HYDRAULICSANDHYDRAULICMACHINER(CE404PC) COURSE PLANNER

I. COURSEOVERVIEW:

Thiscourseis intendedto introducebasicprinciplesoffluid mechanics. Itis 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 thiscourse for mechanicaltechnicians. TheMechanicaltechnicians haveto 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	3	4	FluidMechanics

III. COURSEOBJECTIVES:

1	Strengthentheknowledgeof theoreticalandtechnologicalaspectsof hydrodynamic forces on jets.
2	Correlatetheprincipleswithapplicationsinhydraulicturbines.
3	ApplythepracticalapplicationsonFrancisandKaplanturbine.
4	Analysisthesimilaritiesbetweenprototypeandmodeltypesofhydraulicsimilitude.

COURSEOUTCOMES:

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

CO2	Understand and solve problems in uniform, gradually and rapidly variedflowsinopenchannelin steadystateconditions.	L2:Understand, L4: Analyzing	PO2,PO3,PO4,PO6,PSO1.
CO3	Apply dimensional analysis andtodifferentiatethemodel, prototype and similitude conditionsforpractical problems.	L3:Applying	PO1,PO3,PO4,PSO1.
CO4	Get the knowledge ondifferent hydraulic machinery devicesand itsprinciples thatwillbeutilizedin	L1: Remember, L2:Understan	PO1,PO3,PO4,PO5,PSO3.
CO5	hydropowerdevelopmentand for other practical usages	d,L3: Applying	

IV. HOWPROGRAMOUTCOMESAREASSESSED:

ProgramOutcomes(PO)		**Level**	**Proficiency assessedby**
PO1	**Engineeringknowledge**:ToApplytheknowledge ofmathematics,science,engineeringfundamentals principals, and civil engineering to the solution of complex engineeringproblems encountered in modern engineering practice.	3	Assignments

PO2	**Problem analysis**: Ability to Identify, formulate, review research literature, and analyze complex engineeringproblemsrelatedtoCivilEngineering and reaching substantiated conclusionsusing first principles of mathematics, natural sciences, and engineeringsciences.	3	Exercise, Exams
PO3	**Design/development of solutions**: Design solutions for complex engineering problems related to Civil Engineering and design system components or processes that meet the specified needswithappropriateconsiderationforthepublic healthandsafety,andthecultural,societal,and environmentalconsiderations.	2	Exercise
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methodsincludingdesignofexperiments,analysis and interpretation of data, and synthesis ofthe informationtoprovidevalid conclusions.	2.7	Discussion, Seminars
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including predictionand modelingtocomplexengineeringactivitieswith anunderstandingofthelimitations.	3	Discussion, Seminars
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 relevantto the CivilEngineeringprofessionalengineering practice.	2	Discussions
PO7	**Environment and sustainability**: Understand the impact of the Civil Engineering professional engineering solutions in societal and environmental contexts, and demonstrate the knowledgeof,andneedforsustainable development.	_	------
PO8	**Ethics**:Applyethicalprinciplesandcommitto professionalethicsandresponsibilitiesandnorms ofthe engineeringpractice.	_	------
PO9	**Individualandteamwork**:Functioneffectively asanindividual,andasamemberorleaderin diverse teams, and in multidisciplinary settings.	_	------

PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering communityand withsocietyat large, such as, being able to comprehend and write effectivereportsanddesigndocumentation, make effectivepresentations,andgiveandreceiveclear instructions.	–	------
PO11	**Projectmanagementandfinance**: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, tomanageprojectsandin multidisciplinary environments.	–	-----
PO12	**Life-longlearning**:Recognizetheneed for,and have the preparation and ability to engage in independentandlife-longlearninginthe broadestcontextoftechnologicalchange.	–	Prototype, Discussions

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

V. HOWPROGRAMSPECIFICOUTCOMESAREASSESSED:

Programspecificoutcomes		**Level**	**Proficiency AssessedBy**
PSO1	**ENGINEERINGKNOWLEDGE:**Graduateswillbeable to applytechnicalknowledge indrawing, analysis, design, laboratory investigations and construction aspects of civil engineeringinfrastructure,alongwithgoodbasicsin mathematics, basicsciencesandtechnicalcommunication	2.5	Lectures, Exercisesand Assignments

PSO2	**BROADNESSANDDIVERSITY:**Graduateswillbeable to summarize and can demonstrate about societal, economical, environmental, health and safety factors involved in infrastructural development, and shall work withinmultidisciplinaryteamswithcompetenceinmodern toolusage.	2	Project
PSO3	**SELF-LEARNINGANDSERVICE:**Graduateswillbe able to pursue lifelong learning and professional developmenttofacethechallengingandemergingneeds of our society, ethically and responsibly.	2	Guestlectures

0-None 2-Supportive 3-HighlyRelated

VI. SYLLABUS:JNTUHSYLLABUS

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 uniformflow – Factors affecting Manning's Roughness Coefficient "n". Most economical sections. Computation of Uniform flow, Normaldepth.

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 - Dynamicequation for G.V.F; Classification ofchannel bottom slopes – Classification and characteristics of Surface profiles– Computation of watersurface profilesby 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 locationofhydraulic jump, Energy dissipation and other uses – Positive and Negative Surges (Theoryonly).

UNIT-III

Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity – Rayleigh's method and Buckingham's pi methods – Dimensionless groups. Similitude, Modelstudies, Types of models. Applicationofdimensionalanalysis and modelstudies to fluid flow problems. Distorted models.

BasicsofTurbo Machinery: Hydrodynamic forceofjetsonstationaryand moving flat, inclinedandcurved vanes, Jet strikingcentrallyandattip, Velocitytrianglesat inlet and outlet, expressions for work done and efficiency –Angular

UNIT-IV

HydraulicTurbines–I: ElementsofatypicalHydropowerinstallation–Headsand efficiencies – Classification ofturbines – Pelton wheel – Francis turbine – Kaplan turbine –working,workingproportions,velocitydiagram,workdoneandefficiency,hydraulic design. Draft tube – Classification, functions and efficiency.

HydraulicTurbines–II: Governingofturbines– Surgetanks–Unit andspecific turbines–Unit speed–Unit quantity–Unit power–Specificspeed–Performance characteristics – Geometric similarity – Cavitation. Selection of turbines.

