Techno India NJR Institute of Technology

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Course File

Fluid Mechanics (3CE4-06)

Semester: III Year: II (2023-24)

Name of faculty: Jitendra Choubisa

Email ID: jitendra.choubisa@technonjr.org

Total Number of Lectures: 28

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INDEX - COURSE FILE

Techno India NJR Institute of Technology

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VISSION & MISSION OF INSTITUTE

Vision

Empowering student with recent and emerging technologies to create innovative technical leaders capable of contributing to industrial and societal needs for betterment of mankind across the globe.

Mission

M1: To provide dynamic learning environment to students by providing constant exposure to latest technologies by linking closely with the industries.

M2: To establish effective interface with industry to obtain live problems to enhance critical thinking and problem solving skills among students and consultancy projects for faculty.

M3: To provide avenues and opportunities to faculty for domain specific trainings and qualification upgradation.

M4: To develop ethical leaders with strong communication skills.

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VISION & MISSION OF DEPARTMENT

Department Vision

To increase students learning of fundamentals for designing and planning of buildings and latest technologies through industry-aligned project-based learning which will help in transforming students to be good civil engineering professionals leading to innovation and incubation of new ideas.

Department Mission

M1: To create experimental learning through solving problems of Government, Society, Smart Cities, Industry and other entities.

M2: To teach the latest technologies to the students as beyond the syllabus activity so that they are updated and industry ready.

M3: To enable engineering students understand industry-aligned technologies and learn to find solutions from their early engineering days and this is the only way to produce globally relevant engineers solving real-life problems applying current technologies.

M4: To enable students to generate projects through problem faced by and requirement of Smart cities, industry, Government and other entities whereby those outlined problem statements are to be studied deeply by a group of faculty members to convert them into real-time project format.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs 1: To provide an in-depth understanding of the fundamentals of Civil Engineering and create a foundation for lifelong learning to facilitate a progressive career in the construction Industry, as an entrepreneur and in pursuit of higher studies.

PEOs 2: To equip the students with technical and analytical skills to develop innovative solutions to complex real-life problems using existing and novel technologies. To equip the students with good communication and interpersonal skills, inter-disciplinary teamwork and leadership skills to enable them to fulfill professional responsibilities.

PEOs 3: To expose them to various contemporary issues which will enable them to become ethical and responsible towards themselves, co-workers, Society and the Nation.

PEOs 4: To make the student's industry ready by imparting education related to the latest technologies so that they can grab future industry jobs.

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO1: To be aware of and initiate some-work on future technologies and new developments which may impact the future Industry 4.0.

PSO2: Hands on training on upcoming technologies and project-based learning.

PSO3: Get exposure to BIM (Building Information Modeling).

PROGRAMME OUTCOMES (POs)

A student will develop:

PO01. ENGINEERING KNOWLEDGE: An ability to apply knowledge of Mathematics, Science and Engineering Fundamentals in Electronics and Communication Engineering.

PO02. PROBLEM ANALYSIS: Ability to analyze and interpret data by designing and conducting experiments. Develop the knowledge of developing algorithms, designing, implementation and testing applications in electronics and communication related areas.

PO03. DESIGN/ DEVELOPMENT OF SOLUTION: An ability to Design a system Component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

PO04. CONDUCTION OF INVESTIGATION OF COMPLEX PROBLEMS: Ability to Identify, formulate and solve engineering problems.

PO05. MODERN TOOL USAGE: An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

PO06. THE ENGINEERING AND SOCIETY: Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.

PO07. ENVIRONMENT & SUSTAINABILITY: Understand the impact of professional engineering solution in societal and environmental contexts, and demonstrate the knowledge of, and need of sustainable development.

PO08. ETHICS: An ability to understand the professional, social and ethical responsibility.

PO09. INDIVIDUAL AND TEAM WORK: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. COMMUNICATION: An ability to Communicate effectively in order to succeed in their profession such as, being able to write effective reports and design documentation, make effective presentations.

PO11. PROJECT MANAGEMENT & FINANCE: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in team, to manage projects and in multidisciplinary environment.

PO12. LIFE-LONG LEARNING: Recognize the need and an ability to engage in life-long learning.

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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 Outcome:

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:

Necessary Background: Vector calculus, ordinary and partial differential equations, some exposure to complex variables. Undergraduate course in fluid mechanics or a background in Newtonian mechanics.

