28	09	10	31
39	10	11	12	13	14	A	15	16	17	A	18	19	20	21	A	22	23	39	98	30	30	12	9	33
40	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	40	100	20	30	27	9	35
41	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	40	98	21	30	7	10	30
42	10	11	12	13	14	15	A	A	A	15	A	16	17	A	18	A	19	35	88	30	30	8	9	32
43	A	A	A	A	A	A	A	A	A	A	A	1	2	3	4	5	6	21	55	20	30	10	10	34
44	4	5	A	6	7	8	9	10	A	11	A	A	12	A	13	14	15	32	80	24	28	21	10	35
45	A	A	A	3	4	5	6	7	8	9	A	A	10	11	12	13	14	31	81	30	30	28	10	36
46	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	42	100	22	27	02	9	26
47	5	7	8	9	10	11	12	13	14	15	16	17	A	A	A	A	18	35	88	29	30	30	10	40
48	12	13	14	15	16	17	18	19	A	A	A	A	A	20	21	22	23	40	100	27	30	19	10	33
49	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	40	100	27	30	11	10	33
50	11	12	A	13	14	15	16	17	18	19	A		A	20	21	A	A	37	92	30	30	14	10	31
51	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	34	88	24	30	6	10	30
52	A	A	A	A	A	1	A	A	2	A	A	3	4	5	A	6	7	23	56	28	22	16	10	32
53	A	A	A	A	A	1	A	A	2	A	A	3	A	5	6	7	8	24	58	21	28	10	10	30
54	A	A	A	A	A	A	1	A	A	2	A	3	A	4	5	6	7	22	56	29	30	11	10	34
55	A	A	A	A	A	A	A	A	A	A	A	A	1	2	3	4	5	23	55	28	30	12	10	34
56	A	A	A	A	A	A	A	A	A	A	A	A	1	2	3	4	5	22	55	—	—	—		
57	A	A	A	1	A	A	A	A	A	A	A	2	3	4	5	6	7	18	45	26	30	28	10	35
58	A	A	A	1	A	A	A	A	2	A	A	3	4	5	6	7	8	22	55	28	28	7	9	28
59	A	A	A	A	A	1	2	A	A	3	A	4	5	6	7	8	9	21	54	30	30	29	10	40
60	A	A	A	A	A	1	2	A	A	3	A	4	5	6	7	8	9	18	45	29	28	12	10	33
61	A	A	A	A	A	A	A	A	A	1	A	2	3	4	5	6	7	24	60	30	30	22	10	38

Class : 3A Subject Code : 18CV33 Subject : Fluid Mechanics Total No. of Classes : 44

Sl No.	USN	NAME	25/12	29/12	02/01/2021	05/01	9/1	11/1	16/1	18	23	25/1/21	30/1/21	04/02/21	08/02/21	13/02/21	15/02/21	16/02/21	No. of Days Present (16)	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
62	4BD20CV433	Sandeep B.N	1	2	3	4	5	6	7	8	9	10	11	12	A	13	14	15	15	94	28	30	17	10	35
63.	4BD20CV435	Shankar Rao Kulkarni . C	1	2	3	4	5	6	7	8	9	10	12	13	A	14	15	16	16	100	25	30	19	10	35
64.	4BD20CV402	Ambika H.J	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	16	100	30	30	30	10	40
65.	4BD20CV441	Thriveni G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	16	100	29	30	28	10	39
66	4BD20CV430	Pallavi . D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	16	100	30	30	30	10	40
67.	4BD20CV417	Harish S.D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	16	100	25	25	25	10	35
68	4BD20CV444	Veena . B . Bharamagoudra	1	2	3	4	5	6	7	8	9	10	9	10	A	11	12	13	13	81	30	30	20	10	37
69.	4BD20CV418	Harsha C.N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	16	100	30	30	25	10	39
70	4BD20CV416	Harish L.G	1	2	3	4	5	6	7	8	A	A	A	9	10	11	12	13	13	81	30	30	24	10	38
71	4BD20CV442	Trupti . S Balikai	1	2	3	4	5	6	7	8	9	10	11	12	A	13	14	15	15	94	30	30	20	10	37
72	4BD20CV411	Deepak.L	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	16	100	30	29	28	10	39
73	4BD20CV413	Firdosh Anjum H.		1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	16	100	29	29	29	10	39

FLUID AND THEIR PROPERTIES MI (a)

"Fluid Mechanics" is the branch of science which deals with behaviour of fluids at rest as well as in motion.

The study of fluids in motion where pressure force are not considered is called "fluid Kinematics" and if force pressure considered it is called "fluid dynamics."

Properties of fluids:

Certain characteristics of a continuous fluid are independent of the motion of a fluid. These characteristics are called basic properties of the fluid.

(1) Density or Mass density or Specific mass (ρ)

It is defined as the ratio of the mass of a fluid to its volume or Mass per unit volume of fluid unit is Kg/m^3. Mass density of water is $1000\ kg/m^3$. Density of liquid is constant where as the gases changes with pressure and temperature.

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

(2) Specific weight or weight density (w):

Defined as the ratio between the weight of a fluid to its volume.

$$w = \frac{\text{weight of fluid}}{\text{Volume of fluid}}$$

$$w = \frac{(\text{mass of fluid}) \times (\text{Acceleration due to gravity})}{\text{Volume of fluid}}$$

$$w = \frac{m \times g}{V}$$

$$w = \rho g$$

Unit is N/m^3

Volume of specific weight of water is (1000×9.81) i.e $(\rho \times g)$

$= 9810\ N/m^3$

(3) Specific volume:

It is defined as the volume occupied by the unit mass or volume per unit mass of fluid. It is expressed as

$$\text{Specific volume} = \frac{\text{Volume of fluid}}{\text{mass of fluid}} \text{ or } \frac{\text{Vol. of fluid}}{\text{weight of fluid}}$$

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

$$= \frac{1}{\rho} = \frac{1}{\text{mass density}}$$

Unit is m^3/kg

4)

wei

w

(4) Specific gravity:

Specific gravity is defined as, ratio of weight density (or density) of fluid to the weight density (or density) of a standard fluid.

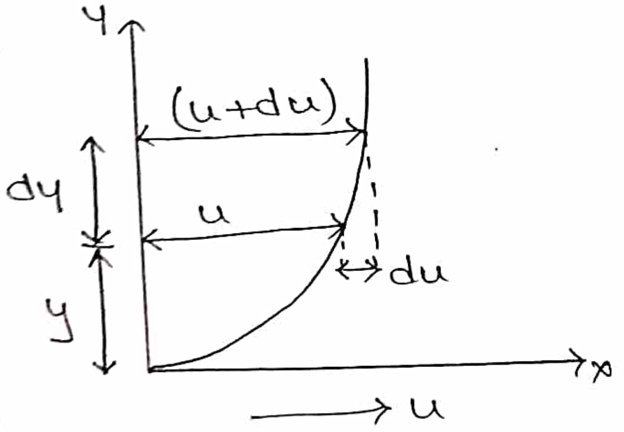
$$S = \frac{\text{Specific weight of fluid}}{\text{Specific weight of standard fluid}}$$

$$= \frac{\text{mass density of fluid}}{\text{mass density of standard fluid.}}$$

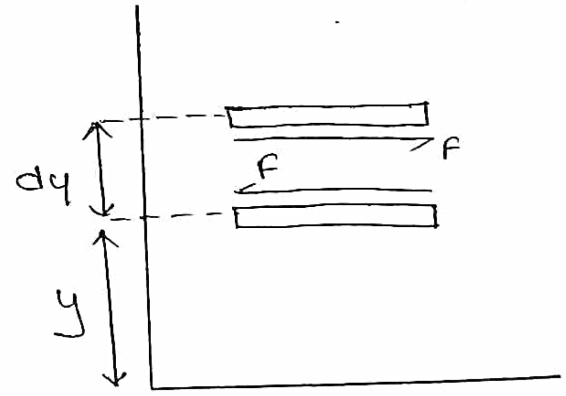
Specific gravity of water at standard temperature is 1.

(5) Viscosity:

Viscosity is defined as, property of fluid which offers resistance to the movement of one layer of fluid over another adjacent layer of fluid.



fig(1) velocity profile of parallel flow of fluid



fig(2) Two adjacent Layers of moving fluid.

Consider a flow in which all fluid particles are moving in the same direction in such a way that fluid la[yers] move parallel with different velocities fig(
Fig(2) represents 2 adjacent layers of flui[d]
a distance y from reference axis. When t[he]
layers of liquid at a distance of dy apar[t]
moving one over the other at different velocities, the top layer causes shear stress adjacent lower layer, while the lower laye[r] causes shear stress on adjacent top layer. ∴
shear stress is proportional to rate of cha[nge]
of velocity with respect to y.

Mathematically, $\tau \propto \frac{du}{dy}$

$$\tau = \mu \frac{du}{dy} \longrightarrow (1)$$

where, μ = coefficient of dynamic viscosit[y]

$\frac{du}{dy}$ = rate of change of shear strain or velocity gradient.

From (1), we have $\mu = \frac{\tau}{du/dy} \longrightarrow (2)$

[Thus viscosity is also defined as shear stress required to produce unit rate of shear strain.]

[unit is Ns/m^2]

Kinematic viscosity (ν)

It is defined as the ratio of dynamic viscosity to density of fluid.

$$\nu = \frac{\text{dynamic viscosity}}{\text{mass density}} = \frac{\mu}{\rho}$$

Unit is m^2/s

Newton's law of Viscosity

It states that shear stress τ on a fluid element layer is directly proportional to the rate of shear strain.

$$\tau \propto \frac{du}{dy}$$

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

Variation of Viscosity with temperature

Temperature affects the viscosity. The viscosity of liquid decreases with the increase of temperature while the viscosity of gases increases with increase of temperature. This is due to the reason that the viscous forces of a fluid are due to cohesive forces and molecular momentum transfer. In liquids the cohesive forces predominates the molecular momentum transfer due to the closely packed molecules and with the increase in temperature cohesive forces .... with the result of decreasing viscosity. But in cases of gases, the cohesive forces are small and molecular momentum transfer predominates, with increase in temperature, molecular momentum transfer increases and hence viscosity increases.

The relation between viscosity and temperature for liquids and gases are:

(i) For liquids, $\mu = \mu_0 \left(\frac{1}{1 + \alpha t + \beta t^2} \right)$ ⟶ (1)

where, μ = viscosity of liquid at t°c in poise

μ_0 = viscosity of liquid at 0°c in poise

α and β are constants.

For water $\mu_0 = 1.79 \times 10^{-3}$ poise, $\alpha = 0.03368$ and $\beta = 0.000221$

Thus eq (1) shows that with increase of temperature the viscosity decreases.

(ii) For gas,

$$\mu = \mu_0 + \alpha t - \beta t^2 \longrightarrow (2)$$

where for air $\mu_0 = 0.000017$, $\alpha = 0.00000005$[illegible], $\beta = 0.1189 \times 10^{-9}$, eq (2) shows that with increase of temperature viscosity increases.

① Hydrostatic Pressure on Surfaces: Civil.

Total Pressure force:

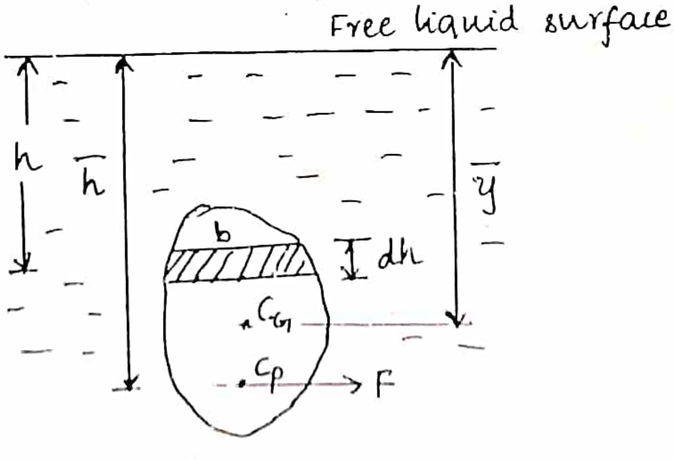
It is defined as the force exerted by static fluid on a surface (either plane or curved) when the fluid comes in contact with the surface. This force is always at right angles (or normal) to the surfaces.

Centre of Pressure:

It is defined as the point of application of the total pressure on the surface. There are four cases of submerged surfaces on which the total pressure force and centre of pressure is to be determined. The submerged surfaces may be:

1. Vertical plane surface
2. Horizontal plane surface
3. Inclined plane surface
4. Curved surface.

Vertical plane surface submerged in liquid:



consider a plane vertical surface of arbitrary shape immersed in a static mass of liquid. of specific weight w as shown in fig. Let 'A' be the total of surface.

C_G - centroid of plane surface

$\bar{y}$ - Distance of C_G of area from free surface of liquid

F - Total pressure force

C_p - centre of pressure

$\bar{h}$ - Distance of C_p from free surface of liquid

consider a strip of thickness dh and width b at a depth of h from free surface of liquid as shown in the figure.

Pressure intensity on strip $P = wh$

Area of strip, $dA = b \cdot dh$

Then pressure force on elemental strip

i.e. $dF = p \times dA$

$= wh \times dA$

$\therefore$ Total pressure on the whole surface

$$F = \int dF = \int wh \, dA$$

$$F = w \int h \, dA$$

From basic principle of mechanics,

$$\int h \, dA = A\bar{y}$$

$\therefore$ Total pressure force $\boxed{F = wA\bar{y}}$

To f
pre
c
n

To find the position of total pressure i.e. centre of pressure,

Centre of pressure is calculated by using principle of moments which states that moments of the resultant force about an axis is equal to sum of moments of its components about the same axis.