UNIT-V

CentrifugalPumps: Pump installationdetails–classification–workdone–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 ofhydropower potential.

TEXTBOOKS:

1. FluidMechanicsbyModiandSeth,Standard BookHouse.
2. FluidMechanicsandHydraulic machinesbyManishKumarGoyal,PHIlearning Private Limited,2015
3. Fluidmechanics&HydraulicMachines,Domkundwar&DomkundwarDhanpatRai&Co

REFERENCEBOOKS:

1. FluidMechanicsbyR.C.Hibbeler, PearsonIndiaEducationServicesPvt.Ltd
2. FluidMechanic&FluidPowerEngineeringbyD.S.Kumar (Kataria& Sons Publications Pvt.Ltd.).
3. OpenchannelflowbyV.T.Chow(McGrawHillBookCompany).
4. IntroductiontoFluidMechanicsand FluidMachinesbySKSom, GautamBiswas, SumanChakraborthy, McGraw Hill Education (India) PrivateLimited
5. HydraulicMachinesbyBanga&Sharma(KhannaPublishers).

MOOC'S-SWAYAM/NPTEL:

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

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

GATESYLLABUS:

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,hydraulicjump.Forcesonimmersedbodies,flowmeasurementsinchannels,tanks

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

IES SYLLABUS:

A. openchannelflow,pipeflow

Dimensional Analysis, Modeling; Cavitations; Flow oscillations; Momentum and Energy principles in Open channel flow, Flow controls, Hydraulic jump, Flow sections and properties;Normalflow, Graduallyvaried flow;Surges;Flowdevelopment and losses inpipe flows, Measurements;Siphons;Surgesand Waterhammer; DeliveryofPowerPipe networks.

B. Hydraulicmachinesand 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. COURSEPLAN:

Lecture No.	Unit No.	Date	Topicstobecovered	Linkfor PPT	LinkforPDF	Course learning outcomes	Teaching Methodology	Reference

1	**1**		IntroductiontoOpenchannel flow-Comparison between open channel flow and pipe flow,	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Differentiate between pipeflow and open flow	chalk&talk/PPT	**T1 R1**
2			Classification of open channels,Classificationof open channel flows	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Classify types of flowsand channels	chalk&talk/PPT	
3			Velocitydistribution.	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Understand velocity distribution	chalk&talk/PPT	
4			studentPresentation	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Remember characteristics	chalk&talk/PPT	

5			Characteristicsofuniform flow,Chezy's,Manning's and Bazin formulae for uniform flow	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Derive roughness coefficient	chalk&talk/PPT	
6			FactorsaffectingManning's Roughness Coefficient "n".	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Design economical sections	chalk&talk/PPT	
7			Mosteconomicalsections	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Design economical sections	chalk&talk/PPT	
8			studentPresentation	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Define uniform flow	chalk&talk/PPT	

9			Mosteconomicalsections	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Derive specific energy	chalk&talk/PPT	
10			ComputationofUniform flow, Normal depth	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Understand and apply critical depths	chalk&talk/PPT	
11			Specificenergy–critical depth	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Understand and apply critical depths	chalk&talk/PPT	
12			studentPresentation	https://drive.google.com/drive/folders/1LdXc4JTZc6QRLn1H23DEuok-wpvz4dKm?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Understand channel transitions.	chalk&talk/PPT	

13			Computationofcriticaldepth	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Remember non uniform flow	chalk&talk/PPT	
14			Critical,subcriticaland super critical flows	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Derive GVF	chalk&talk/PPT	
15	**2**		Channeltransitions	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Classify bottom slopes	chalk&talk/PPT	
16			studentPresentation	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Understand surface profiles	chalk&talk/PPT	**T1 R1**
17			Non-uniform flow – GraduallyVariedFlow	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwr	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Analyze surface profiles	chalk&talk/PPT	

				ElfsSI?usp=sharing				
18			Dynamicequationfor G.V.F	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Study direct step method	chalk&talk/PPT	
19			Classificationofchannel bottom slopes	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Understand hydraulic jump	chalk&talk/PPT	
20			studentPresentation	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Locate hydraulic jump	chalk&talk/PPT	
21			Classification and characteristicsofSurface profiles	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Analyze hydraulic jump	chalk&talk/PPT	

22			Computation of water surface profiles by NumericalandAnalytical approaches	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Classify hydraulic jump	chalk&talk/PPT	
23			Directstepmethod	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Explain energy dissipation	chalk&talk/PPT	
24			studentPresentation	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing		chalk&talk/PPT	
25			Elementsandcharacteristics (Length and Height) of Hydraulic jump in rectangular channel	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Solve problems	chalk&talk/PPT	
26			Elementsandcharacteristics (Length and Height) of Hydraulic jump in rectangular channel	https://drive.google.com/drive/folders/1xFBK47xd8qUkzy7O3Gz7GKwSwrElfsSI?usp=sharing	https://drive.google.com/drive/folders/1zvI_ZoVy3lBcaXzPJJKdJmKmaCz3T8qq?usp=sharing	Solve problems	chalk&talk/PPT	

27			Elementsandcharacteristics (Length and Height) of Hydraulic jump in rectangular channel	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	State dimensional homogeneity	chalk&talk/PPT	
28			Types, applications and locationofhydraulicjump	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Explain and compute using rayleigh' smethod.	chalk&talk/PPT	
29			Energydissipationandother uses	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Explain and compute using bukingham's method	chalk&talk/PPT	T1 R1
30			PositiveandNegativeSurges	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Classify dimensionless groups	chalk&talk/PPT	
31			studentPresentation	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Explain typesof models.	chalk&talk/PPT	

		Imid exams						
32			Dimensionalhomogeneity	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	solve fluidflow problems	chalk&talk/PPT	T1 R1
33			Rayleigh's method	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Apply dimensional analysis	chalk&talk/PPT	
34			Buckingham'spimethods	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	understand Rayleigh's method	chalk&talk/PPT	
35			studentPresentation	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	understandmethod for analysis	chalk&talk/PPT	