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Mapping COs, POs and PSOs:

Fluid Mechanics Year of study: 2023-24														
Course Outcome	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO23406.1	2	3	3	2	0	2	1	0	0	0	0	0	1	1	1
CO23406.2	2	2	3	1	0	2	1	0	0	0	0	0	1	1	1
CO23406.3	2	2	3	2	0	1	1	0	0	0	0	0	1	1	1
CO23406.4	2	3	3	2	0	2	1	0	0	0	0	0	1	1	1
CO23406.5	2	2	3	1	0	2	1	0	0	0	0	0	1	1	1

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UNIVERSITY ACADEMIC CALENDAR

Academic Calendar for Odd Semester for Session

RAJASTHAN TECHNICAL UNIVERSITY KOTA

Course: Bachelor of Technology (B.TECH.) for Odd Semester				
Semester	I	III	V	VII
Induction Program	17.08.2023			
Commencement of Classes	11.09.2023	24.08.2023	04.09.2023	04.09.2023
Commencement of First Mid Term	02.11.2023	03.10.2023	05.10.2023	05.10.2023
Commencement of Second Mid Term	07.12.2023	16.11.2023	20.11.2023	20.11.2023
Last Working Day	23.12.2023	02.12.2023	02.12.2023	30.11.2023
Commencement of Practical Exams	02.01.2024	04.12.2023	23.12.2023	14.12.2023
Commencement of Theory Exams	18.01.2024	14.12.2023	08.12.2023	07.12.2023
Winter Break				

ACADEMIC CALENDAR OF INSTITUTE

Academic Calendar

Academic Calendar for Odd Semester for Session 2023-24 (Odd Semester)

Course: Bachelor of Technology (B.TECH.)				
Semester	I	III	V	VII
Induction Program	10-08-2023			
Commencement of Classes	20-08-2023	11-09-2023	30-08-2023	22-08-2023
Commencement of First Mid Term	04-11.2023	02-11.2023	02-11.2023	27-09-2023
Commencement of Second Mid Term	15-01-2024	27-12-2023	27-12-2023	05-12-2023
Last Working Day	20-01-2024	12-01-2024	12-01-2024	20-12-2023
Commencement of Practical Exams	29-01-2024	15-01-2024	15-01-2024	31-12-2023
Commencement of Theory Exams	15-02-2024	30-01-2024	29-01-2024	27-12-2023

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Evaluation Scheme

FACULTY DETAILS:

Name of the Faculty : Mr. Jitendra Choubisa

Designation : Assistant Professor

Department : Civil Engineering

1. TARGET

a) Percentage Pass : 100 %
b) Percentage I class: 70 %

2. METHOD OF EVALUATION

2.1. Continuous Assessment Examinations (Mid-Term 1 & 2)

2.2. Assignments / Seminars

2.3. Mini Projects

2.4. Quiz

2.5. Semester Examination

Others_____

3. List out any new topic(s) or any innovation you would like to introduce in teaching the subject in this Semester.

1. Take the help of creative tools to stimulate creativity. Include slide presentations, demonstration or forms of visual exercises that will excite the young minds and capture their interest.

Signature of Faculty: **Signature of HOD**

UNIVERSITY SYLLABUS

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:30, ETE:70)
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 of Fluid Statics**: Basic equations, Pascal Law, 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	**Kinematics of Flow**: Visualisation of 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

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

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

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WEEKLY TIME TABLE OF THE TEACHER

First Time Table: with effect from (Date): Effective from 17 August 2023

Day	1	2	3	4	5	6	7
Monday		FM					
Tuesday						FM	
Wednesday							
Thursday							
Friday				FM			
Saturday	FM		FM				

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COURSE-PLAN

Lect. No.	UNIT	TOPICS	Teaching Methods/ Teaching Aids
1.	1	Introduction to scope objective and outcome of the subject.	White Board, PPT,
2.	2	Fluids: Definition, Type of fluids, Ideal fluids, real fluids, Newtonian and non-Newtonian fluids.	White Board, PPT, Demonstration
3.	3	Properties of Fluids: Units of measurement, Mass density, Specific weight	White Board
4.	3	Properties of Fluids: Specific volume, Specific Gravity, Viscosity,	White Board
5.	3	Surface tension and Capillarity, Compressibility and Elasticity.	White Board
6.	4	Principles of Fluid Statics: Basic equations, Pascal Law,	White Board, PPT
7.	4	Type of pressure:-atmospheric pressure, Gauge pressure, vacuum pressure, absolute pressure,	White Board
8.	4	Manometers, Bourdon pressure gauge	White Board
9.	5	Buoyancy; Forces acting on immersed plane surface.	White Board, PPT
10.	5	Centre of pressure, forces on curved surfaces.	White Board
11.	5	Conditions of equilibrium for floating bodies, meta-centre and analytical determination of meta centric height.	White Board
12.	6	Kinematics of Flow: Visualisation of flow, Types of flow: Steady and unsteady, uniform and non-uniform,	White Board, PPT,
13.	6	Rotational and irrotaional flow Laminar and turbulent flow, streamline	White Board
14.	6	Path line, streak line, principle of conservation of mass, equation of continuity	White Board, PPT, Demonstration
15.	6	Acceleration of fluid particles local and convective, velocity, acceleration,	White Board

