FLUID MECHANICS AND HYDRAULIC MACHINES (ME404PC)

COURSE PLANNER

I. COURSE OVERVIEW:

Mechanics of Fluid is a fundamental subject dealt for Mechanical, Electrical, Chemical, Civil and Aeronautical Engineering branches in an interdisciplinary manner. Machineries associated with fluid handling are of utmost importance for the aforesaid Engineers. The characteristic performances of these machines are studied to ascertain the suitability of the same for the specific purpose. The dynamics of fluid deals with all kinds of understanding the intricacies of the subject.

The subject deals with various elements that are used in Hydro Electric power plant and ocean power plant. Various equipment's are studied with their performance like Pelton turbine, Francis Turbine and various other pumps.

The purpose of studying this course is to imbibe the basic knowledge on fluid mechanics. This will be useful for Mechanical, civil and electrical engineering students for designing and applying to flow systems. Flow systems are applied for turbines, pumps, pipes etc.

II. PREREQUISITE(S):

Students are expected to know the fundamentals of engineering mechanics, resolving of forces, Statics, Dynamics and flow kinematics. Students are also expected to have expertise on several fluid handling equipment's such as different pumps, turbines, hydroelectric power plant.

III. COURSE OBJECTIVES:

The objectives of the course are to enable the student

- To understand the basic principles of fluid mechanics
- To identify various types of flows
- To understand boundary layer concepts and flow through pipes
- To evaluate the performance of hydraulic turbines
- To understand the functioning and characteristic curves of pumps

IV. COURSE OUTCOMES

Sl.NO	Description	Bloom's Taxonomy level
CO1	Able to explain the effect of fluid properties on a flow system.	L2: Understand
CO2	Able to identify type of fluid flow patterns and describe continuity equation.	L2: Understand
CO3	To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.	L4: Analyze
CO4	To select and analyze an appropriate turbine with reference to given situation in power plants.	L4: Analyze
CO5	To estimate performance parameters of a given Centrifugal and Reciprocating pump.	L4: Analyze
CO6	Able to demonstrate boundary layer concepts.	L2: Understand

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignment/ Exam
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Assignment/ Exam
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignment/ Exam
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignment/Exams
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	-	-
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	-	-
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	-	-
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	-	-
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	Assignment/Exams
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Assignment/Exams
PO11	**Project management and 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 a team, to manage projects and in multidisciplinary environments.	-	-
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Assignment/Exams

VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Level	Proficiency assessed by
PSO1	The student will be able to apply the knowledge of Mathematics, Sciences and engineering fundamentals to formulate, analyze and provide solutions for the problems related to Mechanical engineering and communicate them effectively to the concerned.	2	Lectures, Assignments
PSO2	Design mechanical systems in various fields such as machine elements, thermal, manufacturing, industrial and inter-disciplinary fields by using various engineering/technological tools to meet the mercurial needs of the industry and society at large.	2	Lectures, Assignments
PSO3	The ability to grasp the latest development, methodologies of mechanical engineering and posses competent knowledge of design process, practical proficiencies, skills and knowledge of programme and developing ideas towards research.	2	Lectures, Assignments

VII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CO's	Program Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO.1	3	1	--	--	--	--	--	--	3	2	--	2
CO.2	3	2	2	--	--	--	--	--	3	2	--	2
CO.3	3	2	3	1	--	--	--	--	3	2	--	2
CO.4	3	1	3	1	--	--	--	--	3	2	--	2
CO.5	2	3	3	1	--	--	--	--	3	2	--	2
CO.6	2	1	1	1	--	--	--	--	3	2	--	2
Average	**3**	**2**	**2**	**1**	--	--	--	--	**3**	**2**	--	**2**

Program Specific Outcomes (PSO's)

CO's	PSO1	PSO2	PSO3
CO1.	--	2	3
CO2.	--	2	3
CO3.	2	2	3
CO4.	2	2	1
CO5.	3	2	1
CO6.	--	2	3
Average	2	2	2

VIII. SYLLABUS:

Unit – I	**Fluid Statics**: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.
Unit – II	**Fluid Kinematics** : Stream line, path line and streak lines and stream tubes, classification of flows- steady & unsteady, uniform & non uniform, laminar & turbulent, rotational& irrotational flows – Equation of continuity for one dimensional flow . **Fluid dynamics**: Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.
Unit – III	**Boundary Layer Concepts:** Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary in transition, separation of boundary layer, submerged projects-drag and lift. **Closed conduit flow**: Reynolds's experiment –Darcy Weisbach equation – Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow: Pitot tube, Venturi meter and Orifice meter, Flow nozzle.
Unit – IV	**Basics of Turbo Machinery**: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes. **Hydraulic Turbines** : Classification of turbines, Head and efficiency, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine- working principles , work done, efficiencies, hydraulic design-Draft tube theory and deficiency. **Performance of hydraulic Turbines**: Geometric similarity, unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.
Unit - V	**Centrifugal pumps** : classification, working, work done-barometric head – losses and efficiencies specific speed –pumps in series and parallel, performance characteristic curves, NPSH Reciprocating pumps :Working , Discharge, slip, Indicator Diagram

SUGGESTED BOOKS/RESOURCES:

TEXT BOOKS:

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

REFERENCES:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

<u>**Additional Reading:**</u>

NPTEL Web Course:
https://nptel.ac.in/courses/112105182/.

