



## HYDRAULICS AND HYDRAULIC MACHINER (CE405PC) COURSE PLANNER

### I. COURSE OVERVIEW:

This course is intended to introduce basic principles of fluid mechanics. It is further extended to cover the application of fluid mechanics by the inclusion of fluid machinery especially water turbine and water pumps. Now days the principles of fluid mechanics find wide applications in many situations directly or indirectly. The use of fluid machinery, turbines pumps in general and in power stations in getting as accelerated fill up. Thus there is a great relevance for this course for mechanical technicians. The Mechanical technicians have to deal with large variety of fluids like water, air, steam, ammonia and even plastics. The major emphasis is given for the study of water. However the principle dealt with in this course will be applicable to all incompressible fluids

### II. PREREQUISITE(S):

Level	Credits	Periods	Prerequisite
UG	4	5	Fluid Mechanics

### III. COURSE OBJECTIVES:

1	Strengthen the knowledge of theoretical and technological aspects of hydrodynamic forces on jets.
2	Correlate the principles with applications in hydraulic turbines.
3	Apply the practical applications on Francis and Kaplan turbine.
4	Analysis the similarities between prototype and model types of hydraulic similitude.

### COURSE OUTCOMES:

Course Outcomes	Description	Bloom's Taxonomy Levels	Program Outcomes, Program Specific Outcomes
CO1	Apply their knowledge of fluid mechanics in addressing problems in open channels and hydraulic machinery.	L3: Applying	PO1,PO2,PO3,PSO2.



<b>CO2</b>	Understand and solve problems in uniform, gradually and rapidly varied flows in open channel in steady state conditions.	L2:Understand, L4: Analyzing	PO2,PO3,PO4,PO6, PSO1.
<b>CO3</b>	Apply dimensional analysis and to differentiate the model, prototype and similitude conditions for practical problems.	L3: Applying	PO1, PO3,PO4, PSO1.
<b>CO4</b>	Get the knowledge on different hydraulic machinery devices and its principles that will be utilized in	L1 : Remember, L2:Understand,	PO1,PO3,PO4,PO5,PSO3.
<b>CO5</b>	hydropower development and for other practical usages	L3: Applying	

#### IV. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (PO)		Level	Proficiency assessed by
PO1	<b>Engineering knowledge:</b> To Apply the knowledge of mathematics, science, engineering fundamentals principals, and civil engineering to the solution of complex engineering problems encountered in modern engineering practice.	3	Assignments



PO2	<b>Problem analysis:</b> Ability to Identify, formulate, review research literature, and analyze complex engineering problems related to Civil Engineering and reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Exercise, Exams
PO3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems related to Civil Engineering and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Exercise
PO4	<b>Conduct investigations of complex problems:</b> 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.	2.7	Discussion, Seminars
PO5	<b>Modern tool usage:</b> 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.	3	Discussion, Seminars
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Civil Engineering professional engineering practice.	2	Discussions
PO7	<b>Environment and sustainability:</b> Understand the impact of the Civil Engineering professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	—	-----
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	—	-----
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	—	-----



PO10	<b>Communication:</b> 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.		-----
PO11	<b>Project management and finance:</b> 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	<b>Life-long learning:</b> 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.		Prototype, Discussions

**1: Slight (Low)      2: Moderate (Medium)      3: Substantial (High)      0 : None**

#### V. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program specific outcomes		Level	Proficiency Assessed By
PSO 1	<b>ENGINEERING KNOWLEDGE:</b> Graduates will be able to apply technical knowledge in drawing, analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good basics in mathematics, basic sciences and technical communication	2.5	Lectures, Exercises and Assignments



PSO 2	<b>BROADNESS AND DIVERSITY:</b> Graduates will be able to summarize and can demonstrate about societal, economical, environmental, health and safety factors involved in infrastructural development, and shall work within multidisciplinary teams with competence in modern tool usage.	2	Project
PSO 3	<b>SELF-LEARNING AND SERVICE:</b> Graduates will be able to pursue lifelong learning and professional development to face the challenging and emerging needs of our society, ethically and responsibly.	2	Guest lectures

0-None

2-Supportive

3-Highly Related

## VI. SYLLABUS: JNTUH SYLLABUS

### UNIT - I

**Open Channel Flow – I:** Introduction to Open channel flow-Comparison between open channel flow and pipe flow, Classification of open channels, Classification of open channel flows, Velocity distribution. Uniform flow – Characteristics of uniform flow, Chezy's, Manning's and Bazin formulae for uniform flow – Factors affecting Manning's Roughness Coefficient "n". Most economical sections. Computation of Uniform flow, Normal depth.

**Critical Flow:** Specific energy – critical depth - computation of critical depth – critical, sub critical and super critical flows-Channel transitions.

### UNIT - II

**Open Channel Flow – II:** Non-uniform flow – Gradually Varied Flow - Dynamic equation for G.V.F; Classification of channel bottom slopes – Classification and characteristics of Surface profiles – Computation of water surface profiles by Numerical and Analytical approaches. Direct step method.

**Rapidly varied flow:** Elements and characteristics (Length and Height) of Hydraulic jump in rectangular channel– Types, applications and location of hydraulic jump, Energy dissipation and other uses – Positive and Negative Surges (Theory only).

### UNIT - III

**Dimensional Analysis and Hydraulic Similitude:** Dimensional homogeneity – Rayleigh's method and Buckingham's pi methods – Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problems. Distorted models.

**Basics of Turbo Machinery:** Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, Jet striking centrally and at tip, Velocity triangles at inlet and outlet, expressions for work done and efficiency –Angular

### UNIT - IV



**Hydraulic Turbines – I:** Elements of a typical Hydropower installation – Heads and efficiencies – Classification of turbines – Pelton wheel – Francis turbine – Kaplan turbine – working, working proportions, velocity diagram, work done and efficiency, hydraulic design. Draft tube – Classification, functions and efficiency.

**Hydraulic Turbines – II:** Governing of turbines – Surge tanks – Unit and specific turbines – Unit speed – Unit quantity – Unit power – Specific speed – Performance characteristics – Geometric similarity – Cavitation. Selection of turbines.

#### **UNIT - V**

**Centrifugal Pumps:** Pump installation details – classification – work done – Manometric head – minimum starting speed – losses and efficiencies – specific speed. Multistage pumps – pumps in parallel – performance of pumps – characteristic curves – NPSH – Cavitation.