16.	6	Velocity potential and stream function, elementary treatment of flow net	White Board
17.	6	Vorticity, circulation, free and forced vortex. Fluid mass subject to horizontal and vertical acceleration and uniform rotation	White Board
18.	7	Fluid Dynamics: Control volume approach, Euler's equation,	White Board
19.	7	Bernoulli's equation and its applications, Venture-meter, orificemeter,	White Board, PPT
20.	7	orifices & mouthpieces, time of emptying of tanks by orifices	White Board
21.	7	Momentum and angular momentum equations and their applications	White Board, PPT
22.	7	Pressure on flat plates and nozzles.	White Board
23.	8	Laminar Flow through Pipes: Laminar flow through pipes,	White Board, PPT,
24.	8	Relation between shear & pressure gradient.	White Board
25.	8	HagenPoiseuille equation, Flow between plates & pipes,	White Board, Demonstration
26.	8	Equations for velocity distribution,	White Board
27.	8	Pressure difference velocity distribution over a flat plate and in a pipe section,	White Board
28.	8	Darcy-Weisbach equation, friction factor , minor losses, pipe networks	White Board

Signature of Faculty: **Signature of HOD**

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Assignment Sheet

ASSIGNMENT NO. 1

i. If 5 m^3 of certain oil weighs 45 kN calculate the specific weight, specific gravity and mass density of the oil.

ii. A plate (2m x 2m), 0.25 mm distant apart from a fixed plate, moves at 40 cm/s and requires a force of 1 N. Determine the dynamic viscosity of the fluid in between the plates.

iii. A tape of 0.015 cm thick and 1.00 cm wide is to be drawn through a gap with a clearance of 0.01cm on each side. A lubricant of dynamic viscosity 0.021 Ns/m2 completely fills the gap for a length of 80 cm along the tape. If the tape can withstand a maximum tensile force of 7.5 N calculate the maximum speed with which it can be drawn through the gap.

ASSIGNMENT NO. 2

i. Find the pressure inside a water droplet having diameter of 0.5 mm at 200 C if the outside pressure is 1.03N/cm 2and the surface tension of water at that temperature is 0.0736 N/m.

ii. Compare the capillary rise of water and mercury in a glass tube of 2 mm diameter at 200 C. Given that the surface tension of water and mercury at 200 C are 0.0736 N/m and 0.051N/m respectively. Contact angles of water and mercury are 700 and 1300 respectively.

iii. Two pipes on the same elevation convey water and oil of specific gravity 0.88 respectively. They are connected by a U-tube manometer with the manometric liquid having a specific gravity of 1.25. If the manometric liquid in the limb connecting the water pipe is 2 m higher than the other find the pressure difference in two pipes.

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SAMPLE QUIZ QUESTIONS

1. What is fluid mechanics?

a) Study of fluid behaviour at rest

b) Study of fluid behaviour in motion

c) Study of fluid behaviour at rest and in motion

d) Study of fluid behaviour at rest and in motion

Answer: c

Explanation: The study of fluid behaviour (liquids, gases, blood, and plasmas) at rest and in motion is known as fluid mechanics. Fluid mechanics has numerous applications in mechanical and chemical engineering, as well as biological and astrophysical systems.

2. Which of the following is the basic principle of fluid mechanics?

a) Momentum principle

b) Energy equation

c) Continuity equation

d) All of the mentioned

Answer: d

Explanation: The continuity equation (i.e. mass conservation), the momentum principle (or momentum conservation), and the energy equation are the three basic fluid mechanics principles.

3. What is fluid mechanics used for?

a) Fluid mechanics enables to comprehend the behaviour of solid fluids under pressure

b) Fluid mechanics enables to comprehend the behaviour of fluids under a variety of forces & atmospheric conditions

c) Fluid mechanics enables to comprehend the behaviour of fluids under various temperatures only

d) None of the mentioned

Answer: b

Explanation: Fluid mechanics enables to comprehend the behaviour of fluids under a variety of forces and atmospheric conditions, as well as to select the appropriate fluid for a variety of applications.

4. If a person studies about a fluid which is at rest, what will you call his domain of study?

a) Fluid Dynamics

b) Fluid Mechanics

c) Fluid Statics

d) Fluid Kinematics

Answer: c

Explanation: Fluid Mechanics deals with the study of fluid at rest or in motion with or without the consideration of forces, Fluid Statics is the study of fluid at rest, Fluid Kinematics is the study of fluid in motion without consideration of forces and Fluid Dynamics is the study of fluid in motion considering the application forces.

5. Which among the following is the standard symbol for Atwood number?

a) Ar

b) A

c) a

d) AR

Answer: b

Explanation: The standard symbol for Atwood number is A. Atwood's number in fluid mechanics deals with the onset of instabilities in mixtures of fluid. It is due to the density differences in fluid.