Moment of force F about the surface of liquid is equal to $= F \times \bar{h}$ $\longrightarrow$ ①

Moment of force dF acting on the strip about the free liquid surface $= dF \times h$

$= wh \cdot b \cdot dh \cdot h$.

$= wh^2 b\, dh$.

Sum of moments of all such forces about free surface of liquid $= \int wh^2 b\, dh$. $\quad dA = b \cdot dh$

$= w \int h^2 dA$

But $\int h^2 dA$ = moment of inertia of the surface about free liquid surface

$\int h^2 dA = I_0$

$= w I_0$ $\longrightarrow$ ②

Equating ① and ②

$F \times \bar{h} = w I_0$

We know $F = wA\bar{y}$

$\bar{h} = \frac{w I_0}{F}$

$\bar{h} = \frac{w I_0}{w A \bar{y}}$

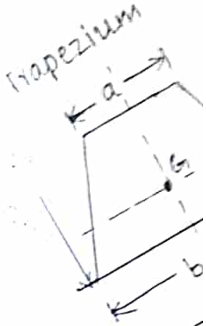
$$\boxed{\bar{h} = \frac{I_0}{A\bar{y}}}$$

By parallel axis theorem

$I_0 = I_G + A(\bar{y})^2$

$$\boxed{\bar{h} = \frac{I_G}{A\bar{y}} + \bar{y}}$$

$\frac{I_G + A\bar{y}^2}{\quad}$



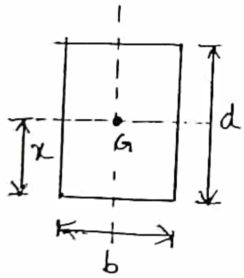
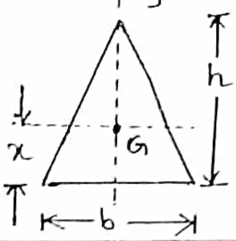
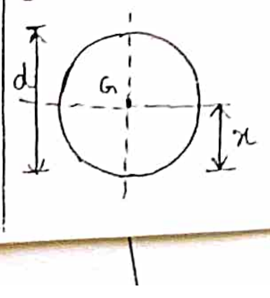
I_G - Moment of inertia of area about an axis through CG of area and parallel to the free of liquid

From the above equation it is clear that,

(1) centre of pressure $\bar{h}$ lies below C.G of the ver surface

(2) The distance of the centre of pressure from the free surface of liquid is independent of the density of the liquid.

<u>Moment of Inertia & other geometric properties of some important plane surfaces.</u>

Plane surface	CG from the base	Area	Moment of inertia about an axis passing through C.G and parallel to base (I_G)	Moment of inertia about base (I_0)
1. Rectangle 	$x = d/2$	bd	$\frac{bd^3}{12}$	$\frac{bd^3}{3}$
2. Triangle 	$x = h/3$	$\frac{bh}{2}$	$\frac{bh^3}{36}$	$\frac{bh^3}{12}$
3. Circle 	$x = d/2$	$\frac{\pi d^2}{4}$	$\frac{\pi d^4}{64}$	-

oment

$\bar{h}'$ - distance of C_p from O-O

Consider a small strip of area dA at a depth, the free liquid surface and at a distance $\bar{h}$ from as shown in fig.

1) To find the total pressure (F)

Pressure intensity on strip $p = w \times h$

Pressure force on the strip $dF = p \times dA$

$= w \times h \times dA$

Total pressure on the whole area,

$$F = \int dF = w \int h \, dA$$

From fig, $\frac{h}{h'} = \frac{\bar{y}}{\bar{y}'} = \frac{\bar{h}}{\bar{h}'} = \sin\theta$

$$h = h' \sin\theta$$

$$F = w \int h' \sin\theta \, dA$$

$$= w \sin\theta \int h' \, dA$$

we know $\int h' \, dA = A\bar{y}'$

$$F = w \sin\theta \, A \bar{y}'$$

$$\boxed{F = wA\bar{y}' \sin\theta}$$

we know, $\bar{y}' \sin\theta = \bar{y}$

$$\boxed{F = wA\bar{y}}$$

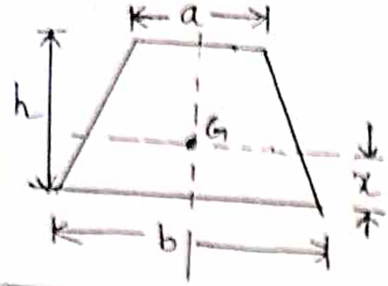
Note: Therefore for a plane surface is submerged in a static mass of liquid held vertical or inclined,

Total pressure = Product of pressure intensity at the centroid of area and the area of the plane surface.

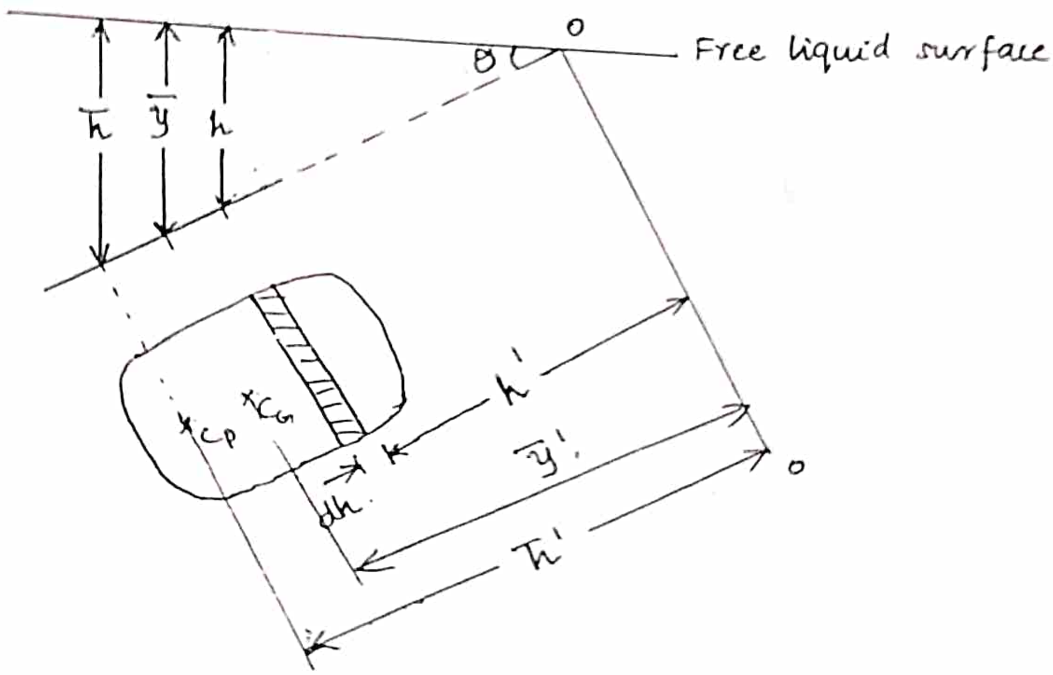
(ii) To find centre of pressure ($\bar{h}$)

Pressure force on the strip $dF = whdA$

$= wh' \sin\theta . dA$

4. Trapezium 	$x = \left(\frac{2a+b}{a+b}\right)\frac{h}{3}$	$\left(\frac{a+b}{2}\right)\times h$	$\left(\frac{a^2+4ab+b^2}{36(a+b)}\right)\times h^3$	—

Inclined Plane surface submerged in liquid :



Consider a plane surface of arbitrary shape immersed in a static mass of liquid of specific weight 'w' in such a way that the plane of surface makes angle θ with the free surface of liquid as shown in fig. Let A - total area of inclined surface

$\bar{y}$ - depth of C_G of area from free liquid surface

$\bar{h}$ - Distance of centre of pressure from free liquid surface

Let $\bar{y}'$ = Distance of C_G of the ~~sin~~ Inclined surface from o-o.

(Q) Dynamics of fluid flow is the study of fluid motion with the forces causing flow. The dynamic behaviour of the fluid flow is analysed by the Newton's second law of motion, which relates the acceleration with the forces. The fluid is assumed to be incompressible and non viscous.

Equations of Motion:

According to Newton's second law of motion, the net force F_x acting on a fluid element in the direction of x is equal to mass m of the fluid element multiplied by the acceleration a_x, in the x direction.

Thus mathematically,

$$F_x = m.a_x \longrightarrow (1)$$

In the fluid flow, following forces are present.

(i) F_g, Gravity force

(ii) F_p, Pressure force

(iii) F_v, Force due to viscosity

(iv) F_t, Force due to turbulence

(v) F_c, Force due to compressibility

Thus eqn (1), the net force,

$$F_x = (F_g)_x + (F_p)_x + (F_v)_x + (F_t)_x + (F_c)_x$$

If the force due to compressibility F_c is negligible, the resulting net force,

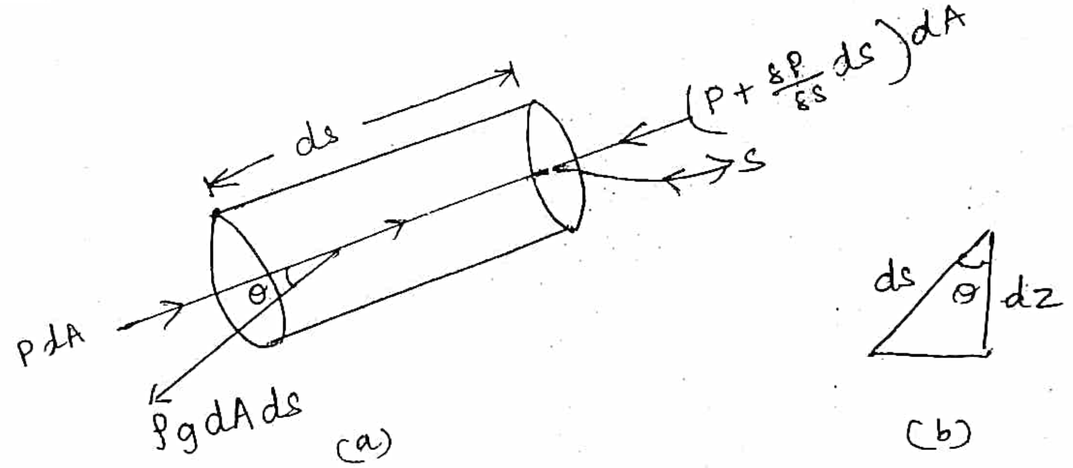
$$F_x = (F_g)_x + (F_p)_x + (F_v)_x + (F_t)_x$$

and equation of motions are called "Reynolds equations of motion".

(ii) For flow, where F_t is negligible, the resulting equation of motion are known as "Navier Stroke equation".

(iii) If the flow is assumed to be ideal, viscous force F_v is zero. and equation of motion are known as Eulers equation of motion.

Euler's Equation Of Motion:



In this equation the forces due to gravity and pressure are taken into consideration. Consider a stream in which flow is taking place in s direction as shown in figure.

Consider the cylindrical element of cross section dA and length ds. The forces acting on the cylindrical element are

(1) Pressure force $p.dA$ in the direction of flow

(2) Pressure force $\left(p + \frac{\delta p}{\delta s}.ds\right) dA$ opposite to the direction of flow.

3) Weight of the element $\rho g\, dA . ds$

Let θ be angle between direction of flow and line of action of weight of the element

Resultant force on the element in the direction of flow S

S = (mass of fluid element) × (acceleration in direction S.)

$$\therefore \; P dA - \left(P + \frac{\delta P}{\delta s} . ds\right) dA - \rho g dA \cos\theta . ds$$

$$= \rho dA . ds . a_s \longrightarrow (2)$$

where a_s is the acceleration in the direction of s.

Now $a_s = \frac{dv}{dt}$, where v is the function of s and t.

$$= \frac{dv}{\delta s} . \frac{ds}{dt} + \frac{\delta v}{\delta t}$$

$$\because \frac{ds}{dt} = v$$

$$a_s = v . \frac{\delta v}{\delta s} + \frac{\delta v}{\delta t}$$

If the flow is steady, $\frac{\delta v}{\delta t} = 0$

$$\therefore \; a_s = v . \frac{\delta v}{\delta s}$$

Substituting the value of a_s in equation (2) and simplifying the equation, we get.

$$-\frac{\delta P}{\delta s} . ds . dA + PdA - PdA - \rho g dA \cos\theta \, ds = \rho . dA . ds . v . \frac{\delta v}{\delta s}$$

Dividing by $\rho \, dA . ds$.

$$-\frac{1}{\rho}\frac{\delta P}{\delta s} - g \cos\theta = v . \frac{\delta v}{\delta s}$$

(From fig(b) $\because \cos\theta = \frac{dz}{ds}$)

$$\text{or} \quad \frac{1}{\rho} . \frac{\delta P}{\delta s} + g . \frac{dz}{ds} + v . \frac{\delta v}{\delta s} = 0$$

or. $$\frac{dP}{\rho} + g \cdot dz + V \cdot dV = 0 \longrightarrow (3)$$

Equation (3) is known as Euler's equation of motion.

