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

No.29, Chimney Hills, Hesaragatta Road, Chikkabanavara
Bangalore -560090, Karnataka, India
Phone/ Fax: +91-08023721315/23721477
Web: www.skitorg.in

Table of Contents

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.

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning 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. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	-	-
	Text books		In Lib / In Dept
1,2,3,4, 5	P N Modi and S M Seth, "Hydraulics and Fluid Mechan ics, including Hydraulic Machines", 20th edition, 2015, Standard Book House, New Delhi		In Lib
1,2,3,4, 5	R.K. Bansal, "A Text book of Fluid Mechanics and Hy draulic Machines", Laxmi Publications, New Delhi		In dept
1,2,3,4, 5	S K SOM and G Biswas, "Introduction to Fluid Mechan ics and Fluid Machines", Tata McGraw Hill,New Delhi		Not Available
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	-	-
1,2,3,4, 5	K Subramanya, "Fluid Mechanics and Hydraulic Machin es", Tata McGraw Hill Publishing Co. Ltd.		In Lib
1,2,3,4, 5	Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press		In Lib
1,2,3,4, 5	C.S.P. Ojha, R. Berndtsson, and P.N. Chandramouli, "Fluid Mechanics and Machinery", Oxford University Publication – 2010		Not Available
	J.B. Evett, and C. Liu, "Fluid Mechanics and Hydraulics ", McGraw-Hill Book Company.-2009.		Not Available
C	**Concept Videos or Simulation for Understanding**	-	-
C1	https://www.youtube.com/watch?v=tV3ShM1fo5Y		
C2	https://www.youtube.com/watch?v=xjYfNvYWmDo		
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-&index=6		
C6	https://www.youtube.com/watch?v=VbsZRqpcJ4w		
C7	https://www.youtube.com/watch?v=3RGguSotX3E		
C8	https://www.youtube.com/watch?v=YgVfJscGj4k		
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	**Others (Web, Video, Simulation, Notes etc.)**	-	-
	NPTEL		Web
	https://nptel.ac.in/courses/105103096/		

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.

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

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	18CV33	FLUID MECHANICS	Basic properties of fluids, BERNOULIS EQUATION	3	-	L3

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.

Modules	Topic / Description	Area	Remarks	Blooms Level
1	Byuoncy	Higher Study	-	Understand L2
2	Open channel uniform flow	Higher Study	-	Understand L2
3	Open channel non-uniform flow, GVF profiles	Higher Study		Understand L2
4	Turbines	Higher Study		Understand L2
5	Pumps	Higher Study		Understand 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.

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

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Use of dimensions and the dimensional formula of physical quantities to find interrelations between them.	CO1	L3
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															-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	17CV43.1	Apply principles of dimensional analysis and Buoyancy to design experiments	3	3	2	2	-	-	-	-	-	-	-	-				L2
2	17CV43.2	Design open channels for most economical sections.	3	3	2	2	-	-	-	-	-	-	-	-				L3
3	17CV43.3	Determine GVF profiles under nonuniform flow	3	3	2	2	-	-	-	-	-	-	-	-				L2
4	17CV43.4	Design the working proportions hydraulic machines	3	3	2	2	-	-	-	-	-	-	-	-				L2
-	**17CV43**	**Average attainment (1, 2, or 3)**																**-**
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer 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 Base Management; S3.Web Design*																