6. Which of the following method is used exclusively in fluid mechanics?

a) Eulerian method

b) Lagrangian method

c) Neither Lagrangian nor Eulerian method

d) Both Lagrangian and Eulerian methods

Answer: a

Explanation: In Fluid Mechanics, the matter of concern is the general state of motion at various points in the fluid system (as in Eulerian approach) rather than the motion of each particle (as in Lagrangian approach). Hence, the Eulerian method is extensively used in Fluid Mechanics.

7. Which of the following method is most commonly used in fluid mechanics for analysis?

a) Eulerian Method

b) Control volume analysis

c) Langragian method

d) None of the mentioned

Answer: a

Explanation: In Eulerian method,we describe velocity, acceleration pressure etc at a point in flow field.hence, it is also most commonly used in fluid mechanics.

8. When is a fluid called turbulent?

a) High viscosity of fluid

b) Reynolds number is greater than 2000

c) Reynolds number is less than 2000

d) The density of the fluid is low

Answer: b

Explanation: Reynolds number is a dimensionless quantity. It helps to predict the flow pattern in fluid mechanics. At high Reynolds number, the flow has a very high density, due to which the value of Reynolds number is greater than 2000.

9. Which among the following is the standard symbol for Blake number?

a) ba

b) b

c) Bi

d) Bl

Answer: d

Explanation: The standard symbol for Blake number is B or Bl. Blake number in fluid mechanics deals with geology, fluid mechanics and porous media. It is due to the inertial over the viscous forces in fluid flow through porous media.

10. Stagnation point is the point in fluid mechanics where the velocity of the fluid at that point is _____

a) unity

b) constant

c) infinite

d) zero

Answer: d

Explanation: Stagnation point is the point in fluid mechanics where the velocity of the fluid at that point is zero. Stagnation points occur at places where the fluid is brought to a state of rest by an object. They usually exist at the surface of objects.

11. Which among the following is the standard symbol for Archimedes number?

a) Ar

b) A

c) a

d) AR

Answer: a

Explanation: The standard symbol for Archimedes number is Ar. Archimedes number in fluid mechanics deals with the motion of fluids. This takes place due to the differences in their densities. It was followed by the Archimedes principle.

12. Which among the following is referred to as the temperature at a stagnation point in the flow of fluids in fluid mechanics and thermodynamics.

a) Absolute temperature

b) Maximum temperature

c) Stagnation temperature

d) Hydraulic temperature

Answer: c

Explanation: Stagnation temperature is the temperature at the stagnation point of the flow of fluids. In thermodynamics and fluid mechanics, these terms find application. At a stagnation point the speed of the fluid is zero and all of the kinetic energy has been converted to internal energy and is added to the local static enthalpy.

13. What is model testing?

a) Overall testing

b) Function testing

c) Partial testing

d) Performance testing

Answer: d

Explanation: The process in fluid mechanics that is used to study the complex fluid dynamics is called as model testing. It is a performance testing. It helps to test models after a standard scaling. Models are usually smaller than the final design.

14. When is the fluid called laminar?

a) Low viscosity

b) The density of the fluid is high

c) Reynolds number is greater than 2000

d) Reynolds number is less than 2000

Answer: d

Explanation: Reynolds number is a dimensionless quantity. It helps to predict the flow pattern in fluid mechanics. At low Reynolds number, the flow has a very low density, due to which the value of Reynolds number is less than 2000.

15. Which among the following provides the third principle in fluid mechanics?

a) Conservation of Heat

b) Conservation of volume

c) Conservation of linear momentum

d) Conservation of mass

Answer: c

Explanation: In fluid mechanics, the third principle is given by the conservation of linear momentum. It is in addition to the continuity of mass and conservation of energy. They are mostly seen in channel flow problems.

16. When a fluid is subjected to resistance, it undergoes a volumetric change due to _____

a) Cohesion

b) Strain

c) Compressibility

d) Adhesion

Answer: c

Explanation: Compressibility is defined as a measure of relative change in volume of a fluid. In fluid mechanics, it is also called as isothermal compressibility due to increase in pressure and temperature.

17. The compressible flow is assumed to be _____

a) Adiabatic only

b) Isentropic only

c) Isentropic and adiabatic

d) Polytropic

Answer: b

Explanation: Compressible flow is a branch of fluid mechanics that deals with different types of flow. Its main significance lies in the change in fluid density. It deals with gas dynamics. Flow is assumed to be isentropic.

18. Principle of fluid mechanics works on the utilization of_____

a) Velocity

b) Accelerating mass

c) Volume

d) Work

Answer: d

Explanation: The Principle of fluid mechanics works on the utilization of useful work. The working is based on the force exerted by a fluid jet striking the surface and moving over a series of vanes about its axis.