NPTEL Video Course:
https://nptel.ac.in/courses/112105182/1

GATE SYLLABUS:

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc. comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

IES SYLLABUS:

Properties and classification of fluids, Manometry, forces on immersed surfaces, Center of pressure, Buoyancy, Elements of stability of floating bodies. Kinematics and Dynamics. Irrotational and incompressible. In viscid flow. Velocity potential, Pressure field and Forces on immersed bodies. Bernoulli's equation, Fully developed flow through pipes, Pressure drop calculations, Measurement of flow rate and Pressure drop. Elements of boundary layer theory, Integral approach, Laminar and tubulent flows, Separations. Flow over weirs and notches. Open channel flow, Hydraulic jump. Dimensionless numbers, Dimensional analysis, Similitude and modelling. One-dimensional isentropic flow, Normal shock wave, Flow through convergent - divergent ducts, Oblique shock-wave, Rayleigh and Fanno lines.

IX: COURSE PLAN

Lecture No.	Unit No.	Topics to be covered	Link for PPT	Link for PDF	Link for Small Projects/ Numericals(if any)	Course learning outcomes	Teaching Methodology	Reference
1	1	Dimensions & units	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain	Chalk and Talk	TB1&RB1
2	1	Physical properties of fluids- Specific gravity	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand	Chalk and Talk	

3	**1**	Viscosity, surface tension,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand	Chalk and Talk
4	**1**	Vapor pressure and their influence on fluid motion	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand	Chalk and Talk
5	**1**	Atmospheric , gauge & vacuum pressure,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5MzcxMDQ0ODk2	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand	Chalk and Talk
6	**1**	Measurement of pressure-piezometer	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
7	**1**	U-tube manometers, Differential manometers	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand, Calculating	Chalk and Talk
8	**1**	PROBLEMS, Student PPT	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand, Calculating	Chalk and Talk
9	**1**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand, Calculating	Chalk and Talk
10	**1**	REVISION	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand, Calculating	Chalk and Talk
11	**1**	**Mock Test - 1**		https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3		Chalk and Talk

12	**2**	UNIT- II Fluid Kinematics: Stream line, path line Streak line and stream tube,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
13	**2**	Classification of flows	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
14	**2**	Steady & unsteady, uniform & non uniform ,Laminar & turbulent , rotational & Irrotational flows, Equation of continuity for one dimensional flow	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
15	**2**	Student PPT	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
16	**2**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand, Calculating	Chalk and Talk	
17	**2**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand, Calculating	Chalk and Talk	
18	**2**	Fluid dynamics : Surface & body forces- Euler's Equation	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand, Calculating	Chalk and Talk	**TB1&RB1**

19	**2**	Bernoulli's equations for flow along a stream line,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
20	**2**	Momentum equation And its application on pipe bend	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
21	**2**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
22	**2**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
23	**2**	Student PPT	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
24	**3**	UNIT- III Definition, thicknesses, characteristics along thin platesLaminar boundary in transition	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
25	**3**	turbulent boundary layers in transition	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
26	**3**	Separation of boundary layer,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
27	**3**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxO	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2M	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY	Calculating	Chalk and Talk

			TY3	DIxOTY3	3			
28	**3**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk	
29	**3**	Submerged objects – drag and lift.	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
30	**3**	Studnt PPT	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk	
		MID- I Exams (Week-9)						
31	**3**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk	
32	**3**	Reynold's experiment- Darcy Weisbach equation	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	TB1&RB1
33	**3**	Minor losses in pipes- pipes in series and pipes in parallel	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
34	**3**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk	

35	**3**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
36	**3**	Total energy line-hydraulic gradient line. Measurement of flow: Pitot tube,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
37	**3**	venturi meter, orifice meter, Flow nozzle	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
38	**4**	UNIT- IV Hydrodynamic force of jets on stationary and moving flat,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
39	**4**	inclined, and curved vanes,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
40	**4**	jet striking centrally and at tip, velocity diagrams,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
41	**4**	work done and efficiency, flow over radial vanes.	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk	
42	**4**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk	**TB1&RB1**

43	4	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
44	4	Classification of turbines, Heads and efficiencies, impulse and reaction turbines,	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
45	4	Pelton wheel, Francis turbine and Kaplan turbine-working proportions	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
46	4	work done, efficiencies , hydraulic design	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Understand, Calculating	Chalk and Talk
47	4	Student PPT	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
48	4	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
49	4	Draft tube theory-functions and efficiency.	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
50	4	Geometric similarity, Unit and specific quantities, characteristic curves, governing of	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk

		turbines,					
51	**4**	selection of type of turbine, cavitation, surge tank, water hammer.	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
52	**5**	UNIT-V Centrifugal pumps: Classification, working, work done	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
53	**5**	Barometric head- losses and efficiencies specific speed	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
54	**5**	Student PPT	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
55	**5**	Reciprocating pumps: Working, Discharge, slip, indicator diagrams	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/t/all	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Explain, Understand	Chalk and Talk
56	**5**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk
57	**5**	PROBLEMS	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	https://classroom.google.com/w/Mjk4ODc4NjE1Mzk4/tc/Mjk5ODM2MDIxOTY3	Calculating	Chalk and Talk