4. Curricular Gap and Content

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

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
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.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
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 Turbines	10	-	2	-	1	1	2	CO7, Co8	L4
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.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO2, CO3, CO4	L4
3, 4	CIA Exam – 2	30	CO5, CO6, CO7, Co8	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 Time:	16 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Apply principles of dimensional analysis and Buoyancy to design experiments	CO1	l4
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**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 Applications	CO1	L3
5	Model Analysis, Similitude	CO1	L3
6	Types Of Similarities, Force Ratios, Similarity Laws, Model Classification	CO1	L3
7	Reynolds 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
18	Determination Of Metacentric Height, Experimental And Theoretical Method	CO1	L3
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
2	Concept of Byuoncy is used for experimental determination of density.	CO1	L4
d	**Review Questions**	-	-
1	Describe the geometric similarity, kinematic similarity and dynamic similarity.	CO1	-
2	Briefly explain geometric, kinematic and dynamic similarities.	CO1	-
3	Explain the terms: distorted models and undistorted models.	CO1	-
4	a. Define the terms i) Model ii) Prototype iii) Model Analysis iv) Hydraulic similitude.	CO1	-
5	State and explain Buckingham Pi — theorem citing an example. Also explain its advantages over Rayleigh's method of dimensional analysis.	CO1	-
6	Explain Froude's model law. List its application in fluid flow problems.	CO1	-
7	Distinguish between : i) Geometric and Kinematic similarity ii) Reynolds's and E.B Froude's number iii) Distorted and undistorted model.	CO1	-
8	Explain the Rayleigh's method of dimensional analysis, with an example.	CO1	-
9	Define the dimensional homogeneity. Give an example.	CO1	-
10	Derive different scale ratio's as per Reynold's model law.	CO1	-
11	Water is flowing through a pipe of diameter 40 cm at a velocity of 4 m/s. 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.	CO1	-
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.	CO1	-
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.	CO1	-
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 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	CO1	-

	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 = 1000kg/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 = 1025kg/m^3).	CO1	-
e	**Experiences**	-	-

Module – 2

Title:	Applied Hydraulics	Appr Time:	10 Hrs
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 No	**Module 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	-
c	**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 open channel.	CO2	-
18	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	CO2	-
19	What do you understand best hydraulic channel section? Derive the conditions for best hydraulic triangular channel section.	CO2	-
20	With neat sketches differentiate between flow through pipes and flow through open channels Time: 3 hrs. Max. Marks:100 Note: 1. Answer FIVE full questions, selecting at least TWO questions from each part 2. Missing data may suitably be assumed. with examples.	CO2	-
21	Derive an expression for the discharge through an open channel using Manning's formula.	CO2	-
22	Differentiate between : i) Hydraulic depth and hydraulic mean depth ii) Steady and uniform flow iii) Alternate depth and conjugate depth iv) Open channel flow and pipe flow.	CO2	-
23	Show that the sloping side of a most economical trapezoidal section	CO2	-

	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 expressions for critical depth and critical velocity.	CO2	-
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 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.	CO2	-
30	Derive an expression for critical depth and critical velocity in case of non-uniform flow through rectangular channel.	CO2	-
31	An earthen channel with a base width 2m and side slope 1H 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.	CO2	-
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 perimeter; ii) Slope of the bed if Manning's n = 0.014.	CO2	-
35	Define specific energy. Explain specific energy curve (sketch).	CO2	-
36	Define specific energy. Draw specific energy curve, and then derive expressions for critical depth, critical velocity and minimum specific energy.	CO2	-
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	-
41	An open channel is to be constructed of trapezoidal section and with side 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.	CO2	-
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?		
e	**Experiences**	-	-
1			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	18CV43	Sem:	IV	Marks:	40	Time:	75 minutes
Course:	Applied Hydraulics						

-	-	Note: Answer any 3 questions, each carry equal marks.	Marks	CO	Level
1	a	Explain the Rayleigh's method of dimensional analysis, with an example.	10	CO1	L2
	b	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.	10	CO1	L4
2	a	Derive different scale ratio's as per Reynold's model law.	10		L2
	b	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		L3
3	a	Derive the conditions for the most economical trapezoidal channel section.	10	CO2	L2
	b	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 perimeter; ii) Slope of the bed if Manning's n = 0.014.	10	CO2	L3
4	a	Derive the Chezy's equation for uniform flow in open channel with usual notations.	10	CO2	L2
	b	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.	10	CO2	L4