**Hydropower Engineering:** Classification of Hydropower plants – Definition of terms – load factor, utilization factor, capacity factor, estimation of hydropower potential.

#### **TEXT BOOKS:**

1. Fluid Mechanics by Modi and Seth, Standard Book House.
2. Fluid Mechanics and Hydraulic machines by Manish Kumar Goyal, PHI Learning Private Limited, 2015
3. Fluid mechanics & Hydraulic Machines, Domkundwar & Domkundwar Dhanpat Rai & Co

#### **REFERENCE BOOKS:**

1. Fluid Mechanics by R. C. Hibbeler, Pearson India Education Services Pvt. Ltd
2. Fluid Mechanics & Fluid Power Engineering by D. S. Kumar (Kataria & Sons Publications Pvt. Ltd.).
3. Open channel flow by V.T. Chow (McGraw Hill Book Company).
4. Introduction to Fluid Mechanics and Fluid Machines by SK Som, Gautam Biswas, Suman Chakraborty, McGraw Hill Education (India) Private Limited
5. Hydraulic Machines by Banga & Sharma (Khanna Publishers).

#### **MOOC'S- SWAYAM/ NPTEL:**

<https://nptel.ac.in/courses/151516/#>

<https://nptel.ac.in/courses/151516>

#### **GATE SYLLABUS:**

Laminar and turbulent flow flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks



and pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

### **IES SYLLABUS:**

#### **A. open channel flow, pipe flow**

Dimensional Analysis, Modeling; Cavitations; Flow oscillations; Momentum and Energy principles in Open channel flow, Flow controls, Hydraulic jump, Flow sections and properties; Normal flow, Gradually varied flow; Surges; Flow development and losses in pipe flows, Measurements; Siphons; Surges and Water hammer; Delivery of Power Pipe networks.

#### **B. Hydraulic machines and hydropower**

Centrifugal pumps, types, performance parameters, scaling, pumps in parallel; Reciprocating pumps, air vessels, performance parameters; Hydraulic ram; Hydraulic turbines, types, performance parameters, controls, choice; Power house, classification and layout, storage, pondage, control of supply.

### **VII. COURSE PLAN:**

<b>Lecture No.</b>	<b>Unit No.</b>	<b>Date</b>	<b>Topics to be covered</b>	<b>Link for PPT</b>	<b>Link for PDF</b>	<b>Course learning outcomes</b>	<b>Teaching Methodology</b>	<b>Reference</b>
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1	1	Introduction to Open channel flow-Comparison between open channel flow and pipe flow,	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRN1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRN1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Differentiate between pipe flow and open flow	chalk & talk/PP T	T1 R1
2		Classification of open channels, Classification of open channel flows	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRN1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRN1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Classify types of flows and channels	chalk & talk/PP T	
3		Velocity distribution.	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRN1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRN1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Understand velocity distribution	chalk & talk/PP T	
4		student Presentation	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRN1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRN1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Remember characteristics	chalk & talk/PP T	



5		Characteristics of uniform flow, Chezy's, Manning's and Bazin formulae for uniform flow	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Derive roughness coefficient	chalk & talk/PP T
6		Factors affecting Manning's Roughness Coefficient "n".	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Design economical sections	chalk & talk/PP T
7		Most economical sections	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Design economical sections	chalk & talk/PP T
8		student Presentation	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Define uniform flow	chalk & talk/PP T



9		Most economical sections	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Derive specific energy	chalk & talk/PP T
10		Computation of Uniform flow, Normal depth	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Understand and apply critical depths	chalk & talk/PP T
11		Specific energy – critical depth	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Understand and apply critical depths	chalk & talk/PP T
12		student Presentation	<a href="https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing">https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Understand channel transitions.	chalk & talk/PP T



13	2	Computation of critical depth	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Remember non uniform flow	chalk & talk/PP T	T1 R1
14		Critical, sub critical and super critical flows	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Derive GVF	chalk & talk/PP T	
15		Channel transitions	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Classify bottom slopes	chalk & talk/PP T	
16		student Presentation	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Understand surface profiles	chalk & talk/PP T	
17		Non-uniform flow – Gradually Varied Flow	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Analyze surface profiles	chalk & talk/PP T	



			<a href="#">ElfsSI?usp=sharing</a>			
18		Dynamic equation for G.V.F	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Study direct step method	chalk & talk/PP T
19		Classification of channel bottom slopes	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Understand hydraulic jump	chalk & talk/PP T
20		student Presentation	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Locate hydraulic jump	chalk & talk/PP T
21		Classification and characteristics of Surface profiles	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Analyze hydraulic jump	chalk & talk/PP T



22		Computation of water surface profiles by Numerical and Analytical approaches	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Classify hydraulic jump	chalk & talk/PP T
23		Direct step method	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Explain energy dissipation	chalk & talk/PP T
24		student Presentation	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>		chalk & talk/PP T
25		Elements and characteristics (Length and Height) of Hydraulic jump in rectangular channel	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Solve problems	chalk & talk/PP T
26		Elements and characteristics (Length and Height) of Hydraulic jump in rectangular channel	<a href="https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing">https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing">https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing</a>	Solve problems	chalk & talk/PP T



27	Elements and characteristics (Length and Height) of Hydraulic jump in rectangular channel	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	State dimensional homogeneity	chalk & talk/PP T	T1 R1
28	Types, applications and location of hydraulic jump	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Explain and compute using rayleigh's method.	chalk & talk/PP T	
29	Energy dissipation and other uses	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Explain and compute using bukingham's method	chalk & talk/PP T	
30	Positive and Negative Surges	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Classify dimensionless groups	chalk & talk/PP T	
31	student Presentation	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Explain types of models.	chalk & talk/PP T	



I mid exams							
32			Dimensional homogeneity	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	solve fluid flow problems	chalk & talk/PP T
33			Rayleigh's method	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Apply dimensional analysis	chalk & talk/PP T
34			Buckingham's pi methods	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	understand Rayleigh's method	chalk & talk/PP T
35			student Presentation	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	understand method for analysis	chalk & talk/PP T

T1  
R1



36			Dimensionless groups	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	understand groups	chalk & talk/PP T
37			Similitude, Model studies, Types of models	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	study model studies	chalk & talk/PP T
38			model studies to fluid flow problems	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Apply model studies to flow	chalk & talk/PP T
39			student Presentation	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	apply to distorted models.	chalk & talk/PP T
40			Application of dimensional analysis, Distorted models	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Understand force of jet	chalk & talk/PP T



