Lok Jagruti Kendra University
University with a Difference

Diploma in Automation & Robotics

LJ Polytechnic

Course Code: 025120302

Fluid Mechanics and Machines

Programme / Branch Name			Diploma in Automation and Robotics			
Course Name	Fluid Mechanics and Machines				**Course Code**	025120302
Course Type	HSSC	BSC	ESC	PCC	OEC	PEC

Legends: HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

1. Teaching and Evaluation Scheme

Teaching Hours / Week				**Evaluation Scheme**			
L	**T**	**P**	**Total Credit**	**CCE**	**SEE (Th)**	**SEE (Pr)**	**TOTAL**
4	0	2	5	50	50	50	150

Legends:
L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

2. Prerequisites

- ✓ Basic Mathematics
- ✓ Engineering Physics

3. Rationale

The main objective of this course is to grasp the basics of the mechanics of fluid and flow properties, fluid behavior at rest and in motion, and employ basic equations related to mass and energy of a fluid system thereby developing an understanding of fluid dynamics and its application in a variety of fields. To apply the above knowledge for using various fluid flow and velocity measuring devices. To get familiar with the working, construction, and calculations for turbomachines like pumps and turbines.

4. Objectives

- ✓ To familiarize with the properties of the fluid and the application of fluid mechanics.
- ✓ To study types of fluid, fluid flow, and flow patterns.
- ✓ To describe fluid pressure and its measurement and Define the relationship between pressure and elevation as it relates to manometers, barometers, and other pressure-measuring devices.
- ✓ Understanding of analyzing flow systems in terms of mass and energy balance.
- ✓ To understand the concept of fluid measurement, types of flows its applications in Industries.
- ✓ To study the basic concepts of various types of turbines and pumps.

5. Contents

Unit No.	Unit Name	Topics	Learning Outcome	% Weightage	Hours
1.	**Properties of Fluids**	1.1. Introduction- Motivation to Study fluid Mechanics, Fluid, Application Areas of Fluid Mechanics 1.2. Properties of Fluid- Density, Specific Weight, Specific Volume, Specific Gravity, Dynamic Viscosity, Kinematic Viscosity, Surface Tension, Capillarity, Compressibility, Bulk Modulus, Vapour Pressure, Cavitation 1.3. Types of Fluids- Newtonian and Non-Newtonian Fluids, Ideal and Real Fluids 1.4. Classification of Fluid Flows-Viscous vs Inviscid Region Flow, Compressible vs Incompressible Flow, Laminar vs Turbulent Flow, Unforced (Natural) vs Forced Flow, Steady vs Unsteady Flow, One-, Two- and Three-Dimensional Flow.	• Understand the basic concepts of fluid mechanics and recognize the various types of fluid flow problems encountered in practice. • Have a working knowledge of the basic properties of fluids and understand the continuum approximation. • Have a working knowledge of viscosity and the consequences of the frictional effects it causes. • Understand the effects of surface tension.	20	12
2.	**Fluid Statics and Pressure Measurement**	2.1. Pressure- Pressure at a point (Pascals Law), Variation of Pressure with depth 2.2. Pressure Terminology- Pressure head, Absolute Pressure, Gauge Pressure, Vacuum Pressure, Units of Pressure. 2.3. Pressure Measurement- Mechanical Pressure Gauges, Manometers - Piezometer, U-Tube Manometer,	• Determine the variation of pressure in a fluid at rest. • Understand the working of pressure measuring devices. • Take readings of pressure using Manometers.	15	8

		Differential Manometer. 2.4. Recent Advancements in pressure measuring technology.			
3.	**Fluid Kinematics and Dynamics**	**Kinematics:** 3.1. Introduction 3.2. Types of Fluid Flow pattern- Streamline, Pathline and Streaklines. 3.3. Continuity equation 3.4. Practical Applications of Continuity equation. **Dynamics:** 3.5. Introduction 3.6. Bernoulli's Equation and Its assumptions - Pressure Head, Kinetic Head and Potential Head. 3.7. Limitations on the use of Bernoulli's Equation. 3.8. Applications of the Bernoulli's Equation (Numerical). 3.9. Reynolds Experiment (Use of Reynold number to determine type of flow. 3.10. Practical Applications of Darcy Weisbach equation (No Derivation), Water Hammer, Syphon.	• Apply the mass equation to balance the incoming and outgoing flow rates in a flow. • Apply the mass equation to balance the incoming and outgoing flow rates in a flow system. • Understand the use and limitations of the Bernoulli equation, and apply it to solve a variety of fluid flow problems. • Have deeper understanding of laminar and turbulent flow in pipes and Calculation of losses in piping networks.	35	18
4.	**Flow Rate and Velocity Measurement**	4.1. Flowmeters 4.1.1. Venturimeter 4.1.2. Orifice meter 4.1.3. Rotameter 4.1.4. Ultrasonic Flowmeter 4.1.5. Electromagnetic Flowmeter 4.1.6. Thermal (Hot wire Anemometer) 4.2. Velocimetry 4.2.1. Pitot Tube 4.2.2. Laser Doppler Velocimetry	• Understand various velocity and flow rate measurement techniques. • Learn their advantages and disadvantages.	10	6

