Maharashtra State Board of Technical Education, Mumbai

K-2

LABORATORY PLAN (LP)

Academic Year: 2025-26

Date: 09/12/2025

Institute Name & Code: K. K. Wagh Polytechnic, Nashik-3 (0078) Class: SYCH

Program and Code: Chemical Engineering (CH) Course Index: CO404

Course Name: INDUSTRIAL FLUID FLOW OPERATION Course Code &. Abbr.: 314310(IFFO)

Total Hrs: 60 Semester: 4th Scheme: K Name of Faculty: Mrs. A. B. Shaikh

- **INDUSTRY EXPECTED OUTCOME**

• Measurement of flow rates of fluids by selecting the appropriate flow meter.
• Select pumping devices for transportation of fluids in Chemical industries.

- **COURSE LEVEL LEARNING OUTCOMES (COS)**
- **CO404.1** - Identify the different properties of fluid used in chemical process.
- **CO404.2** - Apply law of conservation of mass and energy to the flowing fluids.
- **CO404.3**- Estimate the flow rate of fluid in conduit and in open channels by using different flow meters.
- **CO404.4** - Select the appropriate pumping device for transportation of liquids in chemical industries
- **CO404.5**- Choose the suitable pumps for transportation of gases in chemical industries.
- **Teaching and Examination Scheme:**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs/Week			SLH	NLH			Theory				Based on LL & TSL Practical				Based on SL		
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
				CL	TL	LL					Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314310	INDUSTRIAL FLUID FLOW OPERATION	IFFO	DSC	4	-	4	-	8	4	03	30	70	100	40	25	10	25#	10	--	--	150

Abbreviations: CL- Class Room Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

- **Laboratory Learning Outcome (LLO)**

LLO No.	Title of LLO
LLO 1.1	Analyze the effect of temperature on viscosity of liquid.
LLO 2.1	Find out the viscosity of given liquid samples.
LLO 2.2	Measure the density of liquid by using specific gravity bottle.
LLO 3.1 LLO 3.2	Record the reading of water level in two limbs of manometer. Operate valve to change the pressure
LLO 4.1 LLO 4.2	Predict the nature of flow of fluid flowing through a pipe/conduit. Relate the nature of filament with corresponding calculated reynolds number
LLO 5.1 LLO 5.2 LLO 5.3	Relate pressure and velocity of fluid in a manometer tube. Observe the fluid elevation through the manometer tube at different flowrates. Operate appropriate valve to maintain steady flow.
LLO 6.1 LLO 6.2	Find the losses in pipes due to sudden change in diameter of pipe. Determine the associated friction factor under a range of flow rates and flow regimes(laminar or turbulent)
LLO 8.1 LLO 8.2	Use Fanning equation to calculate the losses in pipe. Plot the friction factor chart
LLO 10.1 LLO 10.2	Investigate the variation in pressure at inlet and throat at various rates. Measure the differential pressure using manometer.

LLO No.	Title of LLO
LLO 11.1	Investigate the variation in pressure at inlet and throat at various rates.
LLO 11.2	Measure the differential pressure using manometer.
LLO 12.1	Investigate the variation in pressure at inlet and throat at various rates.
LLO 12.2	Measure the differential pressure using manometer.
LLO 15.1	Perform the priming of centrifugal pump.
LLO 15.2	Use Energy meter to find out energy actually supplied to pump (Input power).