41			Hydrodynamic force of jets on stationary plate.	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Understand force of jet	chalk & talk/PP T
42			Hydrodynamic force of jets on stationary plate moving flat inclined and curved vanes.	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Explain force of jet	chalk & talk/PP T
43			student Presentation	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Solve work done and efficiency for various jet conditions	chalk & talk/PP T
44	4		Jet striking centrally and at tip, Velocity triangles at inlet and outlet	<a href="https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing">https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing">https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing</a>	Solve work done and efficiency for various jet conditions	chalk & talk/PP T
45			Expressions for work done and efficiency	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaY aYxZwxS wFuij965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaY aYxZwxS wFuij965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing">https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing</a>	List elements of hydropower plant	chalk & talk/PP T



46		Expressions for work done and efficiency angular	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing">https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing</a>	Explain heads and efficiencies	chalk & talk/PP T
47		student Presentation	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing">https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing</a>	Classify turbines	chalk & talk/PP T
48		Elements of a typical Hydropower installation	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing">https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing</a>	Explain pelton and francis turbine	chalk & talk/PP T
49		Heads and efficiencies	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing">https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing</a>	Describe Kaplan working design	chalk & talk/PP T
50		Classification of turbines	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing">https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing</a>	Solve work done and efficiency problem	chalk & talk/PP T



51			student Presentation	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing">https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing</a>	Describe draft tube.	chalk & talk/PP T
52			Pelton wheel; Francis turbine	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Explain governing of turbine, uses of surge tanks.	chalk & talk/PP T
53			Kaplan turbine working, hydraulic design	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Explain unit properties	chalk & talk/PP T
54			Velocity diagram, work done and efficiency	<a href="https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing">https://drive.google.com/drive/folders/1oAYxNogkyaYaYxZwxSwFuIjj965k0oq?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Solve problems on geometric similarities	chalk & talk/PP T
55	5			<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCIwWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCIwWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Understand pump installation	chalk & talk/PP T



56		Draft tube Classification, functions and efficiency	<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Classify types of pump.	chalk & talk/PP T
57		Governing of turbines, Surge tanks, Definition of terms, load factor, utilization factor, capacity factor	<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Understand terms	chalk & talk/PP T
58		Unit and specific turbines, Unit speed, Unit quantity, Unit power, Specific speed, Performance characteristics.	<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Apply and analyze for multistage pumps	chalk & talk/PP T
59		student Presentation	<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Explain performance of pumps and NPSH	chalk & talk/PP T
60		Geometric similarity, Cavitation, selection of turbines, Classification of Hydropower plants, estimation of hydropower potential	<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Classify hydropower plants	chalk & talk/PP T



61		Pump installation details, Multistage pumps, pumps in parallel	<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCIWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCIWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Explain the terms for estimation of power	chalk & talk/PP T
62		Classification, work done, performance of pumps, characteristic curves, NPSH – Cavitation	<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCIWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCIWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Apply and analyze for multistage pumps	chalk & talk/PP T
63		Manometric head , minimum starting speed, losses and efficiencies, specific speed.	<a href="https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCIWZnBiSjuZ?usp=sharing">https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCIWZnBiSjuZ?usp=sharing</a>	<a href="https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing">https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing</a>	Explain performance of pumps and NPSH	chalk & talk/PP T
64		II mid exams				

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

Course Objectives	Program Outcomes	Program Specific Outcomes
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	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
<b>I</b>	3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
<b>II</b>	-	3	2	3	-	2	-	-	-	-	-	-	3	-	-
<b>III</b>	3	-	2	2	-	-	-	-	-	-	-	-	2	-	-
<b>IV</b>	3	-	2	3	3	-	-	-	-	-	-	-	-	-	2
<b>AVG</b>	2.25	1.5	2	2	0.75	0.5	-	-	-	-	-	-	1.25	0.5	0.5

### IX. QUESTION BANK: (JNTUH) DESCRIPTIVE QUESTIONS

#### SHORT ANSWER QUESTIONS-UNIT-I

S. N O	Question	Blooms Taxonomy Level	Programme Out come
1.	Explain about the flow in open channel with a neat sketch.	Understand	1
2.	Differentiate between critical, sub critical and super critical flow in open Channel.	Understand	2
3.	What do you mean by economical section of a channel? Explain the conditions applied.	Understand	2
4.	Explain the terms specific energy of a flowing liquid in an open channels	Remember	2
5.	Explain the term mild slope, critical slopes, steep slopes, horizontal slopes and adverse slopes.	Remember	5
6.	Explain specific energy curve.	Remember	2
7.	Explain the characteristics of uniform flow	Understand	2
8.	Explain the difference between open channel flow and pipe flow	Understand	2
9.	Write chezy's, manning's and bazin's formula for calculating discharge through open channels	Remember	2
10.	Classify open channels	Remember	3

#### LONG ANSWER QUESTIONS



S. No	Question	Blooms Taxonomy Level	Programme Out come
1.	Derive an expression for the discharge through a channel by chezy's formula.	Understand	3
2.	Derive the conditions for most economical section of a rectangular channel	Understand	2
3.	Derive the conditions for the best side slope of the most economical trapezoidal section.	Remember	2
4.	Prove that for a channel of circular section, the depth of flow, $d=0.81D$ , $D$ for maximum velocity, and $d=0.95D$ for maximum discharge, $D$ =diameter of a circular channel, $d$ = depth of flow.	Understand	3
5.	Derive an expression for critical depth and critical velocity.	Remember	2
6.	Derive the condition for maximum discharge for a given value of specific energy.	Remember	2
7.	Explain different channel transitions	Understand	2
8.	Prove that for trapezoidal channel sections, hydraulic mean depth = $\frac{1}{2}$ (depth of flow)	Understand	2
9.	What is the relation between manning's and chezy's constants	Remember	2
10.	Prove that for circular channel section, $d=0.81D$ for maximum velocity.	Remember	3