19. Open channel flow takes place _____

a) In a pump

b) Within a cylindrical depth

c) On a free surface

d) In the pipe

Answer: c

Explanation: Open channel flow is a flow that deals with hydraulics in fluid mechanics. It is a type of liquid flow that flows through a free surface. This free surface is called as a channel. And since the channel is free, it is called as an open channel flow.

20. Which of the following is a type of fluid based on viscosity?

a) Real Fluid

b) Ideal Fluid

c) Newtonian Fluid

d) All of the mentioned

Answer: d

Explanation: Fluid based on viscosity:

i) Real Fluid

ii) Ideal Fluid

iii) Newtonian Fluid

iv) Non-Newtonian Fluid

v) Ideal Plastic Fluid

21. The viscous force the relative motion between the adjacent layers of a fluid in motion. Which of the following flowing fits best in the sentence?

a) never affects

b) may effect under certain conditions

c) facilitates

d) opposes

Answer: d

Explanation: Viscosity is the internal friction of a fluid in motion. It is the property by the virtue of which the relative motion between two adjacent fluid layers is opposed.

22. Pressure intensity or force due to pressure gradient for fluid at rest is considered as which of the following kind of force?

a) Body force

b) Force due to motion

c) Surface force

d) None of the mentioned

Answer: c

Explanation: Pressure force is surface force.

23. Pressure variation for compressible fluid is maximum for which of the following kind of process?

a) Adiabatic

b) Quasi Static

c) Isothermal

d) None of the mentioned

Answer: c

Explanation: Due to constant temperature, pressure variation for compressible fluid is maximum for isothermal process.

24. Which of the following principle is used for calculating the centre of pressure?

a) Principle of balancing of momentum

b) Principle of momentum

c) Principle of conservation of energy

d) None of the mentioned

Answer: a

Explanation: We balance the moment in order to calculate the position of centre of pressure.

25. Which of the following cannot be the value of absolute pressure of a fluid at any point?

a) 0

b) 1.45 bar

c) – 1 bar

d) 24 bar

Answer: c

Explanation: Absolute zero pressure is the reference used for the measurement of absolute pressure. Absolute zero pressure is possible (theoretically). Hence, 0 and positive values are possible, but a negative value is impossible.

26. When the body is completely or partially immersed in a fluid, how much its weight be distributed for it to be in stable equilibrium.

a) Is independent of weight distribution

b) Around the lower part

c) Around the upper part

d) None of the mentioned

Answer: b

Explanation: When the weight distribution is around the lower part, the centre of gravity is at lower portion and hence below the centre of buoyancy which is condition for stable equilibrium.

27. Which of the following equation must be perfunctorily satisfied while dealing with fluid flow problems?

a) Newton’s third law

b) Law of conservation of momentum

c) Continuity equation

d) Newton’s second law

Answer: c

Explanation: Continuity equation must be perfunctorily satisfied while dealing with fluid flow problems.

28. 32. Which of the following is the mathematical technique used to predict physical parameters?

a) Dimensional analysis

b) Temperature analysis

c) Pressure analysis

d) Combustion analysis

Answer: a

Explanation: Dimensional analysis is a process which is used to determine physical parameters that influence the fluid flow. The analysis is based on the fundamental units. The fundamental units are mass, length and time.

29. Which among the following is an assumption of Hagen-Poiseuille equation?

a) Fluid is uniform

b) Fluid is laminar

c) Fluid is turbulent

d) Fluid is compressible

Answer: b

Explanation: Fluid flow is laminar as it is assumed to be incompressible and Newtonian. The flow is laminar through the pipe of constant cross section. Thus, there is no acceleration of fluid in the pipe. Therefore, Hagen-Poiseuille assumed that fluid flow is laminar.

30. Which of the following is a formula for the friction factor of circular pipes?

a) Re/64

b) 16/Re

c) 64/Re

d) Re/16

Answer: c

Explanation: Circular pipes have a diameter treated in a round manner. For a fluid flow which is laminar head loss is directly proportional to the fluid velocity. Thus, friction factor is inversely proportional to its velocity. Therefore, the correct option is ‘64/Re’.

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TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

B. TECH 2nd – YEAR (III SEM.) – MT-I

FLUID MECHANICS (**3CE4-06**)

Time: 2 Hr **Max. Marks:** 70

Note:

1) The paper is divided into 2 parts: Part-A and, Part-B.
2) Part-A contains 10 questions and carries 2 mark each.
3) Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

Part- A (20 Marks)

A.	Explain what Specific Gravity is?	CO1
B.	Explain what Kinematic Viscosity is?	CO1
C.	Explain what Metacentre is?	CO1
D.	Explain what is Centre of pressure?	CO1
E.	Explain what Manometers are?	CO2
F.	What do you understand by surface tension?	CO2
G.	What do you understand by Compressibility?	CO2
H.	What is pascal's law?	CO2
I.	What are the types of pressure?	CO3
J.	What is a stream line?	CO3

