Ref No:

< SRI KRISHNA INSTITUTE OF TECHNOLOGY, BENGALURU>



COURSE PLAN

Academic Year 2019-20

Program:	B E – CIVIL ENGINEERING
Semester :	4
Course Code:	18CV43
Course Title:	APPLIED HYDRAULICS
Credit / L-T-P:	3 / 3-0-0
Total Contact Hours:	60
Course Plan Author:	YASHASWINI R V

Academic Evaluation and Monitoring Cell

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Note : Remove "Table of Content" before including in CP Book

Each Course Plan shall be printed and made into a book with cover page Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. COURSE INFORMATION

1. Course Overview

Degree:	B.E	Program:	CV
Year / Semester :	4	Academic Year:	2019-20
Course Title:	Applied Hydraulics	Course Code:	18CV43
Credit / L-T-P:	4/4-0-0	SEE Duration:	180 min
Total Contact Hours:	50	SEE Marks:	60
CIA Marks:	40	Assignment	1/ 2Module
Course Plan Author:	Yashaswini R.V	Sign	Dt : 02.02.2020
Checked By:	Priyankashri K N	Sign	Dt : 10.02.2020

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Mod	Content	Teachi	Identified Module	Blooms
ule		ng	Concepts	Learning
		Hours		Levels
1	Dimensional analysis and similitude: Dimensional homogeneity, Non Dimensional parameter, Rayleigh methods and Buckingham theorem, dimensional analysis, choice of variables, examples on various applications. Model analysis: Model analysis, similitude, types of similarities, force ratios, similarity laws, model classification, Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, scale effects, Distorted models. Numerical problems on Reynold's, and Froude's Model Buoyancy and Flotation: Buoyancy, Force and Centre of Buoyancy, Metacentre and Metacentric height, Stability of submerged and floating bodies, Determination of Metacentric height, Experimental and theoretical method, Numerical problems	10	Dimentional Analysis, Buoyancy	L4
2	Classification of flow through channels, Chezy's and Manning's equation for flow through open channel, Most economical channel sections, Uniform flow through Open channels, Numerical Problems. Specific Energy and Specific energy curve, Critical flow and corresponding critical parameters, Metering flumes, Numerical Problems	10	Uniform flow in channels, Specific Energy	L4
3	Hydraulic Jump, Expressions for conjugate depths and Energy loss, Numerical Problems Gradually varied flow, Equation, Back water curve and afflux, Description of water curves or profiles, Mild, steep, critical, horizontal and adverse slope profiles, Numerical problems, Control sections	10	Nonuniform Flow, GVF Profiles	L4
4	Hydraulic Machines: Introduction, Impulse-Momentum equation. Direct impact of a jet on a stationary and moving curved vanes, Introduction to concept of velocity triangles, impact of jet on a series of curved vanes- Problems 21 Turbines – Impulse Turbines: Introduction to turbines, General lay out of a hydroelectric plant, Heads and Efficiencies, classification of turbines. Pelton wheel components, working principle and velocity triangles. Maximum power, efficiency, working proportions – Numerical problems	10	Velocity Triangles, Pelton turbine	L4
5	Reaction Turbines and Pumps: Radial flow reaction turbines: (i) Francis turbine Descriptions, working proportions and design, Numerical problems. (ii) Kaplan turbine- Descriptions, working proportions and design, Numerical problems. Draft tube theory and unit quantities. (No problems) Centrifugal pumps: Components and Working of centrifugal pumps,	10	Francis turbine, Pumps	L4

	Types of centrifugal pumps, Work done by the impeller,			
	Heads and Efficiencies, Minimum starting speed of			
	centrifugal pump, Numerical problems, Multi-stage pumps.			
-	Total	50	-	-

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes

2. Design: Simulation and design tools used – software tools used ; Free / open source

3. Rese	arch: Recent developments on the concepts – publications in journals; co	nierence	s etc.
Modul	Details	Chapters	Availability
es	Tout beeks (Title Authors Edition Dublisher Veer)	IN DOOK	
A	Text books (Title, Authors, Edition, Publisher, Year.)	-	- In Lib (In Dont
1224	P.N. Modi and S.M. Seth. "Hydraulics and Eluid Mechanics, including		
5	Hydraulic Machines" 20th edition 2015 Standard Book House New		
	Delhi		
1,2,3,4,	R.K. Bansal, "A Text book of Fluid Mechanics and Hy draulic Machines",		In dept
5	Laxmi Publications, New Delni		
1,2,3,4, 5	Machines" Tata McGraw Hill New Delhi		NOL AVAILADLE
B	Reference books (Title, Authors, Edition, Publisher, Year.)	-	-
1,2,3,4,	K Subramanya, "Fluid Mechanics and Hydraulic Machin es", Tata McGraw		In Lib
5	Hill Publishing Co. Ltd.		
1,2,3,4,	Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University		In Lib
5	Press		
1,2,3,4,	C.S.P. Ojha, R. Berndtsson, and P.N. Chandramouli, "Fluid Mechanics and Machinery". Oxford Liniversity Publication 2010.		Not Available
5	IB Evett and C Liu "Eluid Mechanics and Hydraulics." McGraw-Hill		Not Available
	Book Company2009.		
С	Concept Videos or Simulation for Understanding	-	-
C1	https://www.youtube.com/watch?v=tV3ShM1fo5Y		
C2	https://www.youtube.com/watch?v=xjYfNvYWmD0		
C3	https://www.youtube.com/watch?v=X_Gt4-q8wLs		
C4	https://www.youtube.com/watch?v=2HkJr_7vPc4		
C5	https://www.youtube.com/watch?v=j3-		
	2aQ6376c&list=PLSNhedsleX11ykZJbtlIVDH8kZXqB_tO-		
	<u>&index=6</u>		
C6	https://www.youtube.com/watch?v=VbsZRqpcJ4w		
C7	https://www.youtube.com/watch?v=3RGguSotX3E		
C8	<u> https://www.youtube.com/watch?v=YgVfJscGj4k</u>		
C9	https://www.youtube.com/watch?v=V3Be5iu7WJE		
C10	https://www.youtube.com/watch?v=2CjzkHvH4iE		
D	Software Tools for Design	-	-
E	Recent Developments for Research	-	-
F	Utners (web, video, Simulation, Notes etc.)	-	- \\\/ob
	INFIEL https://pptel.ac.in/courses/105102006/		web
	http:// ubterge/ii/ cog/262/ 102102080/		I

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Mod	Course	Course Name	Topic / Description		Remarks	Blooms
ules	Code					Level
1	18CV33	FLUID	Basic properties of	of fluids, 3	-	L3
		MECHANICS	BERNOULIS EQU	JATION		

Students must have learnt the following Courses / Topics with described Content

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Mod	Topic / Description	Area	Remarks	Blooms
ules				Level
1	Byuoncy	Higher	-	Understa
		Study		nd L2
2	Open channel uniform flow	Higher	-	Understa
		Study		nd L2
3	Open channel non-uniform flow, GVF	Higher		Understa
	profiles	Study		nd L2
4	Turbines	Higher		Understa
		Study		nd L2
5	Pumps	Higher		Understa
		Study		nd L2
-				

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Mod	Course	Course Outcome	Teach.	Concept	Instr	Assessme	Blooms'
ules	Code.#	At the end of the course, student	Hours		Method	nt	Level
		should be able to				Method	
1	17CV43.1	Apply principles of dimensional	10	Dimentiona	Lecture	C.I.A	L4
		analysis and Buoyancy to design		l Analysis,			Analyzing
		experiments					
2	17CV43.2	Design open channels for most	15	Flow in	Lecture	C.I.A	L4
		economical sections.		open			Analyzing
				Channels,			
				Specific			
				Energy			
3	17CV43.3	Determine GVF profiles under	05	Water	Lecture	C.I.A	L4
		nonuniform flow		Profiles			Analyzing
4	17CV43.4	Design the working proportions	20	Velocity	Lecture	C.I.A	L4
		hydraulic machines		Triangles,			Analyzing
				Turbines,			
				pumps			
-	-	Total	50	-	-	-	-

2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learnings to ...

Mod	Application Area	СО	Level
ules	Compiled from Module Applications.		
1	Use of dimensions and the dimensional formula of physical quantities to find	CO1	L3
	interrelations between them.		
2	Concept of Byuoncy is used for experimental determination of density.	CO1	L3
3	Uniform flow in channels.	CO2	L4
4	Non uniform flow in channels, rivers.	CO2	L4
5	Study of water profiles during non uniform flow.	CO3	L3
6	Design of Turbines.	CO4	L4
7	Design of Pumps.	CO4	L4

3. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes				-											
Mod	CO.#	At the end of the course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	PS	Lev
ules		student should be able to	1	2	3	4	5	6	7	8	9	10	11	12	O1	02	03	el
1	17CV43.1	Apply principles of dimensional	3	3	2	2	-	-	-	-	-	-	-	-				L2
		analysis and Buoyancy to design																
		experiments																
2	17CV43.2	Design open channels for most	3	3	2	2	-	-	-	-	-	-	-	-				L3
		economical sections.																
3	17CV43.3	Determine GVF profiles under	3	3	2	2	-	-	-	-	-	-	-	-				L2
		nonuniform flow																
4	17CV43.4	Design the working proportions	3	3	2	2	-	-	-	-	-	-	-	-				L2
		hydraulic machines																
-	17CV43	Average attainment (1, 2, or 3)																-
-	PO, PSO	1.Engineering Knowledge; 2.Prob	lem	Ar	naly	sis;	3.L	Des	ign	/	De	velo	pm	ent	of	Sc	oluti	ions;
		4.Conduct Investigations of Compl	lex .	Prol	bler	ns;	5.M	lode	ern	Тоо	l Us	sage	e; 6.	The	e En	gin	eer	and
		Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork;																
		10.Communication; 11.Project Management and Finance; 12.Life-long Learning;																
		S1.Software Engineering; S2.Data E	Base	e Mo	ana	iger	nen	nt; S	3.W	'eb l	Des	ign						

4. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Mod	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
ules					
1	_				

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Mod	Title	Teach.		No. o	f quest	ion in	Exam		CO	Levels
ules		Hours	CIA-1	CIA-2	CIA-3	Asg	Extra	SEE		
							Asg			
1	Dimensional and Model Analysis	10	2	-	-	1	1	2	CO1, CO2	L4
2	Open Channel Flow Hydraulics	10	2	-	-	1	1	2	CO3, CO4	L4
3	Non-Uniform Flow	10	-	2	-	1	1	2	CO5, CO6	L4
4	Hydraulic Machines and Impulse	10	-	2	-	1	1	2	CO7, C08	L4
	Turbines									
5	Reaction Turbines and Pumps	10	-	-	4	1	1	2	CO9, CO10	L4
-	Total	50	4	4	4	5	5	10	-	-

