



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3150311

Semester – V

Subject Name: Analytical Instrumentation Techniques

Type of course: Professional Elective Course

Prerequisite: Biomedical Sensors & Transducer, Human Anatomy & Physiology -I and II.

Rationale: The objective of this course is to impart necessary and practical knowledge of components of spectroscopic methods, Chemical Instrumental Analysis, Electro-analytical methods to numerous applications ranging across clinical, pathological and microbiological industries.

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) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 30 | 20 | 150 |

Content:

| Sr. No. | Content | Total Hrs | % Weig htag e |
|---------|---|-----------|---------------|
| 1 | Introduction: Fundamentals of Analytical Instruments, Elements of an Analytical Instrument, Sensors and Transducers, Signal Conditioning in Analytical Instruments, Read-out (Display) Systems, Performance requirements of Analytical Instruments, PC-Based Analytical Instruments and Instrument Calibration Techniques. | 6 | 14 |
| 2 | Analytical Instruments: Spectrophotometry, Mass Spectrometer, Colorimetry, Auto analysis, Semi auto analysis, Gas & electrolyte analysis, flame photometry, Gas chromatography, Liquid Chromatography, Electrophoresis apparatus and Densitometers. | 10 | 24 |
| 3 | Clinical Instruments: Glucometry, Blood Cell Counter (Flow cytometer), RIA units, PCR units, ELISA reader, Dispenser & washer, Urinometer, Pulse-oximetry, Capnography, Measurement of pH, pO ₂ , pCO ₂ , Arterial blood gas analysis. | 10 | 24 |
| 4 | Laboratory Instruments: Laboratory Incubator, Autoclaves, centrifuges, hot air oven, Balances, Auto pipettes, microtome, Histokinette , Laboratory counters, Anaerobic apparatus, Laminar flow tables. | 8 | 19 |
| 5 | Microscopy - Simple, Compound, Binocular, Trinocular, Dark ground microscopy Phase contrast microscopy, Electron microscopy, Microphotography & projection and their importance in clinical diagnosis. | 8 | 19 |
| | Total | 42 | 100 |

Suggested Specification table with Marks (Theory):



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| Distribution of Theory Marks | | | | | |
|------------------------------|---------|---------|---------|---------|---------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 20% | 30% | 20% | 20% | 10% | 00% |

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 the above table.

Reference Books:

1. R. S. Khandpur, 'Handbook of Analytical Instrumentation, Second Edition
2. Mary C. Haven, Gregory A. Tetrault, Jerald R. Schenken, "Laboratory Instrumentation", John Wiley & Sons, 1994.
3. R. S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill.
4. Douglas B. Murphy, "Fundamentals of Light Microscopy and Electronic imaging", 1st edition, Wiley-Liss, 2001.
5. Gillian McMahon, "Analytical Instrumentation: A Guide to Laboratory, Portable and Miniaturized Instruments", First Edition, John Wiley & Sons Ltd., 2007.
6. Steven Schreiner, Joseph D. Bronzino, Donald R. Peterson, "Medical Instruments and Devices: Principles and Practices", 1st Edition, CRC Press, 2017.

Course Outcomes:

At the end of this course students will be able to

| Sr. No. | CO statement | Marks % weightage |
|---------|---|-------------------|
| CO-1 | Understand and describe the basic principles for Analytical instrumentation. | 14% |
| CO-2 | Illustrate various techniques for identification, analysis, and measurement of molecular concentrations in gases, liquids or solids. | 24% |
| CO-3 | Describe the fundamental principle, instrumentation design, operating procedure, and their significance in diagnosis and prognosis of various clinical disorders. | 24% |
| CO-4 | Understand the instrumentation, operation and maintenance of various laboratory devices required for analytical measurements. | 19% |
| CO-5 | Explain the technique of magnification of micro-particles for structural and functional analysis. | 19% |

Suggested List of Practicals:

| Sr No | Title | Duration (hrs) | Mapped to CO |
|-------|---|----------------|--------------|
| 1 | To study the general structure of analytical device. | 02 | CO – 1 |
| 2 | To study the analysis of various samples using Colorimeter. | 02 | CO – 2 |

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| | | | |
|----|--|----|--------|
| 3 | To study the Auto analyzer. | 02 | CO – 2 |
| 4 | To study the Flame photometer. | 02 | CO – 2 |
| 5 | To study the Chromatography. | 02 | CO – 2 |
| 6 | To study the Electrophoresis Apparatus. | 02 | CO – 2 |
| 7 | To study the Glucometer. | 02 | CO – 3 |
| 8 | To study the Blood Cell counter. | 02 | CO – 3 |
| 9 | To study the Pulse oximeter. | 02 | CO – 3 |
| 10 | To study the Laboratory instruments: Balances, Auto pipettes, microtome, autoclaves, centrifuges, hot air oven, Anaerobic apparatus and Laminar flow tables. | 02 | CO – 4 |
| 11 | To study the structure and components of Optical Microscopy. | 02 | CO – 5 |
| 12 | To study the structure and components of Electron Microscopy. | 02 | CO – 5 |

Major Equipment:

Biomedical Trainer and demo kits , Spectrophotometer, colorimeter, Glucometer, Pulse-Oximeter, pH meter, microscope.

List of Open Source Software/learning website:

Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will assign topics from which students can grasp knowledge about current scenario of the Diagnostic Instrumentation. The application report /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.