Techno India NJR Institute of Technology

Course File

Fluid Mechanics (3CE4-06)

Jitendra Choubisa
(Assistant Professor)
Department of CE

For Techno India NJR Institute of Technology
पंकज पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

II Year - III Semester: B.Tech. (Civil Engineering)

3CE4-06: FLUID MECHANICS

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA:20, ETE:80)
End Term Exam: 2 Hours

SN	Contents	Hrs.
1	**Introduction to objective, scope and outcome of the course.**	1
2	**Fluids**: Definition, Type of fluids, Ideal fluids, real fluids, Newtonian and non-Newtonian fluids.	1
3	**Properties of Fluids:** Units of measurement, Mass density, Specific weight, Specific volume, Specific Gravity, Viscosity, Surface tension and Capillarity, Compressibility and Elasticity.	2
4	**Principles Statics**: equations, Type of pressure:-atmospheric pressure, Gauge pressure, vacuum pressure, absolute pressure, manometers, Bourdon pressure gauge	3
5	**Buoyancy**; Forces acting on immersed plane surface. Centre of pressure, forces on curved surfaces. Conditions of equilibrium for floating bodies, meta-centre and analytical determination of meta centric height.	3
6	flow, Types of flow: Steady and unsteady, uniform and non-uniform, rotational and irrotaional flow, Laminar and turbulent flow, streamline, path line, streak line, principle of conservation of mass, equation of continuity, acceleration of fluid particles local and convective, velocity, acceleration, velocity potential and stream function, elementary treatment of flow net, vorticity, circulation, free and forced vortex. Fluid mass subject to horizontal and vertical acceleration and uniform rotation	6
7	**Fluid Dynamics**: Control volume approach, Euler's equation, Bernoulli's equation and its applications, venture-meter, orificemeter, orifices mouthpieces, time of emptying of tanks by orifices, momentum and angular momentum equations and their applications, pressure on flat plates and nozzles.	6
8	**Laminar Flow through Pipes**: Laminar flow through pipes, Relation between shear & pressure gradient. Flow between plates & pipes. Hagen-Poiseuille equation, Equations for velocity distribution, pressure difference velocity distribution over a flat plate and in a pipe section, Darcy-Weisbach equation, friction factor , minor losses, pipe networks	6
	TOTAL	28

Course Overview:

Fluid Mechanics is an inter-disciplinary course covering the basic principles and its applications in Civil Engineering, Mechanical Engineering and Chemical Engineering The students will have new problem-solving approaches like control volume concept and streamline patterns which are nowadays required to solve the real-life complex problems. The visualization of the fluid-flow problems will be demonstrated to enhance student's interest on the subject.

Fluid Mechanics is the division of physics that studies fluids (liquids, gases, and plasmas) along with the forces on them. It can be divided into fluid statics which studies about the fluids at rest; fluid kinematics which studies about the fluids in motion and fluid dynamics which studies about the effect of forces on fluid motion. It is likewise a part of continuum mechanics, a subject which models matter without utilizing the facts that it is made out of atoms, that is, it demonstrates matter from a plainly visible perspective instead of from an infinitesimal perspective.

Course Outcomes:

3CE4-06	FLUID MECHANICS
3CE5A.1	Students will be able to remember the basic properties of fluid flow.
3CE5A.2	Students will learn to analyze the pressure, buoyancy and types of flow and its characteristics.
3CE5A.3	Students be able to solve problems related to Fluid Kinematics.
3CE5A.4	Students will be able to apply concepts on flow parameters such as discharge, velocity, acceleration etc. on the basis of flow problems (Dynamics).
3CE5A.5	Students be able to analyze the flow through pipes.

Prerequisites:

1. Vector calculus, ordinary and partial differential equations, some exposure to complex variables.
2. Understanding of the background in Newtonian mechanics.

Course Outcome Mapping with Program Outcome:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO236.1	3	3	3	2	1	2	1	1	1	1	1	1	1	1	1
CO236.2	3	2	3	1	1	2	1	1	1	1	1	1	1	1	1
CO236.3	3	2	3	2	1	1	1	1	1	1	1	1	1	1	1
CO236.4	3	3	3	2	1	2	1	1	1	1	1	1	1	1	1
CO236.5	3	2	3	1	1	2	1	1	1	1	1	1	1	1	1
CO236 (AVG)	3	2.4	3	1.6	1	1.8	1	1	1	1	1	1	1	1	1

Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	**1**	**INTRODUCTION TO OBJECTIVE, SCOPE AND OUTCOME OF THE**
2	**2**	**FLUIDS**: Definition, Type of fluids, Ideal fluids, real fluids, Newtonian and
3	**3**	**PROPERTIES OF FLUIDS:** Units of measurement, Mass density, Specific weight,
4	3	Viscosity, Surface tension and Capillarity, Compressibility and Elasticity
5	**4**	**PRINCIPLES OF FLUID STATICS**: Basic equations, Pascal Law
6	4	Type of pressure:-atmospheric pressure, Gauge pressure, vacuum pressure,
7	4	Manometers, Bourdon pressure gauge
8	4	Manometers, Bourdon pressure gauge
9	5	BUOYANCY; Forces acting on immersed plane surface
1	5	Centre of pressure, forces on curved surfaces
1	5	Conditions of equilibrium for floating bodies
1	5	Meta-centre
1	5	Analytical determination of meta centric height
1	6	KINEMATICS OF FLOW: Visualisation of flow, Types of flow: Steady and
1	6	Streamline, path line, streak line, principle of conservation of mass, equation of
1	6	Acceleration of fluid particles local and convective, velocity, acceleration
1	6	Velocity potential and stream function, elementary treatment of flow net
1	6	Fluid mass subject to horizontal and vertical acceleration and uniform rotation
1	7	FLUID DYNAMICS: Control volume approach
2	7	Euler's equation, Bernoulli's equation and its applications, venture-meter, orifice
2	7	Pressure on flat plates and nozzles. Time of emptying of tanks by orifices

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2	7	Momentum and angular momentum equations and their applications
2	8	LAMINAR FLOW THROUGH PIPES: Laminar flow through pipes
2	8	Relation between shear & pressure gradient. Flow between plates & pipes
2	8	Hagen- Poiseuille equation, Equations for velocity distribution
2	8	Pressure difference velocity distribution over a flat plate and in a pipe section
2	8	Darcy-Welsbach equation, friction factor , minor losses, pipe networks

TEXT/REFERENCE BOOKS

1. Fluid Mechanics by Modi & Seth, Standard Publishers, Delhi.
2. Fluid Mechanics by Dr. R.K. Bansal, Laxmi Publication (P) Ltd.
3. Fluid Mechanics by Dr. K.R. Arora, Standard Publishers and Distributers, Delhi.
4. Fluid Mechanics & Machinery by C.S.P.Ojha, R.Berndtsson and P.N.Chandramauli, Oxford Publishers, Delhi

Course Level Problems (Test Items):

CO.NO.	Problem description
1	A. Explain the types of flows in fluid mechanics B. Derive the formulae of hydrostatic law. C. A single pipe A of 300 mm diameter diverges into two pipes B of 150mm diameter and pipe C of 200 mm diameter respectively. Velocity in pipe A is 5m/sec and Pipe B is 2.5m/sec. Calculate velocity in Pipe C.
2	A. Write and explain what is viscosity and its types. B. Explain the basic physical properties of fluids. C. Discuss the concept of bulk modulus and compressibility.
3	A. Explain the concept of pressure and centre of pressure B. Derive the formula for centre of pressure.

Assessment Methodology:

1. Practical exam in lab where they have to analyze the problem statement. (Once in a week)
2. Assignments one from each unit.
3. Midterm subjective paper based on topics mentioned in the modules. (Twice during the semester)
4. Final paper at the end of the semester subjective.

TEACHING AND LEARNING RESOURCES UNIT-WISE

1. All the Fluid Mechanics lectures can be found on below link:

https://youtube.com/playlist?list=PL-Yu0VXx3q-cOM7TNn9INXT_-oFN2gAA8

https://drive.google.com/drive/folders/1TILTARmJ6LPPVCPvrbf6qBMmgFdv8zOh?usp=sharing

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Techno India NJR Institute of Technology
Academic Administration of Techno NJR Institute
Syllabus Deployment

Name of Faculty	: Mr. Jitendra Choubisa	Subject Code: 3CE4-06
Subject	: Fluid Mechanics	
Department	: Civil Engineering	Sem: III
Total No. of Lectures Planned: 28		

COURSE OUTCOMES HERE (3 OUTCOMES)

At the end of this course students will be able to:

CO1: Solve the Hydrostatic problems.

CO2: Describe the physical properties of fluid.

CO3: Calculated the pressure distribution of incompressible fluid.