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Mod	Evaluation	Weightage in	СО	Levels
ules		Marks		
1, 2	CIA Exam – 1	30	CO1, CO2, CO3, CO4	L4
3, 4	CIA Exam – 2	30	CO5, CO6, CO7, C08	L4
5	CIA Exam – 3	30	CO9, CO10	L4
1, 2	Assignment - 1	05	CO1, CO2, CO3, CO4	L4
3, 4	Assignment - 2	05	CO5, CO6, CO7, CO8	L4
5	Assignment - 3	05	CO9, CO10	L4
1, 2	Seminar - 1	05	CO1, CO2, CO3, CO4	L4
3, 4	Seminar - 2	05	CO5, CO6,CO7,CO8	L4
5	Seminar - 3	05	CO9, CO10	L4
1, 2	Other Activities – define – Slip test		CO1 to Co10	L2, L3, L4
	Final CIA Marks	40	-	-

D1. TEACHING PLAN - 1

Module - 1

Title:	Applied Hydraulics	Appr	16 Hrs
		Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Apply principles of dimensional analysis and Buoyancy to design	CO1	l4
	experiments		
b	Course Schedule	-	-
Class No	Module Content Covered	СО	Level
1	Dimensional Homogeneity	CO1	L3
2	Non Dimensional Parameter	CO1	L3
3	Rayleigh Methods And Buckingham Theorem	CO1	L3

4 Dimensional Analysis, Choice Of Variables, Examples On Various CO1 L3 5 Model Analysis, Similutade CO1 L3 6 Types Of Similarities, Force Ratios, Similarity Laws, Model Classification CO1 L3 7 Reynolds Model CO1 L3 9 Euter's Model CO1 L3 10 Webber's Model CO1 L3 11 Mach Medel CO1 L3 12 Scale Effects CO1 L3 13 Distorted Models CO1 L3 14 Numerical Problems On Reynold's, And Froude's Model CO1 L3 15 Buoyany, Force And Centre Of Buoyancy CO1 L3 16 Metacentre And Metacentric Height CO1 L3 17 Stability Of Submerged And Floating Bodies CO1 L3 18 Determination Of Metacentric Height, Experimental And Theoretical CO1 L3 19 Numerical Problems CO1 L4 10 Se of dimensions and the dimensional formula of physical quantities to CO1 L4 10 Describe the geometric similarity. kinematic similarity and dynamic CO1 - 11 Describe the geometric, kinematic and dynamic similarity and dynamic				
5 Model Anuysis, Similarity COI L3 6 Types Of Similarities, Force Ratios, Similarity Laws, Model Classification COI L3 7 Reynolds Model COI L3 8 Froude's Model COI L3 9 Euter's Model COI L3 10 Webber's Model COI L3 11 Mach Model COI L3 12 Scale Effects COI L3 13 Distorted Models COI L3 14 Numerical Problems On Reynold's, And Froude's Model COI L3 15 Buoyancy, Force And Centre Of Buoyancy COI L3 16 Metacentric Height COI L3 17 Stability Of Submerged And Floating Bodies CO1 L3 18 Determination Of Metacentric Height CO1 L3 19 Numerical Problems CO1 L4 10 Application Areas CO1 L4 10 Les of dimensiona and the dimensional formula of physical quantities to CO1 - 11 Use o	4	Dimensional Analysis, Choice Of Variables, Examples On Various Applications	CO1	L3
0 Types Of Similarities, Force Ratios, Similarity Laws, Model Classification CO1 L3 7 Reynolds Model CO1 L3 8 Froude's Model CO1 L3 9 Euter's Model CO1 L3 10 Webber's Model CO1 L3 11 Mach Model CO1 L3 12 Scale Effects CO1 L3 13 Distorted Models CO1 L3 14 Numerical Problems On Reynold's, And Froude's Model CO1 L3 15 Buoyancy, Force And Centre Of Buoyancy CO1 L3 16 Metacentre And Metacentric Height CO1 L3 17 Btability Of Submerged And Floating Bodies CO1 L3 18 Determination Of Metacentric Height CO1 L4 19 Numerical Problems CO1 L4 10 Numerical Problems CO1 L4 11 Describe the geometric, kinematic and dynamic similarity and dynamic similarity. CO1 - <td>5</td> <td>Model Analysis Similitude</td> <td>CO1</td> <td>3</td>	5	Model Analysis Similitude	CO1	3
0 Paynolds Model Co1 L3 8 Froude's Model Co1 L3 9 Euler's Model Co1 L3 10 Webber's Model Co1 L3 11 Mach Model Co1 L3 12 Scale Effects Co1 L3 13 Distorted Models Co1 L3 14 Numerical Problems On Reynold's, And Froude's Model Co1 L3 15 Buoyancy, Force And Centre Of Buoyancy Co1 L3 16 Metacentre And Metacentric Height Co1 L3 17 Stability Of Submerged And Floating Bodies Co1 L3 14 Numerical Problems Co1 L3 15 Buetermination Of Metacentric Height Co1 L4 16 Application Areas Co1 L4 17 Stability Of Byuoncy is used for experimental determination of density. Co1 L4 16 Review Ouestions - - - 17 Describe the geometric kinematic and dynamic similarity and dynamic similarity. Co1 -	6	Types Of Similarities Force Patios Similarity Laws Model Classification	CO1	 2
1 Normation CO1 L3 9 Euler's Model CO1 L3 10 Webber's Model CO1 L3 11 Mach Model CO1 L3 12 Scale Effects CO1 L3 13 Distorted Models CO1 L3 14 Numerical Problems On Reynold's. And Froude's Model CO1 L3 15 Buoyancy, Force And Centre Of Buoyancy CO1 L3 16 Metacentre And Metacentric Height CO1 L3 17 Stability Of Submerged And Floating Bodies CO1 L3 18 Determination Of Metacentric Height. Experimental And Theoretical CO1 L3 19 Numerical Problems CO1 L4 1 Use of dimensions and the dimensional formula of physical quantities to CO1 L4 1 Use of dimensions and the dimensional formula of dynamic CO1 L4 2 Concept of Byuoncy is used for experimental determination of density. CO1 L4 4 Define the terms cioi 1 - - 1 Describe th	7	Revnolds Model	CO1	
0 Folders Model CO1 L3 10 Webber's Model CO1 L3 11 Mach Model CO1 L3 12 Scale Effects CO1 L3 13 Distorted Models CO1 L3 14 Numerical Problems On Reynold's, And Froude's Model CO1 L3 15 Buoyancy, Force And Centre Of Buoyancy CO1 L3 16 Metacentric And Metacentric Height CO1 L3 17 Stability Of Submerged And Floating Bodies CO1 L3 18 Determination Of Metacentric Height, Experimental And Theoretical CO1 L3 19 Numerical Problems CO1 L4 10 Describe the geometric similarity, kinematic similarity and dynamic CO1 - 1 Describe the geometric, kinematic and dynamic similarities. CO1 - - 1 Describe the geometric, kinematic and undistorted models. CO1 - - 1 Describe the geometric, kinematic similarities. CO1 - - - 1 Describe the geometric, similarity, kinemati	2 2	Froudo's Model	CO1	L3
9 Edite's involute 001 L3 10 Webber's Model C01 L3 11 Mach Model C01 L3 12 Scale Effects C01 L3 13 Distorted Models C01 L3 14 Numerical Problems On Reynold's, And Froude's Model C01 L3 15 Buoyancy, Force And Centre Of Buoyancy C01 L3 16 Metacentre And Metacentric Height C01 L3 17 Stability Of Submerged And Floating Bodies C01 L3 18 Determination Of Metacentric Height. Experimental And Theoretical C01 L3 13 Numerical Problems C01 L4 1 Use of dimensions and the dimensional formula of physical quantities to C01 L4 1 Describe the geometric similarity, kinematic similarity and dynamic C01 - 1 Describe the geometric similarity, kinematic similarities. C01 - 2 Briefly explain geometric, kinematic and dynamic similarities. C01 - 3 Explain the terms Cison - -	0	Filder's Model		3
10 WebDer Sindlet CO1 L3 11 Mach Model CO1 L3 12 Scale Effects CO1 L3 13 Distorted Models CO1 L3 14 Numerical Problems On Reynold's. And Froude's Model CO1 L3 15 Buoyancy, Force And Centre Of Buoyancy CO1 L3 16 Metacentre And Metacentric Height CO1 L3 17 Stability Of Submerged And Floating Bodies CO1 L3 18 Determination Of Metacentric Height, Experimental And Theoretical CO1 L3 19 Numerical Problems CO1 L4 10 Use of dimensions and the dimensional formula of physical quantities to CO1 L4 11 Describe the geometric similarity, kinematic similarity and dynamic CO1 - - 11 Describe the geometric, kinematic and dynamic similarities. CO1 - 12 Describe the geometric, kinematic and dynamic similarities. CO1 - 13 Explain the terms CO1 - - 14 Define the terms CO1 -	9	Lucer's Model		3
11 Match Models CO1 L3 12 Scale Effects CO1 L3 13 Distorted Models CO1 L3 14 Numerical Problems On Reynold's. And Froude's Model CO1 L3 15 Buoyancy, Force And Centre Of Buoyancy CO1 L3 16 Metacentre And Metacentric Height CO1 L3 17 Stability Of Submerged And Floating Bodies CO1 L3 18 Determination Of Metacentric Height, Experimental And Theoretical CO1 L3 19 Numerical Problems CO1 L4 10 Set of dimensions and the dimensional formula of physical quantities to CO1 L4 11 Use of dimensions and the dimensional formula of physical quantities CO1 L4 12 Concept of Byuoncy is used for experimental determination of density. CO1 L4 12 Review Questions - - - 13 Describe the geometric, kinematic and dynamic similarities. CO1 - 14 Review Questions CO1 - - 15 State and explain Buckingham Pi — theorem citi	10	Webber's Model	CO1	L3
12 Scale Effects C01 L3 13 Distorted Models C01 L3 14 Numerical Problems On Reynold's, And Froude's Model C01 L3 15 Buryancy, Force and Centre Of Buryancy C01 L3 16 Metacentre And Metacentric Height C01 L3 17 Stability Of Submerged And Floating Bodies C01 L3 18 Determination Of Metacentric Height, Experimental And Theoretical C01 L4 19 Numerical Problems C01 L4 10 Use of dimensions and the dimensional formula of physical quantities to for indimensions between them. C01 L4 2 Concept of Byuoncy is used for experimental determination of density. C01 L4 11 Describe the geometric, kinematic and dynamic similarity and dynamic C01 - 2 Briefly explain geometric, kinematic and dynamic similarities. C01 - 2 Briefly explain geometric, kinematic and dynamic similarities. C01 - 3 Explain the terms: G01 - - 4 Define the terms: G01 - - </td <td>11</td> <td></td> <td>001</td> <td>L3</td>	11		001	L3
13 Distorted Models C01 L3 14 Numerical Problems On Reynold's. And Froude's Model C01 L3 15 Buoyancy, Force And Centre Of Buoyancy C01 L3 16 Metacentre And Netacentric Height C01 L3 17 Stability Of Submerged And Floating Bodies C01 L3 18 Determination Of Metacentric Height. Experimental And Theoretical Method C01 L4 19 Numerical Problems C01 L4 1 Use of dimensions and the dimensional formula of physical quantities to C01 L4 1 Use of dimensions and the dimensional formula of physical quantities C01 L4 2 Concept of Byuoncy is used for experimental determination of density. C01 L4 3 Explain the geometric similarity, kinematic similarity and dynamic C01 - 1 Describe the geometric kinematic and dynamic similarity and dynamic C01 - 2 Briefly explain geometric, kinematic and dynamic similarities. C01 - 3 Explain the terms Gistorted models. C01 - 4 a. Define the dimensional homogenetity. G	12	Scale Effects	001	L3
14 Numerical Problems On Reynold S, And Froude's Model C01 L3 15 Buoyancy, Force And Centre Of Buoyancy C01 L3 16 Metacentre And Metacentric Height C01 L3 17 Stability Of Submerged And Floating Bodies C01 L3 18 Determination Of Metacentric Height, Experimental And Theoretical Method C01 L4 19 Numerical Problems C01 L4 10 Use of dimensions and the dimensional formula of physical quantities to find interretations between them. C01 L4 1 Describe the geometric similarity, kinematic similarity and dynamic S01 - - 1 Describe the geometric, kinematic and dynamic similarities. C01 - 2 Briefly explain geometric, kinematic and dynamic similarities. C01 - 3 Explain the terms C01 - - 10 Define the terms C01 - 11 Model C01 - - 2 State and explain Buckingham Pi — theorem citing an example. Also C01 - 3 Explain the terms C01 - 10 Model - - 11 Model Analysis - - 12 St	13	Distorted Models	CO1	L3
15 Buoyancy, Force And Centre Of Buoyancy C01 L3 16 Metacentre And Netacentric Height C01 L3 17 Stability Of Submerged And Floating Bodies C01 L3 18 Determination Of Metacentric Height, Experimental And Theoretical C01 L3 19 Numerical Problems C01 L4 19 Numerical Problems C01 L4 1 Use of dimensions and the dimensional formula of physical quantities to f01 L4 1 Use of dimensions and the dimensional formula of physical quantities to f01 L4 2 Concept of Byuoncy is used for experimental determination of density C01 L4 1 Describe the geometric similarity, kinematic similarity and dynamic C01 - 1 Describe the geometric, kinematic and dynamic similarities. C01 - 2 Briefly explain geometric, kinematic and dynamic similarity. C01 - 3 Explain the terms: distorted models and undistorted models. C01 - 4 a. Define the terms C01 - - 9 Model in) Model - - </td <td>14</td> <td>Numerical Problems On Reynold's, And Froude's Model</td> <td>CO1</td> <td>L3</td>	14	Numerical Problems On Reynold's, And Froude's Model	CO1	L3
16 Metacentre And Metacentric Height CO1 L3 17 Stability Of Submerged And Floating Bodies CO1 L3 18 Determination Of Metacentric Height, Experimental And Theoretical Method CO1 L4 19 Numerical Problems CO1 L4 c Application Areas CO Level 1 Use of dimensions and the dimensional formula of physical quantities to find interrelations between them. CO1 L4 c Applications Areas CO1 L4 d Review Questions - - 1 Describe the geometric similarity, kinematic similarity and dynamic Similarity, and dynamic Similarity, similarity, and dynamic Similarity, and Anamic Similarity, and Anama Similarity, and Anamic Similarity, and Anamic Similar	15	Buoyancy, Force And Centre Of Buoyancy	CO1	L3
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11 Water is flowing through a pipe of diameter 40 cm at a velocity of 4 m/s. CO1 - 11 Water is flowing through a pipe of diameter 40 cm at a velocity of 4 m/s. CO1 - Find the velocity of oil flowing in another pipe of diameter 10 cm, if the condition of dynamic similarity is satisfied between the two pipes. The viscosity of water and oil are given as 0.01 Poise and 0.025 Poise. The specific gravity of oil = 0.8. - 12 Using Buckingham's pi theorem, obtain an expression for pressure difference AP in a pipe of diameter D and height t due to turbulent flow which depends on the velocity V, viscosity Mu, density p and roughness k. - 13 A pipe of diameter 1.8m is required to transport an oil of sp.gr 0.8 and viscosity 0.04 poise at the rate of 4m/s. Tests were conducted on a 20cm diameter pipe using water at 20°C. Find velocity and rate of flow in model. Viscosity of water at 20°C is 0.01 poise. - 14 A 7.2m high and 15m long spillway discharges 94 m3/sec of water under a head of 2m. If a 1:9 scale model of this spillway model and model discharge. If model experiences a force of 7500N, determine force on the -	10	Derive different scale ratio's as per Revnold's model law	CO1	_
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discharge. If model experiences a force of 7500N, determine force on the		determine model dimensions, head over the spillway model and model		
		discharge. If model experiences a force of 7500N, determine force on the		

