HYDRAULICS AND HYDRAULIC MACHINERY

V Semester: CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACE011	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

COURSE OBJECTIVES:

The course should enable the students to:

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

COURSE OUTCOMES (COs):

CO 1: Describe the concept of different types of flows, designing of most economical sections of the Open Channel and to understand the concept of specific energy.
CO 2: Describe the concept of dimensional quantities and application of similitude concept in designing model and prototype.
CO 3: Understand the concept, working applications of impact of jets with the importance of constructing velocity triangles.
CO 4: Explore the design concept of Pelton, Francis and Kaplan turbines, Centrifugal pumps along with the design of most economical designs.
CO 5: Understand the working mechanism of different types of the pumps with their important characteristic curves.

COURSE LEARNING OUTCOMES (CLOs):

1. Explain the concept for types of flows, type of channels, Non uniform flow - Dynamic equation for G.V.F., Mild, Critical, and Steep channels.
   Understand concept of velocity distribution, energy and momentum correction factors for different flows.
3. Understand Chezy's, Manning's and Basin formulae for uniform flow.
4. Explain the concepts based on Specific energy, critical depth, critical, subcritical and super Critical flows.
5. Understand and designing for the computation of economical sections based on flow parameters and channel characteristics.
6. Understand the Dimensional quantities and analysis for various parameters.
7. Derive the problems based on Rayleigh's method and Buckingham's pi theorem with applications.
8. Explain the concept of similitude with examples and different types of similitude concepts.
9. Remember the concepts of dimensionless numbers to solve numerical problems.
10. Explain the practical problemsassociated with model and prototypesbased on concept of similitude.
11. Explain the different types of jets used in construction of turbines and machinery and their importance.
12. Demonstrate the formulation of velocity triangles at inlet and out let of vanes with different combinations of jet.

13. Derive the expressions based on Angular momentum principle, work done and efficiency for various types of vanes.
14. Explaining the concepts of hydro power plant with various components and their functioning.
15. Deriving numerical problems based on power developed in Hydro power plant, efficiency of jet, stationary and moving vanes.
16. Demonstrating different types of turbines with their principles and practical applications.
17. Remember the concept of work done, efficiency for different vanes and application to the concept of turbines.
18. Deriving the expressions for most economical design of turbines to withstand for the designed discharge.
19. Understand the working principles for various and working of different components of Kaplan, Francis and Pelton turbines.
20. Understand the working mechanism of different types of pumps, importance and functioning of various components.
21. Explain characteristic curves for pumps with their practical applications.
22. Understand the concept of NPSH, performance of pumps and working efficiency.
23. Explain the designing of reciprocating pump and centrifugal pump.
24. Understand the practical problems associated during the installation of pumps.
25. Understand the concept ANOVA to the realworld problems to measure the atmospheric tides.

UNIT-I	**OPEN CHANNEL FLOW**	**Classes: 12**

Types of flows, types of channels, channel characteristics, velocity distribution, energy and momentumcorrection factors, Chezy's, Manning's, Basin's formulae for uniform flow, economical sections,critical flow, critical depth, specific energy, channel transitions

UNIT -II	**DIMENSIONAL ANALYSIS AND SIMILITUDE**	**Classes: 12**

Dimensional analysis, Rayleigh's method, Buckingham's pi theorem, hydraulic models, similaritylaws, geometric, kinematic and dynamic similarities, dimensionless numbers, model and prototyperelations.

UNIT-III	**HYDRODYNAMIC FORCE ON JETS**	**Classes: 12**

Hydrodynamic force of jets on stationary and moving flat inclined and curved vanes, jet strikingcentrally and at tip.

Velocity triangles at inlet and outlet, work done, efficiency, angular momentum principle, layout ofhydropower plant, heads and efficiencies.

UNIT-IV	**HYDRAULICS TURBINES**	**Classes: 12**

Classification of hydraulic machine, Euler's equation of turbo machines, selection of hydraulic machines, design of Pelton turbines, design of Francis turbine, design of Kaplan/ axial flow turbine, draft tube, theoryand function efficiency..

UNIT-V	**CENTRAIFUGAL PUMPS**	**Classes: 12**

Pump installations, classification of pumps, work done, Manometric head, minimum starting speed,losses and efficiency, specific speed, multistage pump, pumps in parallel, performance of pumps, designof centrifugal pumps, design of reciprocating pumps, NPSH, cavitation.

Text Books:

1. Subramanya K, "Open Channel Flow", Tata McGraw Hill Publications, New Delhi, 2008.
2. Modi, Seth, "Fluid Mechanics. Hydraulic and Hydraulic Machines", Standard Book House, 2011.

3. Madan Mohan Das, Mimi Das Saikia, Bhargab Mohan Das, "Hydraulics and Hydraulic Machines Textbook", PHI Learning, 1st edition, 2013.

Reference Books:

1. Ojha CSP, Chandramouli P. N., Berndtsson R., "Fluid Mechanics and Machinery", Oxford University Press, 2010.
2. Chow V.T., "Open Channel Hydraulics", Blackburn Press, 2009.
3. Rajput R.K., "A text book of Fluid Mechanics", S. Chand Publications, 1998.
4. Franck N. White, "Fluid Mechanics", Tata McGrawhill Publications, 8th Edition, 2015.
5. Dr .R.K BansalA text book of Fluid mechanics & Hydraulics machines in SI units Laxmipublications 2015.

Web References:

1. https://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/machine/ui/Course_home-1.htm
2. https://lecturenotes.in/subject/560/hydraulics-and-hydraulic-machinery-hhm
3. https://imammaolana.files.wordpress.com/2010/11/hydraulic_machines_textbook.pdf

E-Text Books:

1. https://www.brijrbedu.org/Brij%20Data/Fluid%20Mechanics/Book/A%20Textbook%20of%20Fluid%20Mechanics%20&%20Hydraulic%20Machines%20By%20R%20K%20Bansal%209%20Ed.pdf.
2. https://mechanicalstudents.com/pdffluid-mechanics-textbook-by-rk-bansal-free-download-2/
3. https://easyengineering.net/a-textbook-of-fluid-mechanics-and-hydraulic-machines-in-si-units-by-rajput/