INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION

Course Title	**FLUID MECHANICS**			
Course Code	A30101			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	2	-	4
Course Coordinator	Mr. G. Anand Reddy G, Assistant Professor, Civil Engineering			
Team of Instructors	Mr. G. Anand Reddy G, Assistant Professor, Civil Engineering			

I. COURSE OVERVIEW

The aim of this course is to introduce basic principles of fluid mechanics and it is further extended to cover the application of fluid mechanics by the inclusion of fluid machinery. Nowadays the principles of fluid mechanics find wide applications in many situations. The course deals with the fluid machinery, like turbines, pumps in general and in power stations. This course also deals with the large variety of fluids such as air, water, steam, etc; however the major emphasis is given for the study of water.

II. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	5	Engineering Physics, Thermodynamics, Engineering

III. MARKS DISTRIBUTION

Sessional Marks	University End Exam Marks	Total Marks
Continuous Assessment Tests (Midterm examinations): There shall be 2 midterm examinations. Each midterm examination consists of one objective paper, one subjective paper and four assignments. The objective paper is for 10 marks and subjective paper is for 10 marks, with duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for subjective paper). Objective paper is set for 20 bits of – multiple choice questions, fill-in the blanks, 10 marks. Subjective paper contains of 4 full questions (one from each unit) of which, the student has to answer 2 questions, each question carrying 5 marks. First midterm examination shall be conducted for 2.5 units of syllabus and second midterm examination shall be conducted for another 2.5 units. 5 marks are allocated for Assignments. First two assignments should be submitted before the conduct of the first mid, and the second two assignments should be submitted before the conduct of the second mid. The total marks secured by the student in each midterm examination are evaluated for 25 marks, and the average of the two midterm examinations shall be taken as the final marks secured by each candidate.	75	100

IV. EVALUATION SCHEME

S.No	Component	Duration	Marks
1	I Mid examination	90 minutes	20
2	I Assignment	--	05
3	II Mid examination	90 minutes	20
4	II Assignment	--	05
5	External examination	3 hours	75

V. COURSE OBJECTIVES

The objectives of the course are to enable the student;

I. To understand the basic principles of fluid mechanics
II. To identify various types of flows
III. To understand boundary layer concepts and flow through pipes
IV. To evaluate the performance of hydraulic turbines
V. To understand the functioning and characteristic curves of pumps.

VI. COURSE OUTCOMES

At the end of this course, a student will be able to:

1. Explain the effect of fluid properties on a flow system.
2. Identify type of fluid flow patterns and describe continuity equation.
3. Analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
4. Demonstrate boundary layer concepts.
5. Explain the concept of prandtl contribution.
6. Evaluate the Vonkarmen momentum integral equation.
7. Analyze the closed conduit flows using Renold's experiment.
8. Analyze the laws of fluid friction using Darcy's equation.
9. Evaluate the head losses in pipes.
10. Solve pipe network problems.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program outcomes		Level	Proficiency assessed by
PO1	**General knowledge:** An ability to apply the knowledge of mathematics, science and Engineering for solving multifaceted issues of Electrical Engineering	S	Assignments
PO2	**Problem Analysis:** An ability to communicate effectively and to prepare formal technical plans leading to solutions and detailed reports for electrical systems	N	Exercise
PO3	**Design/Development of solutions:** To develop Broad theoretical knowledge in Electrical Engineering and learn the methods of applying them to identify, formulate and solve practical problems involving electrical power	H	Assignments , Discussion
PO4	**Conduct investigations of complex problems**: An ability to apply the techniques of using appropriate technologies to investigate, analyze, design, simulate and/or fabricate/commission complete systems involving generation, transmission and distribution of electrical energy	H	Exercise

