Maharashtra State Board of Technical Education, Mumbai

K-2

LABORATORY PLAN (LP)

Academic Year: 2026-27

Date: 01/07/2026

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

Program and Code: Chemical Engineering (CH) Course Index: CO304

Course Name: Utilities and Plant Maintenance Course Code &. Abbr.: 313339(UPM)

Total Hrs: 30 Semester: III[rd] Scheme: K Name of Faculty: Mrs. Y. S. Kumawat

- **INDUSTRY EXPECTED OUTCOME**

The course should be taught and implemented with the aim to develop required skills in students so that they are able to acquire following industry outcome: Apply appropriate plant utilities for given chemical process industries. Identify various maintenance procedures for given chemical process equipment.

- **COURSE LEVEL LEARNING OUTCOMES (COS)**
  - CO304.1 - Select suitable method of water softening for boiler feed water and process plants.
  - CO304.2 - Identify steam generators and non-steam heating systems for chemical industries.
  - CO304.3 - Select appropriate refrigeration system for the chemical process industry.
  - CO304.4 - Use the humidification and dehumidification process for chemical process industries.
  - CO304.5 - Apply relevant maintenance procedures for chemical process plant equipment.

- **Teaching and Examination Scheme:**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										
				Actual Contact Hrs/Week			SLH	NLH			Theory				Based on LL & TSL Practical				Based on SL		Total Marks
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
				CL	TL	LL					Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313339	UTILITIES & PLANT MAINTENANCE	UPM	DSC	3	-	**2**	1	6	3	03	30	70	100	40	26	10	26@	10	26	10	175

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	Explain the concept of alkalinity of water.
LLO 2.1	Explain concept of temporary and permanent hardness to calculate total hardness of water.
LLO 3.1	Explain the concept of pH.
LLO 3.2	Demonstrate the process of pH measurement using pH meter.
LLO 4.1	Describe principle, construction and working of Reverse Osmosis plant.
LLO 4.2	Explain the concept of Total Dissolved Solid (TDS).
LLO 5.1	Explain the concept of dryness fraction.
LLO 5.2	Calculate dryness fraction of steam.
LLO 6.1	Demonstration of various boiler mountings and accessories.
LLO 7.1	Explain concept of entropy, enthalpy and specific heat.
LLO 8.1	Identify parts of refrigeration system.

LLO No.	Title of LLO
LLO 9.1	Explain concept of vapour compression refrigeration cycle.
LLO 9.2	Calculate Coefficient of Performance.
LLO 10.1	Explain construction and working principle of pressure gauge.
LLO 10.2	Selection of appropriate pressure of air depending upon applications.
LLO 11.1	Explain the effect of range and approach values on cooling tower.
LLO 12.1	Calculate all psychrometric properties by using psychrometric chart at various locations.
LLO 13.1	Explain the concept of DBT and WBT.
LLO 13.2	Explain construction and working of a sling psychrometer.
LLO 13.3	Use a sling psychrometer for measuring relative humidity.
LLO 14.1	Explain concept of centrifugal pump.
LLO 15.1	Explain the concept of ball mill.
LLO 16.1	Explain the concept of heat exchanger.

- **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	Determine total alkalinity of well water.	A-06/07/26	A-14/07/26		
				B-03/07/26	B-10/07/26		
				C-10/07/26	C-13/07/26		
2	CO1	LLO 2.1	* Determine the total, temporary and permanent hardness of borewell water / tap water/ lake water.	A-14/07/26	A-21/07/26		
				B-10/07/26	B-17/07/26		
				C-13/07/26	C-20/07/26		
3	CO1	LLO 3.1 LLO 3.2	Determine pH of various acidic and alkaline water using pH meter	A-21/07/26	A-28/07/26		
				B-17/07/26	B-24/07/26		
				C-20/07/26	C-27/07/26		
4	CO1	LLO 4.1 LLO 4.2 .	* Analyze raw water, RO water and rejected RO water quality based on Total Dissolved Solid (TDS), pH and Conductivity.	A-28/07/26	A-04/07/26		
				B-24/07/26	B-31/07/26		
				C-27/07/26	C-03/08/26		
5	CO2	LLO 5.1 LLO 5.2	Calculate the dryness fraction of steam at different pressure and temperature conditions by using a steam table.	A-04/07/26	A-11/08/26		
				B-31/07/26	B-07/08/26		
				C-03/08/26	C-10/09/26		
6	CO2	LLO 6.1	*Identify boiler mountings and accessories of boiler by visiting any chemical plant.	A-11/08/26	A-18/08/26		
				B-07/08/26	B-14/08/26		
				C-10/09/26	C-17/08/26		
7	CO2	LLO 7.1	* Calculate enthalpy and entropy of steam at various pressures by using a Steam Table.	A-18/08/26	A-25/08/26		
				B-14/08/26	B-21/08/26		