36			Dimensionlessgroups	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	understand groups	chalk&talk/PPT	
37			Similitude,Modelstudies, Types of models	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	study model studies	chalk&talk/PPT	
38			modelstudiestofluidflow problems	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Apply model studiesto flow	chalk&talk/PPT	
39			studentPresentation	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	apply to distorted models.	chalk&talk/PPT	
40			Applicationofdimensional analysis, Distorted models	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Understand force of jet	chalk&talk/PPT	

41			Hydrodynamicforceofjets on stationary plate.	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Understand force of jet	chalk&talk/PPT	
42			Hydrodynamicforceofjets on stationary plate moving flat inclined and curved vanes.	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Explain forceof jet	chalk&talk/PPT	
43			studentPresentation	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Solve work doneand efficiency for various jet conditions	chalk&talk/PPT	
44	**4**		Jet striking centrally and at tip,Velocitytrianglesatinlet and outlet	https://drive.google.com/drive/folders/1zNeWvVJ4Tid5fd_betRr1BvufFy53hvi?usp=sharing	https://drive.google.com/drive/folders/1RkF7jjQ9854ppPwhGfrWwk7E-geVNE2F?usp=sharing	Solve work doneand efficiency for various jet conditions	chalk&talk/PPT	
45			Expressionsforworkdone and efficiency	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing	List elements of hydropowerplant	chalk&talk/PPT	

46			Expressionsforworkdone and efficiency angular	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing	Explain headsand efficiencies	chalk&talk/PPT	
47			studentPresentation	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing	Classify turbines	chalk&talk/PPT	
48			Elements of a typical Hydropowerinstallation	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing	Explain peltonnd fransis turbine	chalk&talk/PPT	
49			Headsandefficiencies	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing	Describe Kaplan working design	chalk&talk/PPT	
50			Classificationofturbines	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing	Solve work doneand efficiency problem	chalk&talk/PPT	

51			studentPresentation	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1OuH_JGCT3owQVvFea4_Ziex5GGAzvaxX?usp=sharing	Describe draft tube.	chalk&talk/PPT	
52			Peltonwheel;Francisturbine	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Explain governing of tubine, uses of surge tanks.	chalk&talk/PPT	
53			Kaplanturbineworking, hydraulic design	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Explain unit properties	chalk&talk/PPT	
54			Velocitydiagram,workdone and efficiency	https://drive.google.com/drive/folders/1oAYxNogkyalYaYxZwxSwFuijj965k0oq?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Solve problems on geometric similarities	chalk&talk/PPT	
55	**5**			https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Understand pump installation	chalk&talk/PPT	

56			DrafttubeClassification, functions and efficiency	https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Classify typesof pump.	chalk&talk/PPT	
57			Governingofturbines,Surge tanks, Definition of terms, loadfactor,utilizationfactor, capacity factor	https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Understandterms	chalk&talk/PPT	
58			Unit and specific turbines, Unit speed, Unit quantity, Unit power, Specific speed, Performancecharacteristics.	https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Apply and analyze for multistage pumps	chalk&talk/PPT	
59			studentPresentation	https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Explain performance of pumps and NPSH	chalk&talk/PPT	
60			Geometric similarity, Cavitation, selection of turbines,Classificationof Hydropower plants, estimationofhydropower potential	https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Classify hydropower plants	chalk&talk/PPT	

61			Pump installation details, Multistagepumps,pumpsin parallel	https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Explain theterms for estimation of power	chalk&talk/PPT	
62			Classification, work done, performance of pumps, characteristiccurves,NPSH – Cavitation	https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Apply and analyze for multistage pumps	chalk&talk/PPT	
63			Manometric head , minimumstartingspeed, losses and efficiencies, specific speed.	https://drive.google.com/drive/folders/1awSLDHxY4_HfsFxFHfVsCImWZnBiSjuZ?usp=sharing	https://drive.google.com/drive/folders/1FChPPy12o_RHeA5B6ptuDofutuK7x2AZ?usp=sharing	Explain performance of pumps and NPSH	chalk&talk/PPT	
64			IImid exams					

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

Course Objectives	**Program Outcomes**	**Program Specific Outcomes**

	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
I	3	3	2	_	_	_	_	_	_	_	_	_	_	2	_
II	_	3	2	3	_	2	_	_	_	_	_	_	3	_	_
III	3	_	2	2	_	_	_	_	_	_	_	_	2	_	_
IV	3	_	2	3	3	_	_	_	_	_	_	_	_	_	2
AVG	2.25	1.5	2	2	0.75	0.5	_	_	_	_	_	_	1.25	0.5	0.5

IX. QUESTIONBANK:(JNTUH)DESCRIPTIVEQUESTIONS

SHORT ANSWER QUESTIONS-UNIT-I

S. NO	Question	Blooms Taxonomy Level	Programme Out come
1.	Explainabout the flowinopenchannelwitha neatsketch.	Understand	1
2.	Differentiate betweencritical, subcriticaland super critical flow in open Channel.	Understand	2
3.	What do you meanbyeconomicalsectionofa channel? Explain the conditions applied.	Understand	2
4.	Explainthetermsspecificenergyofa flowing liquid in an open channels	Remember	2
5.	Explainthetermmildslope,criticalslopes, steep slopes, horizontalslopes and adverse slopes.	Remember	5
6.	Explainspecificenergycurve.	Remember	2
7.	Explainthecharacteristicsofuniformflow	Understand	2
8.	Explainthedifference betweenopenchannel flow and pipe flow	Understand	2
9.	Write chezy's,manning's andbazin'sformula for calculatingdischargethroughopenchannels	Remember	2
10.	Classifyopenchannels	Remember	3