- **COs, Practical Laboratory Learning Outcome (LLOs) and Mapping:**

PR. No	Relevant COs	Practical - Laboratory Learning Outcome (LLO)	Name of Experiments/Assignment/ Sheet/ Job/ Project Activity	Planned Dates		Actual Date of conduction	Remark/ Assess-ment Date with Staff sign
				From	To		
1	CO1	LLO 1.1 LLO 1.2	*Determination of viscosity of a given liquid at different temperatures by using redwood viscometer	A-15/12/25	A-22/12/25		
				B-16/12/25	B-23/12/25		
				C-17/12/25	C-24/12/25		
2	CO1	LLO 2.1 LLO 2.2	*Calculation the viscosity of different liquids by using redwood viscometer at constant temperature.	A-22/12/25	A-29/12/25		
				B-23/12/25	B-30/12/25		
				C-24/12/25	C-31/12/25		
3	CO1	LLO 3.1 LLO 3.2	*Determination of gauge pressure and differential pressure by using a set-up of U-tube manometer.	A-29/12/25	A-05/01/26		
				B-30/12/25	B-06/01/26		
				C-31/12/25	C-07/01/26		
4	CO2	LLO 4.1 LLO 4.2 .	*Determination of various types of flows by using reynold's experiment set-up.	A-05/01/26	A-12/01/26		
				B-06/01/26	B-13/01/26		
				C-07/01/26	C-14/01/26		
5	CO2	LLO 5.1 LLO 5.2	*Calculation the total energy of the fluids by using experimental setup of Bernoulli's theorem.	A-12/01/26	A-19/01/26		
				B-13/01/26	B-20/01/26		
				C-14/01/26	C-21/01/26		
6	CO1 CO2	LLO 6.1 LLO 6.2	*Calculation of the coefficient of discharge of fluid in venturimeter	A-19/01/26	A-02/02/26		
				B-20/01/26	B-27/01/26		
				C-21/01/26	C-28/01/26		
7	CO1 CO2	LLO 8.1 LLO 8.2	*Calculation of the coefficient of discharge of fluid orificemeter.	A-02/02/26	A-09/02/26		
				B-27/01/26	B-03/02/26		
				C-28/01/26	C-04/02/26		
8	CO1 CO2 CO3	LLO 10.1 LLO 10.2	*Plot the curve of area vs float position vs actual discharge using rotameter	A-09/02/26	A-16/02/26		
				B-03/02/26	B-10/02/26		
				C-04/02/26	C-11/02/26		
9	CO1 CO2	LLO 11.1 LLO 11.2	*Determination the efficiency of a centrifugal pump and plot the characteristics curves.	A-16/02/26	A-23/02/26		
				B-10/02/26	B-17/02/26		

PR. No	Relevant COs	Practical - Laboratory Learning Outcome (LLO)	Name of Experiments/Assignment/ Sheet/ Job/ Project Activity	Planned Dates		Actual Date of conduction	Remark/ Assess-ment Date with Staff sign
	CO3			C-11/02/26	C-18/02/26		
10	CO2 CO3	LLO 12.1 LLO 12.2	Determination of the fluidization velocity for the bed of solid materials by using fluidized bed.	A-23/02/26	A-02/03/26		
				B-17/02/26	B-24/02/26		
				C-18/02/26	C-25/02/26		
11	CO1 CO4	LLO 15.1 LLO 15.2	Plot the flow rate vs head developed by using the reciprocating pump.	A-02/03/26	A-09/03/26		
				B-24/02/26	B-03/03/26		
				C-25/02/26	C-04/03/26		
12	CO1 CO4	LLO 16.1 LLO 16.2	Calculate the coefficient of discharge of triangular notch.	A-09/03/26	A-16/03/26		
				B-03/03/26	B-10/03/26		
				C-04/03/26	C-11/03/26		
13			**Beyond Syllabus Practical**	A-16/03/26	A-23/03/26		
				B-10/03/26	B-17/03/26		
				C-11/03/26	C-18/03/26		

- **ASSESSMENT METHODOLOGIES/TOOLS**

A. Formative assessment (Assessment for Learning) (FA-TH)

- Two Term Test Examination of 30 Marks.
- Term Work Assessment 25 Marks.

B. Summative Assessment (Assessment of Learning) (SA-TH)

- End Term Theory Examination of 70 Marks.
- End Term Practical Examination 25 Marks.

