Subject Code: 09CH0403
Subject Name: Plant Utilities and Instrumentation
Semester: 4th

Objectives: To learn to Operate different utility plants and various types of instruments.

Credits Earned: 6 credits

Course Outcomes: After completion of this course, student will be able to:

i. Use various methods for water softening and purification
ii. Operate different types of steam generators
iii. Operate compressors, blowers for handling air and inert gases.
iv. Use Refrigeration for Various applications.
v. Measure temperature, pressure, flow, level and viscosity.
vi. Operate various control valves and control systems

Pre-requisite of course: Std. X Chemistry, physics, Mathematics

Teaching and examination scheme:

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid sem (M)	Internal (I)	Practical exam (V)	Term work (TW)	
2	0	4	6	50	30	20	25	25	150

Contents:

Unit	Topics	Contact hours
1	**Basic Utility:** List and use of various utilities in chemical plant, Sources of water, Types of Water, Hard & Soft water, Boiler Feed water and demineralized water. Methods of water softening processes (i) Lime soda process (Hot & Cold), (ii) Zeolite process, (iii) Ion exchange (iv) Filtration (v)Sterilization	4
2	**Steam, Air & Inert Gases:** Utilities: Use of Steam, Air & Inert Gases as utilities, Properties of steam: Enthalpy, Wet steam, Saturated Steam, Superheated steam, Specific volume of steam. Factors affecting selection of Boiler, Construction and working of (i) Locomotive Fire tube boiler (ii) Lancashire boiler, Types of Air compressors Reciprocating Air compressors (i) Multistage compressors (ii) Rotary compressors	6

3	**Refrigeration :** Concept of refrigeration, Methods of Refrigeration: (i) Ice Refrigeration, (ii) Evaporative Refrigeration, (iii) Vapor Refrigeration System. COP and TOR of refrigeration. Types of Primary Refrigerants: Ammonia, Halo Carbons (Freon of Different type), HFC (Hydro Fluorocarbon). Types of secondary Refrigerants: Water, Brine. Selection of Refrigerants.	4
4	**Basics of Instrumentation :** Importance of instrumentation in chemical plant. Classification of instruments, Basic elements of instruments, Static and Dynamic Characteristics of instruments, First order system and second order system .	2
5	**Measuring Devices :** Different Temperature scale, Principle, Construction & Working of: Mercury in glass thermometer, Bi-metallic thermometer, pressure spring thermometer, resistance thermometer, Principles of thermoelectricity: See-back effect, Peltier effect and Thomson effect. Pressure gauges: diaphragm, Bourdon tube gauge, Dead weight Gauge, Strain gauge. Classify: Liquid level measuring devices; Direct level measuring devices : Probe and tape, Sight glass, Floats; Indirect level measuring devices: Air trap box method, Diaphragm box method, Bellow system, Differential pressure manometer; Viscosity measurement: Capillary tube method, Rotating cylinder method, Torsion viscometer; measurement of Specific gravity by hydrometer, Humidity by hygrometer, pH by pH meter.	6
6	**Control Valves, Control Loops & Control System :** Function of relays and interlocks, Control loops: Temperature control, Pressure control, Flow control, Level control. Process control modes : P , P+I , P+I+D, ON –OFF; uses of PLC and DCS System uses of PLC and DCS System	6
	Total hours	28

References:

- **Reference book**

1. Industrial instrumentation, Donald P. Eckman. JohnWilley and Sons publications, New York, 2004.
2. Industrial Instrumentation & Control S. K. Singh 3rd edition Tata-McGrawHil publications, 1987.
3. Process Instrumentation and Control A P Kulkarni 15th Edition, April 2011, Nirali Prakashan, Pune.
4. Unit operation of chemical Engineering. McCabe, Warren L., Julian C. Smith McGraw Hill Publication, New York 2004, 7th Edition.
5. Plant utilities D. B. Dhone 2 nd Edition, 2012 Nirali Prakashan, Pune.
6. Process System Analysis & Control Donald R. Coughnour. 2 nd edition, 1991, McGraw Hill Publication, Newyork.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process.

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	40%	20%	20%	-	-

List of Experiments:

1. Operate and test the working of air compressor
2. Demonstrate different refrigeration cycles
3. Treatment by lime soda process
4. Measure Temperature by thermometer and thermocouple
5. Measure Temperature by Bi-metallic thermometer
6. Measure viscosity by capillary tube method
7. Measure specific gravity by Hydrometer
8. Measure humidity by Hair hygrometer
9. Measure pH by pH meter
10. Prepare a chart of components of DCS system
11. Demonstrate working of control valves and actuators using chart

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.