LONG ANSWER QUESTIONS

S. No	Question	Blooms Taxonomy Level	Programme Out come
1.	Deriveanexpressionforthedischargethrough a channel by chezy‟sformula.	Understand	3
2.	Derivetheconditions formosteconomical sectionofa rectangularchannel	Understand	2
3.	Derivetheconditionsforthebestsideslopeof themosteconomicaltrapezoidalsection.	Remember	2
4.	Provethat forachannelofcircular section,the depth of flow, d=.81D, D for maximum velocity, and=.95D for maximum discharge,D=diameterofacircularchannel,d= depthofflow.	Understand	3
5.	Deriveanexpressionforcriticaldepthand criticalvelocity.	Remember	2
6.	Derivetheconditionformaximumdischarge foragivenvalueofspecificenergy.	Remember	2
7.	Explaindifferent channeltransitions	Understand	2
8.	Provethat fortrapezoidalchannelsections, hydraulic mean depth= ½ (depth of flow)	Understand	2
9.	Whatistherelationbetweenmanning’sand chezy’sconstants	Remember	2
10.	Provethatforcircular channelsection,d= 0.81Dformaximumvelocity.	Remember	3

UNIT-2

SHORTANSWERQUESTIONS-

S.NO	Question	Blooms Taxonomy Level	Programme Out come
1.	Explaindifferenttypesofchannelsbasedondepth of flow.	Remember	1
2.	Define backwater curveandexplainhow doesit formsinachannel.	Remember	2
3.	Explainthedifferencesbetweenchannelandrivers.	Remember	5
4.	Explain the velocity distribution diagram of an open channelandwritetheconditionformaximum velocity.	Remember	5

5.	Explainwithaneatsketchthevelocitydistributions ofrectangular,trapezoidalopenchannels.	Remember	5
6.	Writetheapplicationsofhydraulicjump	Remember	2
7.	Writetheclassificationofchannelbottomslopes.	Understand	2
8.	Whatisenergydissipation	Understand	2
9.	Definehydraulicjump	Remember	2
10.	Findanexpressionfor lossofenergyhead fora hydraulic jump	Understand	2

LONG ANSWER QUESTIONS-

S.NO	Question	Blooms Taxonomy Level	Programme Out come
1.	Derive an expression for the depth of hydraulic jumpintermsofupstreamFroude number.	Understand	2
2.	Derivethedifferentialequationforsteady graduallyvariedflowopenChannelsandlist allassumptions?	Understand	2
3.	Provethatthelossofenergyheadina hydraulicjumpisequaltowhered1andd2 arethe conjugate depths.	Remember	2
4.	Findthedischargethrougharectangular channel of width 2mts, having a bed slope of 4in8.The depthofflow is 1.5mts and takethe value of N in Manning's formula as .12.	Remember	3
5.	Derive the dynamic equation for GraduallyVariedflow.	Understand	2
6.	Writetheclassificationandcharacteristics ofsurface profiles	Remember	2
7.	Write the application and location of hydraulicjump	Understand	2
8.	Elementsandcharacteristicsofhydraulic jumpinrectangularchannel	Remember	5
9.	What is difference between gradually variedflowandrapidlyvariedflow	Remember	5
10.	Howtocomputethewatersurfaceprofile usingDirectstepmethod?	Remember	5

UNIT-3
SHORTANSWERQUESTIONS-

S. NO	Question	Blooms Taxonomy Level	Programme Out come
1.	a. Definethetermdimensionalanalysisand model analysis. b. Discussthedifferencebetweenmodeland prototype with examples of each.	Remember	6
2.	a. Discussfundamentalandderivedunits.Give examples. b. Explaintheterm"dimensionallyhomogeneous equation".	Understand	6
3.	a. Enumeratethemethodofanalysis for dimensional quantities. b. StateRayleigh"stheorem	Understand	6
4.	a. ExplainthetermofGeometricsimilaritywith formula. b. Explainthe termofKinematic similaritywith formula. c. ExplainthetermofDynamicsimilaritywith formula.	Understand	7
5.	Definethetermimpactofjetswithneatsketch? Obtainanexpressionforthe forceexertedbya jet of water ona fixed verticalplate inthe directionof jet.	Understand	12
6.	Water is flowingthroughapipeat theendofwhich anozzle is fitted.thediameterofthe nozzle100mm and the head of water at the centre of nozzle is 100 m .find the force exerted by the jet of water ona fixed verticalplatethe coefficient ofvelocityis 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 excretedbythe jet ofwater inthedirectionthe jet,if the jet is deflected through an angle of 1200 at the out let of the plate..	Remember	12
8.	Obtainanexpressionforthe forceexcretedbya jet of water on a flat vertical plate moving in the direction of jet	Understand	12
9.	a. Writetheequationforthe forceexertedbya jetof water on a moving inclined plate. b. Writetheequationfortheforceexertedbya jetof water on a fixed curved plate at centre. c. Write the equation forthe force exerted bya jet of wateronafixedcurvedplateatoneendtangentially when the plate is symmetrical.	Understand	13
10.	a. Write the equation forthe force exerted bya jet of wateronafixedcurvedplateatoneendtangentially when the plate is unsymmetrical. b. Writetheequationfortheforceexertedbya jetof water on a moving curved plate at center.	Understand	13

LONG ANSWER QUESTIONS-

S.No	Question	Blooms Taxonomy Level	Programme Out come
1.	a. Describetherayleigh‟smethod fordimensional analysis. b. Explain the different types of hydraulic similarities that must exist between a proto typeand its model?	Remember	8

2.	a. Explainthedifferent lawsonwhich modelsare designed for dynamic similarity?Whereareytheyused? b. Provethatratioofinertiaforceto viscousforce gives the Reynold‟s number?	Understand	8
3.	a. Explain about the scale ratios for distortedmodels. b. Determine the dimensions of the quantitiesgiven below : i.angularvelocityii.angularacceleration iii.dischargeiv.kinematicviscosity v.forcevi.Specificweight.	Understand	8
4.	a. The time period of a pendulum depends uponthe length ofthe pendulum, Acceleration due togravity. Determine expression for time period using Rayleigh‟s method. b. Find an expression for the drag force on smooth sphere of diameter “D” withUniform velocity “V” in a fluid of density and dynamicviscosity	Remember	7
5.	a. Explaintheforceontheinclined platemoving in the direction of the jet ? b. Explaintheforceonthecurvedplate whenthe plate is moving in the direction of jet.	Remember	12
6.	a. Explain the force exerted by a jet of water on an unsymmetrical moving curved plate whenjetstrikestangentiallyatoneofthetips ? b. Explaintheforceexertedonaseriesof radialcurved vanes?	Understand	12