	prototype.		
15	A flow meter tested in the laboratory, gave-a pressure drop of 200kN/m for a discharge of 0.2m/s in 200mm diameter pipe. If a geometrically similar model is tested in 1000mm diameter pipe at identical conditions of fluid, determine the corresponding discharge and pressure drop in the model.	CO1	_
16	A 2.5m ship model was tested in fresh water $p = 1000$ kg/m ³ and measurements indicated that there was resistance of 45N when the model was moved at 2m/s. Workout the velocity of 40m prototype. Also calculate the force required to drive the prototype at this speed through sea water ($p = 1025$ kg/m ³).	CO1	_
е	Experiences	-	-

Module – 2

Title:	Applied Hydraulics	Appr	10 Hrs
		Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Design open channels for most economical sections	CO2	l4
b	Course Schedule	-	-
Class N	oModule Content Covered	CO	Level
20	Classification of flow through channels	CO2	-
21	Chezy's and Manning's equation for flow through open channel	CO2	-
22	Most economical channel sections	CO2	-
23	Uniform flow through Open channels	CO2	-
24	Numerical Problems	CO2	-
25	Specific Energy and Specific energy curves	CO2	-
26	Critical flow and corresponding critical parameters	CO2	-
27	Metering flumes	CO2	-
28	Numerical Problems	CO2	-
С	Application Areas	CO	Level
1	Uniform flow in channels.	CO2	L4
d	Review Questions	-	-
17	Bring out the difference between flow through pipes and flow through	CO2	-
	open channel.		
18	Prove that for a trapezoidal channel of most economical section :	CO2	-
	i) Half of top width — length of one ofsloping sides		
	II) hydraulic mean depth = E/2 depth		
	of flow		
19	what do you understand best hydraulic channel section? Derive the	CO2	-
	With next electables differentiate between flow through pines and flow	<u> </u>	
20	through open channels Time: a hrs. May Marks:100	002	-
	Noto		
	1 Answer FIVE full questions selecting at least TWO questions from each		
	part		
	2. Missing data may suitably be assumed, with examples.		
21	Derive an expression for the discharge through an open channel using	CO2	-
	Manning's formula.		
22	Differentiate between : i) Hydraulic depth and hydraulic mean depth	CO2	-
	ii) Steady and uniform flow		
	iii) Alternate depth and conjugate depth iv) Open channel flow and		
	pipe flow.		
23	Show that the sloping side of a most economical trapezoidal section	CO2	-
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	makes an angle 60 with horizontal.		
24	Derive the conditions for the most economical trapezoidal channel section.	CO2	-
25	Derive the Chezy's equation for uniform flow in open channel with usual notations	CO2	-
26	Distinguish between: Pipe flow and open channel flow.	CO2	_
27	Define specific energy Draw specific energy curve and then derive	CO2	_
<i>L</i> /	expressions for critical depth and critical velocity.	002	
28	Determine the maximum discharge of water through a circular channel of diameter 2 m when the bed slope of the channel is 1 in 1500. Take C = 60.	CO2	-
29	A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and the	CO2	-
Ŭ	slope of the bed is 1 in 1500. The area of section is 40 m Find the		
	dimensions of the section and the discharge if it is most economical.		
30	Derive an expression for critical depth and critical velocity in case of non-	CO2	-
	uniform flow through rectangular channel.		
31	An earthen channel with a base width 2m and side slope 1H	CO2	-
	to 2V carries water with a depth of 1 m. The bed slope is 1 in 625. Calculate the discharge if n = 0.03. Also calculate average shear stress at the channel boundary.		
32	Derive the conditions for most economical trapezoidal section. Also show that the most economical trapezoidal section for an open channel is one which has three sides tangential to the semicircle described on the water line.	CO2	-
33	canal is to have a trapezoidal section with one side vertical and the other sloping at 60° to the horizontaL It has to carry water at 30m3/s with mean velocity 2 m/s. Compute the dimensions of the section which will require minimum lining	CO2	-
34	trapezoidal channel with side slopes of 3 horizontal to 2 vertical has to be designed to convey 10 m3/s at a velocity of 1.5 m/s, so that the amount of concrete lining for the bed and sides is minimum. Find: i) The wetted	CO2	-
	perimeter; ii) Slope of the bed if Manning's n = 0.014.		
35	Define specific energy, Explain specific energy curve (sketch).	CO2	-
36	Define specific energy. Draw specific energy curve, and then derive	CO2	_
	expressions for critical depth, critical velocity and minimum specific energy.		
37	The discharge of water through a rectangular channel of width 10 m, is 20 m when depth of flow of water is 2 m. Calculate i) Specific energy of flowing water. ii) Critical depth and critical velocity. iii) Minimum specific energy.	CO2	-
38	Sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4 m. The width of the channel is 8 m. Determine whether a hydraulic jump will occur, and if so, find tits height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump.	CO2	_
39	Water is flowing through the circular open channel at the rate of 400 L/s when the channel is having a bed slope of 1 in 9000. Find the diameter of the channel if the depth of flow is 1.25 times radius of channel and Manning's N = 0.015.	CO2	-
40	A rectangular channel carries water at the rate of 400 litres/sec when bed slope is 1 in 2000. Find the most economical dimensions of the channel if $C = 50$.	CO2	-
⊿1	An open channel is to be constructed of trapezoidal section and with side	CO2	_
	slopes 1 vertical to 1.5 Horizontal. Find relation between bottom width and		
	depth of flow for minimum excavation. If flow is to be 2.7 cumec, calculate		
	the bottom width and depth of flow assuming C in Chezy's formula as 44.5		
	and bed slope is 1 in 4000.		
42	A discharge of 18 m3/s flows through a rectangular channel 6m wide at a	CO2	-

