MECHANICS OF FLUIDS AND HYDRAULIC MACHINES

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AME008	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic principles of fluid mechanics.
II. Understand boundary layer concepts and flow through pipes.
III. Evaluate the performance of hydraulic turbines.
IV. Understand the functioning and characteristic curves of pumps.

COURSE LEARNING OUTCOMES (CLOs):

1. Define the properties of fluids and its characteristics, which will be used in aerodynamics, gas dynamics, marine engineering etc.
2. Explain the hydrostatic forces on submerged bodies, variation with temperature and height with respect to different types of surfaces.
3. Define different types of manometers and explain buoyancy force, stability of floating bodies by determining its metacenter height.
4. Define fluid kinematics and classification of flows, concepts of stream function and velocity potential function which provides solution for velocity and acceleration of fluid flow in real time applications.
5. Explain one dimensional, two dimensional flows in wind tunnel with classification of both compressible and in compressible flows in continuity equation.
6. Recognize the surface and body forces required for obtaining momentum equation and energy equation and explain types of derivatives utilized in various flow field conditions.
7. Develop Bernoulli's equation from Euler's equation and explain phenomenological basis of Navier – stokes equation which are widely used in aerodynamics and gas dynamics for real time problems.
8. Demonstrate Buckingham's π theorem and explain similarity parameters used for scale down models and explain flow measurements with dimensionless parameters.
9. Demonstrate for competitive exams, the concepts of boundary layer and qualitative description of boundary layer thickness and velocity profile on a flat plate.
10. Distinguish the pressure drag and skin friction drag and state the relation between the frictions of both the drags.
11. Demonstrate the various types of major and minor losses in pipes and explain flow between parallel plates.
12. Discuss fully developed flow through pipes and variation with friction factor with Reynolds number and sketch the Moody's chart.
13. Describe the concepts of turbo machinery in the field of aerospace engineering and concepts of internal flows through engines.
14. Explain types of hydraulic pumps, the basic functions and features.
15. Design and select pumps (single or multiple) for different hydraulic applications.
16. Understand pumps classification and be able to develop a system curve used in pump selection .
17. Analyze flow in closed pipes, and design and selection of pipes including sizes.
18. Understand the basic elements of pump and turbine flow, and be able to analyze and select the pump needed for pressurizing situations.

19. Recognize and discuss today's and tomorrow's use of turbomachines for enabling a sustainable society.
20. Explain the working principle of various types of hydro turbines and know their application range
21. Determine the velocity triangles in turbomachinery stages operating at design and offdesign conditions.

UNIT-I	**FLUID STATICS**	**Classes: 12**

Dimensions and units, Physical properties of fluids-specific gravity, viscosity, surface tension, vapour pressure and their influence on fluid motion, atmospheric, gauge and vacuum pressures, measurement of pressure, piezometer, U-tube and differential manometers.

UNIT -II	**FLUID KINEMATICS, FLUID DYNAMICS**	**Classes: 12**

Joint probability distributions, joint probability mass, density function, marginal probability mass, density functions; Correlation: Coefficient of correlation, the rank correlation; Regression: Regression coefficient, the lines of regression, multiple correlation and regression.

UNIT -III	**BOUNDARY LAYER CONCEPTS, CLOSED CONDUIT FLOW**	**Classes: 12**

Boundary layer Concepts: Definition, thickness, characteristics along thin plate, Laminar and turbulent boundary layers, boundary layer in transition, Separation of boundary layer, submerged objects- drag and lift.

Closed Conduit flow: Reynolds's experiment, Darcy Weisbach equation, minor losses in pipes, Pipes in series and pipes in parallel, Total energy line, hydraulic gradient line, Measurement of flow, Pitot tube, venturi meter, and orifice meter, flow nozzle.

UNIT -IV	**BASICS OF TURBO MACHINERY, HYDRAULIC TURBINES AND PERFORMANCE**	**Classes: 12**

Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined vanes, curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow radial vanes; Hydraulic turbines: classification of turbines, heads and efficiencies, impulse and reaction turbines, Peloton Wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design, draft tube theory, functions and efficiency; Performance of hydraulic turbines: Geometric similarity, unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT -V	**CENTRIFUGAL PUMPS AND RECIPROCATING PUMPS**	**Classes: 12**

Centrifugal pumps: Classification, working, work done, barometric head losses and efficiencies, specific speed, performance characteristic curves, NPSH; Reciprocating pumps: working, discharge, slip, indicator diagrams.

Text Books:

1. H Modi, Seth, "Hydraulics, Fluid Mechanics and Hydraulic Machinery", Rajsons Publications, 20th Edition, 2013.
2. Rajput, "Fluid Mechanics and Hydraulic Machines", S.Chand & Co, 6th Edition, 1998.

Reference Books:

1. Dr. R K Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, 9th Edition, 2015.
2. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", Kotaria & Sons, 2013.
3. D. Rama Durgaiah, "Fluid Mechanics and Machinery", New Age International, 1st Edition, 2002.
4. Banga, Sharma, "Hydraulic Machines", Khanna Publishers, 6th Edition, 2001

Web References:

1. https://nptel.ac.in/courses/112104117/
2. https://easyengineering.net/a-textbook-of-fluid-mechanics-and-and-hydraulic-machines-bansal/
3. https://lecturenotes.in/subject/95/fluid-mechanics-and-hydraulic-machines-fmhm
4. https://nptel.ac.in/downloads/112106200/

E-Text Books:

1. https://www.pdfdrive.com/fluid-mechanics-and-hydraulic-machines-e18705469.html
2. https://insightgovtexam.com/basic-fluid-mechanics-and-hydraulic-machines-pdf-free-download/
3. http://www.faadooengineers.com/threads/44517-Fluid-Mechanics-and-Hydraulic-Machines-by-Rajput-Free-Download