Bernoulli's Equation from Euler's Equation

Bernoulli's equation is obtained by integrati the Euler's equation of motion (3) as..

$$\int \frac{dP}{\rho} + \int g \cdot dz + \int v \cdot dv = \text{constant}$$

If the flow is incompressible, ρ is constant and

$$\frac{P}{\rho} + gz + \frac{v^2}{2} = \text{constant}$$

Divide by g throughout

$$\frac{P}{\rho g} + z + \frac{v^2}{2g} = \text{constant} \longrightarrow (4)$$

Equation (4) is called Bernoulli's equation in which,

$\frac{P}{\rho g}$ = Pressure energy per unit weight of fluid or pressure head

$\frac{v^2}{2g}$ = Kinetic energy per unit weight or Kinetic head.

z = potential energy per unit weight or potential head.

Statement of Bernoulli's Theorem:

It states that in a steady, ideal flow of an incompressible fluid, the total energy at any point of the fluid is constant. The total energy consists of pressure energy, kinetic energy and potential energy or datum energy.

These energies per unit weight of the fluid are

Pressure energy $= \frac{P}{\rho g}$

Kinetic energy $= \frac{v^2}{2g}$

Datum energy $= z$.

Thus mathematically Bernoulli's theorem is written as

$$\frac{P}{\rho g} + \frac{v^2}{2g} + z = \text{constant.}$$

Assumptions

The following assumptions are made in the derivation of Bernoulli's equation

(1) Fluid is ideal i.e. viscosity is zero

(2) Flow is steady and continuous

(3) Flow is incompressible

(4) Flow is irrotational

(5) The flow is along the streamline, i.e. it is one dimensional.

(6) The velocity is uniform over the section and is equal to mean velocity

(7) The only forces acting on fluid are gravity and pressure forces.

P....

MODULE - 4

ORIFICE AND MOUTHPIECE

INTRODUCTION :

"An orifice" is an opening in the wall or base of a ve[ssel] through which the fluid flows. The top edge of the ori[fice] is always below the free surface (If the free surface i[s] below the top edge of the orifice, becomes a weir.

"A mouthpiece" is an attachment in the form of a small tube or pipe fixed to the orifice (the length o[f] pipe extension is usually 2 to 3 times the orifice diameter) and is used to increase the amount of discharge.

Orifices and mouthpieces are used to measure the discharge. or rate of flow.

Classification of Orifices:

The orifices are classified as follows :

1. According to size
   (i) Small orifice
   (ii) Large orifice

An orifice is termed as small when its dimension are small compared to the head causing flow. The velocity doesnot vary appreciably from top to the bottom edge of the orifice and is assumed to be uniform.

The orifice is large if the dimensions are comparable with the head causing flow. The variatio[n] in the velocity from the top to the bottom edge is considerable.

" If the head of liquid from the centre of orifice is more than five times the depth of orifi[ce] it is called small

Limitations of Bernoulli's equation :-

(1) Curved Path: If the fluid is flowing in a cur... path, the energy due to centrifugal force should also be considered

(2) Heat: If heat is added or taken from the fluid between the initial and final points and especially if there is a change of state from liquid to vapour or the reverse, the additional terms representing the intrinsic thermal energy per unit weight of the fluid must be added to both the sides of Bernoulli's equation.

(3) Machine: If there is machine in a pipeline to add or subtract energy Ex a pump or reaction turbine, the head added or subtracted by machi... must be included as another term in Bernoulli's equation.

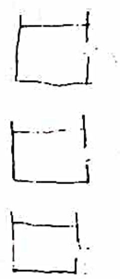
(4) Types of flow: The Bernoulli's theorem applied along any laminar or stream line flow of a liquid at constant density and temperature when acted upon by no outside forces except gravity.

" If the head of liquid is less than five times the depth of orifice, it is knowns as Large orifice".

2. According to shape:
   i) Circular orifice
   ii) Rectangular orifice
   iii) Square orifice
   iv) Triangular orifice

3. Shape of upstream edge:
   i) Sharp- edged orifice
   ii) Bell- mouthed orifice

4. According to discharge conditions:
   i) Free discharge orifices
   ii) Drowned or submerged orifices
      (a) Fully submerged
      (b) Partially submerged



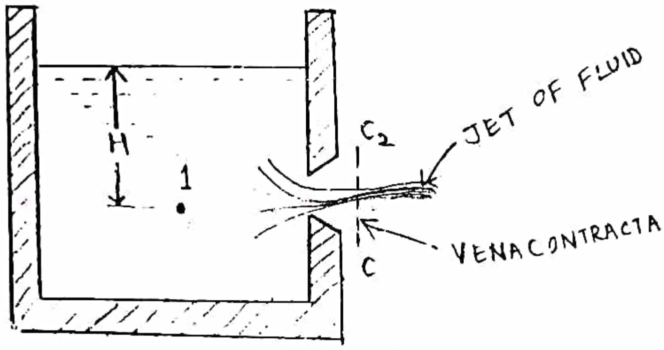
Note: An orifice or a mouthpiece is said to be discharging free when it discharges into atmosphere. It is said to be submerged when it discharges into another liquid.

5. Based on position: (i) Side of vessel wall (ii) Bottom of vesse

FLOW THROUGH AN ORIFICE

Consider a tank fitted with a circular orifice in one of its sides as shown in Fig. Let H be the head of the liquid above the centre of the orifice. The liquid flowing through the orifice forms a jet of liquid whose area of cross section is less than that of orifice.
The area of jet of fluid goes on decreasing and at a section C-C, the area is minimum. This section is approximately at a distance of half of diameter of the

of the orifice. At this section, the streamlines are straight and parallel to each other and perpendicular to the plane of the orifice. This section is called Venacontracta. Beyond this section, the jet diverges and is attracted in the downward direction by the gravity.



TANK WITH AN ORIFICE

Consider two points 1 and 2 as shown in Fig. Point 1 is inside the tank and point 2 at the vena contracta. Let the flow is steady and at a constant head H. Applying Bernoulli's equation at points 1 and 2

$$\frac{P_1}{\rho g} + z_1 + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + z_2 + \frac{V_2^2}{2g}$$

But $z_1 = z_2$

$$\therefore \quad \frac{P_1}{\rho g} + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g}$$

Now $\frac{P_1}{\rho g} = H$

$\frac{P_2}{\rho g} = 0$ (atmospheric pressure)

V_1 is very small in comparision to V_2 as area of tank is very large as compared to the area of the jet of liquid

$$H + 0 = 0 + \frac{V_2^2}{2g} \Rightarrow \boxed{V_2 = \sqrt{2gH}} \quad (2)$$

... Actual velocity will be less than

HYDRAULIC COEFFICIENTS :

The hydraulic coefficients are :-

1. Coefficient of velocity , C_V
2. Coefficient of contraction, C_c
3. Coefficient of discharge C_d

1. Coefficient of Velocity (C_v) :

It is defined as the ratio between the actual velocity of a jet of liquid at vena contracta and the theoritical velocity of jet. $C_v = \frac{\text{Actual velocity of Jet at Vena contracta}}{\text{Theoritical velocity}}$

$$= \frac{V}{\sqrt{2gH}}$$

where V = actual velocity ; $\sqrt{2gH}$ = Theoritical velocity

The value of C_v varies from 0.95 to 0.99. for different orifices, depending on the shape, size of the orifice, and on the head under which flow takes place.
Generally value of $C_v = 0.98$ is taken for sharp edged orifices.

2. Coefficient of contraction : (C_c) :

It is defined as the ratio of the area of jet at vena contracta to area of the orifice.

$$C_c = \frac{\text{area of jet a vena contracta}}{\text{area of orifice}}$$

$$C_c = \frac{a_c}{a_o}$$

The value of C_c varies from 0.61 to 0.69 depending

Experimental Determination of Hydraulic coefficients

Determination of coefficient of Discharge (Cd) :

The water is allowed to flow through an orifice fitted to a tank under constant head H as shown in fig. The water is collected in a measuring tank for a known time t. The height of water in measuring tank is noted down. Then actual discharge through orifice,

$$Q = \frac{\text{Area of measuring tank} \times \text{Height of water in measuring tank}}{\text{Time}}$$

Theoritical discharge = area of orifice × $\sqrt{2gH}$

$$C_d = \frac{Q}{a \times \sqrt{2gH}}$$

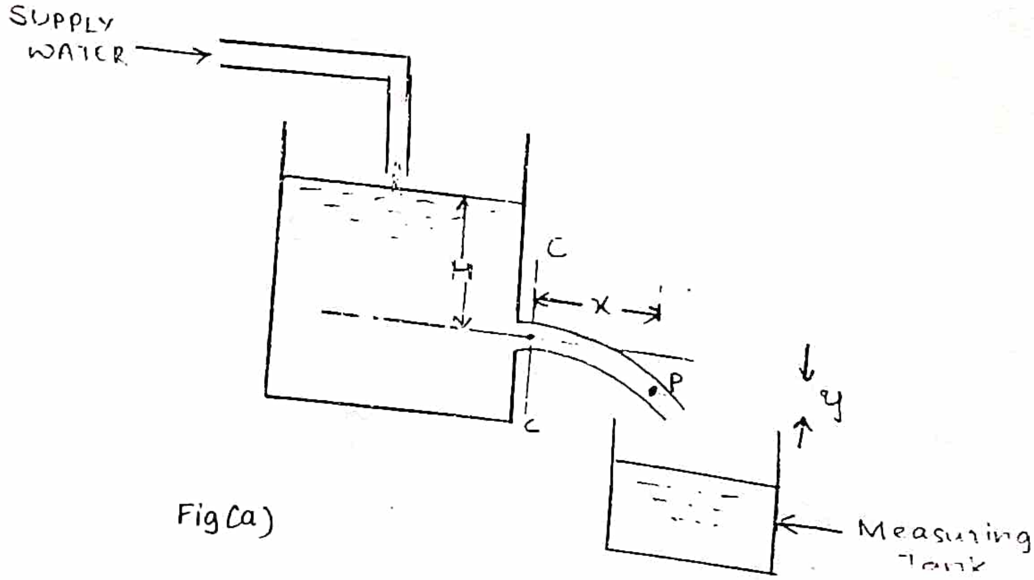


Fig (a)

Determination of coefficient of velocity (C_v)

Let C-C represents the vena contracta of jet of water coming out from an orifice under constant head H as shown in Fig(a). Consider a liquid particle which is at vena contracta at any time and takes the position at P along the jet in time 't' on shape and size of the orifice and head of liquid under which ~~water~~ flow takes place. In general, value of C_c may be taken as 0.64.

3. Coefficient of Discharge (C_d):

It is defined as the ratio of the actual discharge from an orifice to the theoritical discharge from the orifice.

$$C_d = \frac{Q}{Q_{th}} = \frac{\text{Actual discharge}}{\text{Theoritical discharge}}$$

$$= \frac{\text{Actual velocity} \times \text{Actual area}}{\text{Theoritical velocity} \times \text{Theoritical area}}$$

$$C_d = C_v \times C_c$$

The value of C_d varies from 0.61 to 0.65.
For general purpose C_d is taken as 0.62.

4. Coefficient of Resistance (C_r)

The ratio of loss of head (or loss of kinetic energy) in the orifice to the head of water (actual kineti energy) available at the exit of the orifice is known as coefficient of resistance.

$$C_r = \frac{\text{Loss of head in the orifice}}{\text{Head of water}}$$

The loss of head in the orifice takes place, because the walls of the orifice offer some resistance to the liquid as it comes out. While solving the numerical problems C_r is generally neglected.

Module - 5

Introduction:

The term pipe is used to indicate the closed conduit which is used for carrying the fluids under pressure. Such a flow is known as a pipe flow.

The pipes always run full because they carry the fluid under pressure. Thus, the flow in a pipe which does not run full cannot be treated as a pipe flow.

Loss of Energy or Head in Pipes:

When a fluid is flowing through a pipe, the fluid experiences some resistance due to which some of the energy of fluid is lost. This loss of energy is classified as :-

Energy Losses:

(1) Major Energy losses

This is due to friction and it is calculated by the following formulae:

(a) Darcy Weisbach Formula
(b) Chezy's Formula

(2) Minor Energy Losses

This is due to .

(a) Sudden expansion of pip.
(b) Sudden contraction of pipe
(c) Bend in pipe
(d) Pipe fittings etc
(e) An obstruction in pipe

Minor losses in a pipe occurs due to change in magnitud or direction of flow.