	depth of 1.6m. Find:		
	i) Specific energy head		
	ii) Critical depth		
	iii) State weather the flow is subcritical or supercritical		
	iv) What is the depth alternate to the given above?		
е	Experiences	-	-
1			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:		18CV43	Sem:	IV	Marks:	40	Time: 75	5 minute	S	
Cour	se:	Applied Hy	draulics							
-	-	Note: Answ	ver any 3 qu	estions, ead	ch carry ec	ual marks.		Marks	СО	Level
1	а	Explain the	Rayleigh's ı	method of d	limensiona	. analysis, with	i an example.	10	CO1	L2
	b	A pipe of c	diameter 1.8	m is require	ed to trans	sport an oil of	f sp.gr 0.8 and	10	CO1	L4
		diameter ni	ne usina w	ator at 20°	Find veloc	ity and rate of	flow in mode			
		Viscosity of	water at 20	$^{\circ}C$ is 0.01 pc	ise.					
2	а	Derive diffe	rent scale r	atio's as per	Reynold's	model law.		10		L2
	b	A 7.2m high head of 2n determine discharge. I prototype.	and 15m lo n. If a 1:9 s model dime f model exp	ng spillway cale model ensions, hea periences a	discharges of this sp ad over the force of 75	94 m3/sec o illway is to b spillway mo 00N, determin	f water under a e constructed del and mode ne force on the	a 10 , 2		L3
3	а	Derive the section.	conditions	s for the n	nost econ	omical trapez	zoidal channe	l 10	CO2	L2
	b	trapezoida designed to of concrete perimeter; i	l channel w o convey 10 e lining for t i) Slope of t	ith side slop m3/s at a he bed and he bed if Ma	es of 3 hor velocity of I sides is n anning's n =	izontal to 2 ve 1.5 m/s, so th ninimum. Find 0.014.	rtical has to be nat the amoun I: i) The wettee	e 10 t d	CO2	L3
	2	Dorivo the	Chozy/c og	untion for un	aiform flow	in onon char	and with usua	10	<u> </u>	
4	d	notations.	Chezy's eqi	Jation for ur		nn open char	inet with usua	10	02	LZ
	b	Sluice gate velocity of m. Determ height and in the hydra	discharges 6 m/s and c ine whethe loss of ene aulic jump.	water into depth of flow r a hydrauli rgy per kg c	a horizonta w is 0.4 m. ic jump w of water. Al	Il rectangular The width of t Il occur, and so determine	channel with a he channel is 8 if so, find tits the power los	a 10 3 5 t	CO2	L4

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions										
Crs C	Crs Code: 18CV43 Sem: IV Marks: 5/10 Time:									
Cours	se:	Applied H	ydraulics		÷		·			
Note:	Each	n student t	o answer 2-3	assignmer	nts. Each ass	ignment ca	rries	equal ma	rk.	
SNo			A	Assignment	Description	า			Marks	CO
1	Des	cribe the	geometric	similarity,	kinematic	similarity	and	dynamic	10	CO1
	simi	ilarity.								
2	2 Briefly explain geometric, kinematic and dynamic similarities. 10						CO1			
3	3 Explain the terms: distorted models and undistorted models.						10	CO1		
4	a. D	efine the te	erms						10	CO1
	i) Model									

	ii) Prototype		
	iii) Model Analysis		
	iv) Hydraulic		
	Similitude.	10	
5	State and explain Buckingham PI — theorem clung an example. Also explain its advantages over Payleigh's method of dimensional analysis	10	COI
6	Explain Froude's model law List its application in fluid flow problems	10	CO1
7	Distinguish between : i) Geometric and Kinematic similarity	10	CO1
'	ii) Revnolds's and E.B. Froude's number	10	001
	iii) Distorted and undistorted model.		
8	Explain the Rayleigh's method of dimensional analysis, with an example.	10	CO1
9	Define the dimensional homogeneity. Give an example.	10	CO1
10	Derive different scale ratio's as per Reynold's model law.	10	CO1
11	Water is flowing through a pipe of diameter 40 cm at a velocity of 4 m/s.	10	CO1
	Find the velocity of oil flowing in another pipe of diameter 10 cm, if the		
	condition of dynamic similarity is satisfied between the two pipes. The		
	viscosity of water and oil are given as 0.01 Poise and 0.025 Poise. The		
	specific gravity of oil = 0.8.		
12	Using Buckingham's pi theorem, obtain an expression for pressure	10	CO1
	difference AP in a pipe of diameter D and height t due to turbulent flow		
	which depends on the velocity V, viscosity Mu, density p and roughness k.		<u> </u>
13	A pipe of diameter 1.8m is required to transport an oil of sp.gr 0.8 and	10	CO1
	diameter pipe using water at 20°C. Find velocity and rate of flow in model		
	Viscosity of water at 20°C is 0.01 poise		
1/	A 72m high and 15m long spillway discharges 04 m3/sec of water under a	10	CO1
-4	head of 2m. If a 10 scale model of this spillway is to be constructed	10	001
	determine model dimensions, head over the spillway model and model		
	discharge. If model experiences a force of 7500N, determine force on the		
	prototype.		
15	A flow meter tested in the laboratory, gave-a pressure drop of 200kN/m	10	CO1
	for a discharge of 0.2m/s in 200mm diameter pipe. If a geometrically similar		
	model is tested in 1000mm diameter pipe at identical conditions of fluid,		
	determine the corresponding discharge and pressure drop in the model.		
16	A 2.5m ship model was tested in fresh water $p = 1000 \text{kg/m}^3$ and	10	CO1
	measurements indicated that there was resistance of 451N when the model		
	the force required to drive the prototype at this speed through see water (
	- 1025kg/m ³)		
17	Bring out the difference between flow through pipes and flow through open	10	<u> </u>
-/	channel.	10	002
18	Prove that for a trapezoidal channel of most economical section :	10	CO2
	i) Half of top width — length of one ofsloping sides		
	ii) hydraulic mean depth = E/2 depth		
	of flow		
19	What do you understand best hydraulic channel section? Derive the	10	CO2
	conditions for best hydraulic triangular channel section.		
20	With neat sketches differentiate between flow through pipes and flow	10	CO2
	through open channels		00-
21	Derive an expression for the discharge through an open channel using	10	CU2
	Manning S 10mmula.	10	<u> </u>
22	ii) Steady and uniform flow	10	002
	iii) Alternate depth and conjugate depth iv) Open channel flow and		
	pipe flow.		
23	Show that the sloping side of a most economical trapezoidal section makes	10	CO2
-5	an angle 60 with horizontal.	10	202
24	Derive the conditions for the most economical trapezoidal channel section.	10	CO2
25	Derive the Chezy's equation for uniform flow in open channel with usual	10	CO2
_	notations.		

26	Distinguish between: Pipe flow and open channel flow.	10	CO2
27	Define specific energy. Draw specific energy curve, and then derive	10	CO2
_	expressions for critical		
	depth and critical velocity.		
28	Determine the maximum discharge of water through a circular channel of	10	CO2
	diameter 2 m when the bed slope of the channel is 1 in 1500. Take C = 60.		
29	A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and the	10	CO2
	slope of the bed is 1 in 1500. The area of section is 40 m Find the		
	dimensions of the section and the discharge if it is most economical.		
30	Derive an expression for critical depth and critical velocity in case of non-	10	CO2
	uniform flow through rectangular channel.		
31	An earthen channel with a base width 2m and side slope 1H	10	CO2
	to 2V carries water with a depth of 1 m. The bed slope is 1 in 625. Calculate		
	the discharge if n = 0.03. Also calculate average shear stress at the channel		
	boundary.		
32	Derive the conditions for most economical trapezoidal section. Also show	10	CO2
	that the most economical trapezoidal section for an open channel is one		
	which has three sides tangential to the semicircle described on the water		
	line.		
33	canal is to have a trapezoidal section with one side vertical and the other	10	CO2
	sloping at 60° to the horizontaL It has to carry water at 30m3/s with mean		
	velocity 2 m/s. Compute the dimensions of the section which will require		
	minimum uning.		
34	designed to convey 10 m2 (s at a velocity of 1 5 m (s, so that the amount of	10	02
	designed to convey 10 m3/s at a velocity of 1.5 m/s, so that the amount of		
	perimeter: ii) Slope of the bed if Manning's n = 0.014		
35	Define specific energy Explain specific energy curve (sketch)	10	<u> </u>
36	Define specific energy Draw specific energy curve and then derive	10	CO2
	expressions for critical depth, critical velocity and minimum specific energy.	10	
37	The discharge of water through a rectangular channel of width 10 m. is 20 m	10	CO2
	when depth		
	of flow of water is 2 m. Calculate		
	i) Specific energy of flowing water.		
	ii) Critical depth and critical velocity.		
	iii) Minimum specific energy.		
38	Sluice gate discharges water into a horizontal rectangular channel with a	10	CO2
	velocity of 6 m/s and depth of flow is 0.4 m. The width of the channel is 8		
	m. Determine whether a hydraulic jump will occur, and if so, find tits height		
	and loss of energy per kg of water. Also determine the power lost in the		
	hydraulic jump.		

D2. TEACHING PLAN - 2

Module - 3

Title:	Applied Hydraulics	Appr	16 Hrs
		Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Design open channels for most economical sections.	CO2	L4
2	Determine GVF profiles under nonuniform flow	CO3	L3
b	Course Schedule		
Class No	Module Content Covered	СО	Level
1	Hydraulic Jump	CO2	-
2	Expressions for conjugate depths and Energy loss	CO2	-
3	Numerical Problems	CO2	-
4	Gradually varied flow, Equation	CO2	-

5	Back water curve and afflux	CO2	-
6	Description of water curves or profiles	CO3	-
7	Mild slope profiles	CO3	-
8	steep slope profiles	CO3	-
9	critical slope profiles	CO3	-
10	horizontal and adverse slope profiles	CO3	-
11	Numerical problems	CO3	-
12	Control sections	CO3	-
С	Application Areas	CO	Level
1	Non uniform flow in channels, rivers.	CO2	L4
2	Study of water profiles during non uniform flow.	CO3	L3
d	Review Questions	-	-
1	Define the term hydraulic jump. Derive an expression for depth of hydraulic jump in terms of upstream Froude's number.	CO2	-
2	The rectangular channel of bed width 4m is discharging water at the rate of 10m. Determine the following : i) Critical depth ii) Minimum specific energy iii) What will be the type of flow in the depth is 0.6m and 2m.	CO2	_
3	A sluice gate discharges water into a horizontal rectangular channel with a velocity of 5m/sec and depth of flow is 0.4m. The width of the channel is 6m. Determine whether a hydraulic jump will occur, and if so find its height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump.	CO2	_
4	horizontal rectangular channel 4m wide carries a discharge of 16m3/s. If the initial depth of flow is 0.5m, determine is there a possibility of formation of hydraulic jump? If the jump forms, determine the sequent depth, Froude number after jump and energy loss.	CO2	-
5	horizontal rectangular channel 4m wide carries a discharge of 16m3/s. Determine whether a jump may occur at an initial depth of 0.5m or not. If a jump occurs, determine the sequent detpth to, this initial depth. Also determine the energy loss in the Jump.	CO2	_
6	Derive an equation for gradually varied flow in open channels. Also state assumptions made in it.	CO2	-
7	Explain classification of surface profiles in open channels with neat sketches.	CO3	-
8	Give the classification of surface profiles in case of GVF.	CO3	-
9	Derive the differential equation for gradually varied flow and list all the assumptions.	CO2	-
10	The specific energy for 6m wide rectangular channel is to be 5 kg — m/kg. if the rate of flow of water through channel is 24m'/s, determine alternate depths of channel.	CO2	-
	Experiences	-	-