X. QUESTION BANK (JNTUH)

DESCRIPTIVE QUESTIONS:

Unit-I

Short Answers Question

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	Briefly explain Physical Properties of Fluids	Understanding	CO1
2	Write the pressure measuring devices	Understanding	CO1
3	(a) Define the following,, (i) Atmospheric pressure, (ii) Gauge pressure, (iii) Vacuum pressure, (iv) Absolute pressure.	Understanding	CO1
4	Classification of Manometers, explain any one	Explain	CO1
5	Classifications Fluids	Explain	CO1
6	Classifications Newtutation fluids	Understanding	CO1

Long Answers Questions

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	Explain the following, (i) Piezometer, (ii) U-tube manometer.	Explain	CO1
2	A square metal plate 1.5 m side and 1.5 mm thick weighing 50 N is to be lifted through a vertical gap of 25 mm of infinite extent. The oil in the air gap has a specific gravity of 0.95 and viscosity of 2.5 N.s/m2. If the metal plate	Analyze	CO1
3	(a) Define the following,, (i) Atmospheric pressure, (ii) Gauge pressure, (iii) Vacuum pressure, (iv) Absolute pressure.	Understanding	CO1
4	Inside a 60 mm diameter cylinder a piston of 59 mm diameter rotates concentrically. Both the cylinder and piston are 80 mm long. If the space between the cylinder and piston is filled with oil of viscosity 0.3 N.s/m2 and a torque of 1.5 Nm is applied. Find, (i) The r.p.m of the piston	Analyze	CO1
5	Explain the basic principle involved in measuring pressure using manometers. Indicate when the use of manometers is advantageous	Explain	CO1
6	Discuss about the types of differential manometers used with its advantages and disadvantages.	Understanding	CO1
7	Explain the working of Bourdon Pressure gauge with a sketch	Explain	CO1
8	Derive an expression for capillary rise or depression, given the value of contact angle and density and surface tension of the liquid	Understanding	CO1

Unit-II
Short Answers Question

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	Write the Classifications of Fluid Flows	Understanding	CO2
2	Write the Classifications of Fluid Flows Lines.	Understanding	CO2
3	Drive the Continuity Equation	Understanding	CO2
4	Drive the Euler's Equations	Understanding	CO2

Long Answers Questions

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	What do you understand by the terms, (i) Total acceleration, (ii) Convective acceleration, (iii) Local acceleration?	Understanding	CO2
2	250 litre/s of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bent by 135° (i.e., change from initial to final direction is 135°). Find the magnitude and direction of the resultant force on the bend.	Analyze	CO2
3	(a) Elaborate the terms, (i) Velocity potential function, (ii) Stream function. (b) 265 litres/s of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bent by 135° (i.e., change from initial to final direction is 135°), find the magnitude and direction of the resultant force on the bend.	Understanding Analyze	CO2
4	Two Large plates are parallel to each other and are inclined at 30^0 to the horizontal with the space between them filled with a fluid of viscosity 20 centi poise. A small thin plate of 0.125 m^2 slides parallel and midway between the planes and reaches a constant velocity of 2 m/s. The weight of the plate is 1 N. Determine the distance between the plates. b) The velocity vector in a fluid flow is given by $V = 2x^3i - 5x^2yj + 4tk$. Find the velocity and acceleration of a fluid particle at (1,2,3) at time , t =1	Analyze	CO2
5	Derive the Bernoulli's Equation	Understanding Analyze	CO2

Unit-III

Short Answers Question

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	Explain the Venture meter construction	Understanding	CO3
2	Explain the application of Bernoulli's Equation any one	Understanding	CO3
3	Write the Minor Losses	Understanding	CO3
4	Explain shore note of Major losses	Understanding	CO3
5	Explain the Laminar and Turbulent flows	Understanding	CO3

Long Answers Question

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	A Venturimeter of throat diameter 50 mm is fitted into a 125 mm diameter water pipeline. The coefficient of discharge is 0.96. Calculate the flow in the pipeline when the reading a mercury water differential U-tube manometer connected to the upstream and throat sections shows a reading of 200 mm. If the energy loss in the downstream divergent cone of the meter is 10 times the velocity head in the pipe, calculate the total head loss of the meter.	Analyze	CO3
2	The diameters of a pipe at section 1 and 2 are 25 cm and 30 cm respectively. Find the discharge through the pipe if velocity of water at section 1 is 4 m/s Determine also the velocity at section	Analyze	CO3

