Format K1

Maharashtra State Board of Technical Education, Mumbai

TEACHING PLAN (TP) Academic Year: **2026-27 (ODD)**

Institute Code and Name: 0078- K. K. Wagh Polytechnic, Nashik **Semester**: Third
Programme and Code: Chemical Engineering (CH) **Course Index:** 304
Course and Code: Utilities and Plant Maintenance (UPM)
Name of Faculty: Mrs. Y. S. Kumawat **CLASS: SYCH**

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-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category	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	
313339	UTILITIES & PLANT MAINTENANCE	UPM	DSC	3	-	2	1	6	3	03	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem.: 1 Hrs

Abbreviations: CL- Classroom 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

THEORY LEARNING OUTCOME (TLO)

TLO No.	Title of TLO
TLO 1.1	Explain the concept of alkalinity of water.
TLO 1.2	Identify boiler Problems for the given boiler feed water.
TLO 1.3	Explain Softening processes of water.
TLO 2.1	Explain properties and uses of steam in chemical industries.
TLO 2.2	Classify steam generators.

TLO 2.3	Explain construction and working of Lancashire boiler, Babcock and Wilcox Boiler.
TLO 2.4	State functions of boiler Mountings and Accessories.
TLO 2.5	Implement Boiler act in the given industries.
TLO 2.6	Explain construction and working of Thermic Fluid Heater.
TLO 2.7	State properties of Thermic fluid.
TLO 3.1	Explain the working principle of refrigeration.
TLO 3.2	Explain COP and solve numerical based on unit of refrigeration and COP.
TLO 3.3	Use primary and secondary refrigerants.
TLO 3.4	State selection criteria of refrigerants.
TLO 4.1	Explain process and instrument air.
TLO 4.2	Identify the psychrometry properties for the given system.
TLO 4.3	Solve numerical using psychrometric chart.
TLO 4.4	Explain psychrometric processes with diagram.
TLO 4.5	Select the relevant cooling tower for the given process.
TLO 5.1	State objectives of plant maintenance.
TLO 5.2	Enlist types of maintenance.
TLO 5.3	State duties and responsibility of plant maintenance department.

SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	**Programme Outcomes (POs)**							**Programme Specific Outcomes (PSOs)**		
	PO-1 Basic and Discipline Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Long Learning**	**PSO-1**	**PSO-2**	**PSO-3**
CO1	2	3	3	2	3	2	3	3	2	-
CO2	2	2	1	2	2	-	2	2	2	-
CO3	3	2	1	2	2	-	2	2	2	-
CO4	3	2	1	2	2	1	2	2	1	-
CO5	2	3	-	3	1	2	2	3	-	-

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

Maharashtra State Board of Technical Education K-1

Teaching Plan (TP)

Academic Year: 2026-26
Program: Chemical Engineering
Course: Utilities and Plant Maintenance (UPM)
Name of faculty: Mrs. Y. S. Kumawat

Institute Code: 0078
Course Code: 313339
Semester: Third (CH-2K)

Chap No. (Alloted Hrs.)	CO Mention only Number	TLO Mention only Number	Unit Name and Learning Content Title/ Details	No. of Lecture	Plan (From-To)	Actual Execution (From-To)	Teaching method/ Media	Remark
Unit - I Industrial Water								
1 (10)	**CO-1**	**TLO 1.1**	1.1 Industrial water: Properties, Uses, Hard & Soft water	1	03/07/2026		Blackboard, Books, media, PPT	
		TLO 1.1	1.2 Hardness: Total Hardness, Permanent Hardness, Temporary Hardness, Units of hardness, Numerical	2	6/07/2026 to 7/7/2026			
		TLO 1.2	1.3 Boiler Feed water, Scale and Sludge Formation, Corrosion, Priming and Foaming, Caustic Embrittlement **MKCL Quiz 1**	2	10/7/2026 to 13/7/2026			
		TLO 1.3	1.4 Methods of water softening processes (Principle, Construction, Working and Application): a. Lime soda process(cold and hot) b. Zeolite process c. Ion exchange process d. Reverse Osmosis	4	14/7/2026 to 21/7/2026			**1 extra**
			Practice test 1 and MKCL Quiz 2	1	24/7/2026			
Unit - II Steam and Non- Steam Heating System								