Lecture No.	Unit	Topic
1	**1**	**INTRODUCTION TO OBJECTIVE, SCOPE AND OUTCOME OF THE COURSE.**
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8	4	Manometers, Bourdon pressure gauge
9	**5**	**BUOYANCY**; Forces acting on immersed plane surface
10	5	Centre of pressure, forces on curved surfaces
11	5	Conditions of equilibrium for floating bodies
12	5	Meta-centre
13	5	Analytical determination of meta centric height
14	**6**	**KINEMATICS OF FLOW**: Visualisation of flow, Types of flow: Steady and unsteady, uniform and non-uniform, rotational and ir-rotaional flow, Laminar and turbulent flow
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17	6	Velocity potential and stream function, elementary treatment of flow net
18	6	Fluid mass subject to horizontal and vertical acceleration and uniform rotation
19	**7**	**FLUID DYNAMICS**: Control volume approach
20	7	Euler's equation, Bernoulli's equation and its applications, venture-meter, orifice meter, orifices & mouthpieces
21	7	Pressure on flat plates and nozzles. Time of emptying of tanks by orifices
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DEPARTMENT OF CIVIL ENGINEERING

SUBJECT: **FLUID MECHANICS**

MAX MARKS: **80** TIME: 2 Hrs

Instruction for candidates:

PART-A Attempt all Questions, Each question carries 2 Marks.

PART-B Attempt any 4 Questions, Each question carries 10 Marks.

PART-C Attempt any 2 Questions, Each question carries 15 Marks.

PART-A

Q.1: Answer the following terms in 30 words:

(a) Specific Gravity

(b) Kinematic Viscosity

(c) Metacenter

(d) Center of pressure

(e) Manometers. (5 x 2 = 10 Marks)

PART-B

Q.2: Write down any three basic properties of fluid with their respective formulae's and their Units. Calculate the specific weight & density of one litre of a liquid which weighs 7 N. (10 Marks)

Q.3: Define what viscosity is?

A plate 0.025mm distant from a fixed plate, moves at 60 cm/s and require a force of 2 N per unit area i.e., 2 N/m^2 to maintain the speed. Determine the fluid viscosity between the plates. (10 Marks)

Q.4: Define what surface tension is and explain capillarity.

Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (a) water and (b) mercury. Take surface tension $\sigma = 0.0725$ N/m for water and $\sigma = 0.52$ N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact = 130° (10 Marks)

Q.5: Explain in detail what Vapor pressure & Cavitation is.

State what is newton's law of viscosity? (10 Marks)

Q.6: Define what Pascal Law & Hydrostatic law is. A hydraulic press has a ram of diameter 30 cm and a plunger of dia 4.5 cm. Find the weight lifted by press when the force at the plunger is 500 N. (10 Marks)

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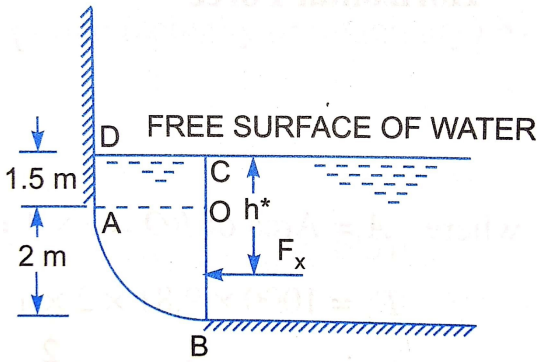
Q.7: Write down the conditions of equilibrium for floating and submerged bodies both. Explain with neat diagram and forces causing the phenomena. (10 Marks)

PART-C

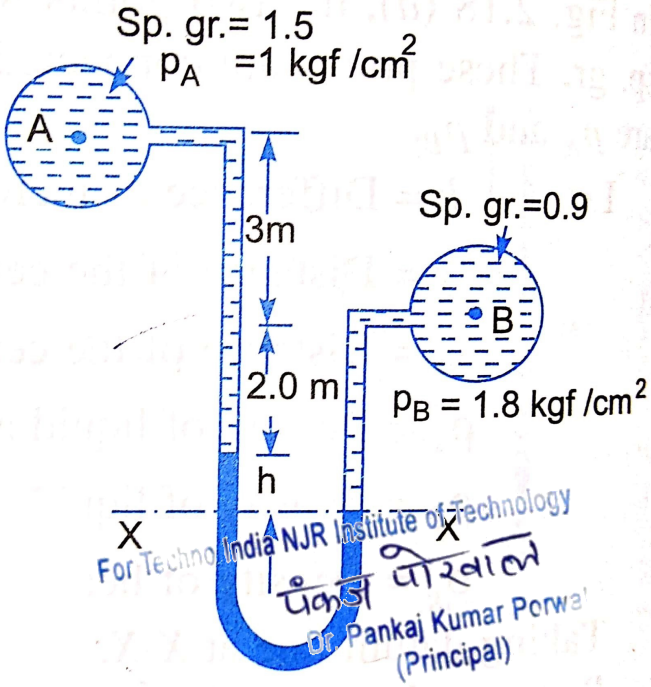
Q.8: Define what total pressure is and center of pressure, derive the expressions for center of pressure.