3	List out the engineering applications of Bernoulli's Equation	Understanding	CO3
4	Derive the expression for Reynold's Number	Understanding	CO3
5	Define displacement thickness. Derive the expression for the displacement thickness	Understanding	CO3
6	Prove that the momentum thickness for boundary layer flows are given by. $\Theta = \int_0^\delta u / U [1 - u / U] dy$	Understanding	CO3, CO6
7	Define laminar boundary layer, turbulent boundary layer, laminar sub layer and boundary layer thickness	Understanding	CO3, CO6
8	Define coefficients of Drag and lift and state factors affecting on which those coefficients depend.	Understanding	CO3, CO6

Unit-IV

Short Answers Question

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	Explain Working Principal of hydroelectric power plant	Understanding	CO4
2	Write the short note of jet of water at tip conditions	Understanding	CO4
3	Explain the velocity diagrams for jet striking of curved vane at center	Understanding	CO4
4	Explain the velocity diagrams for jet striking of curved vane at tip	Understanding	CO4
5	Write the classifications of Turbine	Understanding	CO4
6	Write the main parts of turbine	Understanding	CO4
7	Write the draft tube theory	Understanding	CO4
8	Write the section of turbine	Understanding	CO4

Long Answers Question

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	Differentiate (a) The force exerted by a jet of water on a fixed vertical plate and moving vertical plate. (b) The force exerted by a jet on a single curved moving plate and a series of curved moving plate. (C) Write down step by step procedure for the estimation of power from a given catchment area.	Understanding	CO4
2	A jet of water of diameter 100 mm strikes a curved plate at its centre with a velocity of 15 m/s. The curved plate is moving with a velocity of 7 m/s in the direction of the jet. The jet is deflected through an angle of 150°. Assuming the plate smooth. Find, (i) Force exerted on the plate in the direction of the jet (ii) Power of the jet, (b) Write down step by step procedure for the estimation of power from a given catchment area. (iii) Efficiency.	Analyze	CO4
3	Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet.	Understanding	CO4
4	Explain various components of a hydroelectric power plant along with a neat layout. of water is 4 kPa (abs) and the local atmospheric pressure is 96.0 kPa (abs). Pressure of water flowing is 0.4 MPa. (ii) The power required.	Analyze	CO4
5	A 30mm diameter jet of water having a velocity of 60 m/s impinges	Analyze	CO4

	tangentially on a series of vanes which moves away in the same direction as that of the jet. The shape of each vane is such that , if stationary, they would deflect the jet by 150 degrees. The friction loss over a vane is 0.2 $V_{r1}{}^{2}$/ 2g, V_{r1} being relative velocity at the entry to the vanes, and the windage loss is 0.4 u2 / 2g, u being the vane velocity. Find the vane velocity corresponding to maximum efficiency.		
6	A jet of water, 50 mm diameter impinges on a stationary curved vane at a velocity of 50 m/s. The vane deflects the jet by 1200. Find the magnitude, direction and location of the force exerted by the jet on the stationary vane, assuming the flow over the vane is frictionless. If the vane (single) moves away in the direction of the jet with velocity of 20 m/s. Calculate the power delivered by the jet to the vane.	Analyze	CO4
7	A 5cm wide 2-dimensional horizontal jet strikes a stationary vertical plate inclined to the direction of the jet by 60^0 at a velocity of 25 m/s. Assuming frictionless flow, find the velocities and thickness of the stream at two ends of the plate after jet is deflected.	Analyze	CO4
8	A jet of water 45 mm diameter having a velocity 30 m/s strikes normally a series of flat plates so arranged at the periphery of a wheel rotating at 100 r.p.m that the entire discharge of the jet acts normally at the plates. The distance of the point of application of the jet from the centre of the wheel is 1.2 m. Find the power delivered by the jet to the wheel & hydraulic efficiency.	Analyze	CO4
9	What is a draft-tube? Why is it used in a reaction turbine? Describe different types of draft-tubes along with neat sketches.	Understanding	CO4
10	Explain various components of a hydroelectric power plant along with a neat layout. pressure of water flowing is 39.24 N/cm. is to be lifted at a constant speed of 0.1 m/s. Find the force and power required.	Analyze	CO4
11	A conical draft-tube having inlet and outlet diameters 1 m and 1.5 m discharges water at outlet with a velocity of 2.5 m/s. The total length of the draft-tube is 6 m and 1.20 m of length of the draft-tube is immersed in water. If the atmospheric pressure head is 10.3 m of water and loss of head due to friction in the draft-tube is equal to 0.2 × velocity head at outlet of the tube. Find,(i) Pressure head at inlet	Analyze	CO4

Unit-V

Short Answers Question

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1	Write the Classification of Pumps	Understanding	CO5
2	Write the types of parts in pumps	Understanding	CO5
3	Explain any one part of pumps	Understanding	CO5
4	Explain working principle of any one pumps	Understanding	CO5
5	Write the advantages and disadvantages of pumps	Understanding	CO5
6	Write the main difference of centrifugal pump and reciprocating pumps	Understanding	CO5