Chap No. (Alloted Hrs.)	CO Mention only Number	TLO Mention only Number	Unit Name and Learning Content Title/ Details	No. of Lecture	Plan (From-To)	Actual Execution (From-To)	Teaching method/ Media	Remark
2(10)	CO-2	**TLO 2.1**	2.1 Steam: Uses, Properties and types of steam.	1	27/07/2026		Blackboard, Books, media, PPT	
		TLO 2.2	2.2 Steam Generator : Classification, comparison, components of boiler.	1	28/07/2026			
		TLO 2.3	2.3 Construction and working of: a. Lancashire boiler b. Babcock and Wilcox Boiler **MKCL Quiz 3**	2	31/7/2026 to 3/8/2026			
		TLO 2.4	2.4 Function of all boiler Mountings and Accessories.	2	4/8/2026 to 7/8/2026			
		TLO 2.5	2.5 Boiler Act : Indian Boiler Act and duties of boiler inspector.**(THE INDIAN BOILERS (AMENDMENT) ACT, 2007 –Beyond curriculum topic)**	2	10/8/2026 to 11/8/2026			
		TLO 2.6	2.6 Construction and working of non- Steam Heating System (Thermic Fluid Heater)**MKCL Quiz 4**	2	17/8/2026 to 18/8/2026			
		TLO 2.7	2.7 Properties of Thermic fluid. **Practice test 2**	1	24/8/2026			**1 extra**
Unit - III Refrigeration								
3(9)	CO-3	**TLO 3.1**	3.1 Refrigeration: Concept, Unit of Refrigeration, Coefficient of Performance (COP), Numerical..	2	25/08/2026 to 28/08/2026		Blackboard, Books, media, PPT	
		TLO 3.2	3.2 Types of Primary and Secondary Refrigerants, Selection criteria of refrigerants. **MKCL Quiz 5**	1	01/8/2026			
		TLO 3.3	3.3 Refrigeration Cycle: Reverse Carnot Cycle, Bell Coleman air refrigeration Cycle, Vapor compression and absorption cycle (Li-Br absorption cycle).	5	04/8/2026 to 07/9/2026			**1extra**
		TLO 3.4	**MKCL Quiz 6, Practice test 3**	1	08/9/2026			

Chap No. (Alloted Hrs.)	CO Mention only Number	TLO Mention only Number	Unit Name and Learning Content Title/ Details	No. of Lecture	Plan (From-To)	Actual Execution (From-To)	Teaching method/ Media	Remark
Unit - IV Air and Psychrometry								
4(8)	**CO-4**	**TLO 4.1**	4.1 Concept and Application of process air and instrument air.	1	11/09/2026		Blackboard, Books, media, PPT	
		TLO 4.2	4.2 Psychrometry, Dry Bulb Temperature, Wet Bulb Temperature, Dew Point Temperature, Adiabatic saturation temperature,Humidity, Specific Humidity, Specific Volume, Relative Humidity **MKCL Quiz 7**	3	15/9/2026 to 17/9/2026			**1 extra**
		TLO 4.3	4.3 Sling Psychrometer, Psychrometric Chart, Numerical on Psychrometric Chart	2	18/9/2026 to 21/9/2026			
		TLO 4.4	4.4 Psychrometric Process: Humidification and dehumidification	1	22/9/2026			
		TLO 4.5	4.5 Cooling Tower: Principle, Construction and Working of induced draft and forced draft **Practice test 4 and MKCL Quiz 8**	2	26/9/2026 to 28/10/2026			**1 extra**
Unit - V Plant maintenance								
5(8)	**CO-5**	**TLO5.1**	5.1 Purpose of plant maintenance.	1	29/10/2026		Blackboard, Books, media, PPT	
		TLO 5.2	5.2 Types of maintenance: Preventive maintenance, Predictive maintenance, Corrective maintenance, Routine / Scheduled maintenance, Emergency maintenance, Online maintenance and Shutdown maintenance.	3	5/10/2026 to 7/10/2026			**1 extra**
		TLO 5.3	5.3 Duties and responsibility of plant maintenance department. **MKCL Quiz 9**	2	09/10/2026 to 12/10/2026			
		TLO 5.4	5.4 Online maintenance of pump and rotameter.	1	13/10/2026			
			Practice test 5 and MKCL Quiz 10	1	16/10/2026			**1 extra**

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

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, ISBN13:9789350142554
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: 9789392549090
9	Sushil Kumar Shrivastava	Maintenance Engineering	S. Chand and company, ISBN: 9788121926447

LEARNING WEBSITES & PORTALS

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

Sr. No	Link / Portal	Description
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

Note : Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Mrs. Y. S. Kumawat
(Name & Signature of Staff)

Dr. P. S. Bhandari
(Name & Signature of HOD)