A rectangular plane surface is 2m wide and 3m deep. It lies in vertical plane in water. Determine the total pressure and position of center of pressure on the plane surface when its upper edge is horizontal and (a) coincides with water surface, (b) 2.5m below the free water surface. (15 Marks)

Q.9: Compute the horizontal and vertical components of the total force acting on a curved surface AB, which is in the form of a quadrant of a circle of radius 2 m as shown below. Take the width of gate as unity. (15 Marks)



Q.10: A differential manometer is connected at the points A & B of two pipes as shown below. The pipe A Contains a liquid of sp. gr. = 1.5 while pipe B contains a liquid of sp. gr. = 0.9. The pressure at A and B are 1 kgf/cm^2 and 1.80 kgf/cm^2 respectively. Find the difference of pressure in mercury level in the differential manometer. (15 Marks)



QUIZ ON FLUID MECHANICS

Total Questions 10
Total Marks 10

choubisa.jitendra7@gmail.com (not shared) Switch

* Required

Name Of student *

Your answer

Mass per unit volume of a fluid is known as? * 1 point

- Mass Density
- Weight Density
- Specific Gravity
- Relative Density

Weight per unit volume of a fluid is known as? * 1 point

- Mass Density
- Weight Density or Unit Weight
- Specific Gravity
- Viscosity

The property by which fluid layers resist the flow? * 1 point

- Viscosity
- Density
- Pressure
- Velocity

Kinematic Viscosity has a formula of: * 1 point

- Density / Dynamic Viscosity
- Dynamic Viscosity / Density
- Density / Specific Gravity
- Specific Gravity / Density

Continuity equation for a compressible fluid flow is given by? 1 point

- AV=Q
- A1V1 = A2V2
- (rho)1 A1 V1 = (rho)2 A2 V2
- [illegible]

What is the use of Pitot Tube? * 1 point

- It calculates Discharge
- It Calculates Velocity
- It Calculates Pressure
- None

Sum of all the energies are same throughout the sections of flow, this statement corresponds to: * 1 point

- Continiuity Equation
- Bernoulii's Theorem
- Darcy Weisbach Equation
- Chezy's Theorem

The study of fluid in motion without considering the forces causing that motion: * 1 point

- Dynamics
- Statics
- Kinematics
- Mechanics

What contributes to the major loss of energy in pipes? * 1 point

- Contraction
- Friction
- Expansion
- Bend in pipe

In pipes Velocity is maximum at: * 1 point

- ◯ Inlet
- ◯ Outlet
- ◯ At walls
- ◯ At Center

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SUBJECT NAME : FLUID MECHANICS
SUBJECT CODE : 3CE4-06

Video Tutorial Links for all the Lectures of Fluid Mechanics

1. Till Metacentric Height

   https://www.youtube.com/playlist?list=PL-Yu0VXx3q-cOM7TNn9INXT_-oFN2gAA8

2. After That all the topics videos can be accessed from below link:

   https://drive.google.com/drive/folders/1TILTARmJ6LPPVCPvrbf6qBMmgFdv8zOh?usp=sharing

FACULTY NAME : JITENDRA CHOUBISA

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DEPARTMENT OF CIVIL ENGINEERING

ASSIGNMENT NO. 01

SUBJECT NAME: FLUID MECHANICS

SUBJECT CODE: 3CE4-06

FACULTY NAME: JITENDRA CHOUBISA

Kinematics

Jitendra Choubisa posted a new assignment: Numericals regarding Fluid Dyn... Due Aug 22, 2020

Posted Aug 19, 2020

Complete the numerical no. 6.6 and 6.4 from the book R.K Bansal and Upload the image(JPG) or the PDF Here.

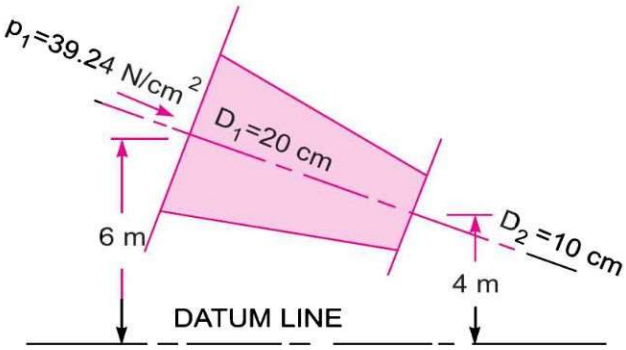
0 Turned in | 1 Assigned | 5 Graded

FM CLASS 1.PNG
Image

FM CLASS 1.PNG
Image

Add class comment...