7.	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 cm2 and the boatismovinginseawaterwithaspeedof 8.33m/sdetermine: i. The propelling force onthe boat. ii. Power required to drive the pump and iii. Efficiencyof jet propulsion	Understand	13
8.	a. Writethecomponentsofhydropower plantsand explain them in detail. b. Whatarethestepsinvolvedincalculating thehydro power with the units? c. Defineheadandexplain differenttypes ofhead.	Remember	13
9.	Explainindetaildifferent typesofefficiencies and write them with formula of each.	Remember	13
10.	The following data relate to a proposed hydro – electric station:Available head = 28 m, catchment area = 420 Sq. Km. Rainfall = 140 cm/year, percentage oftotalrainfallutilized = 68 %, Penstock efficiency = 94 %, Turbine efficiency=80%,generatorefficiency=84 % and load factor = 44 %. Determine the following a. The power developed byturbine. b.Suggestsuitablemachinescorresponding tothegivendataandspecifythesame.	Understand	13

UNIT-4

SHORTANSWERQUESTIONS-

S. NO	Question	Blooms Taxonomy Level	Programme Out come

1.	Defineturbineanddifferent typesofturbine with neat sketch?	Remember	16
2.	Discussaboutfollowingefficiencies: i)hydraulicefficiencyii)mechanicalefficiency iii)volumetricefficiencyiv)overallefficiency.	Understand	17
3.	Writeshort notesonclassificationofhydraulic turbines.	Understand	16
4.	Discussaboutvariouspartsofpeltonwheel.	Remember	17
5.	Discussabout variouspartsofradialflow reaction turbines.	Understand	16
6.	Whataregoverningofturbines?	Remember	17
7.	DefinesurgetanksWithneatsketch .	Remember	16
8.	Definethefollowing:i)unitspeedii)unit power iii)unit discharge.	Understand	16
9.	Discussaboutspecificspeedperformanceof turbine.	Remember	16
10.	Explainaboutcavitationinturbines.	remember	16

LONG ANSWER QUESTIONS-

S. NO	**Question**	**Blooms Taxonomy Level**	**Programme Out come**
1.	Defineadraft tube?Whatareitsfunctions?	Understanding	16
2.	Differentiatebetweenaninwardandoutward flow reaction turbine?	Remember	17
3.	Definecavitation?Howcanit beavoided in reaction turbine ?	Remember	16
4.	Understanding bycharacteristiccurvesofa turbine? Name the important types of characteristic curves?	Remember	16

5.	Define the term governing of turbines? Describewithaneat sketchtheworking ofan oil pressure governor?	Remember	17
6.	A pelton turbine develops 3000 Kw under a head of 300 m. The overall efficiency of the turbine is83%.Ifspeedratio =0.46,cv=0.98 and specificspeed is 16.5 , then find : i) diameter of the turbine and ii)diameter of the jet.	Remember	16
7.	Aturbine develops9000kWwhenrunning at a speed of140 r. p mand under a head of30 m .Determinethespecificspeedofthe turbine.	Understand	16
8.	Deriveanexpressionforspecificspeedofa turbine.	Remember	17
9.	A water turbine has a velocity of 6 m/s at the entrance to the draft tube and avelocity of 1.2 m/sattheexit. Forfrictionlossesof0.1 mand a tailwater 5m below the entrance to the draft tube, find the pressure head at the entrance.	Remember	16
10.	Aturbine istooperateunder aheadof25 mat 200 r. p .m. The discharge is 9 cumsec. i.Specificspeedofturbineii.Powergenerated iii.Typeofmachine	Understand	16

UNIT-5

SHORTANSWERQUESTIONS-

S. NO	Question	Blooms Taxonomy Level	Programme Out come

1.	Definepumpanddiscussaboutpump installation?	Remember	20
2.	Discussaboutclassificationofpumps?	Understand	19
3.	Definethefollowing:i)suctionheadii) delivery head iii)static head	Remember	18
4.	Explainminimumspeed forstartinga centrifugalpump?	Remember	20
5.	Definemultistagecentrifugalpump?	Understand	20
6.	Discussaboutperformanceofpumps?	Remember	20
7.	Discussabouttheclassificationofhydro power plants.	Remember	19
8.	Definethefollowing:i) Loadfactor ii)Utilization factoriii) Capacityfactor	Remember	20
9.	What doYouunderstand bythetermNet Positive Suction Head (NPSH)	Understand	20
10.	Enumeratethelosseswhichoccurwhena centrifugal pump operates.	Understand	18

LONG ANSWER QUESTIONS-

S. NO	**Question**	**Blooms Taxonomy Level**	**Programme Out come**
1.	Defineacentrifugalpump. Explaintheworkingof a single –stagecentrifugal pump with sketches.	Remember	20
2.	Differentiatebetweenthevolutecasingand 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 unitweight ofwater	Remember	21

3.	Definethetermsi)suctionheadii)deliveryhead iii)staticheadiv) manometrichead	Remember	19
4.	Acentrifugalpump isto discharge0.118 m3/sat a speed of 1450 r.p.m against a head of 25 m. The impeller diameter is 250 mm, its widthatoutlet is 50 mm and monomeric efficiency is 75 %. Determinethevane angleattheouterperipheryof 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 outletwidthis60 mm.Ifthevanesangleatoutlet is 400 and manometric efficiency is70 %. Determine:a.Flowvelocityat outlet. b. Absolutevelocityofwaterleavingthevane. c. Anglemadebytheabsolutevelocityat outlet with the direction of motion at outlet, and d. Rateofflow throughpump.	Understand	20
6.	It is required to deliver 0.048 m3/s is of water to a height of24 mthrougha150 mmdiameter and 120 m long, by a centrifugal pump. If the overall efficiency of the pump is 75 % and co-efficient of friction,f=0.01forpipeline,findthepower requiredtodrivethepump.	Understand	20
7.	A centrifugal impeller has dimensions and blade anglesasgivenbelow. Water attherateof60 liters per second enters the impeller radially and the radial velocityremains constant in the impeller. Determine the impeller speed and torque produced byit. Usethe followingdata:R1=7.5cm, R2=15 cm,β1=β2=300.Impellerinletarea–A1=250 cm2.	Remember	20