PO5	**Modern tool usage:** An ability to model real life problems using different hardware and software platforms, both offline and real-time with the help of various tools along with upgraded versions.	N	------
PO6	**The engineer and society**: An Ability to design and fabricate modules, control systems and relevant processes to meet desired performance needs, within realistic constraints for social needs	S	Exercise
PO7	**Environment and sustainability:** An ability To estimate the feasibility, applicability, optimality and future scope of power networks and apparatus for design of eco-friendly with sustainability	S	Discussion,Seminars
PO8	**Ethics:** ToPossess an appreciation of professional, societal, environmental and ethical issues and proper use of renewable resources	N	Discussion, Seminars
PO9	**Individual and team work:** An Ability to design schemes involving signal sensing and processing leading to decision making for real time electrical engineering systems and processes at individual and team levels	S	Discussions
PO10	**Communication:** an Ability to work in a team and comprehend his/her scope of work, deliverables , issues and be able to communicate both in verbal ,written for effective technical presentation	S	Discussion,Seminars
PO11	**Life-long learning**: An ability to align with and upgrade to higher learning and research activities along with engaging in life-long learning.	N	-----
PO12	**Project management and finance**: To be familiar with project management problems and basic financial principles for a multi-disciplinary work	S	Prototype, Discussions

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO 1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	H	Lectures and Assignments
PSO 2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	S	Tutorials
PSO 3	**Successful career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	S	Seminars and Projects

N - None **S - Supportive** **H – Highly Related**

IX. SYLLABUS

UNIT I

Introduction : Dimensions and units – Physical properties of fluids specific gravity, viscosity, surface tension, vapor pressure and their influences on fluid motion pressure at a point, Pascal's law, Hydrostatic law - atmospheric, gauge and vacuum pressure- measurement of pressure. Pressure gauges, Manometers: differential and Micro Manometers.

Hydrostatic Forces : Hydrostatic forces on submerged plane, Horizontal, Vertical, inclined and curved surfaces – Center of pressure. Derivations and problems.

UNTI – II

Fluid Kinematics : Description of fluid flow, Stream line, path line and streak lines and stream tube. Classification of flows : Steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows – Equation of continuity for one, two , three dimensional flows – stream and velocity potential functions, flownet analysis.

UNIT –III

Fluid Dynamics: Surface and body forces – Euler's and Bernoulli's equations for flow along a streamline for 3 -D flow, (Navier – stokes equations (Explanationary) Momentum equation and its application forces on pipe bend. Pitot tube, Venturi meter and orifice meter – classification of orifices, flow over rectangular, triangular and trapezoidal and Stepped notches - –Broad crested weirs.

UNIT – IV

Boundary Layer Theory : Approximate Solutions of Navier Stoke's Equations – Boundary layer – concepts, Prandtl contribution, Characteristics of boundary layer along a thin flat plate, Vonkarmen momentum integral equation, laminar and turbulent Boundary layers (no deviation), BL in transition, separation of BL, control of BL, flow around submerged objects-Drag and Lift- Magnus effect.

UNIT –V

Closed Conduit Flow \: Reynold's experiment – Characteristics of Laminar & Turbulent flows. Flow between parallel plates, Flow through long tubes, flow through inclined tubes. Laws of Fluid friction – Darcy's equation, Minor losses – pipes in series – pipes in parallel – Total energy line and hydraulic gradient line. Pipe network problems, variation of friction factor with Reynold's number – Moody's Chart

Textbooks:

1. Fluid Mechanics by Modi and Seth, Standard book house.
2. Introduction to Fluid Machines by S.K.Som & G.Biswas (Tata Mc.Grawhill publishers Pvt. Ltd.)
3. Mechanics of Fluids by Potter, Cengage Learning Pvt. Ltd.

Referencebooks:

1. Fluid Mechanics Basic Concepts & Principles, Shiv Kumar, Ane Books Pvt Ltd.
2. Fluid Mechanics and Machinary, CSP Ojha, Oxford Higher Eduction
3. Fluid Mechanics by Frank.M. White (Tata Mc.Grawhill Pvt. Ltd.)
4. Fluid Mehanics by A.K. Mohanty, Prentice Hall of India Pvt. Ltd., New Delhi
5. A text of Fluid mechanics and hydraulic machines by Dr. R.K. Bansal - Laxmi Publications (P) ltd., NewDelhi

