Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-5 (B. Tech.)

Subject: Advance Fluid Mechanics – BETCV15318

Type of course: Professional Elective Courses

Prerequisite: Knowledge of Fluid Mechanics

Rationale: Advance Fluid Mechanics is essential because it provides the fundamental understanding of how liquids and gases behave, which is crucial for designing and optimizing countless systems that impact our daily lives, from water supply networks and energy production to transportation and environmental protection; by mastering these principles, engineers can solve real-world problems related to fluid flow, creating more efficient, sustainable, and innovative solutions.

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	
3	0	2	4	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:

Sr. No	Course Content	Hrs.	% Weightage
1	**Flow Through Pipes** Introduction-Continuity equation -Energy Equation Momentum Equation-Major and minor energy losses, hydraulic gradient and total energy line-pipes in series and parallel-pipe networks- hydraulic transmission of power. Navier-Stokes equation of motion- Initial conditions and boundary conditions. Viscous flow- Couette flow, Hagen Poiseuille equation-flow between parallel plates. Turbulent flow in pipes Prandtl's mixing length theory- velocity distribution-Smooth and rough boundaries-water hammer phenomenon	10	20
2	**Boundary Layer** Boundary layer concept-laminar and turbulent boundary layer growth over a flat plate, Von-Karman momentum integral equation-Separation of boundary layer and wake formation.	08	15
3	**Open Channel Flow** Basic concept of open channel flow- Steady Uniform Flow-Velocity Distribution-Optimum shape of cross section for uniform flow-Energy equation-specific energy-specific energy diagram discharge Diagram-Application of specific energy and discharge diagrams. Non-Uniform steady flow-equations for gradually varied flow- Direct Step method, Rapidly varied flow- Hydraulic jump- Location of hydraulic jump- flow under sluices-Water surface profiles.	10	25
4	**Turbo Machinery** Water Turbines: Impulse Turbine-Reaction turbine9 20 Specific Speed-Unit quantities, Performance characteristics for water turbines, Centrifugal pumps: Pumps in series and parallel, Specific speed, Unit quantities, and characteristics curves, Cavitation in turbines and pumps. Introduction to Ventilation System.	07	25
5	**Dimensional Analysis and Similitude** Fundamental dimensions Physical Quantity and Dimensions-Dimensional Homogeneity- Non Dimensional parameters, π-Theorem dimensional analysis, Choice of variables, Determination of Dimensionless parameters. Model Similitude-Physical models-geometric-kinematic and dynamic similarity, Model studies.	10	15

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1	**Case Studies on Fluid Mechanics Problems:** Faculty guide to students in group for the Analyze real-world case studies of fluid mechanics problems, such as pipe failures, dam breaches, or pump malfunctions. Students can investigate the causes of these problems and propose solutions. Make a report and upload on GMIU Web portal	10
2	**Visit on Open Channel:** Visit a open channel used for water distribution by individual students. Learn about the design considerations for these channels. Make Presentation on visit and upload on GMIU Web portal.	10
3	**Review paper on Turbine/Pump Design Project:** Study different types of pump or turbine in group (Min.5 students) using Scopus journal research paper. Research the design principles, operating characteristics, and applications of their assigned machine. Make a Review paper and upload 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 %	20%	30%	20 %	15%	10 %	5%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Analyze fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions.
CO2	Design streamlined objects considering boundary layer effects.
CO3	Analyze open channel flow and design optimal sections; calculate forces on sluice gates considering specific energy and momentum principle.
CO4	Understand, analyze and study the performance characteristics of hydraulic machines.
CO5	Carry out model studies for fluid flow problems

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List of Practical

Sr. No.	Descriptions	Unit No	Hrs
01	Determine Viscous flow through parallel plates	01	02
02	Derive equation of Pipe friction	01	02
03	Determine Pressure distribution around objects	02	04
04	Observe and analysis Uniform flow in Open Channel	03	04
05	Determine application of specific energy and momentum principle (Hydraulic jump)	03	04
06	Performance characteristics of Centrifugal pump	04	04
07	Performance Characteristics of Water Turbines	04	04
08	Determine Similitude and Model Studies	05	02
09	Development of Computer programs for fluid flow in pipes and open channel	01 & 03	02
10	Development of Computer programs for hydraulic machines and dimensional analysis.	04 & 05	02
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.

From the content 10% topics are suggested for flipped mode instruction.

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 the laboratory.

Reference Books:

[1] Theory and Applications of Fluid Mechanics by K Subramanya, McGraw Hill Publication,

[2] Fluid Mechanics by A.K. Jain, Khanna Publishers, New Delhi

[3] Hydraulics and Fluid Mechanics by P.N. Modi and S.M. Seth, Standard Book House, New Delhi

[4] Fluid Mechanics by Victor L. Streeter, E. B. Wylie by, McGraw Hill Publication

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