- **Laboratory Equipment / Instruments / Tools / Software required**

Sr. No.	Equipment Name with Broad Specifications	Relevant LLO Number
1	Redwood Viscometer Stainless steel bath with electrical heating arrangement suitable to operate at 220 Volts AC Mains with tap, oil cup with precision stainless steel jet, cup cover, Ball valve, thermometer clip. Stirrer and M.S. Sheet stand with digital indicator, Controller & FHP motor with lighting arrangement.	1,2
2	Set up of U-Tube Manometer: • Single Well Manometer: Single Tube Type. • Differential Manometer: U Tube Type. 3 • Sensitive Manometer. : Inclined Tube Type • Pressure Gauge. : Bourdon Type • Water Circulation: ½ HP Pump, Crompton/Standard make. • Sump Tank: Capacity 50 Ltrs. • Control Panel Comprises of : Standard make On/Off Switch, Mains Indicator, etc.	3

3	Experimental setup of Reynolds Experiment: • Tube : Material Borosilicate Glass ID 14 mm approx., Length: 600 mm • Dye vessel : Material Stainless Steel, Capacity 1 Ltrs. (approx.) • Capillary Tube: Material Stainless Steel. • Constant Head Water Tank: Capacity 40 Ltrs. • Water Circulation: FHP Pump. • Measuring Cylinder: Capacity 1000 ml. • Stop Watch : Electronic • Sump Tank: Capacity 60 Ltrs. • Control Panel Comprises of: Standard make On/Off Switch, Mains Indicator, etc. • Tanks : Stainless Steel	4
4	Experimental setup of Bernoulli'sTheorm: Test Section: Convergent and Divergent section, Material Acrylic. • Piezometer Tubes: Material P.U. Tubes (7 Nos.) • Water Circulation: ½ HP Pump, Crompton/Standard make. • Flow Measurement : Using Measuring Tank with Piezometer, Capacity 25 Ltrs • Sump Tank: Capacity 70 Ltrs. • Inlet Tank: Capacity 20 Ltrs. with fixed overflow arrangement. • Stop Watch: Electronic. • Control Panel Comprises of: Standard make On/Off Switch, Mains Indicator, etc.	5
5	Sudden expansion/Reduction, bend/elbow Sudden Enlargement: From 15mm to 25mm • Sudden Contraction: From 25mm to 15mm. • Bend : ½" • Elbow : ½" • Ball valve : ½" • Gate valve : ½" • Water Circulation: ½ HP Pump, Crompton/Standard make. • Flow Measurement: Using Measuring Tank with Piezometer, Capacity 25 Ltrs. • Pressure Drop Measurement : Pressurized Differential Pressure manometer. • Sump Tank: Capacity 50 Ltrs. • Stop Watch: Electronic. • Control Panel Comprises of : Standard make On/Off Switch, Mains Indicator, etc.	6,7,9
6	Experimental setup of Venturimeter: Venturi meter: Body Material Acrylic, compatible to 1" Dia. Pipe. • Water Circulation: ½ HP Pump, Crompton/Standard Make. • Flow Measurement: Using Measuring Tank with piezometer Capacity 25 Ltrs. • Sump Tank: Capacity 50 Ltrs. • Stop Watch : Electronic . • Pressure measurement : By Pressurized differential pressure manometer. • Control Panel Comprises of : Standard make On/Off Switch, Mains Indicator, etc.	10
7	Experimental setup of Orifice meter: • Orifice meter: Body Material Acrylic, compatible to 1" Dia. Pipe. Orifice plate made of Stainless Steel . • Water Circulation: ½ HP Pump, Crompton/Standard Make. • Flow Measurement: Using Measuring Tank with piezometer Capacity 25 Ltrs. • Sump Tank: Capacity 50 Ltrs • Stop Watch : Electronic •Pressure measurement : By Pressurized differential pressure manometer • Control Panel Comprises of : Standard make On/Off Switch, Mains Indicator, etc	11
8	Experimental setup of Rotameter:	12

