DEPARTMENT OF CIVIL ENGINEERING
SCHEME OF COURSE WORK

Course Details:

Course Title	**: Hydraulics and Hydraulic Machinery**
Course Code	**: 20CE1111**
L T P C	**: 3 0 0 3**
Program:	**: B. Tech.**
Specialization:	**: Civil Engineering**
Semester	**: IV**
Prerequisites	**: Applied Mechanics, Fluid Mechanics.**
Courses to which it is a prerequisite	**: Water Resources Engineering -II**

Course Outcomes (COs):

At the end of the course, the student will be able to:

CO	Course Outcomes	Learning Outcomes
1	Outline the similarities between model and prototype and compute hydrodynamic force exerted by jet on different surfaces	1. explain concept of Dimensional Analysis for various fluid flow problems (L2) 2. explain similarity laws and model testing (L2) 3. compute hydrodynamic force exerted by jet of water on different vanes (L3) 4. calculate efficiency of jets (L3)
2	Perform the hydraulic design of various turbines and analyze their performance under different operating conditions	1. explain the hydraulic design aspects of Pelton wheel (L2) 2. explain the hydraulic design aspects of Francis / Kaplan turbines (L2) 3. calculate the efficiencies of Pelton/Kaplan/Francis turbines (L3) 4. Apply the concept of unit quantities to compare the performance of turbines (L3)
3	Determine the performance of centrifugal pumps under different operating conditions	1. explain the principles of centrifugal pump (L2) 2. calculate the head losses and efficiencies of centrifugal pump (L3) 3. distinguish of single-stage & multi-stage centrifugal pumps (L2)
4	Discuss the characteristics of uniform and non-uniform flows in open channels	1. distinguish open and closed channel flows (L2) 2. explain the formulae for computation of uniform flow (L2) 3. discuss about the specific energy (L2)
5	Discuss about the gradually varied surface profiles and hydraulic jump	1. discuss the gradually varied flow concepts (L2) 2. draw the water surface profile for different slope conditions (L2) 3. explain the hydraulic jump (L2)

PROGRAMME OUTCOMES

1. Graduates will be able to apply the knowledge of mathematics, science, engineering fundamentals to solve complex civil engineering problems.

2. Graduates will attain the capability to identify, formulate and analyse problems related to civil engineering and substantiate the conclusions
3. Graduates will be in a position to design solutions for civil engineering problems and design system components and processes that meet the specified needs with appropriate consideration to public health and safety.
4. Graduates will be able to perform analysis and interpretation of data by using research methods such as design of experiments to synthesize the information and to provide valid conclusions.
5. Graduates will be able to select and apply appropriate techniques from the available resources and modern civil engineering and software tools, and will be able to predict and model complex engineering activities with an understanding of the practical limitations.
6. Graduates will be able to carry out their professional practice in civil engineering by appropriately considering and weighing the issues related to society and culture and the consequent responsibilities.
7. Graduates will be able to understand the impact of the professional engineering solutions on environmental safety and legal issues.
8. Graduates will transform into responsible citizens by resorting to professional ethics and norms of the engineering practice.
9. Graduates will be able to function effectively in individual capacity as well as a member in diverse teams and in multidisciplinary streams.
10. Graduates will be able to communicate fluently on complex engineering activities with the engineering community and society, and will be able to prepare reports and make presentations effectively.
11. Graduates will be able to demonstrate knowledge and understanding of the engineering and management principles and apply the same while managing projects in multidisciplinary environments.
12. Graduates will engage themselves in independent and life-long learning in the broadest context of technological change while continuing professional practice in their specialized areas of civil engineering.

PROGRAMME SPECIFIC OUTCOMES(PSOs):

1. Collect, process and analyse the data from topographic surveys, remote sensing, hydrogeological investigations, geotechnical explorations, and integrate the data for planning of civil engineering infrastructure.