Part- B (50 Marks)

1. 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.	CO1
OR	
1. Write down any three basic properties of fluid with their respective formulae's and their Units. Calculate the specific weight & density of one liter of a liquid which weighs 7 N.	CO1

2. 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 σ = 0.0725 N/m for water and σ = 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°	CO1
OR	
2. Explain in detail what Vapor pressure & Cavitation is. State what is newton's law of viscosity?	CO1

3. Define what Pascal Law & Hydrostatic law is. A hydraulic press has a ram of diameter 30 cm and a plunger of diameter 4.5 cm. Find the weight lifted by press when the force at the plunger is 500 N.	CO2
OR	
3. Write down the conditions of equilibrium for floating and submerged bodies both. Explain with neat diagram and forces causing the phenomena.	CO2

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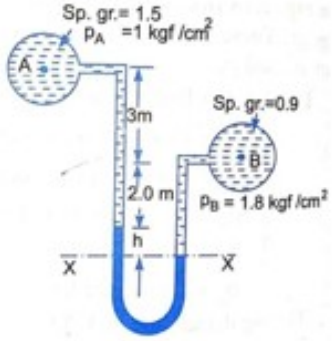
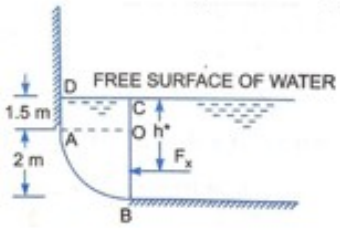
4. A differential manometer is connected at the points A & B of two pipes as shown below. The pipe A Contains a liquid of sp. gr. = 1.5 while pipe B contains a liquid of sp. gr. = 0.9. The pressure at A and B are 1 kgf/cm2 and 1.80 kgf/cm2 respectively. Find the difference of pressure in mercury level in the differential manometer.  	CO2
OR	
4. 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.  	CO2

5. The velocity potential function (ϕ) is given by an expression $$\phi = -\frac{xy^3}{3} - x^2 + \frac{x^3 y}{3} + y^2$$ (i) Find the velocity components in x and y direction. (ii) Show that ϕ represents a possible case of flow.	CO3
OR	
5. A fluid flow field is given by $V = x^2yi + y^2zj - (2xyz + yz^2)k$. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2, 1, 3).	CO3

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Marks and Gap Analysis of Mid-Term 1

S.No.	University Roll No.	Name of Student	Mid-Term 1 MM-70	Remark (Remedial Class need or not – Y/N)
1.	22ETCCE001	ANKIT KUMAR	58	N
2.	22ETCCE002	ARMAAN CHAUHAN	47	N
3.	22ETCCE003	AYUSH SINGH JHALA	44	N
4.	22ETCCE004	PARIDHI NINAMA	65	N
5.	22ETCCE005	PRAVEEN DANGI	54	N
6.	22ETCCE006	ROSHNI TABIYAR	68	N

*(Y, if obtained marks are <50%)

Signature of Faculty: **Signature of HOD**

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Remedial Action Taken to Remove the Gaps (After Mid- Term 1)

S.no.	University Roll no.	Name of Student	Topics to be discussed in Remedial Class	Schedule Date of Remedial Class	Outcome Achieved
1.	NIL				
2.					

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TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

B. TECH 2nd – YEAR (III SEM.) – MT-II

Fluid Mechanics (**3CE4-06**)

Time: 2 Hr Max. Marks: 70

Note:

4) The paper is divided into 3 parts: Part-A & Part-B.
5) Part-A contains 10 questions and carries 2 mark each.
6) Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

Part- A (20 Marks)

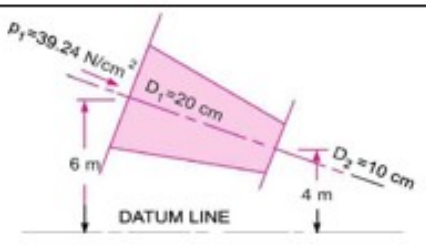
A. Explain what fluid kinematics mean?	CO3
B. Explain what is velocity potential?	CO3
C. Write is free vortex flow?	CO4
D. What is forced vortex flow?	CO4
E. Write Euler equation for fluid motion.	CO4
F. Write Bernoulli's equation.	CO4
G. What is Orificmeter?	CO5
H. What is Hagen-Poiseuille equation?	CO5
I. What is Darcy Weisbach equation?	CO5
J. What is friction factor?	CO5

CO3- 04, CO4- 08, CO5-08

Part- B (50 Marks)