b. Assignment -1

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

Model Assignment Questions

Crs Code:	18CV43	Sem:	IV	Marks:	5/10	Time:	
Course:	Applied Hydraulics						

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

SNo	Assignment Description	Marks	CO
1	Describe the geometric similarity, kinematic similarity and dynamic similarity.	10	CO1
2	Briefly explain geometric, kinematic and dynamic similarities.	10	CO1
3	Explain the terms: distorted models and undistorted models.	10	CO1
4	a. Define the terms i) Model	10	CO1

		ii) Prototype iii) Model Analysis iv) Hydraulic similitude.		
5		State and explain Buckingham Pi — theorem citing an example. Also explain its advantages over Rayleigh's method of dimensional analysis.	10	CO1
6		Explain Froude's model law. List its application in fluid flow problems.	10	CO1
7		Distinguish between : i) Geometric and Kinematic similarity ii) Reynolds's and E.B Froude's number iii) Distorted and undistorted model.	10	CO1
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. 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.	10	CO1
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.	10	CO1
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.	10	CO1
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 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
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.	10	CO1
16		A 2.5m ship model was tested in fresh water p = 1000kg/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 = 1025kg/m^3).	10	CO1
17		Bring out the difference between flow through pipes and flow through open channel.	10	CO2
18		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
19		What do you understand best hydraulic channel section? Derive the conditions for best hydraulic triangular channel section.	10	CO2
20		With neat sketches differentiate between flow through pipes and flow through open channels	10	CO2
21		Derive an expression for the discharge through an open channel using Manning's formula.	10	CO2
22		Differentiate between : i) Hydraulic depth and hydraulic mean depth ii) Steady and uniform flow iii) Alternate depth and conjugate depth iv) Open channel flow and pipe flow.	10	CO2
23		Show that the sloping side of a most economical trapezoidal section makes an angle 60 with horizontal.	10	CO2
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 notations.	10	CO2

26	Distinguish between: Pipe flow and open channel flow.	10	CO2
27	Define specific energy. Draw specific energy curve, and then derive expressions for critical depth and critical velocity.	10	CO2
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.	10	CO2
29	A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and the 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.	10	CO2
30	Derive an expression for critical depth and critical velocity in case of non-uniform flow through rectangular channel.	10	CO2
31	An earthen channel with a base width 2m and side slope 1H 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.	10	CO2
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.	10	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.	10	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 perimeter; ii) Slope of the bed if Manning's n = 0.014.	10	CO2
35	Define specific energy. Explain specific energy curve (sketch).	10	CO2
36	Define specific energy. Draw specific energy curve, and then derive expressions for critical depth, critical velocity and minimum specific energy.	10	CO2
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.	10	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.	10	CO2

D2. TEACHING PLAN - 2

Module – 3

Title:	Applied Hydraulics	Appr Time:	16 Hrs
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**	**CO**	**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	-
c	**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 Time:	16 Hrs
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**	**CO**	**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	-

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	-
c	**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 work done per second by jet striking unsymmetrical moving vane tangentially at one end of the tips.	CO4	-
25	Differentiate between : i) Impulse and Reaction turbine ii) Radial and Axial flow turbine iii) Kaplan and Propellor turbine.	CO4	-
26	For a Pelton wheel, derive an expression for work done and hydraulic efficiency. Also determine the condition for maximum hydraulic efficiency.	CO4	-
27	With the help of velocity triangles derive an expression for work done and maximum hydraulic efficiency of a pelton wheel.	CO4	-
28	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.	CO4	-
29	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 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.	CO4	-
30	pelton wheel has to be designed for the following data : Power to be developed = 6000kW, Net head available = 300m, Speed = 550 rpm, 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 quantity of water required. Assume Cv = 0.98 and speed ratio 0.46.	CO4	-
31	Design a Pelton wheel with the following data, shaft power = 735.75 kN H = 200m, N = 800 rpm no = 0.86 D/d = 10 Cv = 0.98 (I) = 0.45. Determine D, d and number of jets.	CO4	-
32	A Pelton wheel has to be designed for following data : Power to be 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-eff of velocity as 0.98 and speed ratio as 0.46.	CO4	-
33	Design a Pelton wheel turbine required to develop 1471.5 kW power under a head of 160m at 420 rpm. The overall efficiency may be taken as 85%. Assume c, = 0.98, cu = 0.46, jet ratio = 12.	CO4	-
34	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.	CO4	-
e	**Experiences**	-	-