Long Answers Question

S.No.	Question	Blooms Taxonomy	Course Outcome

		Level	
1	A centrifugal pump rotating at 1000 r.p.m delivers 160 litres/s of water against a head of 30 m. The pump is installed at a place where atmospheric pressure is 1 × 105 Pa (abs.) and vapour pressure of water is 3 kPa (abs.). The head loss in suction pipe is equivalent to 0.2 m of water. Calculate, i. Minimum NPSH ii. Maximum allowable height of the pump from free surface of water in the sump. Efficiency of the turbine. iii. Efficiency of the draft-tube Draw and discuss the operating characteristics of a centrifugal pump.	Analyze	CO5
2	A single acting reciprocating pump having a plunger diameter 220 mm and 320 mm stroke , is placed 4 m above the water level of the sump. The suction pipe is 80 mm in diameter and 5 m long. If the separation takes place at a pressure head of 2.5 m of water .Find the maximum speed of the pump in order to avoid separation. Take barometric reading as 10.4 m of water.	Analyze	CO5
3	Derive the fundamental equation of a centrifugal pump.	Understanding	CO5
4	Discuss various losses and efficiencies occurring during the operation of centrifugal pump.	Understanding	CO5
5	Find the work done per second in case of single acting reciprocating pump	Understanding	CO5

OBJECTIVE QUESTIONS

i)JNTUH:

1.In an open U tube containing mercury, kerosene of specific gravity 0-8 is poured into one of its limbs so that the length of column of kerosene is about 40 cm. The level of mercury column in that limb is lowered approximately by how much?
a. 2.4 cm b. 1.2 cm c. 3.6 cm d. 0.6 cm
2.Which one of the following is correct? The capillary rise on depression in a small diameter tube is
a. directly proportional to the specific weight of the fluid
b. inversely proportional to the surface tension
c. inversely proportional to the diameter
d. directly proportional to the surface area
3. What is the pressure inside a soap bubble, over the atmospheric pressure if its diameter is 2 cm and the surface tension is 0.1 *N* ? *m*
a. 0.4 N/m2 b. 4.0 N/m2 c. 40.0 N/m2 d. 400. N/m2
4. A steady, incompressible flow is given by: u = 2x2 + y2 and v = - 4xy What is the convective acceleration along x-direction at point (1, 2)?
a. ax = 6unit b. ax = 24 unit c. ax = 8 unit d. ax = -24 unit
5.Which one of the following is correct? For flow of an ideal fluid over a cylinder, from the front stagnation point,
a. pressure first decreases then increases
b. velocity first decreases then increases
c. pressure remains the same
d. velocity remains the same
6. Two flows are specified as
A. u y, v = - (3/2)x
B. u = xy2, v = x2y
7.Which one of the following can be concluded

a. Both flows are rotational b. Both flows are irrotational
c. Flow A is rotational while flow B is irrotational d. Flow A is irrotational while flow B is rotational

8.Why are surge tanks used in a pipe line?
a. To reduce frictional loss in pipe b. To ensure uniform flow in pipe
c. To relieve the pressure due to water hammer d. To reduce cavitation

9.Which one of the following is correct? Water-tube boilers are preferred for
a. high pressure and high output b. high pressure and low output
c. low pressure and high output d. low pressure and low output

10.Which one of the following types of impeller vanes are most commonly used in centrifugal type compressors?
a. Forward curved b. Radial c. Backward curved d. Tangential

11.If, in a pump, the discharge is halved, then, assuming that the speed remains unchanged, what would be the ratio of the heads H1/H2?
a. 1/ 3 b. 2 / 3 c. 3 0.25 d. 3 05

12.Which one of the following nondimensional numbers is used for transition from laminar to turbulent flow in free convection?
a. Reynolds number b. Grashof number c. Peclet number d. Rayleigh number

13.The overall efficiency of a pelton turbine is 70%. If the mechanical efficiency is 85 %, what is its hydraulic efficiency?
a. 82.4% b. 59.5% c. 72.3% d. 81.5%

14.Which one of the following pumps is not a positive displacement pump?
a. Reciprocating pump b. Centrifugal pump
c. Vane pump d. Lobe pump

15.An orifice meter, having an orifice of diameter d is fitted in a pipe of diameter D. For this orifice meter, what is the coefficient of discharge Cd?
a. A function of Reynolds number only
b. A function of d/D only
c. A function of d/D and Reynolds number
d. Independent of d/D and Reynolds number

16.Velocity for flow through a pipe, measured at the centre is found to be 2 m/s. Reynolds number is around 800. What is the average velocity in the pipe 9
a. 2 m/s b. 17 m/s c. 1 m/s d. 05 m/s

17.In an axial flow impulse turbine, energy transfer takes, place due to
a. Change in relative kinetic energy b. Change in absolute kinetic energy
c. Change in pressure energy d. Change in energy because of centrifugal force

18.When can a piezometer be not used for pressure measurement in pipes?
a. The pressure difference is low b. The velocity is high
c. The fluid in the pipe is a gas d. The fluid in the pipe is highly viscous

19. Which phenomenon will occur when the value at the discharge end of a pipe connected to a reservoir is suddenly closed?
a. Cavitation b. Erosion c. Hammering d. Surging

20.Which one of the following turbines exhibits a nearly constant efficiency over a 60% to 140% of design speed?

