Course Syllabus
Gyanmanjari Institute of Technology
Semester-4

Subject: Fluid Mechanics and Hydraulic Machinery- BETME14306

Type of course: Major

Prerequisite: Introduction of Mechanical Engineering

Rationale: The study of Fluid Mechanics and Hydraulic Machinery is fundamental in engineering as it provides essential principles for understanding fluid behavior, which is crucial in applications such as pipeline design, pump systems, and hydraulic machinery. It equips students with analytical and computational skills for modeling fluid dynamics, directly impacting sectors like civil, mechanical, and chemical engineering. Additionally, the subject addresses real-world challenges in environmental sustainability and energy production, enhancing problem-solving abilities and broadening interdisciplinary knowledge, ultimately preparing students for diverse career opportunities in various engineering fields.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Unit No	Course content	Hrs	% Weightage
1	**Fluid statics:** Dimensions and units: physical properties of fluids- specific gravity, viscosity and its significance, surface tension, capillarity, and vapor pressure. Atmospheric gauge and vacuum pressure – measurement of pressure. Manometers- Piezometer, U-tube, inverted and differential manometers. Pascal's law, hydrostatic law. Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications. **Fluid kinematics:** Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them.	20	30
2	**Fluid dynamics:** Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend. **Closed conduit flow:** Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.	15	25
3	**Impact of Jet:** Force exerted on stationary flat and curved plates held normal, force exerted on moving plate held normal and on a plate when vane is moving in direction of jet, jet striking on curved vane tangentially at one tip and leaving at another end. **Hydraulic Turbines:** Classification of hydraulic turbines, impulse and reaction turbines, construction, working and analysis of Pelton, Francis and Kaplan turbines, draft tube, governing of the hydraulic turbines, cavitations, performance characteristics)	15	25
4	**Centrifugal pumps:** Classification, working, work done – manometric head- losses and efficiencies- specific speed- pumps in series and parallel- performance characteristic curves, cavitation & NPSH. **Hydraulic Machines:** Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic jack, hydraulic lift, hydraulic ram, fluid couplings, fluid torque converter and air lift pump	10	20

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Group Projects:** Design a fluid system, such as a hydraulic lift or a water distribution network, allowing students to apply theoretical concepts in practical scenarios and upload photographs on GMIU web portal.	10
2	**Case Studies:** Analyze real-world engineering problems related to fluid mechanics, encouraging critical thinking and problem-solving skills and upload case studies on GMIU web portal.	10
3	**Presentations:** Have students research and present on specific topics in fluid mechanics, promoting independent learning and communication skills and upload presentation on GMIU web portal.	10
	Total	30

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	**Remembrance (R)**	**Understanding (U)**	**Application (A)**	**Analyze (N)**	**Evaluate (E)**	**Create (C)**
Weightage	25%	25%	25%	20%	5%	-

Course Outcome:

After learning the course, the students should be able to:	
CO1	Understanding of fundamental principles of fluid mechanics and fluid properties.
CO2	Make use of dimensional analysis and interpret types of fluid flow.
CO3	Analyze theory of impact of jet and apply the same for hydraulic turbine.
CO4	Understand centrifugal pumps, their performance, and various hydraulic machines and devices.

List of Practical:

Sr. No	Description	Unit No	Hrs.
1	**Verification of Bernoulli's Theorem:** Validate Bernoulli's principle using a fluid flow apparatus.	1	2
2	**Determination of Metacentric Height:** Measure the metacentric height of a floating body using a metacentric height apparatus.	1	4
3	**Flow Velocity Measurement:** Measure the velocity of fluid flow using orifice meters and venturi meters.	2	2
4	**Coefficient of Discharge in Open Channel Flow:** Determine the coefficient of discharge for flow over a notch in an open channel.	2	2
5	**Reynolds Experiment:** Investigate different flow patterns (laminar, transitional, turbulent) using Reynolds' experiment.	2	4
6	**Friction Factor Determination:** Measure the friction factor for various pipe types under different flow conditions.	2	2
7	**Loss Coefficients for Pipe Fittings:** Determine loss coefficients for various pipe fittings and bends.	2	2
8	**Impulse-Momentum Principle**: Verify the impulse-momentum principle through experiments on the impact of a jet on a stationary vane.	3	4
9	**Performance Testing of Turbines**: Conduct performance tests on Pelton, Kaplan, and Franci's turbines to analyze efficiency and power output.	3	4
10	**Performance Testing of Centrifugal Pump**: Assess the efficiency and performance parameters of a centrifugal pump.	4	4
		Total	30

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.
Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S. K. Kataria & Sons.

[2] Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Prakashan.

[3] Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S.Chand & Co.

[4] Theory and Applications of Fluid Mechanics by K. Subramanya, McGraw Education.

[5] Fluid Mechanics by Frank.M. White, McGraw Hill Education.

[6] Mechanics of Fluids by Shames, McGraw Hill Education.