Module – 4

Title:	Applied Hydraulics	Appr	16 Hrs
		Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Design the working proportions of hydraulic machines	CO4	L4
b	Course Schedule		
Class No	Module Content Covered	СО	Level
1	Impulse-Momentum equation.	CO4	-
2	Direct impact of a jet on a stationary and moving curved vanes,	CO4	-
3	Introduction to concept of velocity triangles,	CO4	-
4	Impact of jet on a series of curved vanes	CO4	-
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5	Problems on Turbines	CO4	-
6	Impulse Turbines: Introduction to turbines,	CO4	-
7	General lay out of a hydroelectric plant,	CO4	-
8	Heads and Efficiencies,	CO4	-
9	Classification of turbines.	CO4	-
10	Pelton wheel components,	CO4	-
11	Working principle and velocity triangles.	CO4	-
12	Maximum power, efficiency, working proportions	CO4	-
13	Numerical problems	CO4	-
С	Application Areas	CO	Level
1	Design of Turbines.	CO4	L4
d	Review Questions	-	-
11	Jet of water strikes an unsymmetrical moving curves plate tangentially at one of the tips. Derive an expression for the force exerted by the jet in the horizontal direction of motion. Also describe the velocity triangles and obtain an expression for work done and efficiency.	CO4	-
12	Show that maximum efficiency of the jet striking a series of curved vanes moving in the direction at an angle teta with velocity u	CO4	-
13	Derive an expression for the force exerted by a jet of water on a moving semi-circular plate in the direction of the jet when the jet strikes at the centre of semicircular plate.	CO4	-
14	Derive an equation of force exerted by a jet on an unsymmetrical curved vane tangentially,when vane K moving in the x-direction. Draw the velocity triangles and explain. Also find the workdone and efficiency.	CO4	-
15	A jet of water moving at 15 m/s impinges on symmetrical curved vane tangentially to deflect the jet through 120,find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of the jet at exit in magnitude and direction and the work done per second per unit weight of water striking per second? Assume that the vane is smooth.	CO4	-
16	A jet of water with velocity 40m/s strikes a curved vane, which is moving with velocity 20m/s. The jet makes an angle of 30° with the direction of motion of vane at inlet and leaves at an angle of 90° to the direction of motion of vane at outlet. Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet so that the water enters and leaves the vane without shock.	CO4	-
17	A jet of water moving at 20rMs impinges on a symmetrical curved vane so shaped to deflect the jet through 120°. If the vane is moving at 5m/s. find the angle of the jet so that there is no shock at inlet. Also determine the absolute velocity of jet at exit in magnitude and direction and the work done.	CO4	-
18	stationary vane having an inlet angle of zero degree and an outlet angle 25° received water at a velocity of 50m/s. Determine the components of force acting on it in the direction of jet and normal to it. Also find the resultant force. If the vane is moving with a velocity 20m/s in the direction of jet, calculate the resultant force, work done and power developed.	CO4	-
19	A jet of water with a velocity of 40 m/sec strikes a curved vane which moves with a velocity of 20 m/s. The jet makes an angle of 30° with the direction of motion of the vane at the inlet and leaves at 90° to the direction of motion of the vane at the outlet. Determine vane angles at the inlet and outlet if water enters and leaves without shock. Also determine efficiency.	CO4	-
20	jet of water, 60mm in diameter, strikes a curved vane at its centre with a velocity of 18m/s. The curved vane is moving with a velocity of 6m/s in the direction of the jet. The jet is deflected through an angle of 165°. Assuming the plate to be smooth, Find : i) Thrust on the plate in the direction of jet ii) Power of the jet, and iii) Efficiency of the jet	CO4	-
21	Draw a neat sketch of an hydroelectric power plant. Mention the functions of each component.	CO4	-

22	How will you classify the turbines?	CO4	-
23	Give the classification of turbine with examples.	CO4	-
24	Explain the concept of velocity triangles. Also obtain an expression for	CO4	-
	tangentially at one end of the tips		
25	Differentiate between : i) Impulse and Reaction turbine	COA	_
25	ii) Radial and Axial flow turbine	004	
	iii) Kaplan and Propellor turbine.		
26	For a Pelton wheel, derive an expression for work done and hydraulic	CO4	-
	efficiency. Also determine the condition for maximum hydraulic efficiency.		
27	With the help of velocity triangles derive an expression for work done and	CO4	-
	maximum hydraulic efficiency of a pelton wheel.		
28	Derive an expression for the work done per second by water on the	CO4	-
	runner of a Pelton wheel. Hence derive an expression of maximum		
	efficiency of Pelton wheel giving the relationship between the jet speed		
	and bucket speed. The water evailable for a Delten wheel is 4 sumper and the total head	CO 4	
29	from the reservoir to the pozzle is 250 m. The turbine has two runners	CO4	-
	with two jets per runner. All the four jets have the same diameters. The		
	pipeline is 3000 m long. The efficiency of power transmission through the		
	pipeline and the nozzle is 91% and efficiency of each runner is 90%. The		
	velocity coefficient of each nozzle is 0.975 and coefficient of friction `4f" for		
	the pipe is 0.0045. Determine i) the power developed by the turbine ii) the		
	diameter of the jet and iii) the diameter of the pipeline.		
30	pelton wheel has to be designed for the following data :	CO4	-
	Power to be developed = 6000kW, Net head available = 300m, Speed =		
	550 rpm, ratio of jet diameter to wheel diameter = $1/10$ and overall officiancy = $8\pi^{\circ}$. Find the number of jets, diameter of jet, diameter of		
	wheel and quantity of water required. Assume $C_{V} = 0.08$ and speed ratio		
	0.46.		
31	Design a Pelton wheel with the following data, shaft power = 735.75 kN H =	CO4	_
	200m, N = 800 rpm no = 0.86 D/d = 10 Cv = 0.98 (I) = 0.45. Determine D, d		
	and number of jets.		
32	A Pelton wheel has to be designed for following data : Power to be	CO4	-
	developed 6000 kW. Net head available - 300m : Speed - 550 r.p.m. Ratio		
	of jet diameter to wheel diameter = 1/10 and overall efficiency - 85%. Find		
	number of jets , diameter of jet diameter of wheel, and the quantity of water required. Assume co-off of velocity as 0.08 and speed ratio as 0.46		
22	Design a Pelton wheel turbine required to develop 1471 5 kW power under	CO4	
55	a head of 160m at 420 rpm. The overall efficiency may be taken as 85%.	004	
	Assume c, = 0.98, cu		
	= 0.46, jet ratio = 12.		
34	A Pelton wheel is receiving water from a penstock with a gross head of	CO4	-
	510m. One third of gross head is lost in friction in the penstock. The rate of		
	flow through the nozzle fitted at the end of the penstock is 2.2m3/s. the		
	angle of deflection of the jet is 165°. Determine :		
	II) Power given by water to the runner,		
	Take $C_V = 1.0$ and speed ratio = 0.45		
e	Experiences	_	_
L	1		

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs (Code	18CV43	Sem:	IV	Marks:	40	Time:	75 minutes	S	
Cou	rse:	Applied Hy	draulics							
-	-	Note: Answ	/er any 2 qu	lestions, ead	ch carry equ	al marks.		Marks	СО	Level
18CV4	43	Copyright ©2017. cAAS. All rights reserved.								
					D // . O / .	- 0				

1	а	Define the term hydraulic jump. Derive an expression for depth of hydraulic jump in terms of upstream Froude's number.	10	CO2	L2
	b	The rectangular channel of bed width 4m is discharging water at the rate of 10m. Determine the following : i) Critical depth ii) Minimum specific energy iii) What will be the type of flow in the depth is 0.6m and 2m.	10	CO2	L2
				00.	1 -
2	a	Give the classification of surface profiles in case of GVF.	10	CO3	L3
	d	m/kg. if the rate of flow of water through channel is 24m'/s, determine alternate depths of channel. Derive the differential equation for gradually varied flow and list all the assumptions.	10	CO2	L3
3	a	Derive an equation of force exerted by a jet on an unsymmetrical curved vane tangentially,when vane K moving in the x-direction. Draw the velocity triangles and explain. Also find the workdone and efficiency.	10	CO4	L4
	b	A jet of water moving at 15 m/s impinges on symmetrical curved vane tangentially to deflect the jet through 120,find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of the jet at exit in magnitude and direction and the work done per second per unit weight of water striking per second? Assume that the vane is smooth.	10	CO4	L3
4	а	Derive an expression for the work done per second by water on the runner of a Pelton wheel. Hence derive an expression of maximum efficiency of Pelton wheel giving the relationship between the jet speed and bucket speed.	10	CO4	L4
	b	A Pelton wheel is receiving water from a penstock with a gross head of 510m. One third of gross head is lost in friction in the penstock. The rate of flow through the nozzle fitted at the end of the penstock is 2.2m3/s. the angle of deflection of the jet is 165°. Determine : i) Power given by water to the runner, ii) Hydraulic efficiency of the pelton wheel. Take Cv = 1.0 and speed ratio = 0.45.	10	CO4	L3

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

	Model Assignment Questions									
Crs Co	ode:	18CV43	Sem:	IV	Marks:	60	Time:	90-120 m	-120 minutes	
Cours	e:	Applied H	lydraulics							
Note:	Each	student to	o answer 2-3	assignmen	ts. Each assi	gnment carr	ies equal ma	ırk.		
SNo				Assignment	Descriptior	1		Marks	CO	Level
1	Defi jum	ne the ter p in terms	m hydraulic j of upstrean	jump. Derive n Froude's r	e an express 1umber.	ion for depth	n of hydraulio	: 10	CO4	-
2	The 10m the ii) M the	rectangul I. Determir following inimum sp type of flo	lar channel o ne : i) Critical de pecific energ w in the dep	f bed width pth y iii) What w th is 0.6m a	4m is discha /ill be Ind 2m.	arging water	at the rate o	f 10	CO2	-
3	A sluice gate discharges water into a horizontal rectangular channel with a velocity of 5m/sec and depth of flow is 0.4m. The width of the channel is 6m. Determine whether a hydraulic jump will occur, and if so find its height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump.					10	CO4	_		
4	horiz initia hydi num	zontal rec al depth of raulic jum nber after j	tangular cha f flow is 0.5m p? If the jumj jump and en	nnel 4m wic 1, determine 2 forms, det ergy loss.	de carries a c e is there a po termine the s	lischarge of ossibility of f sequent dep	16m3/s. If th ormation of th, Froude	e 10	CO4	-
5	hori	zontal rec	tangular cha	nnel 4m wid	de carries a c	lischarge of	16m3/s.	10	CO4	-