1. A fluid flow is given by: $V = x^2yi + y^2zj - (2xyz + yz^2)k$ Prove that it is a possible case of fluid flow. Calculate the velocity and acceleration at the point (2, 1, 3).	CO3
OR	
1. The velocity potential function (ϕ) is given by: $\phi = -\frac{xy^3}{3} - x^2 + \frac{x^3y}{3} + y^2$ (i) Find the velocity component in x and y direction (ii) Show that ϕ represent a possible case of flow.	CO3

2. Derive the Euler's equation of Motion.	CO4
OR	
2. The water is flowing through a pipe having diameters 20 cm and 10 cm at sections 1 & 2 respectively. The rate of flow through pipe is 35 liters/s. The section 1 is 6 m above datum & 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.	CO4

3. Under application of Bernoulli's theorem, derive expression for rate of flow through Venturimeter.	CO4
OR	
3. A circular tank of diameter 4 m contains water up to a height of 5 m. The tank is provided with an orifice of diameter 0.5 m at the bottom. Find the time taken by water (i) To fall from 5 m to 2 m (ii) For completely emptying the tank. Take Cd = 0.6.	CO4

4. Derive expression for velocity distribution in viscous flow through circular pipe.	CO5
OR	
4. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds.	CO5

5. Explain all the types of losses in pipe.	CO5
OR	
5. Derive the formula for force exerted by the jet on moving vertical flat plate.	CO5

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Marks and Gap Analysis of Mid-Term II

Sr. No.	University Roll No.	Name of Student	Mid-Term 2 MM-70	Remark (Remedial Class need or not – Y/N)
1.	22ETCCE001	ANKIT KUMAR	55	N
2.	22ETCCE002	ARMAAN CHAUHAN	42	N
3.	22ETCCE003	AYUSH SINGH JHALA	48	N
4.	22ETCCE004	PARIDHI NINAMA	60	N
5.	22ETCCE005	PRAVEEN DANGI	58	N
6.	22ETCCE006	ROSHNI TABIYAR	63	N

*(Y, if obtained marks are <50%)

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Remedial Action Taken to Remove the Gaps (After Mid- Term II)

Sr. No.	University Roll no.	Name of Student	Topics to be discussed in Remedial Class	Schedule Date of Remedial Class	Course Outcome
1.	NIL				

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University Question Paper

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3E1625

3E1625

B.Tech. (Sem.III) (Main/Back) Examination, 2015
Civil Engineering
3CE5 Fluid Mechanics

Time : 3 Hours

Total Marks : 80
Min. Passing Marks : 26

Instructions to Candidates :
Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

UNIT – I

1. (a) Differentiate between :
   (i) Real and ideal fluid
   (ii) Specific weight and specific volume
   (iii) Dynamic and kinematic viscosity
   (iv) Compressibility and Bulk Modulus of elesticity. **(8)**

   (b) A thin rigid plate of size 1.25 m × 1.25m and weight 149 N slides down a slope of 30° inclination with an equilibrium speed of 8.5 cm/sec. If the slope is coated with a liquid film of thickness 0.75mm, determine the dynamic co-efficient of viscosity of the liquid. **(8)**

OR

1. (a) Derive the relationship for capillary size in small size tube. What will happen if tube is having insufficient length. **(8)**

   (b) 3.2 m^3 of certain oil weight 27.5 kN. Calculate specific weight, mass density, specific volume and specific gravity with respect to water. If kinematic viscosity of the oil 7×10^{-4} stokes, find its dynamic viscosity in centipoise. **(8)**

UNIT – II

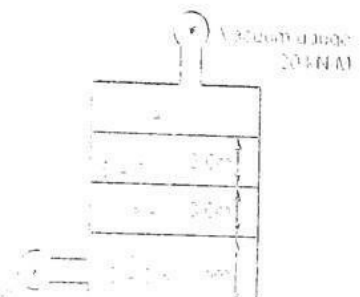
2. (a) State and prove the Pascal's law and give some example where the principle is applied. **(8)**

   (b) A vertical square area 1.50m × 1.50m is sub merged in water with upper edge 1.00m below the water surface. Locate the horizontal line on the surface of the square such that the force on the upper portion equals the force on the lower portion. **(8)**

OR

2. (a) Define "Meta centric height".
   A wooden block in the form of a rectangular prism floats with its shortest axis vertical. The block is 40 cm long, 20 cm wide and 15 cm deep with a depth of immersion 12 cm. Calculate the position of the meta centre and comments on the stability of the block. **(8)**

   (b) Find the gauge reading G in the figure given below.