Loss of Energy due to Friction:

(a) Darcy Weisbach Formula :-

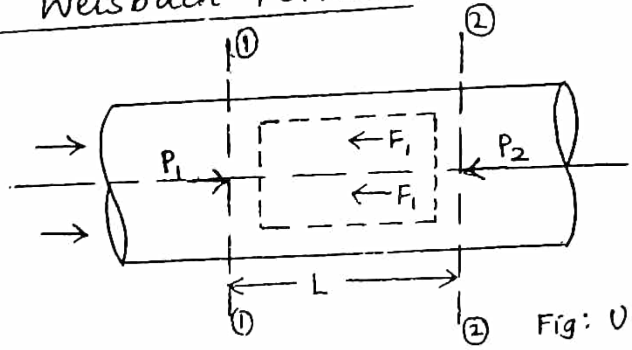


Fig: Uniform Horizontal Pipe

$F_1 = f' \times \pi d L \times V^2$ [Wetted area $= \pi d \times L$, Velocity $= V = V_1 = V_2$, Perimeter $P = \pi d$]

$= f' \times P \times L \times V^2$

Forces acting on the fluid between section 1-1 and 2-2 are

(1) Pressure force at section 1-1 $= P_1 \times A$

where A = Area of pipe

(2) Pressure force at section 2-2 $= P_2 \times A$

(3) Frictional force F_1

Resolving the forces in the horizontal direction, we have

$$P_1 A - P_2 A - F_1 = 0$$

$$(P_1 - P_2) A = F_1$$

$$(P_1 - P_2) A = f' \times \pi d L \times V^2$$

$$(P_1 - P_2) = \frac{f' \times \pi d L \times V^2}{A}$$

From Equation ①, $P_1 - P_2 = \rho g h_f$

$$\rho g h_f = \frac{f' \times \pi d L \times V^2}{A} = \frac{f' \times P \times L V^2}{A}$$ $P = \pi d$ = Perimet

$$h_f = \frac{f'}{\rho g} \times \frac{P}{A} \times L \times V^2 \longrightarrow ③$$

In equation ③ $\frac{P}{A} = \frac{\text{Wetted Perimeter}}{\text{Area}} = \frac{\pi d}{\pi d^2/4} = \frac{4}{d}$

$$h_f = \frac{f'}{\rho g} \times \frac{4}{d} \times L V^2 \longrightarrow ④$$

Putting $\frac{f'}{\rho} = \frac{f}{2}$, where f is known as coefficient of friction or friction factor

Equation ④ becomes $h_f = \frac{4 f L V^2}{2 g d} \longrightarrow ⑤$

where $f = \frac{16}{Re}$ For $(Re < 2000)$; $f = \frac{0.079}{Re^{1/4}}$ for $(Re > 4000)$

Consider a uniform horizontal pipe having flow as shown in fig. Let 1-1 and 2-2 are two ... of pipe.

Let P_1 = Pressure intensity at section 1-1

V_1 = Velocity of flow at section 1-1

L = Length of the pipe between sections 1-1 and 2-2.

d = diameter of pipe

f' = frictional resistance per unit wetted area per uni velocity

h_f = Loss of head due to friction

and P_2, V_2 are values of pressure intensity and velocity at section 2-2.

Applying Bernoulli's equation between sections 1-1 and
(Total head at 1-1) = (Total head at 2-2) + (Loss of head due friction between 1-1 and 2-2)

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2 + h_f$$

But $Z_1 = Z_2$, since the pipe is horizontal.

$V_1 = V_2$ as diameter of pipe is same at 1-1 and 2-2.

$$\therefore \frac{P_1}{\rho g} = \frac{P_2}{\rho g} + h_f$$

$$h_f = \frac{P_1}{\rho g} - \frac{P_2}{\rho g} \longrightarrow ①$$

But h_f is the head loss due to friction and hence intensity of pressure will be reduced in the direction of flow by frictional resistance.

Now frictional resistance

= (frictional resistance per unit wetted area per unit velocity) × (wetted area) × $(\text{velocity})^2$

Equation ⑤ is known as Darcy Weisbach equation. This equation is commonly used for finding loss of head due to friction in pipes.

Consider ...

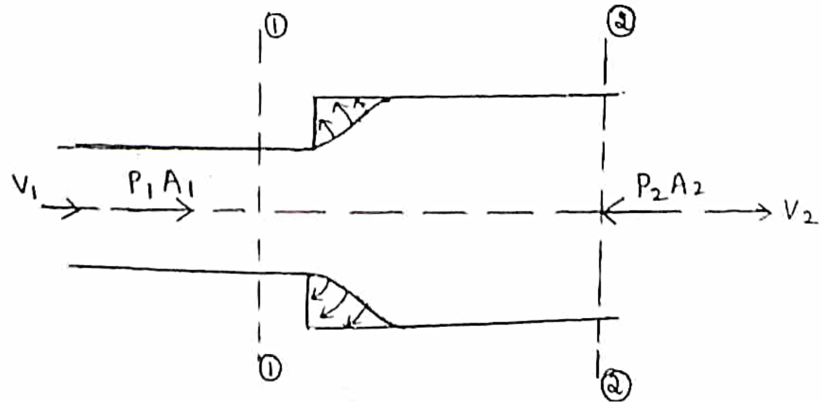
Minor Energy (Head) Losses :-

The loss of head due to friction in a pipe is known as major loss while the loss of energy due to change velocity of the ~~flo~~ following fluid in magnitude or direction is called minor loss of energy. The minor lose of energy includes following cases :-

(1) Loss of head due to sudden enlargement
(2) Loss of head due to sudden contraction
(3) Loss of head at the entrance of pipe
(4) Loss of head at the exit of pipe
(5) Loss of head due to an obstruction in a pipe
(6) Loss of head due to bend in the pipe
(7) Loss of head in various pipe fittings

In case of long pipes the above losses are small when compared with the loss of head due to friction. and hence they are called minor losses and even may be neglected without serious error. But in case of short pipe, these losses are comparable with the loss of head due to friction.

Loss of head Due to Sudden Enlargement



Consider a liquid flowing through a pipe which has a sudden enlargement as shown in figure.

consider 2 sections (1-1) and (2-2) before and after the enlargement. Let P_1 = pressure intensity at section (1-1)

A_1 = Area of pipe at section (1-1)

V_1 = Velocity of flow at section (1-1)

P_2, A_2, V_2 are corresponding values at section (2-2).

Due to sudden change of diameter of pipe from d_1 to d_2. The liquid flowing from smaller pipe is not able to follow the abrupt change of boundary. Thus the flow separates from boundary and turbulent eddies are formed as shown in figure. The loss of head takes place due to formation of these eddies. Let p' is the pressure intensity of liquid eddies on the area $(A_2 - A_1)$

h_e is the loss of head due to sudden expansion.

Applying Bernoulli's equation between section (1-1) and (2-2)

$$\frac{P_1}{w} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{w} + \frac{V_2^2}{2g} + z_2 + h_e$$

But $z_1 = z_2$ As pipe is horizontal

$$\frac{P_1}{w} + \frac{V_1^2}{2g} = \frac{P_2}{w} + \frac{V_2^2}{2g} + h_e$$

$$h_e = \frac{(P_1 - P_2)}{w} + \frac{(V_1^2 - V_2^2)}{2g} \longrightarrow (1)$$

Consider the control volume of liquid between sections (1-1) and (2-2)

Force acting on the liquid in the control volume in the direction of flow is given by,

$$F_x = P_1 A_1 + P'(A_2 - A_1) - P_2 A_2$$

But experimentally it was found that $P' = P_1$

$$h_e = \frac{P_1 - P_2}{w} + \frac{(V_1^2 - V_2^2)}{2g}$$

From ⑤ we know $\frac{P_1 - P_2}{w} = \frac{V_2^2 - V_2 V_1}{g}$

$$h_e = \frac{V_2^2 - V_2 V_1}{g} + \frac{V_1^2 - V_2^2}{2g}$$

$$= \frac{2V_2^2 - 2V_1 V_2 + V_1^2 - V_2^2}{2g}$$

$$h_e = \frac{V_2^2 + V_1^2 - 2V_1 V_2}{2g}$$

$$\boxed{h_e = \frac{(V_1 - V_2)^2}{2g}}$$

Note :--

1) Loss of head due to sudden Enlargement

$$h_e = \frac{(V_1 - V_2)^2}{2g}$$

2) Loss of head due to sudden contraction

$$h_c = \frac{0.5 V_2^2}{2g}$$ if C_c [coefficient of contraction] is given

$$h_c = \frac{k V_2^2}{2g} \quad \text{where } k = \left(\frac{1}{C_c} - 1\right)^2$$

3) Loss of head at the entrance of pipe

$$h_i = \frac{0.5 V_1^2}{2g}$$

4) Loss of head at the exit of pipe

$$h_o = \frac{V_2^2}{2g}$$

5) Loss of head due to obstruction in pipe

$$= \frac{V^2}{2g}\left[\frac{A}{4(A-a)} - 1\right]^2$$

$$F_x = P_1A_1 + P_1(A_2 - A_1) - P_2A_2$$

$$F_x = (P_1 - P_2)A_2 \longrightarrow (2)$$

Net force = Rate of change of momentum

$$= \begin{pmatrix} \text{Moment of liquid per sec} \\ \text{at section (2-2)} \end{pmatrix} - \begin{pmatrix} \text{Momentum of liqu} \\ \text{per sec at section 1-} \end{pmatrix}$$

Momentum of liquid per sec at section 1-1 $= \left(\frac{\text{Mass}}{\text{sec}}\right) \times$ velocity

$$= (\rho A_1 V_1) \times V_1$$

$$= \rho A V_1^2$$

Similarly momentum of liquid per second at section 2-2 $= \left(\frac{\text{Mass}}{\text{sec}}\right) \times$ Velocity

$$= (\rho A_2 V_2) \times V_2$$

$$= \rho A_2 V_2^2$$

∴ Rate of change of momentum

$$= \rho A_2 V_2^2 - \rho A_1 V_1^2 \longrightarrow (3)$$

By continuity equation $Q = A_1V_1 = A_2V_2$

$$A_1 = \left(\frac{V_2}{V_1}\right) \times A_2$$

∴ Equation (3) becomes

Change of momentum/second $= \rho A_2 V_2^2 - \rho\left(\frac{V_2}{V_1}\right) A_2 \times V_1^2$

$$= \rho A_2 (V_2^2 - V_1V_2) \longrightarrow (4)$$

Equating (2) and (4)

$$(P_1 - P_2)A_2 = \rho A_2 (V_2^2 - V_1V_2)$$

Divide both sides by g

$$\frac{P_1 - P_2}{\rho g} = \frac{V_2^2 - V_1V_2}{g}$$

$$\frac{P_1 - P_2}{w} = \frac{V_2^2 - V_1V_2}{g} \longrightarrow (5)$$

CBCS SCHEME

USN | | | | | | | | | | |

18CV33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define the following terms: (i) Ideal fluids and Real fluids.
(ii) Surface tension and capillarity. (06 Marks)

b. State Newton's law of viscosity. Derive an expression for the same. (06 Marks)

c. The space between the two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine the dynamice viscosity of the oil in poise. Also find the kinematic viscosity of the oil in stokes, if the specific gravity of the is 0.95. (08 Marks)

OR

2 a. Explain with neat sketches the differential manometer and simple manometer. (06 Marks)

b. Calculate the gauge pressure and absolute pressure at a point 3 m below the free surface of a liquid having a density of $1.53\times10^3\ kg/m^3$, if the atomospheric pressure is equivalent to 750 mm of mercury. (06 Marks)

c. Petrol of specific gravity 0.8 flows upwards through a vertical pipe. A and B are two points in the pipe, B being 0.3 m higher than A. Connections are led from A and B to a U tube containing mercury. If the difference of pressure between A and B is 0.18 kgf/cm^2. Find the difference in the mercury level in the differential manometer (08 Marks)

Module-2

3 a. Derive an expression for total pressure and centre of pressure on an inclined plane surface submerged in the liquid. (08 Marks)

b. A circular plate of 3 m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and position of centre of pressure. (06 Marks)

c. In a two dimensional flow, $\phi = 3xy$ and $\psi = \frac{3}{2}\left(y^2 - x^2\right)$. Determine the velocity components at the points (1, 3) and (3, 3). Also find the discharge passing between the streamlines passing through the points given above. (06 Marks)

OR

4 a. Define : (i) Uniform flow and Non uniform flow.
(ii) Steady and Unsteady flow.
(iii) Velocity potential and stream function. (06 Marks)

b. A vertical gate closes a horizontal tunnel 3 m high and 3 m wide running full with water. The pressure at the bottom of the gate is 196.2 kN/m^2. Determine the total pressure on the gate and position of the centre of pressure. (08 Marks)

c. Show that streamlines and equipotential lines form a set of perpendicular lines. (06 Marks)

Module-3

5 a. Obtain an expression for Euler's equation of motion along a stream line and deduce it to Bernoulli's equation. (08 Marks)

b. Define impulse momentum equation and give its applications. (04 Marks)

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Department of Civil Engineering

Note : Answer any one full question from each Part.

Q. No.	Question	Marks	RBT Levels
	MODULE 2		
3 a.	**Derive** the expressions for total pressure and centre of pressure for a plane surface submerged vertically in a liquid	07	L2
b.	**Determine** the total force and location of centre of pressure for a circular plate of 2 m diameter immersed vertically in water with its top edge 1.0 m below the water surface 2.125 m.	08	L3
	OR		
4 a.	**Derive** an expression for Continuity Equation for three dimensional flow	05	L2
b.	**Distinguish** between 1. Steady and unsteady flow 2. uniform and non-uniform flow	03	L1
c.	The velocity field in a fluid is given by, $V = (3x + 2y)\,\mathbf{i} + (2z + 3x^2)\mathbf{j} + (2t - 3z)\mathbf{k}$ i. **Determine** the velocity components u, v, and w ? ii. **Determine** the speed at the point (1,1,1). iii. **Determine** the speed at time t=2 s at point (0,0,2) $u = (3x + 2y)$, $v = (2z + 3x^2)$, $w = (2t - 3z)k$ 4.472 units	07	L3

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Sharathraj R.M.
Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

USN										

Course/Subject Title	Fluid Mechanics	**Course/Subject Code**	18CV33
Semester	III – A	**Scheme**	CBCS – 18
Date	08.12.2020	**CIE No.**	1
Time	9 to 10 AM	**Max. Marks**	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the fundamental properties of fluids
CO2	**Explain** the concept of fluid pressure and equipment for its measurement
CO3	**Calculate** the hydrostatic forces acting on surfaces and **explain** the kinematic concepts of fluid flow
CO4	**Apply** Euler's equation and Bernoulli's principle for the practical applications of fluid flow
CO5	**Compute** the discharge through channels and pipes
CO6	**Explain** the losses in pipe flow and effect of water hammer in pipe flow

Note : Answer any one full question from each Part.