## UNIT-2

### SHORT ANSWER QUESTIONS-

S.NO	Question	Blooms Taxonomy Level	Programme Out come
1.	Explain different types of channels based on depth of flow.	Remember	1
2.	Define back water curve and explain how does it forms in a channel.	Remember	2
3.	Explain the differences between channel and rivers.	Remember	5
4.	Explain the velocity distribution diagram of an open channel and write the condition for maximum velocity.	Remember	5



5.	Explain with a neat sketch the velocity distributions of rectangular, trapezoidal open channels.	Remember	5
6.	Write the applications of hydraulic jump	Remember	2
7.	Write the classification of channel bottom slopes.	Understand	2
8.	What is energy dissipation	Understand	2
9.	Define hydraulic jump	Remember	2
10.	Find an expression for loss of energy head for a hydraulic jump	Understand	2

### LONG ANSWER QUESTIONS-

S.N O	Question	Blooms Taxonomy Level	Programme Out come
1.	Derive an expression for the depth of hydraulic jump in terms of upstream Froude number.	Understand	2
2.	Derive the differential equation for steady gradually varied flow open Channels and list all assumptions?	Understand	2
3.	Prove that the loss of energy head in a hydraulic jump is equal to where $d_1$ and $d_2$ are the conjugate depths.	Remember	2
4.	Find the discharge through a rectangular channel of width 2mts, having a bed slope of 4 in 8. The depth of flow is 1.5mts and take the value of N in Manning's formula as .12.	Remember	3
5.	Derive the dynamic equation for Gradually Varied flow.	Understand	2
6.	Write the classification and characteristics of surface profiles	Remember	2
7.	Write the application and location of hydraulic jump	Understand	2
8.	Elements and characteristics of hydraulic jump in rectangular channel	Remember	5
9.	What is difference between gradually varied flow and rapidly varied flow	Remember	5
10.	How to compute the water surface profile using Direct step method?	Remember	5



**UNIT-3**  
**SHORT ANSWER QUESTIONS-**

S. NO	Question	Blooms Taxonomy Level	Programme Out come
1.	a. Define the term dimensional analysis and model analysis. b. Discuss the difference between model and prototype with examples of each.	Remember	6
2.	a. Discuss fundamental and derived units. Give examples. b. Explain the term “dimensionally homogeneous equation”.	Understand	6
3.	a. Enumerate the method of analysis for dimensional quantities. b. State Rayleigh’s theorem	Understand	6
4.	a. Explain the term of Geometric similarity with formula. b. Explain the term of Kinematic similarity with formula. c. Explain the term of Dynamic similarity with formula.	Understand	7
5.	Define the term impact of jets with neat sketch? Obtain an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of jet.	Understand	12
6.	Water is flowing through a pipe at the end of which a nozzle is fitted .the diameter of the nozzle 100mm and the head of water at the centre of nozzle is 100 m .find the force exerted by the jet of water on a fixed vertical plate the coefficient of velocity is given as 0.95.	Remember	12



7.	A jet of water of diameter 50mm moving with a velocity of 40 m/s, strikes a curved fixed symmetrical plate at the centre. Find the force exerted by the jet of water in the direction the jet, if the jet is deflected through an angle of 120° at the outlet of the plate..	Remember	12
8.	Obtain an expression for the force exerted by a jet of water on a flat vertical plate moving in the direction of jet	Understand	12
9.	a. Write the equation for the force exerted by a jet of water on a moving inclined plate. b. Write the equation for the force exerted by a jet of water on a fixed curved plate at centre. c. Write the equation for the force exerted by a jet of water on a fixed curved plate at one end tangentially when the plate is symmetrical.	Understand	13
10.	a. Write the equation for the force exerted by a jet of water on a fixed curved plate at one end tangentially when the plate is unsymmetrical. b. Write the equation for the force exerted by a jet of water on a moving curved plate at center.	Understand	13

#### LONG ANSWER QUESTIONS-

S.No	Question	Blooms Taxonomy Level	Programme Out come
1.	a. Describe the Rayleigh's method for dimensional analysis. b. Explain the different types of hydraulic similarities that must exist between a prototype and its model?	Remember	8



2.	<p>a.Explain the different laws on which models are designed for dynamic similarity? Where are they used?</p> <p>b.Prove that ratio of inertia force to viscous force gives the Reynold's number?</p>	Understand	8
3.	<p>a.Explain about the scale ratios for distorted models.</p> <p>b.Determine the dimensions of the quantities given below :</p> <p>i. angular velocity ii. angular acceleration</p> <p>iii. discharge iv. kinematic viscosity</p> <p>v. force vi. Specific weight.</p>	Understand	8
4.	<p>a.The time period of a pendulum depends upon the length of the pendulum, Acceleration due to gravity. Determine expression for time period using Rayleigh's method.</p> <p>b.Find an expression for the drag force on smooth sphere of diameter "D" with Uniform velocity "V" in a fluid of density and dynamic viscosity</p>	Remember	7
5.	<p>a.Explain the force on the inclined plate moving in the direction of the jet ?</p> <p>b.Explain the force on the curved plate when the plate is moving in the direction of jet.</p>	Remember	12
6.	<p>a.Explain the force exerted by a jet of water on an unsymmetrical moving curved plate when jet strikes tangentially at one of the tips ?</p> <p>b. Explain the force exerted on a series of radial curved vanes?</p>	Understand	12



7.	<p>In a jet propelled boat water is drawn a mid ship and discharged at the back with an absolute velocity of 20 m/s. If the cross - sectional area of the jet is 200 cm<sup>2</sup> and the boat is moving in sea water with a speed of 8.33 m/s determine:</p> <p>i. The propelling force on the boat. ii. Power required to drive the pump and iii. Efficiency of jet propulsion</p>	Understand	13
8.	<p>a. Write the components of hydro power plants and explain them in detail.</p> <p>b. What are the steps involved in calculating the hydro power with the units?</p> <p>c. Define head and explain different types of head.</p>	Remember	13
9.	<p>Explain in detail different types of efficiencies and write them with formula of each.</p>	Remember	13
10.	<p>The following data relate to a proposed hydro - electric station: Available head = 28 m, catchment area = 420 Sq. Km. Rainfall = 140 cm /year, percentage of total rainfall utilized = 68 %, Penstock efficiency = 94 %, Turbine efficiency = 80 %, generator efficiency = 84 % and load factor = 44 %. Determine the following</p> <p>a. The power developed by turbine.</p> <p>b. Suggest suitable machines corresponding to the given data and specify the same.</p>	Understand	13