Problem 6.4 *The water is flowing through a pipe having diameters 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2.*



Solution. Given :

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ASSIGNMENT NO. 02

SUBJECT NAME: FLUID MECHANICS

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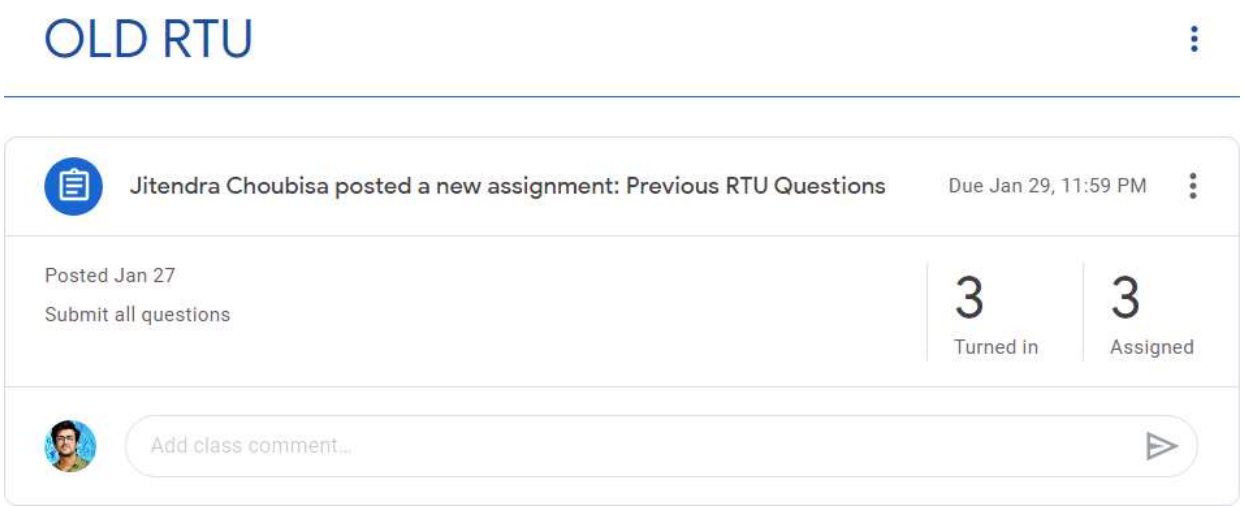
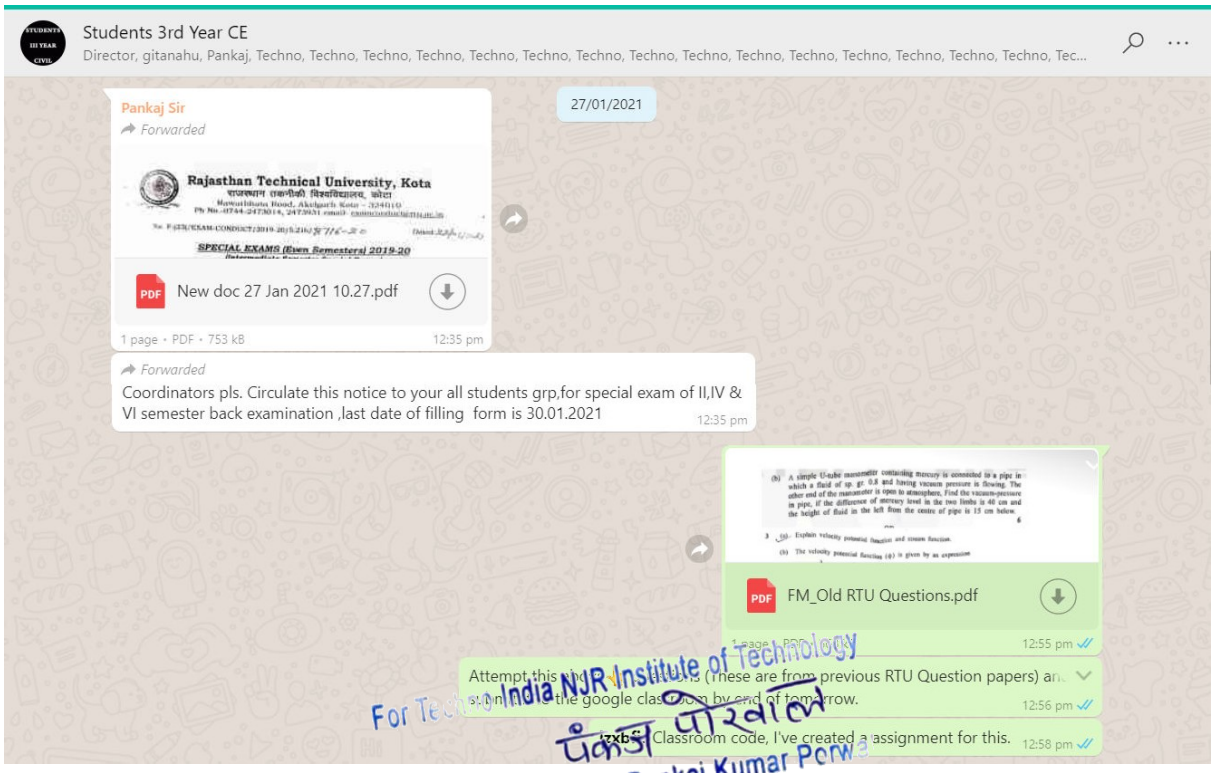
FACULTY NAME: JITENDRA CHOUBISA