2. Analyse and design of substructures and superstructure for buildings, bridges, irrigation structures and pavements.

3. Estimate, cost evaluation, execution and management of civil engineering projects.

Course Outcome Vs Program Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	-	-	-	-	-	1
CO2	3	3	3	1	1	1	1	-	-	-	-	1
CO3	3	3	3	1	1	1	1	-	-	-	-	1
CO4	3	3	2	2	2	1	1	-	-	-	-	1
CO5	3	3	2	2	2	1	1	-	-	-	-	1

Course Outcome Vs Programme Specific Outcomes:

CO	PSO1	PSO2	PSO3
CO1	1	1	-
CO2	1	1	-
CO3	-	1	-
CO4	1	1	-
CO5	1	1	-

Mapping Levels:
1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), put -: No Correlation

Assessment Methods:	Assignment / Seminar / Mid-Test / End Exam

Teaching-Learning and Evaluation:

Week No.	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	Dimensional analysis – Rayleigh's method and Buckingham pi theorem	CO-1	Explain the Rayleigh's method and Buckingham pi theorem	▫ Lecture ▫ Problem solving	Assignment/ Quiz
2	Hydraulic models – study of hydraulic models – geometric, kinematic and dynamic similarities – dimensionless numbers – model and prototype relations	CO-1	Problems on model and prototype relations	▫ Lecture ▫ Problem solving	
3	Hydrodynamic force of jets on stationary and moving flat and inclined and curved vanes	CO-1	Problems on inclined and curved vanes.	▫ Lecture ▫ Problem solving	
4	Jet strikes centrally and at the tip. Velocity triangles at inlet and outlet.Expression for work done and efficiency	CO-1	Problems on Impact of jet.	▫ Lecture ▫ Problem solving	

5	Layout of typical hydro power installation – heads and efficiency – classification of turbines – principle of working, working proportions, velocity diagrams, work done and efficiency, hydraulic design-Pelton wheel.	CO-2	Working principle of Pelton wheel with neat sketch	▫ Lecture ▫ Problem solving	
6	Francis turbine Kaplan turbine – principle of working, working proportions, velocity diagrams, work done and efficiency, hydraulic design.	CO-2	Problems on Francis turbine	▫ Lecture ▫ Problem solving	
7	Draft tube – theory, function and efficiency, modern developments of turbines	CO- 2	Explain about draft tube theory.	▫ Lecture ▫ Problem solving	
8	Governing of turbines, water hammer – surge tanks	CO-2	Explain water hammer.	▫ Lecture	
9	Unit quantities – performance under unit head – specific speed – performance characteristics – cavitations.	CO-2	Explain about cavitation.	▫ Lecture ▫ Problem solving	
10	Pump installation details – classification – work done – manometric head	CO-3	Explain the classification of pumps	▫ Lecture ▫ Problem solving	
11	**MID TEST - I**				
12	Minimum starting speed – losses and efficiencies – specific speed.	CO-3	Explain the losses and efficiencies in pumps.	▫ Lecture ▫ Problem solving	Assignment/ Quiz
13	Multistage pumps – pumps in series and parallel – performance of the pump – characteristics curves – NPSH – cavitations.	CO-3	Explain about Pumps in series and parallel	▫ Lecture ▫ Problem solving	
14	Types of flows – type of channels – velocity distribution – energy and momentum correction factors.	CO-4	What are the types of channels	▫ Lecture	
15	Chezy's, mannings and bazin formulae for uniform flow – most economical sections.	CO-4	Derive the conditions for most economical cross section for rectangular channel.	▫ Lecture ▫ Problem solving	
16	Concept of specific energy - Specific energy curves - critical depth – computation of critical depth – critical, subcritical and super critical flows -Channel transitions.	CO-4	Explain specific energy.	▫ Lecture ▫ Problem solving	
	Non uniform – dynamic equation for GVF mild, critical,steep, horizontal and adverse slopes, surface profiles –	CO-5	Derive dynamic equation for GVF.	▫ Lecture ▫ Problem solving	

	Direct step method.				
17	Hydraulic jump - Elements and characteristics of hydraulic jump - Types of hydraulic jump - Location and applications of hydraulic jump - Energy loss in a hydraulic jump.	CO-5	Explain hydraulic jump.	▫ Lecture ▫ Problem solving	
18	**MID TEST - II**				
	END EXAM				