FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Automobile Engineering)**

Semester: **IV**

Course Code: **202010403**

Course Title: **Fluid Mechanics and Hydraulics Machines**

Course Group: **Professional Core Course**

Course Objectives: This course imparts the fundamental knowledge of fluid mechanics and hydraulic machines, various properties of fluid and its behavior in both static and dynamic conditions.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	50 / 18	25 /9	50 / 17	25 / 9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Fluids and Their Properties:** Definition of fluid, fluid classifications, hypothesis of continuum, shear stress in a moving fluid, molecular structure of material, density, viscosity, surface tension, capillary effect, vapour pressure, compressibility and the bulk modulus. Lab Teaching: Pressure, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity, equality of pressure at the same level in a static fluid, general equation for the variation of pressure due to gravity from a point to point in a static fluid, pressure and head, hydrostatic paradox, pressure measurements by manometers.	03
2	**Static Forces on Surface and Buoyancy:** Fluid statics, action of fluid pressure on surface, resultant force and centre of pressure on a plane surface under uniform pressure and immersed in a liquid. Pressure diagrams, buoyancy, equilibrium of floating bodies, stability of a submerged body, stability of floating bodies, determination of the metacentric height, determination of the position of the metacentre relative to the centre of buoyancy.	06

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3	**Motion of Fluid Particles and Streams:** Fluid flow, different types of flow, frames of reference, analyzing fluid flow, motion of a fluid particle, acceleration of a fluid particle, discharge and mean velocity, continuity of flow, continuity equations for 2-D and 3-D flow in Cartesian coordinates of system.	**03**
4	**The Energy equation and its application:** Momentum and fluid flow, Momentum equation for 2-D flow along a stream line, momentum correction factor, Euler's equation of motion along a stream line, mechanical energy of a flowing fluid, Bernoulli's theorem, kinetic energy correction factor, changes of pressure in tapering pipe, principle of Venturimeter, orifice, rotameter, theory of notches and weirs.	**08**
5	**Two-Dimensional Ideal Fluid Flow:** Rotational and irrotational flow, circulation and vorticity, streamlines and the stream functions, velocity potential and potential flow, relation between stream function and velocity potential, flow nets, stream function and velocity potential for uniform flow, vortex flow.	**04**
6	**Dimensional Analysis and Similarities:** Dimension reasoning, dimensional homogeneity, dimensional analysis using Rayleigh's method, Buckingham π-theorem, use of dimensionless numbers in experimental investigation, geometric similarity, dynamic similarity, kinematic similarity, model testing, model laws, undistorted and distorted models.	**04**
7	**Viscous and Turbulent Flow:** Reynolds' experiment, flow of viscous fluid through circular Pipe-Hagen Poiseuille formula, flow of viscous fluid between two parallel fixed plates, power absorbed in viscous flow through - journal, foot step and collar bearing, turbulent flow expression for coefficient of friction -Darchy Weishbach equation, moody diagram, resistance of smooth and rough pipes, shear stress and velocity distribution in turbulent flow through pipes. Lab Teaching: Flow through pipes: Major and minor energy losses, hydraulic gradient and total energy lines, pipes in series and parallel, equivalent pipes, water hammer in pipes.	**08**
8	**Hydraulic Turbines:** Definitions of heads and efficiencies of turbine, Classification of hydraulic turbines, impulse and reaction turbines, construction, working of Pelton, Francis and Kaplan turbines, draft tube.	**03**
9	**Applications of hydraulic machines in Automobile:** **Impact of Jet**: Force exerted on stationary vertical, Inclined and curved flat plate, force on the flat vertical, Inclined and curved plate when the plate is moving in the direction of jet. **Fluid systems application in Automobile:** Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic jack, hydraulic lift, hydraulic ram. **Centrifugal Pumps:** Classification of Pumps, Work done by the centrifugal pump on water, definitions of heads and efficiencies of a centrifugal pump.	**06**

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List of Practicals / Tutorials:

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1	Verification of Bernoulli's Theorem.
2	Demonstration of pressure measurements.
3	To determine metacentric height by metacentric height apparatus.
4	To measure the velocity of flow using orifice meter and Venturimeter.
5	To determine the coefficient of discharge through open channel flow over a notch.
6	To determine the friction factor for the different pipes.
7	To determine the loss coefficients for different pipe fittings.
8	To Verify Impulse-momentum principle for impact of jet on stationary vane.
9	Performance test on turbines.
10	Performance test on centrifugal pump.

Reference Books:

1	Fluid Mechanics: Fundamentals and Applications by by Yunus A Çengel and John Cimbala, McGraw Hill Education.
2	Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S. K. Kataria & Sons.
3	Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Prakashan
4	Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S.Chand & Co.
5	Theory and Applications of Fluid Mechanics by K. Subramanya, McGraw Education.
6	Fluid Mechanics by Frank M. White, McGraw Hill Education.
7	Mechanics of Fluids by Shames, McGraw Hill Education.

Supplementary learning Material:	
1	NPTEL Resources

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment

Internal Evaluation :

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model

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making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
25%	25%	25%	20%	05%	0%	

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 Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understanding various fluid properties and behaviour of fluid in static mode, including stability of a floating bodies.	**20**
CO-2	Applications of fluid flow conservation laws for Engineering applications	**30**
CO-3	Understanding concept of dimensional analysis and interpretation of types of fluid flow.	**20**
CO-4	Understanding working of various types of hydraulic pumps and turbines.	**20**
CO-5	Understanding fluid power application systems in Automobiles.	**10**

Curriculum Revision:	
Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2027

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