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	18CV43	Sem:	IV	Marks:	40	Time:	75 minutes
Course:	Applied Hydraulics						
-	**-**	**Note: Answer any 2 questions, each carry equal marks.**			**Marks**	**CO**	**Level**

1	a	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
2	a	Give the classification of surface profiles in case of GVF.	10	CO3	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	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	a	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 Code:	18CV43	Sem:	IV	Marks:	60	Time:	90-120 minutes
Course:	Applied Hydraulics						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	Assignment Description	Marks	CO	Level
1	Define the term hydraulic jump. Derive an expression for depth of hydraulic jump in terms of upstream Froude's number.	10	CO4	-
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.	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	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	-
5	horizontal rectangular channel 4m wide carries a discharge 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 assumptions.	10	CO3	-
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.	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 done per second by jet striking unsymmetrical moving vane tangentially at one end of the tips.	10	CO4	-
25		Differentiate between : i) Impulse and Reaction turbine ii) Radial and Axial flow turbine iii) Kaplan and Propellor turbine.	10	CO4	-
26		For a Pelton wheel, derive an expression for work done and hydraulic efficiency. Also determine the condition for maximum hydraulic efficiency.	10	CO4	-
27		With the help of velocity triangles derive an expression for work done and maximum hydraulic efficiency of a pelton wheel.	10	CO4	-
28		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	-
29		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 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.	10	CO4	-
30		pelton wheel has to be designed for the following data : Power to be developed = 6000kW, Net head available = 300m, Speed = 550 rpm, 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 quantity of water required. Assume Cv = 0.98 and speed ratio 0.46.	10	CO4	-
31		Design a Pelton wheel with the following data, shaft power = 735.75 kN H = 200m, N = 800 rpm no = 0.86 D/d = 10 Cv = 0.98 (I) = 0.45. Determine D, d and number of jets.	10	CO4	-
32		A Pelton wheel has to be designed for following data : Power to be 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-eff of velocity as 0.98 and speed ratio as 0.46.	10	CO4	-
33		Design a Pelton wheel turbine required to develop 1471.5 kW power under a head of 160m at 420 rpm. The overall efficiency may be taken as 85%. Assume c, = 0.98, cu = 0.46, jet ratio = 12.	10	CO4	-
34		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	-
35		Define the term hydraulic jump. Derive an expression for depth of hydraulic jump in terms of upstream Froude's number.	10	CO4	-
36		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	CO4	-
37		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	-

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 Time:	16 Hrs
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	-
c			
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 tube.	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	-
23	The internal and external 'diameters of the impeller of a centrifugal pump	CO4	-

	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	-
e	**Experiences**	-	-

E3. CIA EXAM – 3

a. Model Question Paper – 3

Crs Code:	18CV43	Sem:	IV	Marks:	40	Time:	90 minutes
Course:	Applied Hydraulics						

-	-	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	What is a draft tube? With neat sketch, list the different types of draft tube.	10	CO4	
	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	
2	a	Draw the neat sketch of Kaplan turbine and mention the parts.	10	CO4	
	b	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%.	10	CO4	
3	a	What is priming of centrifugal pump? How it is done?	10	CO4	
	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	
4	a	Derive an expression for the minimum starting speed for a centrifugal pump.	10	CO4	
	b	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	