6. Fluid Mechanics and Machinery by D. Ramdurgaia New Age Publications**.**

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1	**Outline** of various units	**UNIT-I** Introduction, dimensions and units	R4, T2
2-5	**Explain** fluid properties	Physical properties of fluids-specific gravity, viscosity, Surface tension, vapour pressure and their influence on fluid motion	R4, T1
6	**Distinguish** various pressures	Atmospheric, gauge and vacuum pressures	R4
7-10	**Determine** pressure with different instruments	Measurement of pressure- piezometer, U-tube and differential manometers	R4, T1, T2
11-12	**Differentiate** various flow lines	**Unit-II: Fluid Kinematics**: Stream line, path line, streak line and stream tube	R4, T2
13-14	**Classify and describe** various flows	Classification of flows- steady and unsteady, uniform and non uniform, laminar and turbulent, rotational and irrotational flows	R4, T1, T2
15-16	**Formulate** continuity equation for 1 and 3-d flow	Equation of continuity for one dimensional flow and three dimensional flows	R4, T1
17	**List** various forces	**UNIT-III-Fluid dynamics:** Surface and body	R4
18-20	**Formulate** Euler's and Bernoulli's equations	Euler's and Bernoulli's equations for flow along a stream line	R4, T2
21-22	**Apply** momentum equation for a pipe bend	Momentum equation and its application on force on pipe bend	R4, T2
23	**Define** boundary layer	**UNIT-III : BOUNDARY LAYER CONCEPTS:** Definition, thickness, characteristics along thin plate	R4, T2
24-25	**Distinguish** boundary layer of laminar, turbulent and transition	Laminar and turbulent boundary layers (No derivation), boundary layer in transition	R4, T2
26-27	**Explain** separation of boundary layer	Separation of boundary layer, submerged objects- drag and lift	R4, T1
28	**Demonstrate** Reynold's experiment	**Closed conduit flow:** Reynolds's experiment	R4
29-30	**Formulate** the Darcy's equation	Darcy Weisbach equation-minor losses in pipes	T2
31-32	**Discuss** the series and parallel connections of pipes	Pipes in series and pipes in parallel	R4, T1
33-35	**Construct** total energy and hydraulic gradient lines	Total energy line - hydraulic gradient line	R4, T1, T2
36-39	**Measure** the discharge	Measurement of flow: Pitot tube, venture meter, and orifice meter, flow nozzle	R4, T2
40-41	**Discuss** the effect of hydrodynamic force on flat vanes	**UNIT – IV: Basics of Turbo machinery:** Hydrodynamic force of jets on stationary and moving flat, inclined vanes	R4, T1

42-45	**Draw** the velocity triangles for Curved vanes	Curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes	R4, T1
46	**Classify** the turbines	**Hydraulic Turbines:** classification of turbines, heads and efficiencies, impulse and reaction turbines	R4, T1, T2
47-52	**Evaluate** the performance of turbines	Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies	R4, T1, T2
53-54	**Describe** the functions of draft tube	Hydraulic design-draft tube theory – functions and efficiency	R4, T2
55-56	**Define** unit quantities and **Draw** characteristic curves	**Performance of hydraulic turbines:** Geometric similarity, unit and specific quantities, characteristic curves	R4, T2
57-59	**Illustrate** the governing of turbines	Governing of turbines, selection of type of turbine	R4, T2
60	**Explain** Cavitation, water hammer, surge tank	Cavitation, surge tank, water hammer	R4, T2
61-64	**Classify and Explain** the working of centrifugal pump	**UNIT-V:Centrifugal pumps:** Classification, working, work done-barometric head losses and efficiencies	R4, T2
65-66	**Compare** the characteristic curves of centrifugal pump	Specific speed – performance characteristic curves, NPSH.	R4, T1, T2
67-70	**Describe and Evaluate** the performance of reciprocating pumps	**Reciprocating pumps:** working, discharge, slip, indicator diagrams	R4, T1, T2

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I					H						S				
II					H										
III		H			H										H
IV	H	H	S											H	H
V			S		H										

N = None **S = Supportive** **H = Highly related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF TSHE PROGRAM OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			S												
2		H			H										H
3											S				
4		H	S												H
5	H		S								S			H	
6	H	H			H									H	H
7		H	S												H
8	H		S								S			H	
9	H	H			H									H	H
10	H													H	

N = None **S = Supportive** **H = Highly related**

Prepared by: Mr.Anand Reddy G, Assistant Professor

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