Q. No.	Question	Marks	RBT Level	CO
	MODULE 1			
1 a.	**Define** the following fluid properties with units i) Mass density, ii) Specific gravity iii) Dynamic Viscosity, iv) Vapour pressure v) Capillarity	10	L1	CO1
b.	**Define** absolute pressure, vacuum pressure and gauge pressure with a neat sketch showing the relationship between them	5	L1	CO2
	OR			
2 a.	Write a note on i) Piezometer ii) U-tube manometer and iii) Differential manometer	6	L1	CO2
b.	Figure 1 shows a conical vessel having its outlet A to which a U-tube manometer is connected. The reading of the manometer given in the figure shows when the vessel is empty. **Determine** the reading of manometer when the vessel is completely filled with water. **OR** In Figure2, the air pressure in the left tank is 230mm of mercury (Vacuum). **Determine** height h in the right limb shown, if the liquid in the right tank is water.	9	L3	CO2

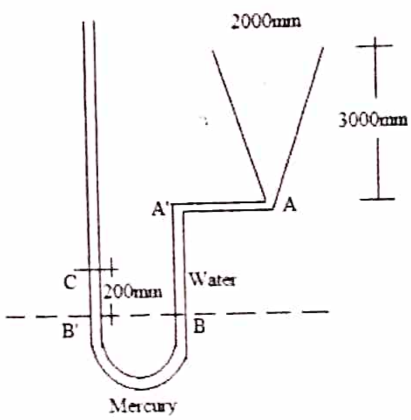

Figure 1

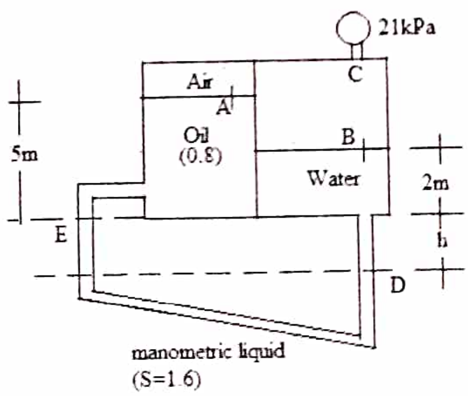

Figure 2

c. A 300 mm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/s. If the axis of the pipe turns through 45°. Find the magnitude and direction of the resultant force at the bend. (08 Marks)

OR

6 a. Derive the equation for discharge through venturimeter. (08 Marks)

b. A venturimeter is to be fitted in a pipe of 0.25 m diameter where the pressure head is 7.6 m of flowing liquid and the maximum flow is 8.1 m^3/minute. Find the diameter of the throat of the venturimeter. Take $C_d = 0.96$. (06 Marks)

c. A pipeline carrying oil of specific gravity of 0.87 changes in diameter from 200 mm at a point A to 500 mm diameter at point B which is 4 m higher. If the pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 ℓ/s. Determine the loss of head and direction of flow. (06 Marks)

Module-4

7 a. Define the hydraulic coefficients (C_C, C_d, C_V) of an orifice and obtain the relation between them. (06 Marks)

b. Explain the classification of orifice and mouthpiece based on their shape, size, sharpness and discharge. (06 Marks)

c. Water flows through a triangular right angled weir first and then over a rectangular weir of 1 m width. The C_d values of triangular and rectangular weir are 0.6 and 0.7 respectively. If the depth of water over the triangular weir is 360 mm, find the depth of water over the rectangular weir. (08 Marks)

OR

8 a. Explain Cipolletti notch. What is the advantage of Cipolletti notch over trapezoidal notch. (06 Marks)

b. Water discharge at the rate of 98.2 litre/sec through a 120 mm diameter vertical sharp edged orifice placed under a constant head of 10 m. A point on the jet measured from the venacontracta of the jet has co-ordinate (4.5, 0.54). Find the coefficients C_C, C_v, C_d of the orifice. (08 Marks)

c. Derive an expression for discharge through a V-notch. (06 Marks)

Module-5

9 a. Explain major and minor losses in a pipe flow. Give an expression for head loss due to sudden expansion in pipe line. (08 Marks)

b. Three pipes of lengths 800 m, 500 m and 400 m and of diameters 500 mm, 400 mm and 300 mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700 m. Find the diameter of the single pipe. (06 Marks)

c. What is the maximum permissible velocity in a cast iron pipeline 10 mm diameter and 15 mm thick which can be suddenly stopped by a valve at the outlet end of the pipe without letting the rise of pressure in the pipe to exceed 1.545×10^3 kN/m^2. Take E for cast iron = 123.606×10^9 N/m^2, K for water = 206.01×10^7 N/m^2. Neglect effect of Poisson's ratio. (06 Marks)

OR

10 a. Define the term compound pipe and equivalent pipe. Derive the expression for diameter of equivalent pipes. (06 Marks)

b. Explain Hardy cross method used in pipe networks. (06 Marks)

c. The population of a city is 8,00,000 and it is to be supplied with water from a reservoir 6.4 km away. Water is to be supplied at the rate of 140 litres per head per day and half the supply is to be delivered in 8 hours. The full supply level of the reservoir is RL 180.00 and its lowest water level is RL 105.00. The delivery end of the main is at RL 22.50 and the head required there is 12 m. Find the diameter of the pipe. Take f = 0.04. (08 Marks)

* * * * *

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Department of Civil Engineering

Assignment No.	1	Maximum Marks	10
Course/Subject Title	FLUID MECHANICS	Course/Subject Code	18CV33
Semester	III A	Scheme	CBCS – 18
Course Co-ordinator	Sharathraj R M		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the fundamental properties of fluids
CO2	**Explain** the concept of fluid pressure and equipment for its measurement
CO3	**Calculate** the hydrostatic forces acting on surfaces and **explain** the kinematic concepts of fluid flow
CO4	**Apply** Euler's equation and Bernoulli's principle for the practical applications of fluid flow
CO5	**Compute** the discharge through channels and pipes
CO6	**Explain** the losses in pipe flow and effect of water hammer in pipe flow

Note : Answer *all* the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Define absolute pressure, vacuum pressure and gauge pressure with a neat sketch showing the relationship between them	2.5	L2	1
2	Write a note on mechanical gauges	2.5	L2	2
3	Explain Eulerian and Lagrangian approach of fluid motion	2.5	L2	3
4	List methods of drawing Flow net and explain any two	2.5	L2	3

Last date for submission	**15**	**12**	**2020**

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Sharathraj R.M 11/12/2020 — **Course Coordinator (Faculty in charge)**

11/12/2020 — **Coordinator DQAC**

11/12/2020 — **Program Coordinator (HOD, Civil)**

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Department of Civil Engineering

Scheme of Valuation

2. a) Piezometer: device used to measure liquid pressure in a system by measuring height to which a column of liquid rises against gravity. → 2

U-tube manometer:
to measure the pressure difference in pitot or orifice located in the airflow in air handling or ventilation system. → 2

Differential manometer is a device that measures the difference in pressure between two places
with figure or explanation. → 2

Types:
* Two piezometer manometer,
* Inverted U tube manometer & Micromanometer.

6.

b) problem.
Solution.

$h_B = 230$ mm of Hg $= 0.23 \times 13.6 = -3.128$ m of water

$h_C = \frac{P_C}{\gamma} = \frac{21}{9.81} = 2.14$ m of water → 2

$-3.128 + 5 \times 0.8 + y \times 1.6 - (y+2) = 2.14$

$-3.128 + 5 \times 0.8 + y \times 1.6 - y - 2 = 2.14$ → 3

$y = 5.446$ m

$\therefore$ Elevation of A $= 100 - 5.446$

Elevation of A $= 94.553$ m → 4

9

Shivashankar R.M. 31/12/2020
Course Coordinator
(Faculty in charge)

31/12/2020
Coordinator
DQAC

5/1/2021
Program Coordinator
(HOD, Civil)

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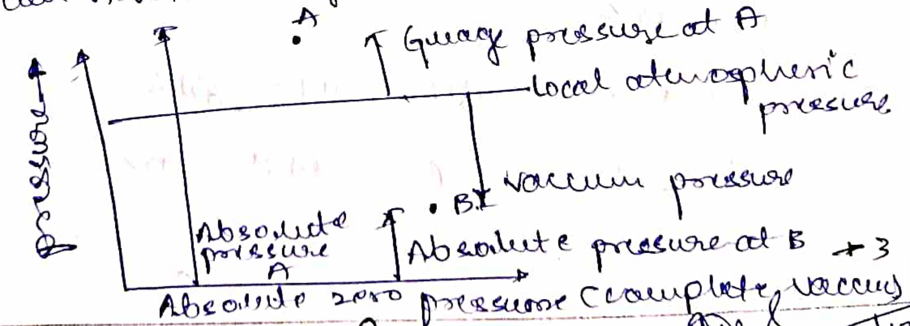
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Fluid Mechanics	Course/Subject Code	18CV33
Semester	III -A.	CIE No.	I
Date	8/12/2020.	Max. Marks	30

1. a)	Define Mass density. $\rho = \frac{\text{mass of fluid}}{\text{Volume of fluid}} = \frac{m}{V}$ $\frac{Kg}{m^3}$ + 2 Specific gravity (G) = $\frac{\text{specific weight of fluid}}{\text{specific weight of standard fluid}}$ + 2 G water = 1, mercury = 13.6. Dynamic viscosity $\mu = \frac{\tau}{du/dy}$ N.s/m² or pascal. second. + 2 vapour pressure a liquid will boil (vapourise) and is in equilibrium with its own vapour increases as temperature increases. , mm/Hg. + 2 capillarity rise or fall of liquid surface in a small tube relative to adjacent general level of liquid when tube is held vertically in liquid. $h = 4\sigma\cos\theta/\rho g d$ + 2	10.
b)	Absolute pressure i.e at a point the intensity of pressure at the point measured with reference to absolute vacuum or absolute zero pressure + 2 + It can never be negative or zero  + 3	5.

Bharathiraj B.M 3/12/2020
Course Coordinator
(Faculty in charge)

3/12/2020
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DQAC

3/12/20
Program Coordinator
(HOD, Civil)

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Bapuji Institute of Engineering and Technology, Davangere–577 004

Department of Civil Engineering

USN										

Course/Subject Title	Fluid Mechanics	**Course/Subject Code**	18CV33
Semester	III – A	**Scheme**	CBCS – 18
Date	04.01.2021	**CIE No.**	II
Time	11:30 to 12:30 AM	**Max. Marks**	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the fundamental properties of fluids
CO2	**Explain** the concept of fluid pressure and equipment for its measurement
CO3	**Calculate** the hydrostatic forces acting on surfaces and **explain** the kinematic concepts of fluid flow
CO4	**Apply** Euler's equation and Bernoulli's principle for the practical applications of fluid flow
CO5	**Compute** the discharge through channels and pipes
CO6	**Explain** the losses in pipe flow and effect of water hammer in pipe flow

Note : Answer any one full question from each Part.

Q. No.	Question	Marks	RBT Level	CO
	MODULE 3			
1 a.	List applications of Bernoulli's equation, Derive the equation for discharge through Venturi meter	7	L1,L2	4
b.	A pipe through which water is flowing having diameter 20cm and 10 cm at the cross section 1 and 2 respectively. The velocity of water at section 1 is given 4m/s Find the velocity head at section 1 and 2and also rate of discharge	8	L3	4
	OR			
2 a.	State and prove Bernoulli's theorem for steady flow of incompressible fluid.	7	L1,L2	4
b.	a pipe of 300mm diameter is conveying $0.3m^3/s$ of water has a right angled bend in horizontal plane. Find the resultant force exerted on the bend if the pressure at inlet and outlet of the bend are 24.525 x 10^4 Pa and 23.544 x 10^4 Pa respectively	8	L3	4
	MODULE 4			
3 a.	Derive Darcy-Weis bach equation for head loss due to friction in pipe	7	L2	6
b.	Find the head loss due to friction in a pipe of diameter 300mm and length 50m ,through which water is flowing at avelocity 3 m/s using Darcy-Weis bach equation, take kinematic viscosity for water = 0.01 strokes	8	L3	6
	OR			
4 a.	Explain water hammer, Derive expression for water hammer due to sudden closure of valve and pipe is rigid	7	L2	6
b.	List the energy losses in pipe flow, Derive equation for head loss due to sudden enlargement in pipe	8	L1,L2	6

Bharathraj.R.M 30/12/2020

Course Coordinator (Faculty in charge)

Coordinator DQAC

Program Coordinator (HOD, Civil)

USN

Scheme of Valuation

4.b) Steady flow – the fluid properties do not change with time (t) $\frac{\partial}{\partial t}(P) = 0$ → 1.5

unsteady flow $\frac{\partial}{\partial t}(P) \neq 0$.

uniform flow $\frac{\partial}{\partial x}(P) = 0$ – (P) do not change over length of flow considered.

non uniform flow $\frac{\partial (P)}{\partial x} \neq 0$ → 1.5 | 3.

4(c). Given.

