Indian Institute of Technology, Kanpur

Proposal for a New Course

1. Course No: CE6** or CE7**

2. Course Title: Hydropower and turbomachines

3. Per Week Lectures: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours [0-2]: 0 (A)

Credits: 3-0-0-0 (9)

Duration of Course: Full Semester

4. Proposing Department/IDP: Civil Engineering

Other Departments/IDPs which may be interested in the proposed course: Mechanical Engineering, Aerospace Engineering, Sustainable Energy Engineering, Kotak School of Sustainability

Other faculty members interested in teaching the proposed course: None

5. Proposing Instructor(s): Chunendra K Sahu (Hydraulics and Water Resources group)

6. Course Description: Elective course for PG and senior UG students

A) ***Objectives***: Learning the basics of hydropower and hydraulic turbomachines is essential for a civil engineer, particularly those graduating with a degree in water resource engineering. The proposed course is designed as an elective course to acquaint postgraduate or senior undergraduate students in civil engineering with the basic principles of hydropower plants and hydraulic turbomachines. Students will learn about the basic requirements and layout of hydropower plants, as well as the functioning of various hydraulic turbines and pumps.

B) ***Contents*** (preferably in the form of 5 to 10 broad titles):

S. No	Broad Title	Topics	No. of 75 minutes Lectures
1	Background	Hydropower. Turbomachines. Historical developments of hydropower plants and turbomachines. Bernoulli equation. Continuity and momentum equations. First law of Thermodynamics.	2
2	Hydropower plants	Hydel energy. Working principles. Hydropower potential. Essential components and layout. Site selection. Classification and features of hydropower plants. Plant capacity and specifications. Hydropower plants in India. Types of Dams.	6
3	Turbomachines and performance parameters	Turbomachine classifications. Coordinate systems and velocity components. Relative velocity. Euler's equation. Lift and drag. Efficiency. Dimensional analysis. Performance parameters and variables. Buckingham-Pi theorem. Flow coefficient. Head coefficient. Specific speed and specific diameter. Cordier diagram.	4
4	Hydraulic turbines	Types. Suitability of a hydraulic turbine for a hydropower plant. Specific speed and flow regimes. Turbine selection. Effect of size on efficiency.	2

S. No	Broad Title	Topics	No. of 75 minutes Lectures
		Cavitation in hydraulic turbines: Reasons. Cavitation limits. Net positive suction head. Cavitation damage and effect of performance. Peripheral velocity factor.	
5	The Pelton turbine	Working principle. Velocity diagram. Controlling the speed of Pelton turbine. Penstock diameter. Jet diameter. Head losses and efficiency.	3
6	Reaction turbines	The Francis turbine. Layout. Draft tube. Velocity diagram and flow angles. Specific work and efficiency. The Kaplan turbine. The pump turbine.	3
7	Hydraulic pumps	Working principle. Positive and non-positive displacement pumps. Hydraulic pump performance. Pressure ratio and head change. Operator control. Cavitation. Axial and centrifugal compressors.	4
8	Wave and tidal power	Wave and tidal energy. The Wells turbine. Schematic and operating principles. Designing and performance analysis.	2
Total (75 minutes lectures)			26

C) **Pre-requisites, if any**: Courses on Fluid Mechanics or Engineering Hydraulics

D) **Short summary for including in the Courses of Study Booklet**: Introduction. Conservation laws. Hydropower plants. Turbomachines. Turbomachines classification. Performance parameters. Dimensional analysis. Hydraulic turbines. Pelton turbine. Francis turbine. Kaplan turbine. Cavitation. Hydraulic pumps. Wave and tidal energy.

7. Recommended books:

Reference book

1. Adams, S. (2022). *Hydropower: An Introduction*. 1st Edition, Murphy & Moore Publishing.
2. Dixon, S.L. (2013). *Fluid Mechanics and Thermodynamics of Turbomachinery*, 7th Edition, Butterworth Heinemann.

Proposer: Chunendra K Sahu

Dated: 23/03/2026

SPGC Convener:

Dated:_____

The course is approved / not approved

Chairperson, SPGC

Dated:_____