#### UNIT-4

#### SHORT ANSWER QUESTIONS-

S. N O	Question	Blooms Taxonomy Level	Program me Out come
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1.	Define turbine and different types of turbine with neat sketch?	Remember	16
2.	Discuss about following efficiencies: i) hydraulic efficiency ii) mechanical efficiency iii) volumetric efficiency iv) overall efficiency.	Understand	17
3.	Write short notes on classification of hydraulic turbines.	Understand	16
4.	Discuss about various parts of pelton wheel.	Remember	17
5.	Discuss about various parts of radial flow reaction turbines.	Understand	16
6.	What are governing of turbines?	Remember	17
7.	Define surge tanks With neat sketch .	Remember	16
8.	Define the following: i) unit speed ii) unit power iii)unit discharge.	Understand	16
9.	Discuss about specific speed performance of turbine.	Remember	16
10.	Explain about cavitation in turbines.	remember	16

#### LONG ANSWER QUESTIONS-

S. N O	Question	Blooms Taxonomy Level	Programme Out come
1.	Define a draft tube? What are its functions?	Understanding	16
2.	Differentiate between an inward and out ward flow reaction turbine?	Remember	17
3.	Define cavitation? How can it be avoided in reaction turbine ?	Remember	16
4.	Understanding by characteristic curves of a turbine? Name the important types of characteristic curves?	Remember	16



5.	Define the term governing of turbines? Describe with a neat sketch the working of an oil pressure governor?	Remember	17
6.	A pelton turbine develops 3000 Kw under a head of 300 m. The overall efficiency of the turbine is 83 % . If speed ratio = 0.46 , $c_v=0.98$ and specific speed is 16.5 , then find : i) diameter of the turbine and ii) diameter of the jet.	Remember	16
7.	A turbine develops 9000 kW when running at a speed of 140 r. p m and under a head of 30 m .Determine the specific speed of the turbine.	Understand	16
8.	Derive an expression for specific speed of a turbine.	Remember	17
9.	A water turbine has a velocity of 6 m/s at the entrance to the draft tube and a velocity of 1.2 m/s at the exit. For friction losses of 0.1 m and a tailwater 5m below the entrance to the draft tube, find the pressure head at the entrance.	Remember	16
10.	A turbine is to operate under a head of 25 m at 200 r. p .m. The discharge is 9 cumsec. i. Specific speed of turbine ii. Power generated iii. Type of machine	Understand	16

## UNIT-5

### SHORT ANSWER QUESTIONS-

S. N O	Question	Blooms Taxonomy Level	Programme Out come
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1.	Define pump and discuss about pump installation?	Remember	20
2.	Discuss about classification of pumps?	Understand	19
3.	Define the following :i) suction head ii) delivery head iii)static head	Remember	18
4.	Explain minimum speed for starting a centrifugal pump?	Remember	20
5.	Define multi stage centrifugal pump?	Understand	20
6.	Discuss about performance of pumps?	Remember	20
7.	Discuss about the classification of hydro power plants.	Remember	19
8.	Define the following : i) Load factor ii) Utilization factor iii) Capacity factor	Remember	20
9.	What do You understand by the term Net Positive Suction Head (NPSH)	Understand	20
10.	Enumerate the losses which occur when a centrifugal pump operates.	Understand	18

#### LONG ANSWER QUESTIONS-

S. N O	Question	Blooms Taxonomy Level	Program Outcome
1.	Define a centrifugal pump. Explain the working of a single –stage centrifugal pump with sketches.	Remember	20
2.	Differentiate between the volute casing and vortex casing for the centrifugal pump. Obtain an expression for the work done by the impeller of a centrifugal pump on water per second per unit weight of water	Remember	21



3.	Define the terms i) suction head ii) delivery head iii) static head iv) manometric head	Remember	19
4.	A centrifugal pump is to discharge 0.118 m <sup>3</sup> /s at a speed of 1450 r.p.m against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75 %. Determine the vane angle at the outer periphery of the impeller.	Understand	20
5.	A centrifugal pump running at 800 r.p.m is working against a total head of 20.2 m. The external diameter of the impeller is 480 mm and outlet width is 60 mm. If the vanes angle at outlet is 40° and manometric efficiency is 70 %. Determine: a. Flow velocity at outlet. b. Absolute velocity of water leaving the vane. c. Angle made by the absolute velocity at outlet with the direction of motion at outlet, and d. Rate of flow through pump.	Understand	20
6.	It is required to deliver 0.048 m <sup>3</sup> /s of water to a height of 24 m through a 150 mm diameter and 120 m long, by a centrifugal pump. If the overall efficiency of the pump is 75 % and coefficient of friction, $f = 0.01$ for pipe line, find the power required to drive the pump.	Understand	20
7.	A centrifugal impeller has dimensions and blade angles as given below. Water at the rate of 60 liters per second enters the impeller radially and the radial velocity remains constant in the impeller. Determine the impeller speed and torque produced by it. Use the following data: $R_1 = 7.5$ cm, $R_2 = 15$ cm, $\beta_1 = \beta_2 = 30^\circ$ . Impeller inlet area – $A_1 = 250$ cm <sup>2</sup> .	Remember	20



8.	<p>A three stage centrifugal pump has impeller 400 mm in diameter and 20 mm wide. The vane angle at outlet is <math>45^\circ</math> and the area occupied by the thickness of the vanes maybe assumed 8 % of the total area. If the pump delivers <math>3.6 \text{ m}^3</math> of water per minute when running at 920 r p m. Determine:</p> <p>a. Power of the pump. b. Manometric head</p> <p>c. Specific speed Assume mechanical efficiency = 88 % and Manometric efficiency = 77 %.</p>	Understand	21
9.	<p>Find the power required to drive a centrifugal pump which delivers <math>0.04 \text{ m}^3/\text{s}</math> of water to a height of 20 m through a 15 cm diameter pipe and 100 m long. The overall efficiency of the pump is 70% and co-efficient of friction <math>f = 0.15</math> in the formula</p>	Understand	22
10.	<p>The internal and external diameters of the impellers of a centrifugal pump are 300 mm and 600 mm respectively. The pump is running at 1000 r. p.m. The vane angles at inlet and outlet are <math>20^\circ</math> and <math>30^\circ</math> respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water.</p>	Understand	20