b. Assignment – 3

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

Model Assignment Questions							
Crs Code:	18CV43	Sem:	IV	Marks:	10	Time:	90-120 minutes
Course:	Applied Hydraulics						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	**Assignment Description**	**Marks**	**CO**	**Level**
1	Draw the neat sketch of Kaplan turbine and mention the parts.	10	CO4	-
2	Define draft tube theory and obtain an expression for efficiency of a draft tube.	10	CO4	-
3	What is a draft tube? With neat sketch, list the different types of draft tube.	10	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	10	CO4	-

	the diameter, speed and specific speed of the turbine.			
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.	10	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.	10	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.	10	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%.	10	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.	10	CO4	-
10	Describe the different heads of a centrifugal pump with necessary equations.	10	CO4	-
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 centrifugal pump.	10	CO4	-
13	Distinguish between pumps in series and pumps in parallel.	10	CO4	-
14	Explain the following i) Suction head ii) Delivery head iii) Static head iv) Manometric head.	10	CO4	-
15	Define: i) Manometric efficiency ii) Mechanical efficiency iii) Overall efficiency.	10	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.	10	CO4	-
17	What is priming of centrifugal pump? How it is done?	10	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%.	10	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?	10	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.	10	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.	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

Course:	Fluid Mechanics					Month / Year	May /2020
Crs Code:	17CV43	Sem:	IV	Marks:	100	Time:	180 minutes

Module	**Note**	Answer all FIVE full questions. All questions carry equal marks.	**Marks**	**CO**	**Level**
1	a	State and explain Buckingham Pi — theorem citing an example. Also explain its advantages over Rayleigh's method of dimensional analysis.	10	CO1	L3
	b	Water is flowing through a pipe of diameter 40 cm at a velocity of 4 m/s. 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.	10	CO1	L3
		OR			
1	a	Explain the Rayleigh's method of dimensional analysis, with an example.	10	CO1	L2
	b	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.	10	CO1	L3
2	a	Derive an expression for the discharge through an open channel using Manning's formula.	10	CO2	L3
	b	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.	10	CO2	L4
		OR			
2	a	Define specific energy. Draw specific energy curve, and then derive expressions for critical depth, critical velocity and minimum specific energy.	10	CO2	L3
	b	An open channel is to be constructed of trapezoidal section and with side 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.	10	CO2	L4

3	a	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
		OR			
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	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	L4
		OR			
4	a	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	a	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	a	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

Course:	Fluid Mechanics							
Crs Code:	18CV43	Sem:	IV	Marks:	100	Time:		180 minutes

	Note	Answer all FIVE full questions. All questions carry equal marks.	-	-	
Module	Qno.	Important Question	**Marks**	**CO**	**Year**
1	a	a. Define the terms i) Model ii) Prototype	10	CO1	2015

		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
	c	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	a	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
	c	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 of flow of water is 2 m. Calculate i) Specific energy of flowing water. ii) Critical depth and critical velocity. iii) Minimum specific energy.	10	CO2	2017
3	a	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	2012
	b	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	CO2	2014
	c	Derive the differential equation for gradually varied flow and list all the assumptions.	10	CO	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	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	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
	c	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	a	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
	c	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
	e	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

INTERNAL TEST	**T1**						**T2**				**T3**			
Course Outcome	**CO 1**		**CO 1**		**CO 2**		**CO 2**		**CO 3**		**CO7**		**CO 8**	
QUESTION NO	**Q1**	**LV**	**Q2**	**LV**	**Q3**	**LV**	**Q1**	**LV**	**Q2**	**LV**	**Q1**	**LV**	**Q2**	**LV**
MAX MARKS														
USN-1														
USN-2														
USN-3														
USN-4														
USN-5														
USN-6														
Average CO Attainment														

LV Threshold : 3:>60%, 2:>=50% and <=60%, 1: <=49%

CO1 Computation:

PO Computation

Program Outcome	PO1		PO3		PO3		PO1		PO12		PO12		PO6		PO1	
Weight of CO - PO															1	
Course Outcome															CO8	
Test/Quiz/Lab	T1						T2						T3			
QUESTION NO	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																