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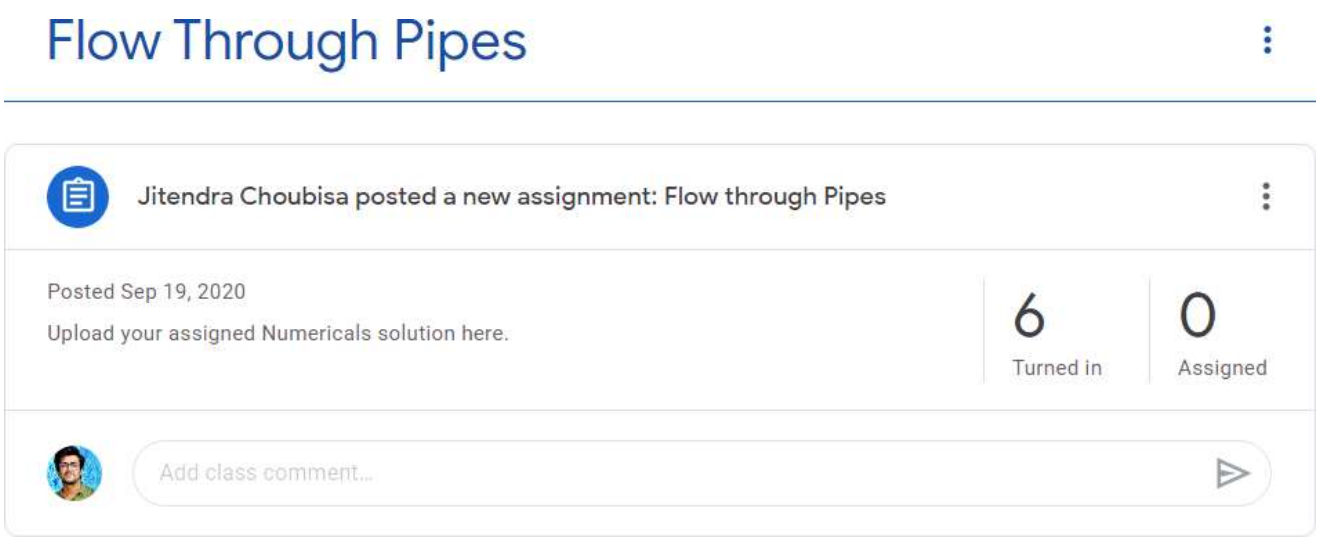
DEPARTMENT OF CIVIL ENGINEERING

ASSIGNMENT NO. 03

SUBJECT NAME: FLUID MECHANICS

SUBJECT CODE: 3CE4-06

FACULTY NAME: JITENDRA CHOUBISA



Problem 11.9 *At a sudden enlargement of a water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10 mm. Estimate the rate of flow.* (J.N.T.U., S 2002)

Problem 11.10 *The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine :*

(i) loss of head due to sudden enlargement, (ii) pressure intensity in the large pipe,

(iii) power lost due to enlargement.