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
				C-17/08/26	C-24/09/26		
8	CO3	LLO 8.1	* Identify different parts of the domestic refrigerator in view of compressor, condenser, expansion valve and vaporator.	A-25/08/26	A-01/09/26		
				B-21/08/26	B-28/08/26		
				C-24/09/26	C-31/08/26		
9	CO3	LLO 9.1 LLO 9.2	Calculate Co-efficient of Performance (COP) vapour compression refrigeration cycle.	A-01/09/26	A-08/09/26		
				B-28/08/26	B-04/09/26		
				C-31/08/26	C-07/09/26		
10	CO4	LLO 12.1	* Determine psychometric properties like DPT, % Relative humidity volume at various DBT , specific enthalpy and specific and WBT by using psychrometric chart.	A-08/09/26	A-15/09/26		
				B-04/09/26	B-11/09/26		
				C-07/09/26	C-21/09/26		
11	CO4	LLO 13.1 LLO 13.2 LLO 13.3	* Calculate the relative humidity of outer atmosphere by using sling psychrometer.	A-15/09/26	A-22/09/26		
				B-11/09/26	B-18/09/26		
				C-21/09/26	C-28/09/26		
12	CO5	LLO 14.1	*Perform maintenance procedure for the Centrifugal Pump	A-22/09/26	A-29/09/26		
				B-18/09/26	B-09/10/26		
				C-28/09/26	C-05/10/26		
13	CO1	LLO 1.1	Determine the turbidity of Well water **(Practical beyond curriculum)**	A-29/09/26	A-06/10/26		
				B-09/10/26	B-12/10/26		
				C-05/10/26	C-16/10/26		

- **ASSESSMENT METHODOLOGIES/TOOLS**

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

- Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering
  - 60% weightage is to process
  - 40% weightage to product

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

- Continuous Assessment based on Process and Product related performance indicators. Each practical will be assessed considering
  - 60% weightage to Process
  - 40% weightage to Product

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

Sr. No.	Equipment Name with Broad Specifications	Relevant LLO Number
1	Test tubes (15 ml capacity)	1,2,3,4
2	Measuring Cylinders (10 ml, 50ml 100ml)	1,2,3,4
3	Beakers (50, 100, 260 ml)	1,2,3,4
4	Burette (50ml, L.C.: 0.1 ml)	1,2,3,4
5	Conical Flasks (100 ml, 260 ml)	1,2,3,4
6	Volumetric flask (100, 260, 500 ml)	1,2,3,4
7	Pipette (10 ml, 26 ml)	1,2,3,4
8	Acid and alkali Proof hand gloves	1,2,3,4
9	Bourdon tube type pressure gauge	10
10	Cooling tower	11
11	Standard Psychrometric chart	12
12	Sling Psychrometer or Whirling hygrometer (0 to 5º C range) Body material : Plastic or wood	13
13	Weighing Balance (Digital Display, 300 g, Sensitivity. 0.01 g)	3
14	pH meter with Calibration arrangement Suitable for 0-14 pH range and Temperature compensating and calibration arrangement.	3,4
15	Buffer solutions 4 , 7 and 9.2 pH	3,4
16	Digital TDS meter	4
17	Steam table book	7

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

Sr. No.	Author	Title of Book	Publication
1	Jain and Jain	Engineering Chemistry	Dhanpatrai Publications, New Delhi, 2008, ISBN-978-87-403-0363-6
2	Powel S. T.	Industrial Water	Mc Graw Hill, New York, 2009, ISBN 9781118843727
3	Balleney P. L.	Thermal Engineering	Khanna Publication, New Delhi 1975, ISBN 9788174090317
4	Rajput R. K.	A Text book of Refrigeration and Air Conditioning	Kataria s. K. and sons, New Delhi 2003, ISBN13:9789350142654
5	James K. Carson	Refrigeration : Theory and Applications	Mc Graw Hill, New York, 2009, ISBN: 078-87-403-0363-6
6	Sathiyamoorthy Manickkam	Chemical Plant Utilities	Lambert Academic Publishing, October 2016, ISBN: 978-3-659-97828-9
7	Kraus, Milton N.	Safe and Efficient Plant Operation and Maintenance	Mc. Graw Hill Inc. New York US, 1980, ISBN: 978-0070107076
8	R. K. Jain	Plant maintenance engineering and management	Khanna Publication, ISBN: 9789392649090
9	Sushil Kumar Shrivastava	Maintenance Engineering	S. Chand and company, ISBN: 9788121926447

- **Learning Websites & Portal**

Sr. No	Link / Portal	Description
1	https://www.sciencedirect.com/bookseries/advances-in-chemical-engineering	Chemical Engineering books
2	https://wbboilers.gov.in/sites/default/files/actsrules/Boilers_Act_1923.pdf	India Boiler Regulation Act 1923
3	https://www.vedantu.com/jee-main/chemistry-hardness-of-water	Temporary, Permanent and Total Hardness of Water
4	https://www.intarcon.com/en/refrigeration-system/	Refrigeration System
5	https://website.maintenanceconnection.com/resources/blog-posts/3-elements-maintenance-success-chemical-industry	Maintenance success in the Chemical Industry
6	https://www.google.com/search?q=nptel+videos+on+chemical++pl	Plant Maintenance
7	https://onlinecourses.nptel.ac.in/noc23_me31/preview	Problems on Steam
8	https://archive.nptel.ac.in/courses/103/107/103107211/	Chemical Process Utilities, Boiler water treatment
9	https://onlinecourses.nptel.ac.in/noc23_me31/preview	Vapour compression Refrigeration Cycle
10	https://home.iitk.ac.in/~gtm/thermodynamics/ui/Course_home-36.htm	Psychrometer chart, Humidification and Dehumidification operation
11	https://onlinecourses.nptel.ac.in/noc23_me31/preview	Cooling Tower Types and performance

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