8.	A three stage centrifugal pump has impeller 400 mm in diameter and 20 mm wide. The vane angle at outlet is 450 and the area occupied by the thickness of the vanes maybe assumed 8 % of the totalarea. Ifthepump delivers3.6 m3ofwater per minute when running at 920 r p m. Determine: a.Powerofthepump. b. Manometrichead c. Specific speed Assume mechanicalefficiency= 88 % and Manometric efficiency = 77 %.	Understand	21
9.	Find the power required to drive a centrifugalpumpwhichdelivers0.04 m3/sofwaterto aheight of 20 m through a 15 cm diameter pipe and 100 m long.Theoverallefficiencyofthepumpis70% andco-efficientoffriction f=0.15intheformula	Understand	22
10.	The internaland externaldiametersofthe impellers of a centrifugal pump are 300 mm and 600 mm respectively. The pump is running at 1000 r. p.m. The vane anglesat inlet and outlet are 200 and 300 respectively. The water enters the impeller radially andvelocityofflowisconstant.Determinethe workdonebytheimpellerper unitweight ofwater.	Understand	20

X. OBJECTIVEQUESTIONS:

JNTUH

UNIT1

1. Forsubcriticalflowinanopenchannel,thecontrolsectionforgraduallyvaried flowprofiles is
   (A) atthedownstreamend(B)at theupstreamend

   (C)atbothupstreamand downstreamends(D)atany intermediatesection
2. Thenormaldepthinawiderectangularchannelisincreasedby10%.Thepercentageincrease inthe discharge in the channel is:
   (A)20.1(B)15.4(C)10.5(D)17.
3. Atrapezoidalchannelis10.0 mwideat thebaseand hasasideslopeof4 horizontalto 3 vertical. Thebedslope is0.002. Thechannelis linedwithsmoothconcrete(Manning'sn= 0.012). The hydraulic radius (in m) for a depthof flow of3.0 m is

   A)20.0 (B)3.5(C)3.0(D)2.1

4. Arectangular openchannelofwidth5.0 miscarrying adischargeof100 m^3/s. TheFroude number ofthe flow is 0.8. The depthof flow (in m) inthe channel is

(A)4(B)5(C)16(D)20

5. Thetopwidthandthedepthofflow inatriangular channelwere measured as4 mand1 m, respectively. The measuredvelocitiesonthecentre lineatthewatersurface, 0.2mand0.8 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 m3/s) in the channel is

(A)1.4(B)1.2(C)1.0(D)0.8

6. Foragivendischarge,thecriticalflowdepthinanopenchanneldependson
(A) Channelgeometryonly(B)Channelgeometryandbedslope

(C)Channelgeometry,bedslopeandroughness(D)Channelgeometry,bedslope, roughness and Reynolds number

7. Flowinopenchannelsisdefinedastheflowofaliquidwith a_____surface.

8. Ifthe depthofflow, velocityofflow, slope ofthe bed ofchanneland cros-sectionremain

constant, the is called_____, otherwise it is called_____flow.

9. For sub-critical flow, the Froude number is_____andforsuper-criticalflow,the

Froudenumber is_____.

10. VelocityofChezy'sformulaisgivenby_____.

UNIT2

1.Whentheflowinanopenchannelisgraduallyvaried,theflowissaidtobe

(A)steadyuniformflow(B)steadynon-uniformflow

(C)unsteadyuniformflow(D)unsteadynon-uniformflow

2. Athickliquidlikeasyruphasa_____viscositythanalightliquidlikewater.
3. Whichofthefollowing assumptionsaboutaGVFisfalse?
a)Channelisprismaticb) Pressuredistributionishydrostaticc) Flowcharacteristics change with time d) Roughness co efficient is constant

4. Determine thedynamic equationfortherateofchangeofdepthhaving bedslope$S_0$and slope of total energy line S_f.

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

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

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

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

5. Thewatersurfaceprofilefortheflowd/sofasluicegateinachannelwithmildslopeis

   a.M1 b.M2 c.M3 d.Noneofthe above.

6. Atthecontrolsection,thedepthisknown

   a. Trueb.False

7. Subcriticalflowalwaysoccurswhenthe

   a.Depth offlowislessthanthecritical depthb.Slopeismildc.Depthismorethanthe critical depth d. None of the above.

8. Thestandardstepmethodaimstosolve

   a. The continuity equation b. The energyequation c. The momentumequation d. None of the above

9. Whenthedepthofwaterincreasesinthedirectionofflowthenthesurfaceprofileis classifiedasbackwatercurveandwhenitdecreasesthen itiscalledasdrawdowncurve.

   a. Trueb.False

10. Inasustainingslopethebottomslopeisalways

    a)Zerob)Negativec)Positived)Goesfrompositivetonegative

UNIT3

1. Efficiencyofa series ofvanesisgivenas_____andconditionofmaximumefficiencyis
2. For acurved radialvane, the workdoneper second is_____
3. For acurved radialvane the efficiencyisgiven by_____
4. foraseriesofvanes,theforceandworkdonearegivenas_____and _____
5. The liquid comesout inthe formofajet fromthe oulet ofa nozzle, which is fitted to apipe through which the liquid is flowing will be under _____

6. Group-Icontainsdimensionlessparametersand Group-IIcontainstheratios.

Group-I	Group -II
P. MachNumber	1.Ratioofinertialforceandgravitationalforce
Q. ReynoldsNumber	2.Ratiooffluidvelocityandvelocityofsound
R. WeberNumber	3.Ratioofinertialforceandviscousforce
S. Froude Number	4.Ratioofinertialforceandsurfacetension force

7. Thecorrectmatchofdimensionless parametersinGroup-IwithratiosinGroup-IIis:
   (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. FlowinpipesislaminarifReynoldsnumberis_____.
10. Theratioofinertia forcetoelastic forceacting inanyflow, ignoringotherforces,is called _____

UNIT4

1. Cavitationiscausedby
   A) Highvelocity B)lowbarometricpressure C)LowpressureD) highpressur
2. Unitpowerofaturbineisgivenby
   A) $P/H^{1/2}$ B)$P/H^{3/2}$B) $P/H^{3/4}$B)$P/H^{5/2}$

3. Francisturbineis
   A) animpulseturbineB)areactionturbineC) atangentialflowturbineD)Animpulseturbine

4. thehydraulicmachines,which convertthehydraulicenergy intomechanical energy,are called

5. Grossheadistheverticaldifferencebetweenthe_____race and_____race.
6. Netheadisalsocalledas_____head.
7. Hydraulicefficiencyofturbineisgivenas_____andmechanicalefficiencyisgivenas __
8. Peltonwheelisa_____flowimpluseturbineand_____headtubine.
9. Francisturbineis an_____flow_____turbine.
10. Drafttube isapipeofgraduallyincreasinfgareaused fordischargingwaterfromexit of a _____turbine.