$V = (3x+2y)i + (2z+3x^2)j + (2t-3z)k$.

i) $u = 3x+2y$
$v = 2z+3x^2$ velocity component x, y, z.
$w = 2t - 3z$ — 2

ii) Substituting $x=1, y=1, z=1$ in expression

$u = (3\times1 + 2\times1) = 5$
$v = (2\times1 + 3\times1) = 5$
$w = (2t - 3\times1) = (2t-3)$

$V^2 = u^2 + v^2 + w^2$
$V^2 = 4t^2 - 12t + 59$ at point (1, 1, 1). — 2

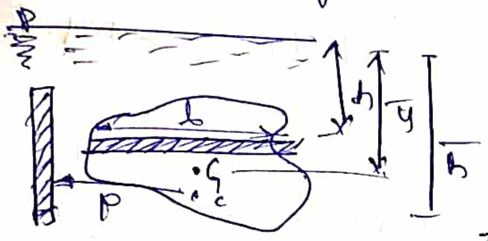
iii) Substituting
$t=2, x=0, y=0, z=2$.
$u=0, v=4+0, w=4-6=-2 = -2$

$V^2(0,0,2) = 0^2 + 4^2 + (-2)^2 = 16+4 = 20$

$V = \sqrt{20} = 4.472$ **V = 4.472 units** — 3 | 7.

Scheme of Valuation

3. a) Hydrostatic forces on vertical plane surface



where
A = Total area of surface
$\bar{y}$ = Depth of centroid from free surface → 3.5
G = centroid of immersed surface
C = centre of pressure.

$P = \rho g h$.

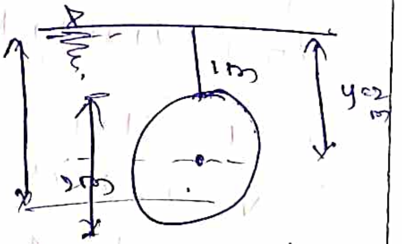
$dP = (\rho g h) \cdot dA$

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

$\boxed{P = \rho g A\bar{h} = \gamma A\bar{h}}$ → 3.5

γ → specific weight of water. — 7

b) $A = \frac{\pi \times D^2}{4} = \frac{\pi \times 2^2}{4} = 3.142\,m$



$\rho = 1000\ kg/m^3 \quad g = 10\ m/s^2$

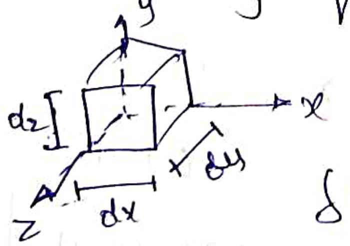
$P = \rho g A\bar{y} = 1000 \times 10 \times 3.142 \times 2$
$= 62.83\ kN$. → 4

Centre of pressure

$\bar{h} = \bar{y} + \frac{I_g}{A\bar{y}} \quad I_g = \frac{\pi R^4}{4} = \frac{\pi \times 1^4}{4} = 0.785\ m^4$ — 8.

$\bar{h} = 2 + \frac{0.785}{3.142 \times 2} = 2.125\ m \quad \boxed{\bar{h} = 2.125\ m}$ → 4

4. a) Continuity equation for 3 dimensional flow.



$dM_x = -\frac{\partial}{\partial x}(\rho u)\,dx\,dy\,dz$

$dM_y,\ dM_z$

$$\frac{\delta(\rho u)}{\delta x} + \frac{\delta(\rho v)}{\delta y} + \frac{\delta(\rho w)}{\delta z} = 0$$ — 5

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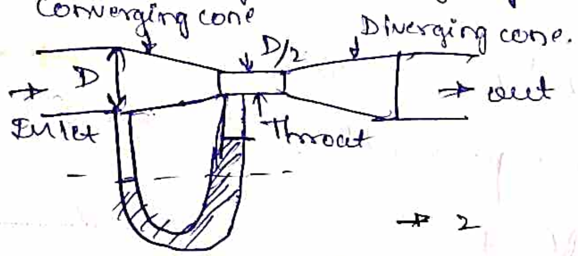
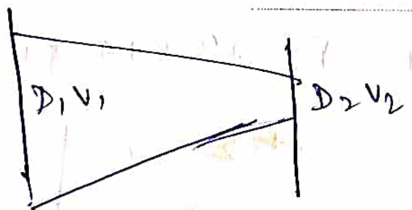
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Fluid Mechanics	Course/Subject Code	18CV33
Semester	III . A .	CIE No.	II
Date	04/01/2021	Max. Marks	30.

1. a.	**Discharge through venturimetre:-** A device used to measure rate of flow in pipe consists of converging cone, throat, diverging cone → 2  * Bernoulli's equation. $\frac{P}{\rho g} + \frac{V^2}{2g} + Z = 0$ → 2 $Q_{act} = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2gh}$ $h = x\left[\frac{S_H}{S_O} - 1\right]$, $h = x\left[1 - \frac{S_L}{S_O}\right]$ → 3.5	7.5
(b).	problem] solution] venturimeter. $Q_{th} = \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2gh}$. $D_1 = 20\ cm = 0.2\ m$, $D_2 = 0.1\ m$  $A_1 = \frac{\pi D_1^2}{4} = 0.0314\ m^2$ $A_2 = 0.0785\ m^2$ → 2 continuity equation $Q_1 = Q_2$ $A_1 V_1 = A_2 V_2$ $V_2 = \frac{A_1 V_1}{A_2} = 16\ m/s$ → 2 $\frac{V_1^2}{2g} = \frac{4^2}{2 \times 9.81} = 0.815\ m$ $\frac{V_2^2}{2g} = \frac{16^2}{2 \times 9.81} = 83.047\ m$ $Q = A_1 V_1$ $= 0.0314 \times 4$ $= 0.1256\ m^3/s$ → 3.5 **Q = 125.6 litres/sec**	7.5

Course Coordinator (Faculty in charge) 31/12/2020 — Coordinator DQAC 31/12/2020 — Program Coordinator (HOD, Civil) 31/12/20

Scheme of Valuation

2.a. Bernoulli's theorem. In a steady, incompressible flow the total energy remain constant at any point

$$\frac{P}{\rho g} + \frac{V^2}{2g} + z = \text{constant.} \quad \rightarrow 2$$

pressure head + velocity head + Datum head = constant

it is obtain from integration of Eulers equation

$$\int \frac{\partial P}{\rho} + \int g.dz + \int v.dv = \text{Constant.} \quad \rightarrow 2$$

if the flow is incompressible ρ is constant.

$$\frac{P}{\rho} + gz + \frac{V^2}{2} = \text{constant.}$$

Divide by g throughout,

$$\boxed{\frac{P}{\rho g} + \frac{V^2}{2g} + z = \text{constant.}} \rightarrow \text{Bernoulli's equation} \quad \rightarrow 3.5$$

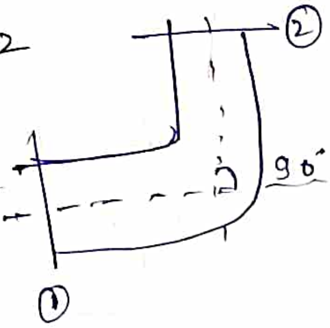
7.5

b). Pitot tube.

Data: $D_1 = D_2 = 300\ mm$

$P_1 = 24.525 \times 10^4$ Pa $\quad P_2 = 23.544 \times 10^4\ N/m^2$.

$Q = 0.3\ m^3/s$ $\quad \rightarrow 2$



$V_1 = V_2 = \frac{Q}{A_1} = 4.24\ m/s$.

$F_x = \rho Q (V_1 - V_2 \cos\theta) + P_1 A_1 - P_2 A_2 \cos\alpha$

$= 18606.27\ N$

$F_y = -17912.89\ N$ $\quad \rightarrow 2$

$F = \sqrt{F_x^2 + F_y^2} = 25827.59\ N \qquad \alpha = \tan^{-1}\left[\frac{F_y}{F_x}\right] = 43.89'$ $\quad \rightarrow 3.5$

7.5

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Scheme of Valuation

4 a). Water hammer in pipes. In a long pipe when the flowing water is suddenly brought to rest by closing valve, there will be sudden rise in pressure due to the momentum of water being destroyed. +3

The sudden rise in pressure has effect of hammer action on walls of pipe.

Factors :- Length, elastic properties of pipe, velocity of flow. +1

Sudden closure of valve in rigid pipe :-

$$p = \frac{\rho l V}{T}, \quad p^2 = \rho K V^2$$

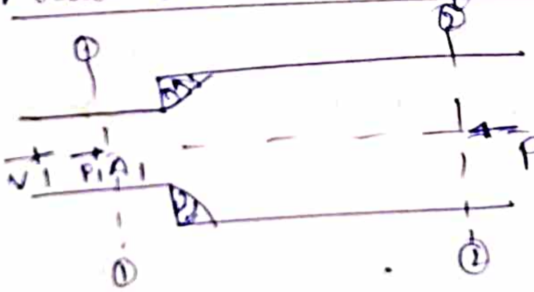
$$p = V\sqrt{\rho K}$$

$$p = V\sqrt{\frac{K\rho^2}{\rho}}$$

$$p = \rho V C$$

where $C = \sqrt{\frac{K}{\rho}}$ = velocity of pressure wave. +3.5

b) Head loss due to sudden enlargement :-



* Minor losses.
* Bernoulli's equation @ ①① and ②②.

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2 + h_e \qquad z_1 = z_2$$

$$h_e = \frac{(V_1 - V_2)^2}{2g}$$ head loss due to sudden enlargement.

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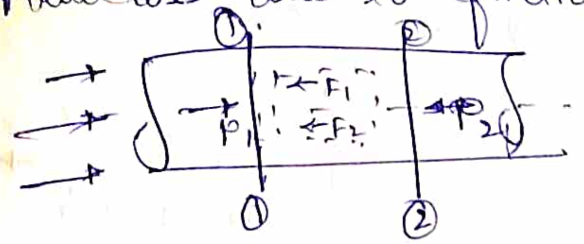
Scheme of Valuation

3. a) Losses in pipe flow → Major & Minor loss

Head loss due to friction → Darcy's weis-bach eqn



Apply Bernoulli's eqn. at ①① & ②② → 2

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2 + h_f$$ → head loss due to friction

$z_1 = z_2$

$V_1 = V_2$

$$h_f = \frac{f_1}{\rho g} * \frac{P}{A} \times L \times V^2 \quad \rightarrow ③.$$

→ 2

$$h_f = \frac{f_1}{\rho g} \times \frac{4}{d} \times L \times V^2 \quad \rightarrow ④.$$

$P = \pi d.$

$$\frac{f_1}{\rho} = \frac{f}{2}$$

$$\boxed{h_f = \frac{4fLV^2}{2gd.}}$$

$f = \frac{16}{Re}$ | $Re < 2000$

$f = \frac{0.079}{R^{1/4}}$ | $Re > 4000$ → 3.5 7

3. b) problem

Data: Dia = d = 300mm = 0.3 m, L = 50 m, V = 3 m/s

$\gamma = 0.01 \text{ cm}^2/\text{sec} = 0.01 \times 10^{-4} \text{ m}^2/\text{s}$ → 2

$$h_f = \frac{4fLV^2}{2gd}$$

$$Re = \frac{Vd}{\gamma} = 9 \times 10^5$$

$$h_f = \frac{4 \times 0.00256 \times 50 \times 3^2}{2 \times 9.81 \times 0.3}$$

$$f = \frac{0.079}{Re^{1/4}} = 0.00256 \quad \rightarrow 2$$

$$\boxed{h_f = 0.7828 \text{ m.}}$$ → 3.5 7

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Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	FLUID MECHANICS	Course/Subject Code	18CV33
Semester	III Semester	CIE No.	III
Date	|02|2021	Max. Marks	30.

1. a) Hydraulic co-efficients:-

1). Co-efficient of velocity ($C_v = 0.98$)
2). co-efficient of contraction ($C_c = 0.61$ to 0.69)
3). co-efficient of discharge ($C_d = 0.61$ to 0.65) → 3

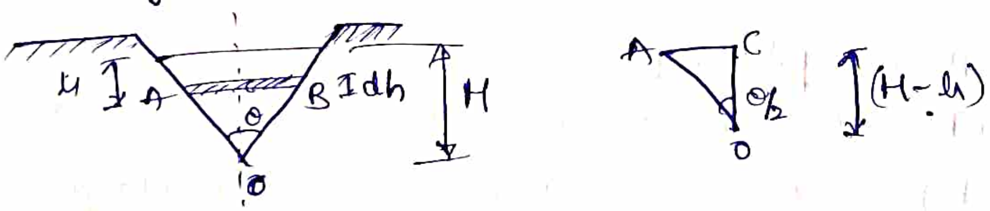
$C_v = \frac{\text{Actual velocity of jet @ vena contracta}}{\text{Theoritical velocity}} = \frac{V}{\sqrt{2gH}}$

$C_c = \frac{\text{Area of jet at vena contracta}}{\text{area of orifice}} = \frac{a_c}{a_o}$ → 3

$C_d = \frac{\text{Actual discharge}}{\text{Theoritical discharge}}$

$$C_d = C_v \times C_c$$ → 1.5   7.5

1. b) Triangular Notch.