UNIT – III

3. (a) Derive continuity equation in [illegible] (8)

(b) A 2-D fluid flow is described by [illegible] and $v = -2xy$. Evaluate the stream function. Find velocity and acceleration at point P [illegible] (8)

OR

3. (a) Define stream lines. What are the important characteristics of stream line. (4)

(b) Derive Euler's equation of motion along stream line for an ideal fluid flow stating clearly the assumptions. How Bernoulli's equation along a stream line is obtained by integrating this equation. (12)

UNIT – IV

4. (a) How, Pitot tube can be used to find the velocity at a point in a fluid. Explain with figure. (6)

(b) A horizontal venturi meter is provided in a 250mm diameter pipeline conveying water. The throat diameter of the venturi meter is 25 mm. If the pressure in the pipe is 147.15 kPa and the vaccum pressure at the throat is 280 mm of mercury, calculate the rate of flow in the pipe. Assume $C_d = 0.98$. Draw figure also. (10)

OR

4. (a) Justify the statement in a convergent-Divegent mouth-piece, the loss of head is practically eliminated. (6)

(b) A weir 36 meters long is divided into 12 equal bays by vertical posts, each 600 mm wide. Determine the discharge over the weir if the head over the crest is 1.20m and the velocity of approach is 2m/sec. Draw figure also. (10)

UNIT – V

5. (a) Distinguish between
(i) Laminar and Turbulent flow
(ii) Flow theory parallel pipes × pipes in series. (6)

(b) A pipe of diameter 25 cm connects two reservoir. The difference of water levels in two reservoir is 15m. To increase the discharge, another pipeline of same diameter is laid from mid-point of original pipeline to lower reservoir. If length of pipeline is 1600 m and Darcy's f = 0.017, calculate increase in discharge. (10)

5. (a) Explain
(i) Hydraulic gradient line
(ii) Water hammer (6)

(b) Determine the difference in the elevations between the surfaces in the two tanks, connected by a horizontal pipe of diameter 300m and length 450 m. The rate of flow of water through the pipe is 325 lit/sec. Consider all losses and taking Darcy's f = 0.008. Draw h.g.l. also. (10)

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STUDENT PERFORMANCE REPORT

Roll No.	Name of Student	I Mid-Term	II Mid-Term	Average
22ETCCE001	ANKIT KUMAR	58	55	56.5
22ETCCE002	ARMAAN CHAUHAN	47	42	44.5
22ETCCE003	AYUSH SINGH JHALA	44	48	46
22ETCCE004	PARIDHI NINAMA	65	60	62.5
22ETCCE005	PRAVEEN DANGI	54	58	56
22ETCCE006	ROSHNI TABIYAR	68	63	65.5

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RESULT ANALYSIS

S.NO.	RTU ROLL NUMBER	NAME OF STUDENT	END TERM MARKS	SESSIONAL MARKS	TOTAL
		MAX MARKS	**70**	**30**	**100**
1.	22ETCCE001	ANKIT KUMAR	17	25	42
2.	22ETCCE002	ARMAAN CHAUHAN	5	20	25
3.	22ETCCE003	AYUSH SINGH JHALA	0	19	19
4.	22ETCCE004	PARIDHI NINAMA	28	28	56
5.	22ETCCE005	PRAVEEN DANGI	16	23	39
6.	22ETCCE006	ROSHNI TABIYAR	30	29	59

TOTAL	PASS	FAIL	ABSENT	PASS %
6	4	2	0	66.67 %

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Indirect Assessment:

Overall Teacher Self-Assessment (at the completion of course) in terms of course objective and outcomes

Course Objectives:

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:

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.

CO4: Students be able to solve problems related to Fluid Kinematics.

CO5: Students will be able to apply concepts on flow parameters such as discharge, etc.

Methodology to identify bright student

Considered a range of criteria, including academic performance, creativity, critical thinking, problem-solving skills, and enthusiasm for learning. Bright students often excel in multiple areas. Observed how students perform in the classroom. In terms of active participation, engagement in discussions, leadership, and the ability to grasp complex concepts.

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Efforts to keep students engaged

1. Active Learning:
   - Incorporate active learning strategies, such as group discussions, problem-solving activities, and hands-on projects. Active participation keeps students engaged and encourages critical thinking.
2. Varied Teaching Methods:
   - Use a variety of teaching methods, including lectures, group work, multimedia presentations, and interactive activities to cater to different learning preferences.
3. Technology Integration:
   - Leverage technology, such as online platforms, educational apps, and interactive software, to make lessons more engaging and interactive.

Methodology to identify weak student

Considered a range of criteria, including classroom observation, formative assessment, summative assessment, assignment review e.t.c. Weak students are struggling students with sensitivity and a desire to support their learning. Some measures, such as additional tutoring, personalized assignments, or alternative assessment methods, to help students succeed.

Targeted inventions for weak student

1. Additional Resources

Offer supplementary learning materials, such as textbooks, online resources, or multimedia content, to provide alternative explanations and reinforce key concepts.

2. Remedial classes

Establish a tutoring program where students can receive extra help from teachers.

3. Flipped classroom

Students are assigned pre-class learning materials, often in the form of videos, readings, or online modules, to cover the foundational concepts before coming to class.