## X. OBJECTIVE QUESTIONS:

### JNTUH

#### UNIT 1

- For subcritical flow in an open channel, the control section for gradually varied flow profiles is  
(A) at the downstream end (B) at the upstream end  
(C) at both upstream and downstream ends (D) at any intermediate section
- The normal depth in a wide rectangular channel is increased by 10%. The percentage increase in the discharge in the channel is:  
(A) 20.1 (B) 15.4 (C) 10.5 (D) 17.
- A trapezoidal channel is 10.0 m wide at the base and has a side slope of 4 horizontal to 3 vertical. The bed slope is 0.002. The channel is lined with smooth concrete (Manning's  $n = 0.012$ ). The hydraulic radius (in m) for a depth of flow of 3.0 m is  
A) 20.0 (B) 3.5 (C) 3.0 (D) 2.1



- 
4. A rectangular open channel of width 5.0 m is carrying a discharge of  $100 \text{ m}^3/\text{s}$ . The Froude number of the flow is 0.8. The depth of flow (in m) in the channel is
- (A) 4 (B) 5 (C) 16 (D) 20
5. The top width and the depth of flow in a triangular channel were measured as 4 m and 1 m, respectively. The measured velocities on the centre line at the water surface, 0.2 m and 0.8 m below the surface are 0.7 m/s, 0.6 m/s and 0.4 m/s, respectively. Using two-point method of velocity measurement, the discharge (in  $\text{m}^3/\text{s}$ ) in the channel is
- (A) 1.4 (B) 1.2 (C) 1.0 (D) 0.8
6. For a given discharge, the critical flow depth in an open channel depends on
- (A) Channel geometry only (B) Channel geometry and bed slope
- (C) Channel geometry, bed slope and roughness (D) Channel geometry, bed slope, roughness and Reynolds number
7. Flow in open channels is defined as the flow of a liquid with a \_\_\_\_\_ surface.
8. If the depth of flow, velocity of flow, slope of the bed of channel and cross-section remain constant, the is called \_\_\_\_\_, otherwise it is called \_\_\_\_\_ flow.
9. For sub-critical flow, the Froude number is \_\_\_\_\_ and for super-critical flow, the Froude number is \_\_\_\_\_.
10. Velocity of Chezy's formula is given by \_\_\_\_\_.

## UNIT 2

1. When the flow in an open channel is gradually varied, the flow is said to be
- (A) steady uniform flow (B) steady non-uniform flow
- (C) unsteady uniform flow (D) unsteady non-uniform flow
2. A thick liquid like a syrup has a \_\_\_\_\_ viscosity than a light liquid like water.
3. Which of the following assumptions about a GVF is false?
- a) Channel is prismatic b) Pressure distribution is hydrostatic c) Flow characteristics change with time d) Roughness coefficient is constant



4. Determine the dynamic equation for the rate of change of depth having bed slope  $S_0$  and slope of total energy line  $S_f$ .

a)  $\frac{dy}{dx} = \frac{S_0 - S_f}{1 - \frac{Q^2 T}{gA^3}}$

b)  $\frac{dy}{dx} = \frac{S_0 - S_f}{1 - \frac{Q^2 T}{gA^2}}$

c)  $\frac{dy}{dx} = \frac{S_0 - S_f}{1 - \frac{Q^2 T}{gA^3}}$

d)  $\frac{dy}{dx} = \frac{S_0 - S_f}{1 - \frac{Q^2 T}{gA}}$

5. The water surface profile for the flow d/s of a sluice gate in a channel with mild slope is  
a. M1 b. M2 c. M3 d. None of the above.
6. At the control section, the depth is known  
a. True b. False
7. Subcritical flow always occurs when the  
a. Depth of flow is less than the critical depth b. Slope is mild c. Depth is more than the critical depth d. None of the above.
8. The standard step method aims to solve  
a. The continuity equation b. The energy equation c. The momentum equation d. None of the above
9. When the depth of water increases in the direction of flow then the surface profile is classified as back water curve and when it decreases then it is called as draw down curve.  
a. True b. False
10. In a sustaining slope the bottom slope is always  
a) Zero b) Negative c) Positive d) Goes from positive to negative

### UNIT 3

1. Efficiency of a series of vanes is given as \_\_\_\_\_ and condition of maximum efficiency is \_\_\_\_\_
2. For a curved radial vane, the work done per second is \_\_\_\_\_
3. For a curved radial vane the efficiency is given by \_\_\_\_\_
4. for a series of vanes, the force and workdone are given as \_\_\_\_\_ and \_\_\_\_\_
5. The liquid comes out in the form of ajet from the outlet of a nozzle, which is fitted to a pipe through which the liquid is flowing will be under \_\_\_\_\_



6. Group-I contains dimensionless parameters and Group- II contains the ratios.
- | Group-I            | Group -II                                            |
|--------------------|------------------------------------------------------|
| P. Mach Number     | 1. Ratio of inertial force and gravitational force   |
| Q. Reynolds Number | 2. Ratio of fluid velocity and velocity of sound     |
| R. Weber Number    | 3. Ratio of inertial force and viscous force         |
| S. Froude Number   | 4. Ratio of inertial force and surface tension force |
7. The correct match of dimensionless parameters in Group- I with ratios in Group-II is:  
(A) P-3, Q-2, R-4, S-1 (B) P-3, Q-4, R-2, S-1  
(C) P-2, Q-3, R-4, S-1 (D) P-1, Q-3, R-2, S-4
8. The ratio of inertia force to gravitational force acting in any flow, ignoring other forces, is called (A) Euler number (B) Froude number (C) Reynold number (D) Weber number
9. Flow in pipes is laminar if Reynolds number is \_\_\_\_\_.
10. The ratio of inertia force to elastic force acting in any flow, ignoring other forces, is called \_\_\_\_\_.

#### UNIT 4

1. Cavitation is caused by  
A) High velocity B) low barometric pressure C) Low pressure D) high pressure
2. Unit power of a turbine is given by  
A)  $P/H^{1/2}$  B)  $P/H^{3/2}$  C)  $P/H^{3/4}$  D)  $P/H^{5/2}$
3. Francis turbine is  
A) an impulse turbine B) a reaction turbine C) a tangential flow turbine D) An impulse turbine
4. the hydraulic machines, which convert the hydraulic energy into mechanical energy, are called \_\_\_\_\_.
5. Gross head is the vertical difference between the \_\_\_\_\_ race and \_\_\_\_\_ race.
6. Net head is also called as \_\_\_\_\_ head.
7. Hydraulic efficiency of turbine is given as \_\_\_\_\_ and mechanical efficiency is given as \_\_\_\_\_.
8. Pelton wheel is a \_\_\_\_\_ flow impulse turbine and \_\_\_\_\_ head turbine.
9. Francis turbine is an \_\_\_\_\_ flow \_\_\_\_\_ turbine.
10. Draft tube is a pipe of gradually increasing area used for discharging water from exit of a \_\_\_\_\_ turbine.