UNIT5

1. Ifhydroplantoperateunderaheadof100m,itmaybeclassifiedas
   A) averyhighspeed plantB) highhead plant

   C)Mediumhead plant D)lowheadplant
2. Oneoftheriver plantareusually
   A) averyhighspeed plantB) highhead plant

   C)Mediumhead plant D)lowheadplan
3. ADouble actingpumpthetheoryofdischargeisgivenby\
   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. Atheoreticalpumpis
   A) ALN/60 B)ALN/30C)ALN/120D)ALN/180
5. Thehydraulicmachinewhichconvertsthe mechanical energy into_____energybymeansofcentrifugalforceis called _____pump.
6. Thecentrifugalpumpctsasareverseofan inwardradialflow_____turbine.
7. The vertical heightof the centre-line of the centrifugal pumpfrom the water surfacein the pumpis called the_____head.
8. _____headistheverticaldistancebetweenthecentrelineofthepumpandthewater surface in the tank to which the water is lifted.
9. The Manometric efficiency of the pump is given as_____and mechanical efficiency isgiven as_____.
10. Theminimumspeedfor startingacentrifugalpumpisgiven by_____.

XI. GATEQUESTIONS:

1. Forsubcriticalflowinanopenchannel,thecontrolsectionforgraduallyvaried flowprofiles is
   (A) atthe downstreamend(B)attheupstreamend

   (C)atbothupstreamand downstreamends(D)atany intermediatesectio
2. Thenormaldepthinawiderectangularchannelisincreasedby10%.Thepercentageincrease inthe discharge in the channel is:
   (A)20.1(B)15.4(C)10.5(D)17.2
3. Atrapezoidalchannelis10.0 mwideat thebaseand hasasideslopeof4 horizontalto 3 vertical. Thebedslope is0.002. Thechannelis linedwithsmoothconcrete(Manning'sn=

   0.012).Thehydraulicradius(in m)foradepthofflow of3.0 mis

   (A)20.0(B)3.5(C)3.0(D)2.1

4. Arectangular openchannelofwidth5.0 miscarrying adischargeof100 m^3/s. TheFroude number ofthe flow is 0.8. The depthof flow (in m) inthe channel is

   (A)4(B)5(C)16(D)20

5. The top widthand the depthof flow ina triangular channelwere measured as 4 mand 1 m, respectively. The measured velocities on the centre line at the water surface, 0.2 mand 0.8 mbelow the surface are 0.7m/s, 0.6 m/sand 0.4m/s, respectively. Using two-point method of velocity measurement, the discharge (in m3/s) in the channel is
   (A)1.4(B)1.2(C)1.0(D)0.8

6. Foragivendischarge,thecriticalflowdepthinanopenchanneldepends on
   (A) Channelgeometryonly(B)Channelgeometryandbedslope

   (C) Channelgeometry,bed slopeand roughness

(D) Channelgeometry,bedslope,roughnessandReynoldsnumber

7. Group-Icontainsdimensionlessparametersand Group-IIcontainstheratios.

Group-I	Group -II
P. MachNumber	1.Ratioofinertialforceandgravitationalforce
Q. ReynoldsNumber	2.Ratiooffluidvelocityandvelocityofsound
R. WeberNumber	3.Ratioofinertialforceandviscousforce
S. Froude Number	4.Ratioofinertialforceandsurfacetension force

8. ThecorrectmatchofdimensionlessparametersinGroup-IwithratiosinGroup-IIis:
   (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. Theforceexertedbyajetonacurved plateis
   A). less than that on flat plate B).Equaltothatonaflat plate

   C).more than that on a flat plate

   D).sometimesmoreandsometimeslessthanthatonaflatplate

10. Anormalshockwave
    A)isreversibleB)mayoccurinaconvergingtubeC) is irreversibleD)isisentropic

11. Cavitationiscausedby

    A)Highvelocity B)lowbarometricpressure C)LowpressureD) highpressure

12. unitpowerofaturbineisgivenby
    A)$P/H^{1/2}$ B)$P/H^{3/2}$ B) $P/H^{3/4}$B)$P/H^{5/2}$

13. Francisturbineis
    A)animpulseturbineB)areactionturbineC)atangentialflowturbineD)Animpulse

turbine

14. Ifhydroplantoperateunderaheadof100m,itmaybeclassifiedas
A)averyhighspeedplantB) highheadplant

C)Mediumhead plant D)lowheadplant

15. Oneoftheriver plantareusually
A)averyhighspeedplantB)highhead plant

C)Mediumheadplant D)lowheadplan

16. ADoubleactingpump thetheoryofdischargeisgivenby\
A)Q=(2A-A_P)LN/60B)(2A-A_P)LN/120 C)(2A-A_P)LN/90 D)(2A-A_P)LN/90

17. Atheoreticalpumpis
A)ALN/60 B)ALN/30C)ALN/120D)ALN/180

IESQUESTIONS:

1. Considerthefollowingstatements:
1. Hydraulicallymost efficient channelsectionforanopenchannelflowwillcarry maximum discharge for a given area of cross section.

2. For agivencrosssectionalareahydraulicradius maximumwhenthewetted perimeter is minimum. Which ofthe statements given above is/are correct?

a. 1onlyb.2onlyc.Both1 and2 d.Neither1 nor2

2. A rectangular channel 3 m wide is laid on a slope of0.0002. When the depth of flow in the channel is 1.5 m, what is the average boundaryshear stress (nearly)?
a.0.3N/m2b.0.15N/m2c.3.0 N/m2d.1.5N/m2

3. A right-angled triangular channel, symmetrical in section about the vertical, carries a dischargeof5m3/swithavelocityof1.25m/s.What istheapproximatevalueoftheFroude number of the flow?
a.0.3b.0.4c.0.5 d. 0.615.

