GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)
APPLIED FLUID MECHANICS
SUBJECT CODE: 2160602
B.E. 6th SEMESTER

Type of course: Applied Physics

Prerequisite: Fluid Mechanics

Rationale: To develop basic understanding for solving field problems related to fluid flow through pipes, open channels, turbo-machines and perform model analysis.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total
				Theory Marks			Practical Marks			Marks
L	T	P	C	ESE	PA (M)		ESE (V)		PA	
				(E)	PA	ALA	ESE	OEP	(I)	
3	0	2	5	70	20	10	20	10	20	150

Contents

Sr No	Contents	Teaching hrs	Weightage %
1	**Module I** **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	12	30
2	**Module II** **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.	4	10
3	**Module III** **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.	11	30
4	**Module IV** **Turbo Machinery**:Water Turbines: Impulse turbine-Reaction turbine-	9	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.		
5	**Module V** **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.	6	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**10**	**15**	**15**	**10**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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.

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

Course Outcomes:

After successful completion of the course the students shall be able to:
1. Analyze fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions
2. Analyze and design streamlined objects considering boundary layer effects.
3. Analyze open channel flow and design optimal sections; calculate forces on sluice gates considering specific energy and momentum principle.
4. Understand, analyze and study the performance characteristics of hydraulic machines
5. Carry out model studies for fluid flow problems

List of Experiments:

Students will have to perform following experiments in laboratory and prepare the laboratory manual. The students will have to solve five problems covering all modules.

1. Viscous flow through parallel plates
2. Pipe friction
3. Pressure distribution around objects
4. Uniform flow in Open Channel
5. Application of specific energy and momentum principle (Hydraulic jump)
6. Performance characteristics of Centrifugal pump
7. Performance Characteristics of Water Turbines
8. Similitude and Model Studies
9. Development of Computer programs for fluid flow in pipes, open channel, hydraulic machines and dimensional analysis.

Design based/open ended problem on:

1. Pipes in series and parallel
2. Pipe network analysis
3. Design of optimal open channel sections for uniform flow
4. Specific energy and hydraulic jump, forces on Sluice gates
5. Design of Pelton turbine, Francis turbine, Kaplan turbine, pumps in series and parallel
6. Model studies related to pipe flow, open channel flow, hydraulic machines etc.
7. Any other relevant problem suggested by faculty members.

Major Equipments:
1. Pipe friction apparatus
2. Wind tunnel
3. Open channel with necessary attachments for Uniform flow and Hydraulic Jump experiment
4. Test rig for Centrifugal pump
5. Test rig for Pelton turbine
6. Test rig for Francis turbine and
7. Test rig for Kaplan turbine

List of Open Source Software/learning website: www.nptel.ac.in

Active Learning Assignments (ALA):
Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work - The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.