## UNIT 5

1. If hydro plant operate under a head of 100m, it may be classified as  
A) a very high speed plant B) high head plant  
C) Medium head plant D) low head plant
2. One of the river plant are usually  
A) a very high speed plant B) high head plant  
C) Medium head plant D) low head plan
3. A Double acting pump the theory of discharge is given by \   
A)  $Q=(2A-A_p)LN/60$  B)  $(2A-A_p)LN/120$   
C)  $(2A-A_p)LN/90$  D)  $(2A-A_p)LN/90$
4. A theoretical pump is  
A)  $ALN/60$  B)  $ALN/30$  C)  $ALN/120$  D)  $ALN/180$
5. The hydraulic machine which converts the mechanical energy into \_\_\_\_\_ energy by means of centrifugal force is called \_\_\_\_\_ pump.
6. The centrifugal pump acts as a reverse of an inward radial flow \_\_\_\_\_ turbine.
7. The vertical height of the centre-line of the centrifugal pump from the water surface in the pump is called the \_\_\_\_\_ head.
8. \_\_\_\_\_ head is the vertical distance between the centre line of the pump and the water surface in the tank to which the water is lifted.
9. The Manometric efficiency of the pump is given as \_\_\_\_\_ and mechanical efficiency is given as \_\_\_\_\_.
10. The minimum speed for starting a centrifugal pump is given by \_\_\_\_\_.

### XI. GATE QUESTIONS:

1. For subcritical flow in an open channel, the control section for gradually varied flow profiles is  
(A) at the downstream end (B) at the upstream end  
(C) at both upstream and downstream ends (D) at any intermediate section
2. The normal depth in a wide rectangular channel is increased by 10%. The percentage increase in the discharge in the channel is:  
(A) 20.1 (B) 15.4 (C) 10.5 (D) 17.2
3. A trapezoidal channel is 10.0 m wide at the base and has a side slope of 4 horizontal to 3 vertical. The bed slope is 0.002. The channel is lined with smooth concrete (Manning's  $n = 0.012$ ). The hydraulic radius (in m) for a depth of flow of 3.0 m is  
(A) 20.0 (B) 3.5 (C) 3.0 (D) 2.1
4. A rectangular open channel of width 5.0 m is carrying a discharge of  $100 \text{ m}^3/\text{s}$ . The Froude number of the flow is 0.8. The depth of flow (in m) in the channel is  
(A) 4 (B) 5 (C) 16 (D) 20



5. The top width and the depth of flow in a triangular channel were measured as 4 m and 1 m, respectively. The measured velocities on the centre line at the water surface, 0.2 m and 0.8 m below the surface are 0.7 m/s, 0.6 m/s and 0.4 m/s, respectively. Using two-point method of velocity measurement, the discharge (in m<sup>3</sup>/s) in the channel is  
(A) 1.4 (B) 1.2 (C) 1.0 (D) 0.8
6. For a given discharge, the critical flow depth in an open channel depends on  
(A) Channel geometry only (B) Channel geometry and bed slope  
(C) Channel geometry, bed slope and roughness  
**(D) Channel geometry, bed slope, roughness and Reynolds number**
7. Group-I contains dimensionless parameters and Group- II contains the ratios.
- | Group-I            | Group -II                                            |
|--------------------|------------------------------------------------------|
| P. Mach Number     | 1. Ratio of inertial force and gravitational force   |
| Q. Reynolds Number | 2. Ratio of fluid velocity and velocity of sound     |
| R. Weber Number    | 3. Ratio of inertial force and viscous force         |
| S. Froude Number   | 4. Ratio of inertial force and surface tension force |
8. The correct match of dimensionless parameters in Group- I with ratios in Group-II is:  
(A) P-3, Q-2, R-4, S-1 (B) P-3, Q-4, R-2, S-1 (C) P-2, Q-3, R-4, S-1 (D) P-1, Q-3, R-2, S-4
9. The force exerted by a jet on a curved plate is  
A). less than that on flat plate B). Equal to that on a flat plate  
C).more than that on a flat plate  
D).sometimes more and sometimes less than that on a flat plate
10. A normal shock wave  
A) is reversible B) may occur in a converging tube C) is irreversible D) is isentropic
11. Cavitation is caused by  
A) High velocity B) low barometric pressure C) Low pressure D) high pressure
12. unit power of a turbine is given by  
A)  $P/H^{1/2}$  B)  $P/H^{3/2}$  C)  $P/H^{3/4}$  D)  $P/H^{5/2}$
13. Francis turbine is  
A) an impulse turbine B) a reaction turbine C) a tangential flow turbine D) An impulse



turbine

14. If hydro plant operate under a head of 100m, it may be classified as  
A) a very high speed plant B) high head plant  
C) Medium head plant D) low head plant
15. One of the river plant are usually  
A) a very high speed plant B) high head plant  
C) Medium head plant D) low head plant
16. A Double acting pump the theory of discharge is given by \  
A)  $Q=(2A-A_P)LN/60$  B)  $(2A-A_P)LN/120$  C)  $(2A-A_P)LN/90$  D)  $(2A-A_P)LN/90$
17. A theoretical pump is  
A)  $ALN/60$  B)  $ALN/30$  C)  $ALN/120$  D)  $ALN/180$