$\tan \theta/2 = \frac{AC}{OC} = \frac{AC}{(H-h)}$

$AB = 2AC = 2(H-h)\tan\theta/2$

Area of strip $= 2(H-h)\tan\theta/2 \times dh$. → 3

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USN | | | | | | | | | | |

Course/Subject Title	Fluid Mechanics	Course/Subject Code	18CV33
Semester	III – A	Scheme	CBCS – 18
Date	22/02/2021	CIE No.	03
Time	9 to 10	Max. Marks	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the fundamental properties of fluids
CO2	**Explain** the concept of fluid pressure and equipment for its measurement
CO3	**Calculate** the hydrostatic forces acting on surfaces and **explain** the kinematic concepts of fluid flow
CO4	**Apply** Euler's equation and Bernoulli's principle for the practical applications of fluid flow
CO5	**Compute** the discharge through channels and pipes
CO6	**Explain** the losses in pipe flow and effect of water hammer in pipe flow

Note : Answer any one full question from each Part.

Q. No.	Question	Marks	RBT Level	CO
	PART A			
1 a.	Explain different hydraulic coefficients and establish relation between them	7.5	L2	5
b.	Derive an expression for discharge over Triangular notch	7.5	L2	5
	OR			
2 a.	The head of water over an orifice of diameter 40mm is 10 m, find actual discharge and actual velocity of jet at vena contracta ,take Cd=0.6 and Cv =0.98	7.5	L3	5
b.	Stating assumptions made , Derive the Eulers equation and hence obtain Bernoulis equation from it	7.5	L2	4
	PART B			
3 a.	What is Cipolletti notch and derive an expression for discharge over cipolletti notch	7.5	L2	5
b.	For a Borda's mouthpiece (running free) show that Cc is 0.5	7.5	L2	5
	OR			
4 a.	Find the discharge over a triangular notch of angle 60° when the head over the V notch is 0.3m assume Cd=0.6	7.5	L3	5
b.	Derive an expression for head loss due to friction in pipes	7.5	L2	6

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Course Coordinator (Faculty in charge) — Coordinator DQAC — Program Coordinator (HOD, Civil)

004

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...nment No.	2	**Maximum Marks**	10
...rse/Subject Title	FLUID MECHANICS	**Course/Subject Code**	18CV33
...mester	III A	**Scheme**	CBCS – 18
Course Co-ordinator	Sharathraj R M		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the fundamental properties of fluids
CO2	**Explain** the concept of fluid pressure and equipment for its measurement
CO3	**Calculate** the hydrostatic forces acting on surfaces and **explain** the kinematic concepts of fluid flow
CO4	**Apply** Euler's equation and Bernoulli's principle for the practical applications of fluid flow
CO5	**Compute** the discharge through channels and pipes
CO6	**Explain** the losses in pipe flow and effect of water hammer in pipe flow

Note : Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Write a note on Euler;s equation of motion along stream line	2.5	L2	4
2	List applications of Bernoulli's equation, Explain pitot tube	2.5	L2	4
3	Explain network of pipes using Hardy cross method	2.5	L2	6
4	Define water hammer , derive equation for pressure rise due to sudden closure of valve for elastic pipes.	2.5	L2	6

Last date for submission	**05**	**01**	**2021**

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Sharathraj. R.M 30/12/2020
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Coordinator DQAC

Program Coordinator (HOD, Civil)

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Scheme of Valuation

1 b)	$Q = \frac{8}{15} Cd \tan\theta/2 \sqrt{2g}\, H^{5/2}$
	for right angled v-notch, if $Cd = 0.6$
	$\theta = 90°$ $\tan\theta/2 = 1$
	$Q = \frac{8}{15} \times 0.6 \times 1 \sqrt{2\times9.81} \times H^{5/2} = 1.417 H^{5/2}$
	→2.5 7.5
2. a)	Solution:- ORIFICE
	Given Head = H = 10m, d = 40mm = 0.04 m
	Area, $a = \frac{\pi \times 0.04^2}{4} = 0.001256\ m^2$ Cd = 0.6
	Cv = 0.98
	$\frac{\text{Actual discharge}}{\text{Theoritical discharge}} = 0.6$ →1
	$V_{th} = \sqrt{2gH} = \sqrt{2\times9.81\times10}$
	$= 14\ m/s$
	$Q_{th} = 14 \times 0.001256 = 0.01758\ m^3/s$
	$Q_d = 0.6 \times Q_{th} = 0.01054\ m^3/s$ →3
	$\frac{\text{Actual velocity}}{\text{Theoritical velocity}} = Cv = 0.98$
	Actual velocity = Cv × Theoritical velocity
	$= 0.98 \times 14 = 13.72\ m/s$ →3.5 7.5
2 b)	Assumptions:-
	+ Fluid is ideal i.e viscosity is zero.
	+ Fluid is steady and continuous
	+ Flow is incompressible.
	+ Flow is irrotational
	+ Flow is along streamline, that is one dimensional →3

Course Coordinator (Faculty in charge) 10/3/24

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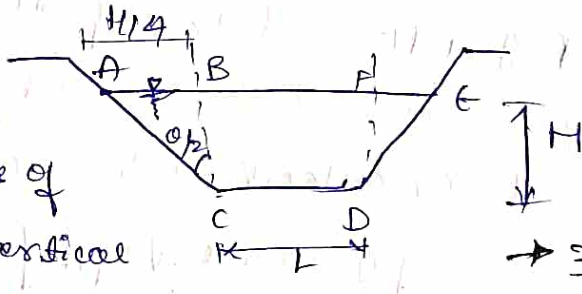
Scheme of Valuation

2. b) Bernoullis' Theorem:- In a steady, ideal flow of an incompressible fluid, the total energy consists of pressure energy, kinetic energy and datum energy. → 3

$$\frac{P}{\rho g} + \frac{V^2}{2g} + z = \text{constant}. \quad \rightarrow 1.5 \quad 7.5$$

3. a) Cipolletti notch:-

it is a trapezoidal weir, which has side slopes of 1 horizontal to 4 Vertical → 3



Thus in Δ ABC

$$\tan \theta/2 = \frac{AB}{BC} = \frac{H/4}{H} = 1/4$$

$$\theta/2 = \tan^{-1}(1/4) = 14°2'$$

$$Q = \frac{2}{3} \, Cd \, (L - 0.2H) \sqrt{2g} \, H^{3/2} \quad \rightarrow 3$$

$$Q = \frac{8}{15} \, Cd \sqrt{2g} \tan \theta/2 \, H^{5/2}$$

$$Q = \frac{2}{3} \, Cd \, L \sqrt{2g} \left[(H + h_a)^{3/2} - h_a^{3/2} \right] \quad \left[\because h_a = V_a^2/2g \right]. \quad \rightarrow 1.5 \quad 7.5$$

3 b) Borda's Mouthpiece Running free.

→ (2)

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Scheme of Valuation

3. b) Total pressure $= \rho g a h$.

Rate of change of momentum = mass of fluid × [final − initial velocity]

$= \rho a_c V_c [V_c - 0] = \rho a_c V_c^2 \rightarrow (ii)$

$\rho g a H = \rho a_c V_c^2 \rightarrow (iii)$ → 3

$V_c = \sqrt{2gH}$

$\rho g a H = \rho a_c 2g . H$

since there is no loss of head, $C_v = 1$

$C_d = C_v . C_c = 1 \times 0.5 = 0.5$ $Q = C_d a \sqrt{2gH}$

$$\boxed{Q = 0.5 a \sqrt{2gH}}$$

→ 2.5 | 7.5

4 a) Triangular notch

Given Angle of V-notch $\theta = 60°$

Head over notch $H = 0.3m$, $C_d = 0.6$ → 2

$Q = \frac{8}{15} C_d \tan\frac{\theta}{2} \sqrt{2g} H^{5/2} = \frac{8}{15} \times 0.6 \times \tan\left(\frac{60}{2}\right) \times \left[\sqrt{2 \times 9.81} \times 0.3^{5/2}\right]$ → 3

$Q = 0.53 \times 0.6 \times 0.57 \times 0.21$

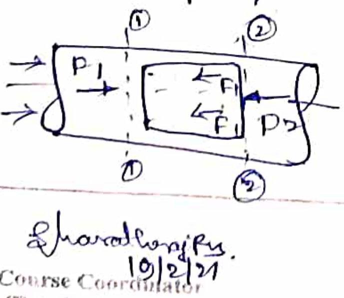
$$\boxed{Q = 0.04\ m^3/s}$$

→ 2.5 | 7.5

4 b) Types of losses a) Major losses b) minor losses

* head loss due to friction
  ① Darcy weisbach formula
  ② Chezy's formula.

* sudden expansion and contraction of pipe → 2
* Bend in pipe & pipe fittings. → 3



$$\boxed{h_f = \frac{4fLV^2}{2gd}}$$

→ 2.5 | 7.5

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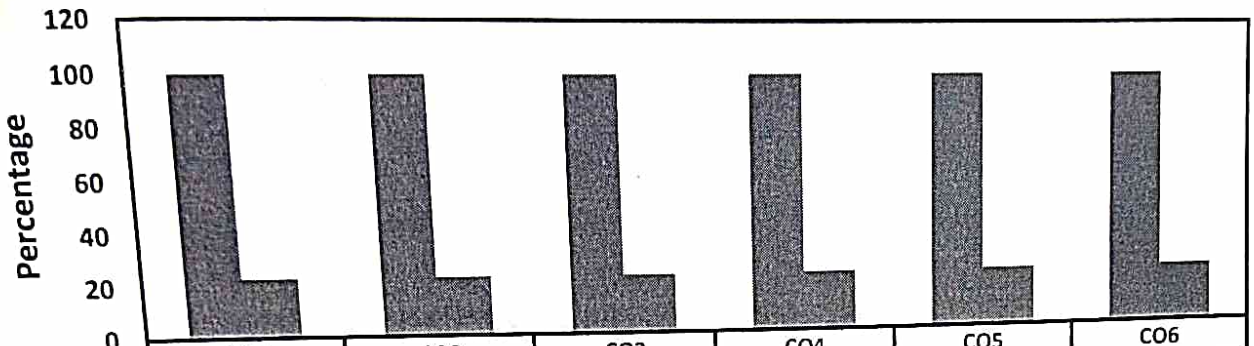
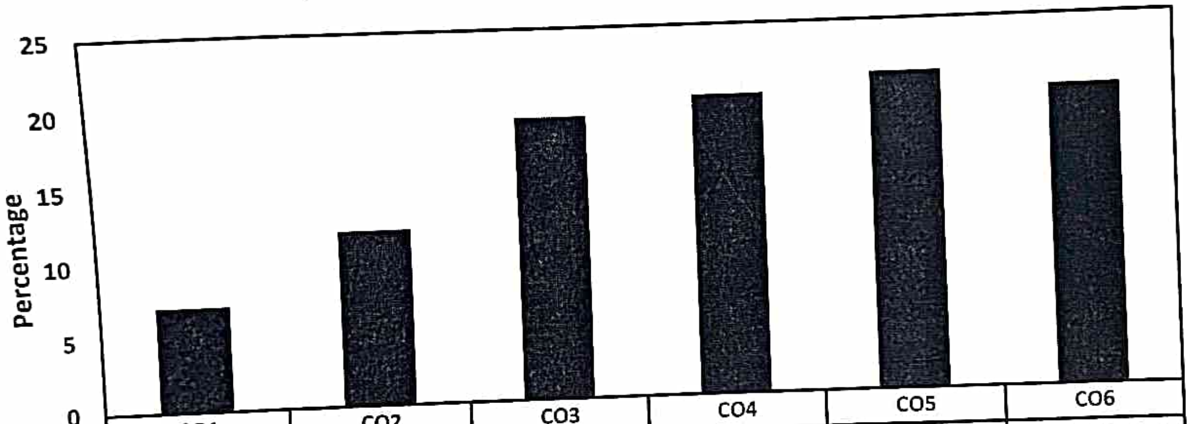
% of Students reaching more than the target



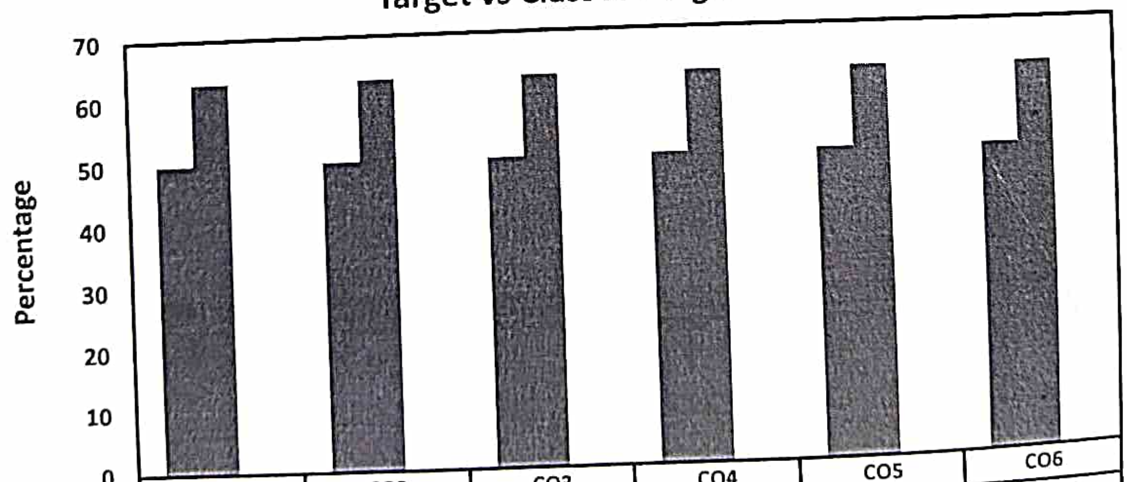
	CO1	CO2	CO3	CO4	CO5	CO6
CIE	100	100	100	100	100	100
SEE	23	23	23	23	23	23