4. Which ofthe following equations are used for the derivation ofthe differential equation for water surface profile in open channel flow?
1.ContinuityEquation2.EnergyEquation3.MomentumEquation

5. Selectthecorrectanswer usingthecodegivenbelow

a. 1,2 and 3b.Only1 and3 c.OnlyIand 2d.Only2 and3

6. Flowdepthsacrossasluicegateare2.0mand0.5m.Whatisthedischarge(per meterwidth)
   a.1.0m2/sb.1.4m2/sc.2.0m2/sd.2.8 m2/s

7. A rectangular channel is 6 mwide and discharges 30 m3 s–1. The upstreamdepth is 2.0 m, acceleration due to gravity is 10 ms–2. Then, what is the specific energy(approximate)?
   a.2.5b.0.3c.2.3d.None ofthe above

8. Whichoneofthefollowing statementsisnotcorrect?
   Acontrolsectioninanopenchannelisthesite

   a.wheretheflowquantitycanbecontrolledb. atwhich flowisknowntobecritical

   c.wherethedischargecanbemeasuredd.wherethespecificenergyisdetermined

9. What isthenormaldepthinawiderectangularchannelcarrying0.5 m2/sdischargeat abed slope of 0.0004 and Manning's n = 0.01 ?
   a.0.13mb.0.32mc.0.43md.0.50m

10. Flowhappensat acriticaldepthof0.5 minarectangular channelof4 mwidth. What is the value of discharge?

    a.5.4m3/sb.5.1 m3/sc.4.9m3/sd.4.4 m3/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.9.81πkNb19.62πkNc.29.43πkN d.39.24πkN

12. Ahydraulicjumpoccursatthetoeofaspillway.Thedepthbeforejumpis0.2m.Thesequent depth is 3.2 m. What is the energydissipated in m (approximate)?
    a.27b.10.5c.15d.42

13. Inawiderectangularchannel,anincreaseinthenormaldepth20%correspondstohowmuch (approximate) increase in discharge?
    a.12%b.20%c.36%d. 48%

    c.Headincreaseswithspeedd. Manometricheaddecreaseswithdischarge

14. Apenstockis2000mlongandthevelocityofpressurewaveinit is1000m/s.Waterhammer pressure head for instantaneous closure of valve at the downstreamend ofthe pipe is 60 m. Ifthe valve is closed in4 s, thenwhatis the peak water hammer pressure in mofwater?
    a.15b.30c.60d.120

15. Togenerate8100kWunderaheadof81mwhileworkingataspeedof540r.p.m.,whattype of turbine is suitable?
    a.Peltonb.Kaplanc.Bulbd.Francis
16. At arated capacityof44cumec, acentrifugalpump develops36 mofhead When operating at 725 r.p.m: What is its specific speed?

    a.327b.255c.350d.45
17. Centrifugalpumpshould beinstalledabovethewaterlevelinthesump suchthat
    a. Itsheightisnotmorethan10.3 matroomtemperatureofliquid

    b. Itsheightisnotallowedtoexceed6.7m

    c. Thenegativepressuredoesnotreachaslowasthevapourpressure

    d. Thenegativepressureisnotallowedtodevelopintheimpeller
18. Whichoneof thefollowinginferencesisnotdrawnbystudyingperformancescurvesof centrifugalpumps?
    a.Dischargeincreaseswithspeedb.Powerdecreaseswithspeed

    c.Headincreaseswithspeedd. Manometricheaddecreaseswithdischarge
19. Centrifugalpumpshould beinstalledabovethewaterlevelinthesump suchthat
    a. Itsheightisnotmorethan10.3 matroomtemperatureofliquid

    b. Itsheightisnotallowedtoexceed6.7m

    c. Thenegativepressuredoesnotreachaslowasthevapourpressure

    d. Thenegativepressureisnotallowedtodevelopintheimpeller
20. In the selection ofturbine byspecific speed or head, which one ofthe following statements is not correct ?
    a. Forspecificspeed10—35, Kaplanturbines

    b. Forspecificspeed60—300,Francisturbines

    c. Forhead50—150m.Francisturbinesd.For headabove300m,Peltonwheel

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

EXPERTDETAILS:

1. Dr.B.S.Thandaveswara

DepartmentofCivilEngineering,IITMadras. email:

thand12345@yahoo.co.in

phone:9894868380

2. Prof.B.S.Murty

DepartmentofCivilEngineering,IITMadras. email:

bsm@iitm.ac.in

phone:(91-44)22574262

XV. JOURNALS:(NATIONAL&INTERNATIONAL)

0970-1141	ThesisDigestoncivilEngineering	1987
0973-8061	InternationalEngineeringandTechnologyJournalofCiviland Structure	2007
0975-5314	Internationaljournalofcivilengineering	2009
0975-6744	Journalofinformationknowledgeandresearch in civilengineering	2009
0976-6308	Internationaljournalofcivilengineeringandtechnology	2010
2249-426X	InternationalJournalofCivilEngineeringandApplications	2011
2249-8753	RecentTrendsinCivilEngineeringand Technology	2011
2277-5986	WorldResearchJournalofCivilEngineering	2011
2277-7032	InternationalJournalofStructuralandCivilEngineering	2012
2278-9987	InternationalJournalofCivilEngineering(IJCE)	2012
2319-6009	InternationalJournalofStructuralandCivilEngineeringResearch	2012
2320-723X	InternationalJournalofAdvanced ResearchinCivil,Structural, EnvironmentalandInfrastructureEngineering and Developing	2013

XVI. LISTOFTOPICS FOR STUDENTSEMINARS:

- ClassificationofFlows
- OpenChannels
- HydraulicJump
- HydraulicTurbines
- CentrifugalPumps
- HydropowerPlants

XVII. CASESTUDIES /SMALLPROJECTS:

- StudyofOpenChannels
- StudyofHydroTurbines
- StudyofCentrifugalPumps
- StudyofHydropowerplants