	Determine whether a jump may occur at an initial depth of 0.5m or not. If a jump occurs, determine the sequent detpth to, this initial depth. Also determine the energy loss in the Jump.			
6	Derive an equation for gradually varied flow in open channels. Also state assumptions made in it.	10	CO4	-
7	Explain classification of surface profiles in open channels with neat sketches.	10	CO4	-
8	Give the classification of surface profiles in case of GVF.	10	CO3	-
9	Derive the differential equation for gradually varied flow and list all the	10	CO3	-
	assumptions.			
10	I he specific energy for 6m wide rectangular channel is to be 5 kg — m/kg. if the rate of flow of water through channel is 24m'/s, determine alternate depths of channel.	10	CO4	-
11	Jet of water strikes an unsymmetrical moving curves plate tangentially at one of the tips. Derive an expression for the force exerted by the jet in the horizontal direction of motion. Also describe the velocity triangles and obtain an expression for work done and efficiency.	10	CO4	-
12	Show that maximum efficiency of the jet striking a series of curved vanes moving in the direction at an angle teta with velocity u	10	CO4	-
13	Derive an expression for the force exerted by a jet of water on a moving semi-circular plate in the direction of the jet when the jet strikes at the centre of semicircular plate.	10	CO4	-
14	Derive an equation of force exerted by a jet on an unsymmetrical curved vane tangentially,when vane K moving in the x-direction. Draw the velocity triangles and explain. Also find the workdone and efficiency.	10	CO4	-
15	A jet of water moving at 15 m/s impinges on symmetrical curved vane tangentially to deflect the jet through 120,find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of the jet at exit in magnitude and direction and the work done per second per unit weight of water striking per second? Assume that the vane is smooth.	10	CO4	-
16	A jet of water with velocity 40m/s strikes a curved vane, which is moving with velocity 20m/s. The jet makes an angle of 30° with the direction of motion of vane at inlet and leaves at an angle of 90° to the direction of motion of vane at outlet. Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet so that the water enters and leaves the vane without shock.	10	CO4	-
17	A jet of water moving at 20rMs impinges on a symmetrical curved vane so shaped to deflect the jet through 120°. If the vane is moving at 5m/s. find the angle of the jet so that there is no shock at inlet. Also determine the absolute velocity of jet at exit in magnitude and direction and the work done.	10	CO4	-
18	stationary vane having an inlet angle of zero degree and an outlet angle 25° received water at a velocity of 50m/s. Determine the components of force acting on it in the direction of jet and normal to it. Also find the resultant force. If the vane is moving with a velocity 20m/s in the direction of jet, calculate the resultant force, work done and power developed.	10	CO4	-
19	A jet of water with a velocity of 40 m/sec strikes a curved vane which moves with a velocity of 20 m/s. The jet makes an angle of 30° with the direction of motion of the vane at the inlet and leaves at 90° to the direction of motion of the vane at the outlet. Determine vane angles at the inlet and outlet if water enters and leaves without shock. Also determine efficiency.	10	CO4	-
20	jet of water, 60mm in diameter, strikes a curved vane at its centre with a velocity of 18m/s. The curved vane is moving with a velocity of 6m/s in the direction of the jet. The jet is deflected through an angle of 165°. Assuming the plate to be smooth, Find : i) Thrust on the plate in the direction of jet ii) Power of the jet, and iii) Efficiency of the jet	10	CO4	_
21	Draw a neat sketch of an hydroelectric power plant. Mention the functions of each component.	10	CO4	-

22	How will you classify the turbines?	10	CO4	-
23	Give the classification of turbine with examples.	10	CO4	-
24	Explain the concept of velocity triangles. Also obtain an expression for work	10	CO4	-
	done per second by jet striking unsymmetrical moving vane tangentially at			
	one end of the tips.			
25	Differentiate between : i) Impulse and Reaction turbine	10	CO4	-
	ii) Radial and Axial flow turbine			
	iii) Kaplan and Propellor turbine.			
26	For a Pelton wheel, derive an expression for work done and hydraulic	10	CO4	-
	efficiency. Also determine the condition for maximum hydraulic efficiency.			
27	With the help of velocity triangles derive an expression for work done and	10	CO4	-
	maximum hydraulic efficiency of a pelton wheel.			
28	Derive an expression for the work done per second by water on the runner	10	CO4	-
	of a Pelton wheel. Hence derive an expression of maximum efficiency of			
	Pelton wheel giving the relationship between the jet speed and bucket			
	speed.			
29	The water available for a Pelton wheel is 4 cumecs and the total head from	10	CO4	-
	the reservoir to the nozzle is 250 m. The turbine has two runners with two			
	iets per runner. All the four jets have the same diameters. The pipeline is			
	3000 m long. The efficiency of power transmission through the pipeline and			
	the nozzle is 91% and efficiency of each runner is 90%. The velocity			
	coefficient of each nozzle is 0.975 and coefficient of friction `4f" for the pipe			
	is 0.0045. Determine i) the power developed by the turbine ii) the diameter			
	of the jet and jij) the diameter of the pipeline.			
30	pelton wheel has to be designed for the following data:	10	CO4	-
	Power to be developed = 6000kW. Net head available = 300m. Speed = 550	10	004	
	rom ratio of jet diameter to wheel diameter = $1/10$ and overall efficiency =			
	85% Find the number of jets diameter of jet diameter of wheel and			
	$\alpha_{\rm L}$ and the number of jets, diameter of jet, diameter of wheet and $\alpha_{\rm L}$			
21	Design a Pelton wheel with the following data shaft power = 735.75 kN H = $\frac{1}{2}$	10	COA	_
	200 m N = 800 rpm no = 0.86 D/d = 10 Cy = 0.08 (l) = 0.45 Determine D d	10	004	
	and number of jets			
22	A Pelton wheel has to be designed for following data : Power to be	10	COA	-
52	developed 6000 kW/ Net head available - 200m ' Speed - 550 rp m Patio of	10	004	
	iet diameter to wheel diameter = $1/10$ and overall efficiency - 85% Find			
	number of jets ' diameter of jet diameter of wheel ' and the quantity of water			
	required Assume co-eff of velocity as 0.08 and speed ratio as 0.46			
22	Design a Pelton wheel turbing required to develop 1471 5 kW power under a	10	COA	
33	head of 160m at 420 rpm. The overall efficiency may be taken as 85%	10	004	
	Assume $c = 0.08$ cu			
	= 0.46 jet ratio = 12			
24	A Pelton wheel is receiving water from a penstock with a gross head of	10	COA	
54	510m. One third of gross head is lost in friction in the penstock. The rate of	10	004	
	flow through the nozzle fitted at the end of the penstock is 2 2m3/s the			
	angle of deflection of the jet is 165°. Determine			
	i) Power given by water to the runner			
	ii) Hydraulic efficiency of the pelton wheel			
	Take $C_V = 1.0$ and speed ratio = 0.45			
35	Define the term hydraulic jump. Derive an expression for depth of hydraulic	10	CO4	-
30	iump in terms of upstream Froude's number	10		
26	The rectangular channel of bed width 4m is discharging water at the rate of	10	CO4	_
	10m Determine	10		-
	the following : i) Critical depth			
	ii) Minimum specific energy iii) \V/hat will be			
	the type of flow in the denth is 0.6m and 2m			
	A cluico gato dischargos wator into a horizontal rootangular channel with a	10	CO4	
3/	In suice yate discharges water into a nonzontal rectangular channel with a property of Em (see and donth of flow is 0.4m. The width of the observation	10		-
	6 Determine whether a hydraulic jump will occur and if so find its height			
	and loss of anorgy por kg of water. Also determine the new or lost in the			
	bydraulic jump			
	nyaradac jump.			

38	horizontal rectangular channel 4m wide carries a discharge of 16m3/s. If the initial depth of flow is 0.5m, determine is there a possibility of formation of hydraulic jump? If the jump forms, determine the sequent depth, Froude number after jump and energy loss.	10	CO4	-
39	horizontal rectangular channel 4m wide carries a discharge of 16m3/s. Determine whether a jump may occur at an initial depth of 0.5m or not. If a jump occurs, determine the sequent detpth to, this initial depth. Also determine the energy loss in the Jump.	10	CO4	-

D3. TEACHING PLAN - 3

Module – 5

Title:	Applied Hydraulics	Appr	16 Hrs
		l ime:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Design the working proportions hydraulic machines	CO4	L4
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Radial flow reaction turbines	CO4	-
2	Francis turbine Descriptions, working proportions and design	CO4	-
3	Numerical problems	CO4	-
4	Kaplan turbine- Descriptions, working proportions and design	CO4	-
5	Numerical problems	CO4	-
6	Draft tube theory and unit quantities. (No problems)	CO4	-
7	Components and Working of centrifugal pumps	CO4	-
8	Types of centrifugal pumps	CO4	-
9	Work done by the impeller	CO4	-
10	Heads and Efficiencies	CO4	-
11	Minimum starting speed of centrifugal pump	CO4	-
С			
1			
2			
d			
1	Draw the neat sketch of Kaplan turbine and mention the parts.	CO4	-
2	Define draft tube theory and obtain an expression for efficiency of a draft	CO4	-
3	What is a draft tube? With neat sketch, list the different types of draft tube.	CO4	
4	A Kaplan turbine develops 24647.6 kW power at an average head of 39 m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of boss equal to 0.35 times the diameter of the runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine.	CO4	-
5	A Kaplan turbine working under a head of 20m develops 12000 kW. The outer diameter of the runner is 3.5m and inner diameter of the hub is 1.75m. The guide blade angle at the extreme edge of the runner is 35° . The hydraulic and overall efficiency is 88% and 84% respectively. If velocity of whirl is zero at outlet, determine the runner vane angle at outlet and inlet and also speed of the turbine.	CO4-	-
6	Kalpan turbine runner is to be designed to develop 10000 kW. The net head is 6.0m. The speed ratio = 2.09, flow ratio = 0.68, overall efficiency is 80% and diameter of the loss is 1/3 the diameter of the runner. Find the diameter of the runner, its speed and the specific speed of the turbine.	CO4-	-
7	A Kaplan turbine produces 60,000 kW under a net head of 25m with an overall efficiency of 90%. Taking the value of speed ratio as 1.6, flow ratio as 0.5 and huh diameter as 0.35 times the outer diameter, find diameter and speed of turbine.	CO4-	_