% CO marks distribution in CIE



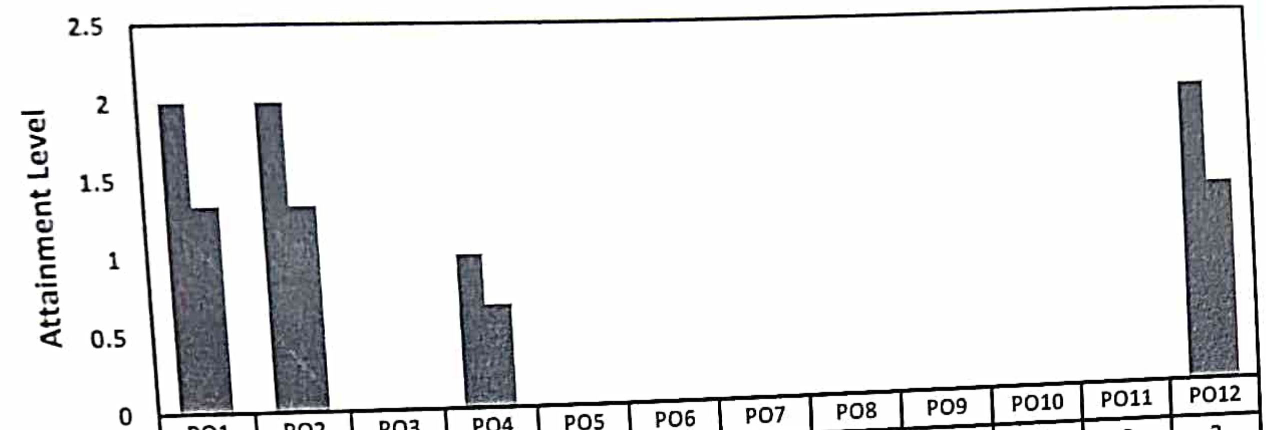
	CO1	CO2	CO3	CO4	CO5	CO6
%	7.14	11.9	19.05	20.24	21.43	20.24

Target vs Class Average



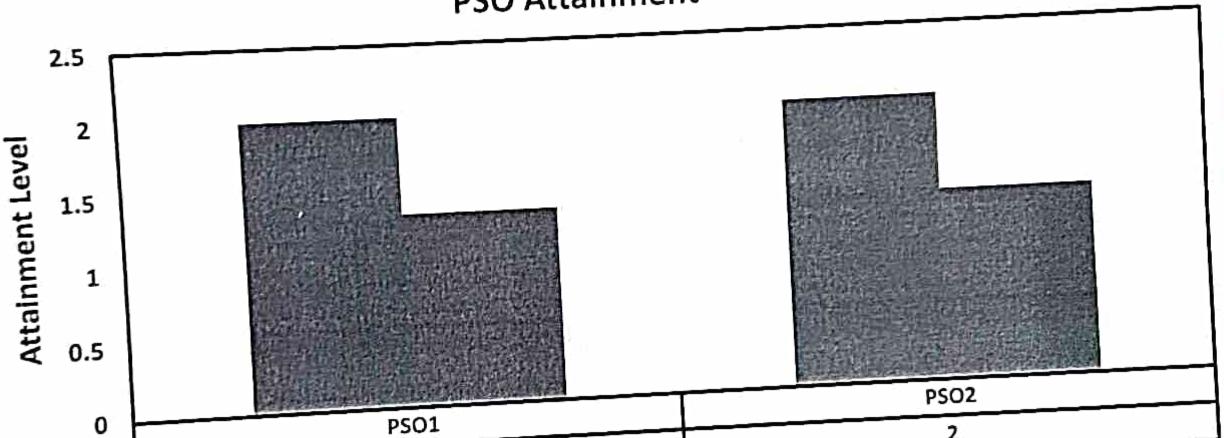
	CO1	CO2	CO3	CO4	CO5	CO6
Target	50	50	50	50	50	50
Class Average	63	63	63	63	63	63
Gap	0	0	0	0	0	0

PO Attainment



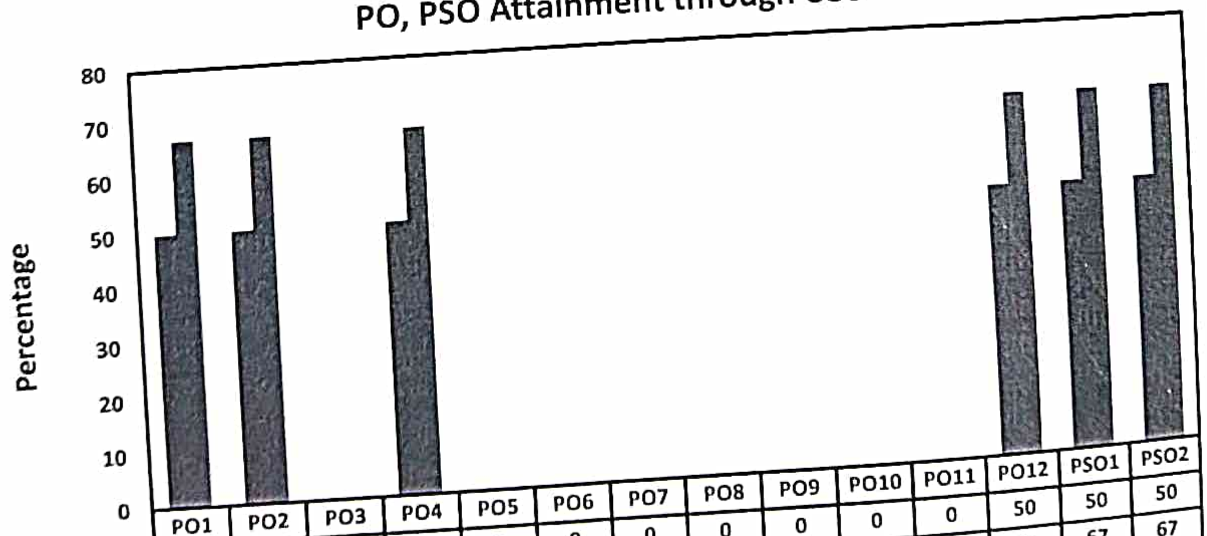
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Expected	2	2	0	1	0	0	0	0	0	0	0	2
Actual	1.33	1.33	0	0.67	0	0	0	0	0	0	0	1.33

PSO Attainment



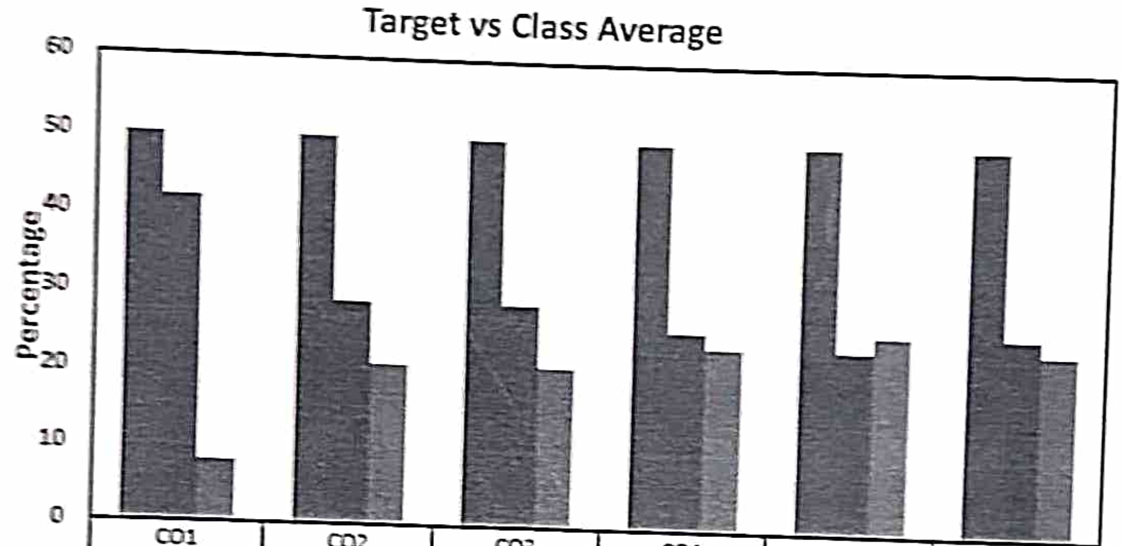
	PSO1	PSO2
Expected	2	2
Actual	1.33	1.33

PO, PSO Attainment through COs

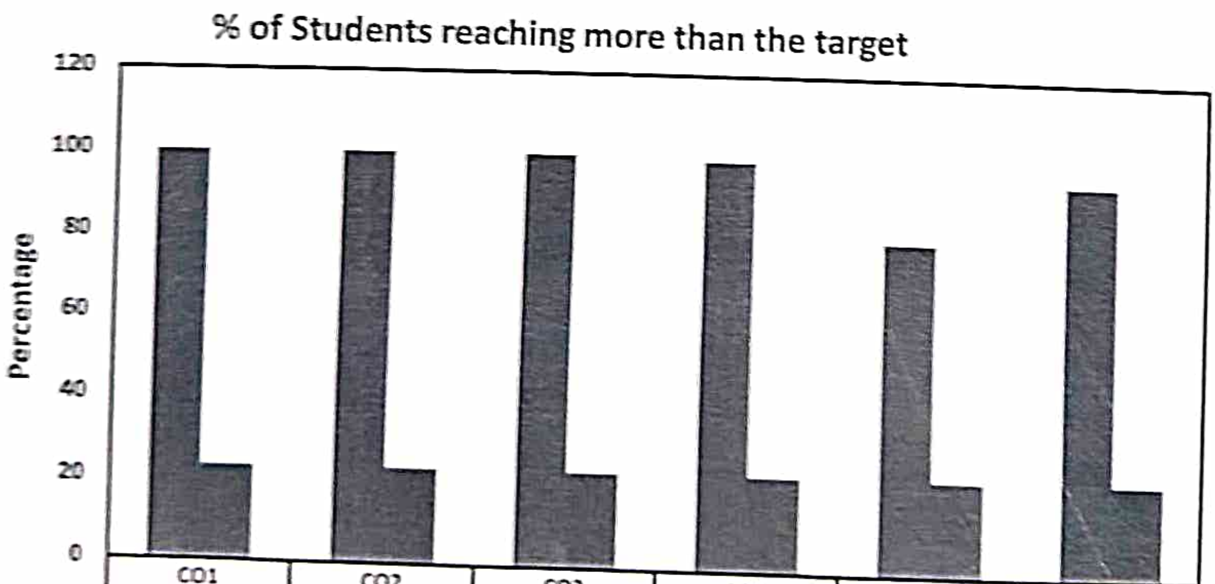


	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Target	50	50	0	50	0	0	0	0	0	0	0	50	50	50
Attainment	67	67	0	67	0	0	0	0	0	0	0	67	67	67

Subject (Course) Title	Fluid Mechanics
Subject (Course) Code	18CV33
Semester	3
Section	A
Branch	CIVIL
Faculty incharge	Sri. SHARATHRAJ R M
Batch	2018-2022
Academic Year	2020-2021



	CO1	CO2	CO3	CO4	CO5	CO6
Target	50	50	50	50	50	50
Class Average	42	29	29	26	24	26
Gap	8	21	21	24	26	24



	CO1	CO2	CO3	CO4	CO5	CO6
CIE	100	100	100	99	80	95
SEE	23	23	23	23	23	23

1 004

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...ment No.	03	Maximum Marks	10
...Subject Title	FLUID MECHANICS	Course/Subject Code	18CV33
...ester	III A	Scheme	CBCS – 18
...urse Co-ordinator	Sharathraj R M		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Explain** the fundamental properties of fluids
CO2	**Explain** the concept of fluid pressure and equipment for its measurement
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CO4	**Apply** Euler's equation and Bernoulli's principle for the practical applications of fluid flow
CO5	**Compute** the discharge through channels and pipes
CO6	**Explain** the losses in pipe flow and effect of water hammer in pipe flow

Note : Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Derive an expression for discharge over Rectangular notch	2.5	L2	1
2	Derive an expression for discharge over Trapezoidal notch	2.5	L2	2
3	Explain with neat sketch Bord's mouth piece	2.5	L2	3
4	Explain Hydraulic coefficients Cd,Cc and Cv	2.5	L2	3

Last date for submission	**26**	**12**	**2020**

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

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Course Coordinator
(Faculty in charge)

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(HOD, Civil)

Result analysis information which is to be put in Course File

a) Percentage CO covered / Percentage of CO addressed.

- Refer Graph Titled "**% CO marks distribution in CIE**" in Attainment Sheet.

Note : If you have written CO wise marks (from 3 CIE and Assignment) in Attainment sheet, you can get the above graph. If attainment is calculated considering final CIE and SEE marks, then get the graph from Excel sheet **which is attached herewith**)

b) CO-PO and CO-PSO Attainment

- Refer Graph Titled **"PO Attainment"** in Attainment Sheet
- Refer Graph Titled **"PSO Attainment"** in Attainment Sheet.

Note : You can also put graph titled **"% of Students reaching more than the target"** above the "PO Attainment" graph.

c) Percentage of students passed

Branch	**No. of students appeared for the exam**	**No. of students passed**	**Pass %**
Civil 3A 18CV33	68	48	71