a. Pelton turbine. b. Francis turbine c. Deriaz turbine d. Kaplan turbine

21. When a hydraulic turbine is operated, it is found that it has a high design efficiency and this efficiency remains constant over a wide range of regulation from the design condition. What is the type of this turbine?

a. Pelton b. Francis c. Kaplan d. Propeller

22.Consider the following properties of a fluid:

1. Viscosity 2. Surface tension 3. Capillarity 4. Vapour pressure

23.Which of the above properties can be attributed to the flow of jet of oil in an unbroken swam?

a. 1 only b. 2 only c. 1 and 3 d. 2 and 4

24. Why is a minimum of Net Positive Suction Head required for a hydraulic pump?

a. To prevent cavitations b. To increase discharge c. To increase suction head d. To increase efficiency

25.A Pelton wheel with single jet rotates at 600 rpm. The velocity of the jet from the nozzle is 100 m/s. if the ratio of the vane velocity to jet velocity is 0.44, what is the diameter of the Pelton wheel?

a. 0.7 m b. 1.4 m c. 2.1 m d. 2.8 m

26.Which of the following types of turbine is/are suitable for tidal power plants?

1. Tubular turbine 2. Kaplan turbine 3. Bulb turbine 4. Francis turbine

27.Select the correct answer using the code given below:

a. 1 only b. 1 and 3 c. 2 and 4

28.A U-tube open at both ends and made of 8 mm diameter glass tube mercury up to a height of 10 cm in both the limbs. If 19 cm3 of water is added to one of the limbs, what is the difference in mercury levels in the two limbs at equilibrium?

a. 4.5 mm b. 1.0 mm c. 2.8 mm d. 3.2 mm

29.A centrifugal pump needs 1000 W of power when operating at 1500 rpm. What is the power requirement if the speed of the pump is increased to 3000 rpm?

a. 2000 W b. 4000 W c. 6500 W d. 8000 W

30.Two centrifugal pumps have impellers with outer dimensions of each equal to twice the inner dimensions. The inner diameter of the second impeller is three times the inner diameter & the first one.

What is the speed ratio N2/N1 of pumps, if the pumps are required to develop the same man metric head to Start delivery of water?

a. 9 b. 4 c. ½ d. 1/3

31.Water is required to be lifted by a 10 kW pump from a depth of 100 m. If the pump is unable to lift the water, then which one of the following is correct?

a. A greater capacity pump has to be used

b. A lager diameter delivery pipe has to be used

c. A larger diameter suction pipe has to be used

d. A multistage pump has to be used

32 A Francis turbine is coupled to an alternator to generate electricity with a frequency of 50 Hz. If the alternator has 12 poles, then the turbine should be regulated to run at which one of the following constant speeds?

a. 250 rpm b. 500 rpm c. 600 rpm d. 1000 rpm

33.Which of the following functions represent the velocity potential in a two-dimensional flow of an ideal fluid?
1. 2x + 3y 2. 4x2 - 3y2 3. cos (x - y) 4. tan-1 (x/y)
34.Select the correct answer using the codes given below
a. 1 and 3 b. 1 and 4 c. 2 and 3 d. 2 and 4

ii) GATE QUESTIONS:

Q.1 In order to have maximum power from a Pelton turbine, the bucket speed must be
(A) equal to the jet speed. (B) equal to half of the jet speed.
(C) equal to twice the jet speed. (D) independent of the jet speed.
GATE 2013

Q.2 Oil flows through a 200 *mm* diameter horizontal cast iron pipe (friction factor, $f = 0.0225$) of
length 500 *m*. The volumetric flow rate is 0.2 *m3/s*. The head loss (in *m*) due to friction is (assume
g = 9.81 m/s2)
(A) 116.18 (B) 0.116 (C) 18.22 (D) 232.36 GATE 2012
Q.3 An incompressible fluid flows over a flat plate with zero pressure gradient. The boundary layer
thickness is 1 *mm* at a location where the Reynolds number is 1000. If the velocity of the fluid alone is increased by a factor of 4, then the boundary layer thickness at the same location, in *mm*
will be
(A) 4 (B) 2 (C) 0.5 (D) 0.25 GATE 2012
Q.4 A streamline and an equipotential line in a flow field
(A) Are parallel to each other (B) Are perpendicular to each other
(C) Intersect at an acute angle (D) Are identical
Answer: - (B)

Q.5 The maximum velocity of a one-dimensional incompressible fully developed viscous flow, between two fixed parallel plates, is $6ms^{-1}$. The mean velocity (in ms^{-1}) of the flow is

(A) 2 (B) 3 (C) 4 (D) Q.6
A hydraulic turbine develops 1000kW power for a head of 40m. If the head is reduced to 20m, the power developed (in kW) is

(A) 177 (B) 354 (C) 500 (D) 707

Q.7 A smooth pipe of diameter 200mm carries water. The pressure in the pipe at section S1 (elevation: 10m) is 50kPa. At Section S2 (elevation: 12m) the pressure is 20kPa and velocity is $2ms^{-1}$. Density of water is $1000kgm^{-3}$ and acceleration due to gravity is $9.8ms^{-2}$. Which of the following is TRUE?