8	A Kaplan turbine runner js to be designed to develop brake power of 7350kW, under a head of 5.5m. Diameter of bass is 1/3rd of diameter of runner. Assuming speed ratio = 2.09, flow ratio = 0.68, calculate: i) diameter of runner and boss; ii) speed of runner. Take Efficiency = 85%.	CO4-	
9	A Kaplan turbine develops 22000kW at an average head of 35m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of the boss equal to 0.35 times the diameter of the runner and an overall efficiency of 88%, calculate the diameter, speed and specific speed of the turbine.	CO4	-
10	Describe the different heads of a centrifugal pump with necessary equations.	CO4	-
11	Explain briefly the various types of efficiencies of a centrifugal pump.	CO4	-
12	Derive an expression for the minimum starting speed for a centrifugal pump.	CO4	-
13	Distinguish between pumps in series and pumps in parallel.	CO4	-
14	Explain the following i) Suction head ii) Delivery head iii) Static head iv) Manometric head.	CO4	_
15	Define: i) Manometric efficiency ii) Mechanical efficiency iii) Overall efficiency.	CO4	-
16	Differentiate between : i) Pump and Turbine ii) Suction head and delivery head iii) Manometric and overall efficiency iv) Single stage and multistage pumps.	CO4	-
17	What is priming of centrifugal pump? How it is done?	CO4	-
18	The diameter of an impeller of a centrifugal pump at inlet and outlet at 30 cm and 60 cm respectively. The velocity of flow at outlet is 2.0 m/s and the vanes are set back at an angle of 45° at the outlet. Determine the minimum starting speed of the pump if the manometric efficiency is 70%.	CO4	_
19	A three stage centrifugal pump has impellers 40 cm in diameter and 2 cm wide at outlet. The vanes are curved back at the outlet at 45° and reduce the circumferential area by 10%. The manometric efficiency is 90% and the overall efficiency is 80%. Determine the head generated by the pump when running at 1000 rpm delivering 50 litres per second. What should be the shaft horse power?	CO4	_
20	A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 40m. The velocity of flow through the impeller is constant and is equal to 2.5m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500mm and width at outlet is 50mm, determine i) Vane angle at inlet ii) Work done by impeller on water per second iii) Manometric efficiency.	CO4	_
21	A centrifugal pump runs at 1000 rpm and delivers water against a head of 15m. The impeller diameter and width at the outlet are 0.3m and 0.05m respectively. The vanes are curved back at an angle of 30° with the periphery at the outlet iman = 0.92 find discharge.	CO4	_
22	A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 r.p.m works against a total head of 40m. The velocity of Bow through the impeller is constant and equal to 2.5m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500mm and width at outlet is 50mm, determine : i) Vane angle at inlet ii) Work done by impeller on water iii) Manometric efficiency.	CO4	_
1 23	The international and externational diameters of the impeller of a centrifugal pump	CO4	- 1

	are respectively 200mm and 40mm. The' pump is running at 1200rpm. The vane angles of the impeller at inlet and outlet are 20° and 30°. Water enters radially "36 velocity of flow is constant. Determine the workdone by the impeller per unit weight of Virate		
24	A centrifugal pump is to discharge 0.118m3/s at a speed of 1450rpm against a head of 25m. The impeller diameter is 250mm, its width at outlet is 50mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.	CO4	-
е	Experiences	-	-

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs C	Code:	18CV43	Sem:	IV	Marks:	40	Time:	90 minute	es	
Cour	se:	Applied Hy	draulics							
-	-	Note: Answ	ver any 2 qu	estions, eac	h carry equ	al marks.		Marks	CO	Level
1	а	What is a tube.	draft tube?	With neat s	sketch, list t	he different	types of dr	aft 10	CO4	
	b	A Kaplan tu Assuming 0.35 times calculate tł	urbine develo a speed ratio the diameter, ne diameter,	ops 24647.6 o of 2, flow er of the ru speed and :	kW power a ratio of 0.6, nner and a specific spe	at an average diameter of n overall effi ed of the tur	e head of 39 boss equal ciency of 90 bine.	m. 10 to 0%,	CO4	
2	а	Draw the n	eat sketch o	f Kaplan turl	oine and me	ention the pa	rts.	10	CO4	
	b	A Kaplan turbine runner is to be designed to develop brake power of 7350kW, under a head of 5.5m. Diameter of bass is 1/3rd of diameter of runner. Assuming speed ratio = 2.09, flow ratio = 0.68, calculate: i) diameter of runner and boss; ii) speed of runner. Take Efficiency = 85%.						of 10 of ter	CO4	
3	а	What is pri	ming of cent	rifugal pum	p? How it is	done?		10	CO4	
	b	The diame cm and 60 the vanes minimum s	ter of an imp cm respect are set bacl tarting spee	eller of a ce ively. The v < at an ang d of the pun	entrifugal pu elocity of fla le of 45° at np if the ma	mp at inlet a ow at outlet the outlet. nometric effi	nd outlet at is 2.0 m/s a Determine t ciency is 70%	30 10 nd he %.	CO4	
4	а	Derive an pump.	expression f	or the mini	mum startii	ng speed fo	r a centrifuç	gal 10	CO4	
	b	A centrifug against a h is 50mm a the outer p	gal pump is ead of 25m. nd manome eriphery of t	to discharg The impelle tric efficienc he impeller.	ge 0.118m3, r diameter is cy is 75%. De	/s at a spee s 250mm, its etermine the	ed of 1450rp width at out vane angle	om 10 let at	CO4	

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

				Model	Assignment	Questions				
Crs Co	ode:	18CV43	Sem:	IV	Marks:	10	Time: g	90-120 m	inutes	
Cours	Course: Applied Hydraulics									
Note:	Each	student to	o answer 2-3	assignment	ts. Each assig	gnment carr	ies equal ma	rk.		
SNo			ŀ	Assignment	Description			Marks	CO	Level
1	Drav	Draw the neat sketch of Kaplan turbine and mention the parts.						10	CO4	-
2	Defi	ne draft t	ube theory a	and obtain a	an expressic	n for efficie	ncy of a draf	t 10	CO4	-
	tube	Э.								
3	Wha	at is a draf	t tube? With	neat sketch	, list the diffe	erent types o	of draft tube.	10	CO4	-
4	A Ka	A Kaplan turbine develops 24647.6 kW power at an average head of 39 r						n. 10	CO4	-
	Assu	Assuming a speed ratio of 2, flow ratio of 0.6, diameter of boss equal to 0.3!					5			
	time	es the diar	neter of the	runner and	an overall e	fficiency of g	90%, calculate	e		

	the diameter, speed and specific speed of the turbine.			
5	A Kaplan turbine working under a head of 20m develops 12000 kW. The	10	CO4	-
	outer diameter of the runner is 3.5m and inner diameter of the hub is 1.75m.			
	The guide blade angle at the extreme edge of the runner is 35°			
	. The hydraulic and overall efficiency is 88% and 84% respectively. If velocity			
	of whirl is zero at outlet, determine the runner vane angle at outlet			
	and inlet and also speed of the turbine.			
6	Kalpan turbine runner is to be designed to develop 10000 kW. The net head	10	CO4	-
	is 6.0m. The speed ratio = 2.09, flow ratio = 0.68, overall efficiency is 80% and			
	diameter of the loss is 1/3 the diameter of the runner. Find the diameter of			
	the runner, its speed and the specific speed of the turbine.			
7	A Kaplan turbine produces 60,000 kW under a net head of 25m with an	10	CO4	-
	overall efficiency of 90%. Taking the value of speed ratio as 1.6, flow ratio as			
	0.5 and huh diameter as 0.35 times the outer diameter, find diameter and			
	speed of turbine.			
8	A Kaplan turbine runner is to be designed to develop brake power of	10	CO4	-
	7350kW, under a head of 5.5m. Diameter of bass is 1/3rd of diameter of			
	runner. Assuming speed ratio = 2.09. flow ratio = 0.68. calculate: i) diameter			
	of runner and boss; ii) speed of runner. Take Efficiency = 85%.			
a	A Kaplan turbine develops 22000kW at an average head of 35m. Assuming	10	COA	_
	a speed ratio of 2, flow ratio of 0.6, diameter of the boss equal to 0.35 times			
	the diameter of the runner and an overall efficiency of 88% calculate the			
	diameter speed and specific speed of the turbine			
10	Describe the different heads of a centrifugal nump with necessary	10	COA	
10	equations	10	004	
11	Explain briefly the various types of efficiencies of a centrifugal pump	10	CO4	_
12	Derive an expression for the minimum starting speed for a contribution	10	CO4	
12	pump	10	004	-
10	Distinguish between numps in series and numps in parallel	10	CO4	
13	Distinguish between pumps in series and pumps in parattet.	10	C04	-
14	i) Sustian head	10	04	-
	i) Delivery head			
	II) Delivery nead			
	III) Static riedu			
	IV) Manometric nead.		<u> </u>	
15	Define:	10	C04	-
	i) Manometric elliciency			
	II) Mechanical elliciency			
	III) Overall elliciency.		00.	
10	Unierentiale between : 1) Pump and Turbine	10		-
	III Suction nead and delivery nead			
	III) Manometric and overall efficiency IV) Single stage and multistage pumps.			
17	what is priming of centrifugal pump? How it is done?	10	CO4	-
18	I ne diameter of an impeller of a centrifugal pump at inlet and outlet at 30	10	CO4	-
	cm and 60 cm respectively. The velocity of flow at outlet is 2.0 m/s and the			
	vanes are set back at an angle of 45 at the outlet. Determine the minimum			
	starting speed of the pump if the manometric efficiency is 70%.			
19	A three stage centrifugal pump has impellers 40 cm in diameter and 2 cm	10	CO4	-
	wide at outlet. The vanes are curved back at the outlet at 45° and reduce			
	the circumferential area by 10%. The manometric efficiency is 90% and the			
	overall efficiency is 80%. Determine the head generated by the pump when			
	running at 1000 rpm delivering 50 litres per second. What			
	should be the shaft horse power?			
20	A centrifugal pump having outer diameter equal to two times the inner	10	CO4	-
	diameter and running at 1000 rpm works against a total head of 40m. The			
	velocity of flow through the impeller is constant and is equal to 2.5m/s. The			
	vanes are set back at an angle of 40° at outlet. If the outer diameter of the			
	impeller is 500mm and width at outlet is 50mm, determine			
	i) Vane angle at inlet			
	ii) Work done by impeller on water per second			
	iii) Manometric efficiency.			