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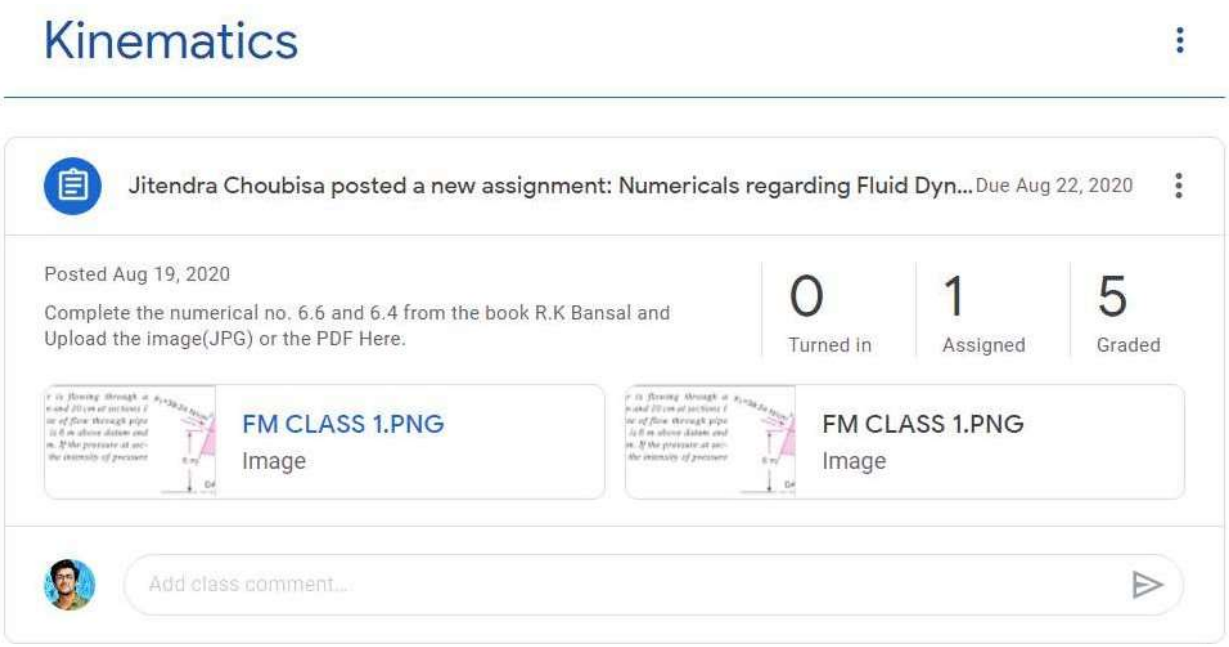

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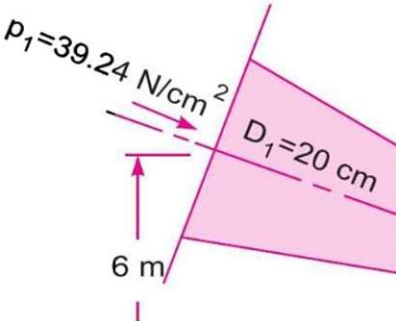

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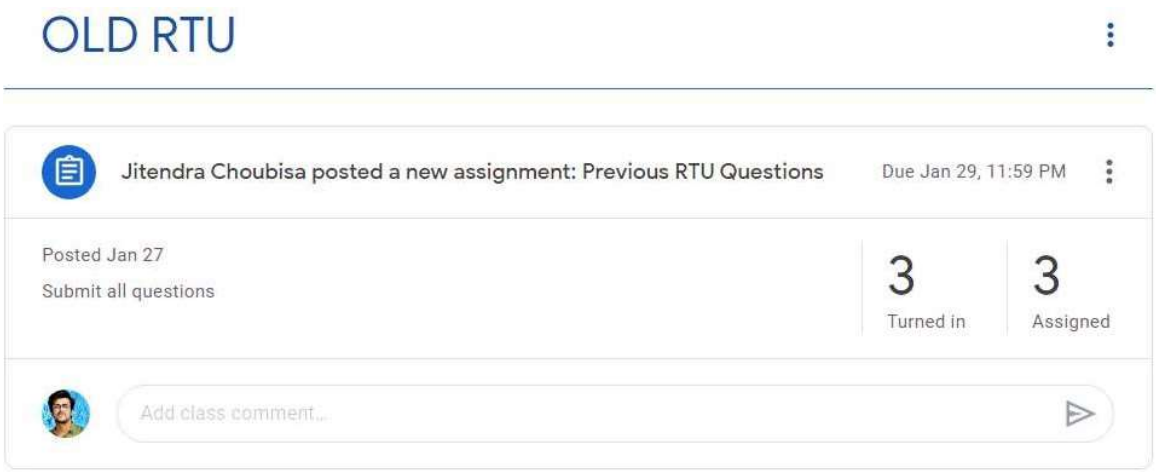