### IES QUESTIONS:

1. Consider the following statements:  
1. Hydraulically most efficient channel section for an open channel flow will carry maximum discharge for a given area of cross section.  
2. For a given cross sectional area hydraulic radius maximum when the wetted perimeter is minimum. Which of the statements given above is/are correct?  
a. 1 only b. 2 only c. Both 1 and 2 d. Neither 1 nor 2
2. A rectangular channel 3 m wide is laid on a slope of 0.0002. When the depth of flow in the channel is 1.5 m, what is the average boundary shear stress (nearly)?  
a. 0.3 N/m<sup>2</sup> b. 0.15 N/m<sup>2</sup> c. 3.0 N/m<sup>2</sup> d. 1.5 N/m<sup>2</sup>
3. A right-angled triangular channel, symmetrical in section about the vertical, carries a discharge of 5 m<sup>3</sup>/s with a velocity of 1.25 m/s. What is the approximate value of the Froude number of the flow?  
a. 0.3 b. 0.4 c. 0.5 d. 0.615.
4. Which of the following equations are used for the derivation of the differential equation for water surface profile in open channel flow?  
1. Continuity Equation 2. Energy Equation 3. Momentum Equation



5. Select the correct answer using the code given below
- a. 1, 2 and 3   b. Only 1 and 3   c. Only I and 2   d. Only 2 and 3
6. Flow depths across a sluice gate are 2.0 m and 0.5 m. What is the discharge (per meter width)
- a. 1.0 m<sup>2</sup>/s   b. 1.4 m<sup>2</sup>/s   c. 2.0 m<sup>2</sup>/s   d. 2.8 m<sup>2</sup>/s
7. A rectangular channel is 6 m wide and discharges 30 m<sup>3</sup> s<sup>-1</sup>. The upstream depth is 2.0 m, acceleration due to gravity is 10 m s<sup>-2</sup>. Then, what is the specific energy (approximate)?
- a. 2.5   b. 0.3   c. 2.3   d. None of the above
8. Which one of the following statements is not correct?  
A control section in an open channel is the site
- a. where the flow quantity can be controlled   b. at which flow is known to be critical
- c. where the discharge can be measured   d. where the specific energy is determined
9. What is the normal depth in a wide rectangular channel carrying 0.5 m<sup>2</sup>/s discharge at a bed slope of 0.0004 and Manning's  $n = 0.01$  ?
- a. 0.13 m   b. 0.32 m   c. 0.43 m   d. 0.50 m
10. Flow happens at a critical depth of 0.5 m in a rectangular channel of 4 m width.  
What is the value of discharge?
- a. 5.4 m<sup>3</sup>/s   b. 5.1 m<sup>3</sup>/s   c. 4.9 m<sup>3</sup>/s   d. 4.4 m<sup>3</sup>/s
11. One end of a two dimensional water tank has the shape of quadrant of a circle of radius 2 meters. When the tank is full, the vertical component of the force per unit length of curved surface will be
- a.  $9.81\pi$  kN   b.  $19.62\pi$  kN   c.  $29.43\pi$  kN   d.  $39.24\pi$  kN
12. A hydraulic jump occurs at the toe of a spillway. The depth before jump is 0.2 m. The sequent depth is 3.2 m. What is the energy dissipated in m (approximate)?
- a. 27   b. 10.5   c. 15   d. 42
13. In a wide rectangular channel, an increase in the normal depth 20% corresponds to how much (approximate) increase in discharge?
- a. 12%   b. 20%   c. 36%   d. 48%
- c. Head increases with speed   d. Manometric head decreases with discharge
14. A penstock is 2000 m long and the velocity of pressure wave in it is 1000 m/s. Water hammer pressure head for instantaneous closure of valve at the downstream end of the pipe is 60 m. If the valve is closed in 4 s, then what is the peak water hammer pressure in m of water?
- a. 15   b. 30   c. 60   d. 120



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15. To generate 8100 kW under a head of 81 m while working at a speed of 540 r.p.m., what type of turbine is suitable?  
a. Pelton b. Kaplan c. Bulb d. Francis
16. At a rated capacity of 44 cumec, a centrifugal pump develops 36 m of head  
When operating at 725 r.p.m: What is its specific speed?  
a. 327 b. 255 c. 350 d. 45
17. Centrifugal pump should be installed above the water level in the sump such that  
a. Its height is not more than 10.3 m at room temperature of liquid  
b. Its height is not allowed to exceed 6.7m  
c. The negative pressure does not reach as low as the vapour pressure  
d. The negative pressure is not allowed to develop in the impeller
18. Which one of the following inferences is not drawn by studying performances curves of centrifugal pumps?  
a. Discharge increases with speed b. Power decreases with speed  
c. Head increases with speed d. Manometric head decreases with discharge
19. Centrifugal pump should be installed above the water level in the sump such that  
a. Its height is not more than 10.3 m at room temperature of liquid  
b. Its height is not allowed to exceed 6.7m  
c. The negative pressure does not reach as low as the vapour pressure  
d. The negative pressure is not allowed to develop in the impeller
20. In the selection of turbine by specific speed or head, which one of the following statements is not correct ?  
a. For specific speed 10—35, Kaplan turbines  
b. For specific speed 60—300, Francis turbines  
c. For head 50—150 m, Francis turbines d. For head above 300 m, Pelton wheel

## **XII. WEBSITES:**

- a. <http://nptel.iitm.ac.in/courses/IIT-MADRAS/Hydraulics/>
- b. <http://www.asce.org>
- c. <http://www.icivilengineer.com>
- d. <http://www.construction-guide.in>



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**XV. JOURNALS:(NATIONAL & INTERNATIONAL)**

0970-1141	Thesis Digest on civil Engineering	1987
0973-8061	International Engineering and Technology Journal of Civil and Structure	2007
0975-5314	International journal of civil engineering	2009
0975-6744	Journal of information knowledge and research in civil engineering	2009
0976-6308	International journal of civil engineering and technology	2010
2249-426X	International Journal of Civil Engineering and Applications	2011
2249-8753	Recent Trends in Civil Engineering and Technology	2011
2277-5986	World Research Journal of Civil Engineering	2011
2277-7032	International Journal of Structural and Civil Engineering	2012
2278-9987	International Journal of Civil Engineering (IJCE)	2012
2319-6009	International Journal of Structural and Civil Engineering Research	2012
2320-723X	International Journal of Advanced Research in Civil, Structural, Environmental and Infrastructure Engineering and Developing	2013



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## **XVI. LIST OF TOPICS FOR STUDENT SEMINARS:**

- Classification of Flows
- Open Channels
- Hydraulic Jump
- Hydraulic Turbines
- Centrifugal Pumps
- Hydropower Plants

## **XVII. CASE STUDIES / SMALL PROJECTS:**

- Study of Open Channels
- Study of Hydro Turbines
- Study of Centrifugal Pumps
- Study of Hydropower plants