(A) flow from S1 to S2 and head loss is 0.53m

(B) flow from S2 to S1 and head loss is 0.53m

(C) flow from S1 to S2 and head loss is 1.06m

(D) flow from S2 to S1 and head loss is 1.06m

Q.8 Match the following

P: Compressible flow	U: Reynolds number
Q: Free surface flow	V: Nusselt number
R: Boundary layer flow	W: Weber number
S: Pipe flow	X: Froude number
T: Heat convection	Y: Mach number
	Z: Skin friction coefficient

(A) P-U; Q-X; R-V; S-Z; T-W (B) P-W; Q-X; R-Z; S-U; T-V

(C) P-Y; Q-W; R-Z; S-U; T-X (D) P-Y; Q-W; R-Z; S-U; T-V

Q.9 A streamline and an equipotential line in a flow field

(A) are parallel to each other (B) are perpendicular to each other

(C) intersect at an acute angle (D) are identical

Answer: (B)

Q. 10 Figure shows the schematic for the measurement of velocity of air (density = 1.2kg /m^3) through a constant-area duct using a pitot tube and a water-tube manometer. The differential head of water (density = 1000 kg /m^3) in the two columns of the manometer is 10mm. Take acceleration due to gravity as 2 9.8m/ s^2. The velocity of air in m/s is

(A) 6.4 (B) 9.0 (C) 12.8 (D) 25.6

Answer: (C)

A pump handling a liquid raises its pressure from 1 bar to 30 bar. Take the density of the liquid as 990 3 kg /m^3. The isentropic specific work done by the pump in kJ/kg is

(A) 0.10 (B) 0.30 (C) 2.50 (D) 2.93

iii) <u>IES QUESTIONS:</u>

01. In a reciprocating pump, air vessels are used to
(a) smoothen the flow (b) reduce suction head (c) increase delivery head (d) reduce acceleration head
Ans: (d)
02. Consider the following statements pertaining to centrifugal pumps:1. The inlet to the impeller of a centrifugal pump is always axial,while the outlet may be radial or inclined.2. The impeller may be shrouded on both sides with an eye at the centre and vanes curved backwards.3. Impeller of double entry type has a balanced radial thrust.4. Un-shrouded and part shrouded impeller are used only where high efficiency is unimportant.
Which of these statements are correct?
(a) 1, 2, 3 and 4 (b) 1, 2 and 3 only (c) 1, 2 and 4 only (d) 2, 3 and 4 only
Ans: (d)
03. A centrifugal pump is fully primed, but on starting it fails to deliver fluid. The probable reasons are listed below:
1. Leaky foot valve or suction line 2. Suction head is very low 3. Insufficient motor speed
4. Damaged or closed delivery valve
Which of these reasons are correct?
(a) 1, 2, 3 and 4 (b) 1, 2 and 3 only (c) 2, 3 and 4 only (d) 1, 3 and 4 only
Ans: (d)
04. For a given centrifugal pump (a) head varies inversely as square of speed
(b) discharge varies directly as speed (c) discharge varies directly as square of speed
(d) Power varies directly as fifth power of speed
Ans: (b)
05. A centrifugal pump is to discharge 0.118 m3/s at speed of 1450 rpm against a head of 25m. The impeller diameter is 25cm, its width at outlet is 5 cm and manometric efficiency is 75%. The vane angle at outer periphery of impeller is
(a) 56.770 (d) 59.770
(c) 61.770 (d) 48.770
Ans: (b)
06. A turbine is working under a head of 200m. The power developed by the turbine is 100 kW and discharge through the turbine is 0.125 m3/s. In such case, the ratio of unit power to unit discharge for the turbine will be
(a) 4000 (b) 16000 (c) 160 □□10^3 (d) None of the above
Ans: (a)
07. Two geometrically similar pumps are running at 1000 rpm speed (both). If one pump has impeller diameter of 0.3m and discharges 20 lps against 20 m head, and the other pump gives half of this discharges rate; calculate head and diameter of second pump
(a) 12.5 m and 0.12 m (b) 10.5 m and 0.12 m (c) 10.5 m and 0.23 m (d) 12.5 m and 0.23 m

08. The component of torque converter that allows torque multiplication is
(a) turbine (b) impeller (c) stator (d) freewheel
Ans: (b)