21	A centrifugal pump runs at 1000 rpm and delivers water against a head of 15m. The impeller diameter and width at the outlet are 0.3m and 0.05m respectively. The vanes are curved back at an angle of 30° with the periphery at the outlet iman = 0.92 find discharge.	10	CO4	-
22	A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 r.p.m works against a total head of 40m. The velocity of Bow through the impeller is constant and equal to 2.5m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500mm and width at outlet is 50mm, determine : i) Vane angle at inlet ii) Work done by impeller on water iii) Manometric efficiency.	10	CO4	_
23	The internal and external 'diameters of the impeller of a centrifugal pump are respectively 200mm and 40mm. The' pump is running at 1200rpm. The vane angles of the impeller at inlet and outlet are 20° and 30°. Water enters radially "36 velocity of flow is constant. Determine the workdone by the impeller per unit weight of Virate	10	CO4	-
24	A centrifugal pump is to discharge 0.118m3/s at a speed of 1450rpm against a head of 25m. The impeller diameter is 250mm, its width at outlet is 50mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.	10	CO4	-

F. EXAM PREPARATION

1. University Model Question Paper

Cours	se:	Fluid Mech	nanics				Month /	′ Year	May /2	2020
Crs C	ode:	17CV43	Sem:	IV	Marks:	100	Time:		180 mi	nutes
Mod	Note	Answer all	FIVE full ques	stions. All qu	uestions carry e	qual marks.		Marks	СО	Level
ule										
1	а	State and	explain Buck	kingham Pi	- theorem ci	ting an exam	ple. Also	10	CO1	L3
		explain its a	advantages o	ver Rayleigł	n's method of d	imensional an	alysis.			
	b	Water is flo	Water is flowing through a pipe of diameter 40 cm at a velocity of 4 m						CO1	L3
		Find the ve	elocity of oil f	lowing in a	nother pipe of	diameter 10 diamet	cm, if the			
		condition o	of dynamic si	milarity is s	satisfied betwe	en the two p	ipes. The			
		specific ar	water and c	nt are givei 8	n as 0.01 Poise	e and 0.025 P	oise. The			
		specific gro	avity of oit - 0.	0.	OR					
1	а	Explain the	Ravleigh's m	ethod of dir	mensional analy	sis with an ex	ample	10	CO1	12
-	b	A pipe of	diameter 1.8n	n is require	d to transport	an oil of sp.g	0.8 and	10	CO1	13
		viscosity 0.	.04 poise at th	ne rate of 4r	n/s. Tests were	conducted o	n a 20cm			
		diameter p	ipe using wat	er at 20°C. F	- ind velocity an	d rate of flow	in model.			
		Viscosity o	f water at 20°C	C is 0.01 pois	se.					
2	а	Derive an Manning's	expression fo formula.	r the disch	arge through a	an open chan	nel using	10	CO2	L3
	b	canal is to I	have a trapez	oidal sectio	n with one side	vertical and th	ne other	10	CO2	L4
		sloping at 6	30° to the hori	zontaL It ha	is to carry water	at 30m3/s wi	th mean	_		
		velocity 2 r	n/s. Compute	the dimen	sions of the sec	tion which wil	l require			
		minimum l	ining.							
					OR					
2	а	Define spe	cific energy. D	raw specifi	c energy curve,	and then deri	ve	10	CO2	L3
		expression	s for critical d	epth, critica	l velocity and m	ninimum speci	fic			
		energy.								
	b	An open ch	nannel is to be		ed of trapezoida	at section and	with side	10	CO2	L4
		slopes 1 ve	ertical to 1.5 HC	orizoniai. Fir	nd relation betw	veen bollom w	/idtn and			
		the bottom	width and de	nt excavall	assuming C in	Chezy's formu	la ac			
		115 and he	ed slope is 1 ir	1 /000	assuming C III	CHEZY STOTTIU	10 05			

3	а	Define the term hydraulic jump. Derive an expression for depth of hydraulic jump in terms of upstream Froude's number.	10	CO2	L3
	b	The rectangular channel of bed width 4m is discharging water at the rate of 10m. Determine the following : i) Critical depth ii) Minimum specific energy iii) What will be the type of flow in the depth is 0.6m and 2m.	10	CO2	L3
				00.	
3	a	Give the classification of surface profiles in case of GVF.	10	CO2	L3
	b	The specific energy for 6m wide rectangular channel is to be 5 kg — m/kg. if the rate of flow of water through channel is 24m'/s, determine alternate depths of channel. Derive the differential equation for gradually varied flow and list all the assumptions.	10	CO3	L3
4	а	Derive an equation of force exerted by a jet on an unsymmetrical curved vane tangentially,when vane K moving in the x-direction. Draw the velocity triangles and explain. Also find the workdone and efficiency.	10	CO4	L4
	b	A jet of water moving at 15 m/s impinges on symmetrical curved vane tangentially to deflect the jet through 120,find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of the jet at exit in magnitude and direction and the work done per second per unit weight of water striking per second? Assume that the vane is smooth.	10	CO4	L4
		OR			
4	а	Derive an expression for the work done per second by water on the runner of a Pelton wheel. Hence derive an expression of maximum efficiency of Pelton wheel giving the relationship between the jet speed and bucket speed.	10	CO4	L4
	b	A Pelton wheel is receiving water from a penstock with a gross head of 510m. One third of gross head is lost in friction in the penstock. The rate of flow through the nozzle fitted at the end of the penstock is 2.2m3/s. the angle of deflection of the jet is 165°. Determine : i) Power given by water to the runner, ii) Hydraulic efficiency of the pelton wheel. Take Cv = 1.0 and speed ratio = 0.45.	10	CO4	L4
5	а	What is a draft tube? With neat sketch, list the different types of draft tube.	10	CO4	L2
	b	A Kaplan turbine develops 24647.6 kW power at an average head of 39 m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of boss equal to 0.35 times the diameter of the runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine.	10	CO4	L3
		OR			
5	а	What is priming of centrifugal pump? How it is done?	10	CO4	L2
	b	The diameter of an impeller of a centrifugal pump at inlet and outlet at 30 cm and 60 cm respectively. The velocity of flow at outlet is 2.0 m/s and the vanes are set back at an angle of 45° at the outlet. Determine the minimum starting speed of the pump if the manometric efficiency is 70%.	10	CO4	L4

2. SEE Important Questions

Cours	purse: Fluid Mechanics									
Crs C	ode:	18CV43	Sem:	IV	Marks:	100	Time:		180 minutes	
	Note Answer all FIVE full questions. All questions carry equal marks.					-	-			
Mod	Qno.	Important Que	stion					Marks	CO	Year
ule										
1	а	a. Define the te	erms					10	CO1	2015
		i) Model								
		ii) Prototype								

		iii) Model Analysis iv) Hydraulic similitude.			
	b	State and explain Buckingham Pi — theorem citing an example. Also explain its advantages over Rayleigh's method of dimensional analysis.	10	CO1	2011
	С	A 7.2m high and 15m long spillway discharges 94 m3/sec of water under a head of 2m. If a 1:9 scale model of this spillway is to be constructed, determine model dimensions, head over the spillway model and model discharge. If model experiences a force of 7500N, determine force on the prototype.	10	CO1	2013
2	а	Prove that for a trapezoidal channel of most economical section : i) Half of top width — length of one ofsloping sides ii) hydraulic mean depth = E/2 depth of flow	10	CO2	2012
	b	What do you understand best hydraulic channel section? Derive the conditions for best hydraulic triangular channel section.	10	CO2	2013
	С	Define specific energy. Draw specific energy curve, and then derive expressions for critical depth, critical velocity and minimum specific energy.	10	CO	2015
	d	The discharge of water through a rectangular channel of width 10 m, is 20 m when depth	10	CO2	2017
		i) Specific energy of flowing water. ii) Critical depth and critical velocity. iii) Minimum specific energy.			
3	а	The rectangular channel of bed width 4m is discharging water at the rate of 10m. Determine the following : i) Critical depth	10	CO2	2012
	h	ii) Minimum specific energy iii) What will be the type of flow in the depth is 0.6m and 2m.	10	<u>(</u>)2	2014
	5	velocity of 5m/sec and depth of flow is 0.4m. The width of the channel is 6m. Determine whether a hydraulic jump will occur, and if so find its height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump.	10	002	2014
	С	Derive the differential equation for gradually varied flow and list all the assumptions.	10	СО	2015
	d	The specific energy for 6m wide rectangular channel is to be 5 kg — m/kg. if the rate of flow of water through channel is 24m'/s, determine alternate depths of channel.	10	CO2	2016
4	а	Derive an equation of force exerted by a jet on an unsymmetrical curved vane tangentially, when vane K moving in the x-direction. Draw the velocity triangles and explain. Also find the workdone and efficiency.	10	CO4	2016
	b	A jet of water moving at 15 m/s impinges on symmetrical curved vane tangentially to deflect the jet through 120,find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of the jet at exit in magnitude and direction and the work done per second per unit weight of water striking per second? Assume that the vane is smooth.	10	CO4	2013
	С	Derive an expression for the work done per second by water on the runner of a Pelton wheel. Hence derive an expression of maximum efficiency of Pelton wheel giving the relationship between the jet speed and bucket speed.	10	CO4	2017
	d	The water available for a Pelton wheel is 4 cumecs and the total head from the reservoir to the nozzle is 250 m. The turbine has two runners with two jets per runner. All the four jets have the same diameters. The pipeline is 3000 m long. The efficiency of power transmission through the pipeline	10	CO4	2015

		and the nozzle is 91% and efficiency of each runner is 90%. The velocity coefficient of each nozzle is 0.975 and coefficient of friction `4f" for the pipe is 0.0045. Determine i) the power developed by the turbine ii) the diameter of the jet and iii) the diameter of the pipeline.			
5	а	What is a draft tube? With neat sketch, list the different types of draft tube.	10	CO4	2011
	b	A Kaplan turbine develops 24647.6 kW power at an average head of 39 m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of boss equal to 0.35 times the diameter of the runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine.	10	CO4	2013
	С	Explain briefly the various types of efficiencies of a centrifugal pump.	10	CO4	2016
	d	Derive an expression for the minimum starting speed for a centrifugal pump.	10	CO4	2017
	е	A centrifugal pump runs at 1000 rpm and delivers water against a head of 15m. The impeller diameter and width at the outlet are 0.3m and 0.05m respectively. The vanes are curved back at an angle of 30° with the periphery at the outlet iman = 0.92 find discharge.	10	CO4	2015

Course Outcome Computation

Academic Year: 2019-20

Odd / Even semester	
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INTERNAL TEST	T1						T2						Тз				
Course	CO		CO		CO		CO		СО			C07		СО			
Outcome	1		1		2		2		3					8			
QUESTION	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV		Q1	LV	Q2	LV		
NO																	
MAX																	
MARKS																	
USN-1																	
USN-2																	
USN-3																	
USN-4																	
USN-5																	
USN-6																	
Average CO																	
Attainment																	
LV Threshold	l : 3:>	60%	, 2:>=	50%	and <	=60%	5, 1: <	=49	%								
CO1 Computation:																	

PO Computation

Program Outcome Weight of	PO1		PO3		PO3		PO1		PO12	PO12		PO6		PO1 1	
Course Outcome														CO8	
Test/Quiz/L	T1						T2					T3			
ab															
QUESTION	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2 LV	Q3	LV	Q1	LV	Q2	LV
MAX															
MARKS															
USN-1															
USN-2															
USN-3															
USN-4															
USN-5															
USN-6															
Average CO															
Attainment															