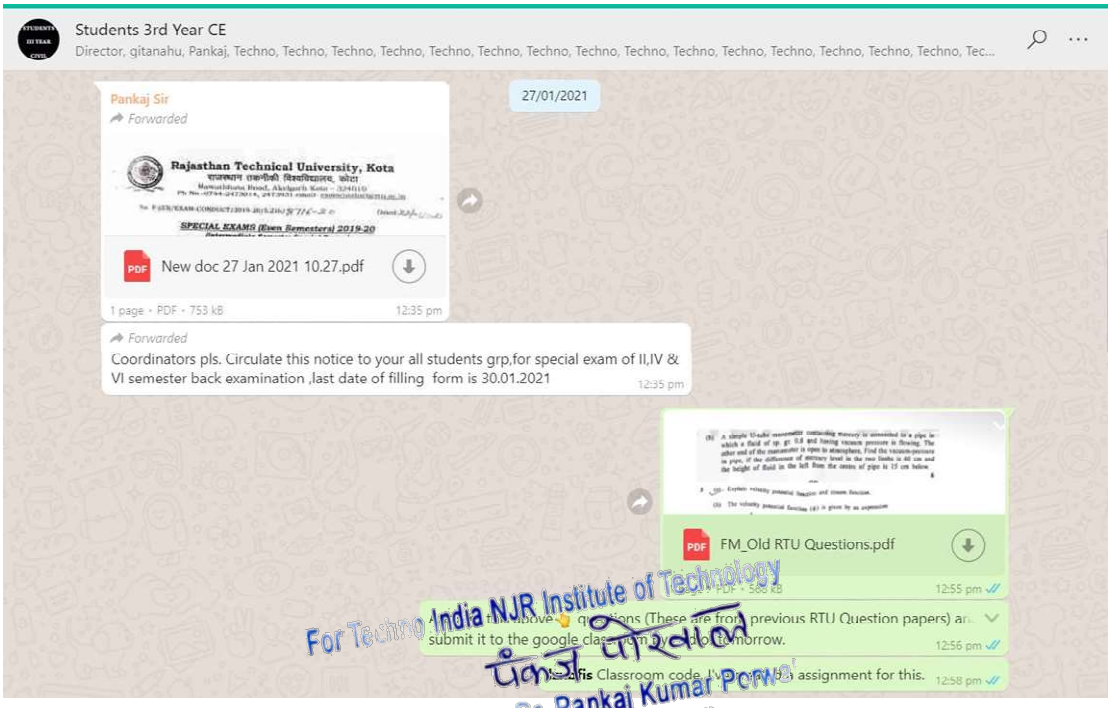

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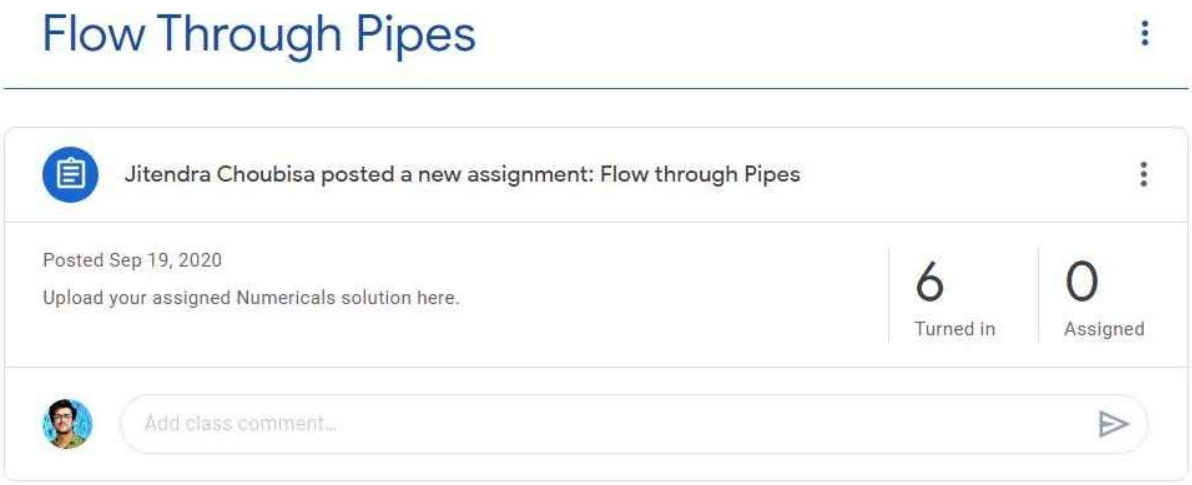

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