		4.2.3. Practical Image Velocimetry			
5.	**Turbo Machinery**	5.1. Pumps 5.1.1. Introduction 5.1.2. Classification of Pumps 5.1.3. Centrifugal Pump 5.1.4. Reciprocating Pump,Gear Pump 5.1.5. Priming in Pumps 5.1.6. Specific Speed for Pumps 5.2. Turbines 5.2.1. Introduction and Classification 5.2.2. Impulse Turbines 5.2.3. Reaction Turbines 5.2.4. Specific Speed for Turbines	• Identify various types of pumps and turbines, and understand how they work. • Use specific speed for preliminary design and selection of pumps and turbines.	20	12
				Total Hours	**56**

6. List of Practicals / Exercises

The practicals/exercises have been properly designed and implemented in an attempt to develop different types of skills so that students can acquire the competencies/programme outcomes. Following is the list of practicals/exercises.

Sr. No.	Practical / Exercises	Key Competency	Hours
1.	To demonstrate various types of fluids and fluid properties.	Observe the densities of different fluids like Mercury, Petrol, Water, and Air.	2
2.	To understand the working of Orifice meter and to determine the coefficient of discharge of Venturimeter.	To learn the operation of the orifice meter and its similarity with the Venturimeter. To understand control flow measurement by means of valves. Calculation of Discharge measurement through pipes. Observing and Evaluating results obtained in manometer into pressure terms.	6

3.	To verify the Bernoulli's Theorem.	Check conversion of energies into different forms.	4
4.	Estimate Reynolds number for a given Flow and pipe dimensions.	Calculate Reynolds number for a pipe flow. Classify a pipe flow as laminar, turbulent, or transitional by observing a dyed streak in the flow. Classify a pipe flow as laminar, turbulent, or transitional using the Reynolds Number	2
5.	To understand the specifications of pump and use it to compute theoretical discharge and compare it with actual discharge.	Gather data and understand the specification of pump. Compute discharge on the basis of specifications given on the a pump. Measure actual discharge by using conventional methods for the same pump.	6
6.	To determine the efficiency of Francis Turbine.	Check the performance of a Francis turbine at different flow rates mathematically.	6
7.	Case Study: a) Study of failures in Hydraulic Systems Activities: a) To calculate the volume of Household Tank. b) To evaluate velocity of water coming out of tap by measuring actual discharge rate and diameter of tap. c) To verify the calculated velocity.	-	2
		Total Hours	**28**

7. Suggested Specification Table for Evaluation Scheme

Unit No.	Unit Name	Distribution of Topics According to Bloom's Taxonomy					
		R %	U %	Ap %	C %	E %	An %
1.	Properties of Fluids	40	40	-	-	10	10
2.	Fluid Statics and Pressure Measurement	24	22	20	-	24	10
3.	Fluid Kinematics and Dynamics	13	26	20	-	26	15
4.	Flow Rate and Velocity Measurement	20	35	35	-	10	-
5.	Turbo Machinery	26	34	13	-	14	13

Legends: R: Remembering U: Understanding
App: Applying C: Creating
E: Evaluating An: Analyzing

8. Textbooks

1) Fluid Mechanics and Hydraulic Machines, Dr. RK Bansal, Laxmi Publication.
2) Fluid Mechanics and Hydraulic Machines, RK Rajput, S Chand.

9. Reference Books

1) Applied and computational Fluid Mechanics, Scott Post, Firewall Media Publication.
2) Principles of Fluid Mechanics and Fluid Machines, N Narayanan Pillai, Universities Press.
3) Thermal Fluid Science, Yunus Cengel, John Cimbala, McGrawhill Publication.
4) Fluid Mechanics, AK Jain, Khanna Publications.
5) Fluid Mechanics Fundamentals and Applications, Yunus Cengel, John Cimbala, McGrawhill Publication.

10. Open Sources (Website, Video, Movie)

1) https://nptel.ac.in/courses/112/105/112105206/
2) https://youtu.be/GkQorTnV56k
3) https://nptel.ac.in/courses/112/105/112105171/
4) https://uta.pressbooks.pub/appliedfluidmechanics/
5) https://arxiv.org/ftp/arxiv/papers/1407/1407.3162.pdf
6) https://www.springer.com/series/5032
7) https://lecturenotes.in/subject/240/fluid-mechanics-fm
8) https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_FLUID%20MECHANICS_LECTURE_NOTES.pdf
9) http://fma.if.usp.br/~eabdalla/exacta/000m1.pdf
10) http://ftp.demec.ufpr.br/disciplinas/TM240/Marchi/Bibliografia/White_2011_7ed_Fluid-Mechanics.pdf