

# GUJARAT TECHNOLOGICAL UNIVERSITY

## INSTRUMENTATION & CONTROL ENGINEERING (17)

### ENVIRONMENTAL INSTRUMENTATION

**SUBJECT CODE:** 2161711

**B.E. 6<sup>th</sup> SEMESTER**

**Type of course:** Core Engineering

**Prerequisite:** Fundamental knowledge of sensors & transducers

**Rationale:** Climate change is a big issue in today's scenario. Change in climate affecting not only the farmers but also affecting the living species on the earth. This subject will help to know the threats to environment, measurement of the parameters affecting the environment and control techniques by which such parameters are maintained at specified limit

#### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA(M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

#### Content:

S. N.	Content	Total Hrs	% Weight age
1	<b>Introduction:</b> Necessity of Instrumentation & Control for environment, sensor requirement for environment. Instrumentation methodologies: Ultraviolet analyzers, total hydrocarbon analyzers using flame ionization detector, Gas chromatography in environmental analysis, photo ionization, portable & stationary analytical instruments.	12	24
2	<b>Quality of water:</b> Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters: Thermal conductivity, detectors, Opacity monitors, pH analyzers & their application, conductivity analyzers & their application. Water treatment: Requirement of water treatment facilities, process design.	12	24
3	<b>Sedimentation &amp; flotation:</b> General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin, reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation. Ground water monitoring: Level measurement in ground water monitoring wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution.	6	10
4	<b>Waste water monitoring:</b> Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants.	6	10

5	<p><b>Air pollution:</b> definitions, energy environment relationship, importance of air pollution, air pollution from thermal power plant, their characteristics &amp; control. Air sampling methods &amp; equipments, analytical methods for air pollution studies. Control of air pollution.</p> <p>Flue gas analysis for pollution control – Measurement of CO, carbon di-oxide, NOX and SOX, dust and smoke measurement. Chromatography – Basic principles of liquid and gas chromatography – Column details – Detectors for chromatography – Thermal conductivity detector – Flame ionization detector – Flame photometric detector – Electron capture detector – Effect of temperature programming – High pressure liquid chromatography (HPLC).</p>	12	24
6	<p><b>Air monitoring:</b> measurement of ambient air quality. Flow monitoring: Air flow measurement, gas flow, non-open channel flow measurement, open channel waste water flow measurement. Rain water harvesting: necessity, methods, rate of NGOs municipal corporation, Govt., limitations. Quality assurance of storage water.</p>	4	8

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	14	21	21	7	0

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

1. Environmental Instrumentation & Analysis Handbook by Randy D. Down and Jay H. Lehr, John-Wiley & Sons, ISBN 0-471-46354-X.
2. Principles of Instrumental Analysis by Skoog, Holler, Nieman, Thomson books-cole publications, Sixth ed., 2006.
3. Introduction to Instrumental Analysis by Braun, Robert D., Pharma Book Syndicate, Hyderabad. 2006.
4. Analytical Instrumentation by Sherman, R.E. and Rhodes L.J., ISA Press, New York, 1996.
5. Process Measurement and Analysis by Liptak B.G, 3rd Edition, Chilton Book Company, Pennsylvania, 1995.
6. Process / Industrial Instruments and Controls Handbook by Considine D.M, 4th Edition, McGraw Hill, Singapore, 1993.
7. Air pollution engineering – M. N. Rao & H. V. N. Rao.
8. Air pollution control technology – Wark & Warner.
9. Instrumental Methods of Analysis by Willard, Merritt, Dean and Settle, 7<sup>th</sup> Edition, CBS Publishers and Distributors, India, 1988.
10. Instrumental Methods of Analysis by Ewing G.W, 5th Edition, McGraw Hill, Singapore, 1992.
11. Mechanical and Industrial Measurements by Jain R. K, Khanna Publishers, Nai Sarak, Delhi, 1985.

**Course Outcome:**

After learning the course the students should be able to:

- CO1 summarize and classify capabilities and limitations of analytical instruments.
- CO2 justify use of an analytical instrument in solving real world problem.
- CO3 familiarize with current literature, research in analytical instrumentation.
- CO4 develop analytical instrument with emphasize on safe use of analytical instruments.

**List of Experiments:**

1. To find out transmittance and absorbance of a given sample using colorimeter
2. Qualitative and quantitative analysis using UV-Visible spectrophotometer
3. To analyze a given water sample using turbidity meter
4. To detect hydrocarbon contents from a gas sample
5. Test and calibrate the pH electrode and pH meter.
6. To calibrate the conductivity meter and measure the conductivity of given sample.
7. Study of Gas Chromatograph
8. Study of HPLC system
9. Study of measurement for air polluting parameters like SO<sub>2</sub>, NO<sub>x</sub>, etc.
10. Prepare a report on weather stations
11. Prepare a visit report on water/waste water/ effluent treatment plant.
12. To design low cost analytical instrument.

**Design based Problems (DP)/Open Ended Problem:**

1. Propose a Web based Air Quality Monitoring System for your city/ town/ village.
2. Propose a Web based Weather Monitoring System for your city/ town/ village.
3. Design a microcontroller based pH/ ambient temperature/ humidity/ analytical parameter measurement system.

**Major Equipment:**

Analytical instruments, Ambient condition monitoring system, etc.

**List of Open Source Software/learning website:**

<http://www.nptel.ac.in/courses/105102089/9>

<http://nptel.ac.in/video.php>

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.