09. Which of the following statements are correct with respect to regenerative feed heating in a steam cycle?
1. It increases cycle efficiency 2. It increases specific output 3. It reduces the condenser load
4. It improves the steam quality at the end of expansion
(a) 1 and 3 only (b) 2 and 4 only (c) 2 and 3 only (d) 1, 2, 3 and 4
Ans: (a)
10. Consider the following statements: Isentropic flow through a steam nozzle becomes ‘choked’ when
1. Discharge is maximum 2. Discharge is zero 3. Nozzle pressure ratio is □□critical pressure ratio
4. Throat velocity reaches sonic value Which of these statements are correct?
(a) 1, 2, 3 and 4 (b) 1, 2 and 3 only (c) 2, 3 and 4 only (d) 1, 3 and 4 only
Ans: (d)
11. Frictional losses in the nozzle
(a) reduces the enthalpy of the fluid (b) increases the enthalpy of the fluid (c) no effect on enthalpy of the fluid (d) None of the above
Ans: (b)
12. In a nozzle designed for maximum discharge conditions, the flow velocity in the convergent section of the nozzle is
(a) subsonic (b) sonic (c) supersonic (d) depends on initial pressure and condition of steam
Ans: (a)
13. The risk of radioactive hazard is greatest in the turbine with following reactor
(a) pressurized water (b) boiling water (c) gas cooled (d) liquid metal cooled
Ans: (b)
14. Without reducing the fluid flow rate,the speed of an impulse steam turbine can be brought down to practical limits by which of the following methods?
(a) Large flywheel (b) Centrifugal governor (c) Velocity compounding (d) Steam bleeding
(a) 1, 2 and 3 (b) 2, 3 and 4 (c) 2 only (d) 3 only
Ans: (d)
15. To improve the quality of steam at turbine exit which of the following will be used?
1. Reheat cycle 2. Increase the maximum pressure when maximum and minimum temperatures are fixed 3. Use superheated steam, instead of saturated steam when the maximum and inimum
pressures are fixed
(a) 1, 2 and 3 (b) 1 and 2 only (c) 1 and 3 only (d) 2 and 3 only
Ans: (c)
16. In the centrifugal compressor the work input is equal to sum of
(a) pressure head, relative head and dynamic head (b) dynamic head, centrifugal head and relative head (c) pressure head, centrifugal head and dynamic head (d) pressure head, centrifugal head and relative head.
Ans: (b)
17. For a centrifugal compressor with radial vanes, slip factor is the ratio of
(a) isentropic work to Euler work (b) whirl velocity to the blade velocity at the impeller exit
(c) stagnation pressure to static pressure (d) isentropic temperature rise to actual temperature rise
Ans: (b)

18. The specific speed of a centrifugal compressor is generally
(a) less than that of reciprocating Compressor (b) independent of compressor type,but depends only on size of compressor (c) higher than that of axial compressor (d) more than specific speed of reciprocating compressor but less than axial compressor
Ans: (d)
19. In a centrifugal compressor, the highest Mach number leading to shock wave in the fluid flow occurs at
(a) diffuser inlet radius (b) diffuser outlet radius (c) impeller inlet radius (d) impeller outlet radius
Ans: (c)
20. In a centrifugal compressor, an increase in speed at a given pressure ratio causes
(a) increase in flow and increase in efficiency (b) increase in flow and decrease in efficiency
(c) decrease in flow and increase inefficiency (d) decrease in flow and decrease in efficiency
Ans: (d)
21. In an axial flow compressor, the ratio of pressure rise in the rotor blades to the pressure rise in the compressor in one stage is known as
(a) pressure coefficient (b) work factor (c) degree of reaction (d) slip facto
Ans: (c)

XI. WEBSITES:

1. www.madesy.com
2. www.neptel.com
3. www.gateforoum.com
4. www.csire.gov.in

XII. EXPERT DETAILS:

1. **Vinayak Eswaran ,Professor & Head of the Department, I.I.T Hyderabad**
2. **Raja Banerjee , Assistant Professor , , I.I.T Hyderabad**
3. **Dr.YVD Rao** .Faculty Incharge, Engineering Services Division, BITS Pilani, Hyderabad Campus,
4. **Dr. Jeevan Jaidi,** Associate Professor ,Dept. of Mechanical Engineering, BITS-Pilani, Hyderabad Campus
5. **Dr P.laxminarayana , Head ,** Dept. of Mechanical Engineering , Osmania University College of Engineering , Hyderabad

XIII. JOURNALS (National & International):

- Annual Review of Fluid Mechanics
- Experiments in Fluids
- Flow, Turbulence and Combustion
- International Journal for Numerical Methods in Fluids
- Journal of Fluid Mechanics

- International Journal for Numerical Methods in Fluids Fluid Dynamics Research
- The available journals in the Library related to the subject are
- Journal of Engineering for HydraulicTurbines and Power
- Journal of Hydraulic machinery
- Journal of Institution of Engineers (India)-Mechanical
- Engineering Advances in Fluid mechanics
- Journal of Energy Resources and Technology
- Journal of Fluids engineering

XIV. LIST OF TOPICS FOR STUDENT SEMINARS:

1. Closed conduit flow
2. Measurement of flow
3. Basics of Turbo machinery
4. Hydro electric Power Stations
5. Performance of hydraulic turbines
6. Centrifugal pumps
7. Reciprocating pumps
8. Capillarity
9. Reynolds experiment
10. Turbine flow meter
11. Draft tube theory
12. Geometric similarity
13. Surge Tank
14. Water Hammer
15. Mass curve

CASE STUDIES/SMALL PROJECTS:

1. Measurement of flow: Pitot tube, Venturi meter and Orifice meter.
2. Estimation of power developed from a given catchment area.

CONTENTS BEYOND SYLLABUS

- Concept of buoyancy.
- Potential and velocity functions and their applications