	• Rotameter: Glass Tube Rotameter. • Water Circulation: ½ HP Pump, Crompton/Standard Make. • Flow Measurement: Using Measuring Tank with piezometer Capacity 25 Ltrs. • Sump Tank: Capacity 50 Ltrs. • Stop Watch : Electronic • Pressure measurement : By Pressurized differential pressure manometer • Control Panel Comprises of : Standard make On/Off Switch, Mains Indicator, etc.	
9	Centrifugal pump Test Rig: Pump: Kirloskar Make, Capacity 1 HP. Speed 2800 RPM (max.), Head 12 m (max.) • Medium Flow: Clear Water. • Drive: 1 HP DC motor. • Speed Control: Thyristor controlled. • Sump Tank: Capacity 110 Ltrs. approx. • Measuring Tank: Capacity 70 Ltrs. approx. with Piezometer. • Stop Watch: Electronic. • Pressure Gauge: Bourdon type. • Control Panel Comprises of: Energy measurement: Electronic Energy meter, L&T make. RPM measurement: Digital RPM Indicator with Proximity sensor. Standard make On/Off Switch, Mains Indicator, etc.	15

- **References:**
- **Suggested Learning Materials / Books**

Sr. No.	Author	Title of Book	Publication
1	R. K. Bansal	A Textbook of Fluid Mechanics and Hydraulic Machines	Laxmi Publications ISBN: 9788131808153, 8131808157
2	Robert W. Fox, Alan T. McDonald, Philip J. Pritchard	Introduction to fluid mechanics	Wiley ISBN: 9780470234501, 0470234504
3	Warren McCabe, Julian Smith, Peter Harriott	Unit Operations of Chemical Engineering	McGraw-Hill Education ISBN: 9780072848236, 0072848235
4	Shiv Kumar	Fluid Mechanics (Vol. 2) Basic Concepts and Principles	Springer International Publishing ISBN: 9783030997540, 3030997545
5	Paul J. LaNasa, E. Loy Upp	Fluid Flow Measurement A Practical Guide to Accurate Flow Measurement	Elsevier Science ISBN: 9780124095328, 0124095321
6	Franz Durst	Fluid Mechanics An Introduction to the Theory of Fluid Flows	Springer ISBN: 9783540713425, 3540713425
7	Jamal Mohammed Saleh	Fluid Flow Handbook	McGraw-Hill Companies,Incorporated ISBN: 9780071363723, 0071363726
8	R. Peter King	Introduction to Practical Fluid Flow	Elsevier Science ISBN: 9780080495842, 0080495842
9	R. K. Singal	Hydraulic Machines: Fluid Machinery	I.K. International Publishing House Pvt. Limited ISBN: 9789380026015, 9380026013
10	R. S. Khurmi, N Khurmi	Hydraulics, Fluid Mechanics and Hydraulic Machines	S. Chand Limited ISBN: 9788121901628, 8121901626

- **Learning Websites & Portal**

Sr. No	Link / Portal	Description
1	https://nptel.ac.in/courses/105101082	(Videos and Texts) Fluid Mechanics, IIT Bombay
2	https://archive.nptel.ac.in/courses/112/106/112106200/	(Videos and Texts) Fluid Dynamics and Turbomachines, IIT Madras
3	https://archive.nptel.ac.in/courses/112/105/112105269/	(Videos and Texts) Introduction to Fluid Mechanics, IIT Kharagpur
4	https://nptel.ac.in/courses/112104118	(Videos and Texts) Fluid Mechanics, IIT Kanpur
5	https://nptel.ac.in/courses/103104044	(Videos and Texts) Fluid Mechanics, IIT Kanpur
6	https://nptel.ac.in/courses/105103192	(Videos and Texts) Fluid Mechanics, IIT Guwahati

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