FIRST-YEAR OF MASTER OF SCIENCE CHEMISTRY REVISED SYLLABUS ACCORDING TO CBCS NEP2020

COURSE TITLE: ANALYTICAL CHEMISTRY
SEMESTER-I
W.E.F. 2023-2024

RECOMMENDED BY THE BOARD OF STUDIES IN CHEMISTRY
AND
APPROVED BY THE ACADEMIC COUNCIL

Devrukh Shikshan Prasarak Mandal's
Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce, and Vid. Dadasaheb Pitre Science College (Autonomous), Devrukh.
Tal. Sangameshwar, Dist. Ratnagiri-415804, Maharashtra, India

Academic Council Item No: 03 dated 08 July 2023

Name of the Implementing Institute	:	Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce, and Vid. Dadasaheb Pitre Science College (Autonomous), Devrukh. Tal. Sangameshwar, Dist. Ratnagiri-415804,
Name of the Parent University	:	University of Mumbai
Name of the Programme	:	Master of Science
Name of the Department	:	Chemistry
Name of the Class	:	First Year
Semester	:	First
No. of Credits	:	04
Title of the Course	:	Analytical Chemistry
Course Code	:	S502CHT
Name of the Vertical in adherence to NEP 2020	:	Compulsory Major
Eligibility for Admission	:	Chemistry Graduate learner seeking Admission to Post Graduate Programme in adherence to Rules and Regulations of the University of Mumbai and Government of Maharashtra
Passing Marks	:	40%
Mode of Assessment	:	Formative and Summative
Level	:	PG
Pattern of Marks Distribution for SEE and CIA	:	60:40
Status	:	NEP-CBCS
To be implemented from Academic Year	:	2023-2024
Ordinances /Regulations (if any)		

Syllabus for First Year of Master of Science in Chemistry

(With effect from the academic year 2023-2024)

SEMESTER-I **Paper No.- II**

Course Title: Analytical Chemistry **No. of Credits - 04**

Type of Vertical: Compulsory Major **COURSE CODE: S502CHT**

Learning Outcomes Based on BLOOM's Taxonomy:

After completing the course, the learner will be able to…		
Course Learning Outcome No.	Blooms Taxonomy	Course Learning Outcome
CLO-01	Remember	recall basic concepts of analytical chemistry.
CLO-02	Understand	discuss role of quality management system and explain terms like stoichiometry, equivalent weight.
CLO-03	Apply	illustrate applications of thermal methods and distinguish between TGA and DTA.
CLO-04	Analyse	calculate concentration of solutions in terms of ppm, ppb and examine hazardous effects of various chemicals.

Syllabus for First Year of Master of Science in Chemistry

(With effect from the academic year 2023-2024)

SEMESTER-I **Paper No.- II**

Course Title: Analytical Chemistry **No. of Credits - 04**

Type of Vertical: Compulsory Major **COURSE CODE: S502CHT**

COURSE CONTENT			
Module No.	**Content**	**Credits**	**No. of Hours**
1	**Unit 1:** **Language of Analytical Chemistry** • Analytical perspective, Common analytical problems, terms involved in analytical chemistry (analysis, determination, measurement, techniques, methods, procedures and protocol) • An overview of analytical methods, types of instrumental methods, instruments for analysis, data domains, electrical and non-electrical domains, detectors, transducers and sensors, selection of an analytical method, accuracy, precision, selectivity, sensitivity, detection limit and dynamic range. • Errors, determinate and indeterminate errors. Types of determinate errors, tackling of errors. • Quantitative methods of analysis: calibration curve, standard addition and internal standard method. **Quality in Analytical Chemistry** • **Quality Management System (QMS):** Evolution and significance of Quality Management, types of quality standards for laboratories, total quality management (TQM), philosophy implementation of TQM (reference of Kaizen, Six Sigma approach & 5S), quality audits and quality reviews, responsibility of laboratory staff for quality and problems. • **Safety in Laboratories**: Basic concepts of Safety in Laboratories, Personal Protection Equipment (PPE), OSHA, Toxic Hazard (TH) classifications, Hazardous Chemical Processes (including process calorimetry / thermal build up concepts).	01	15

	• **Accreditations:** Accreditation of Laboratories, Introduction to ISO series, Indian Government Standards (ISI, Hallmark, Agmark) • **Good Laboratory Practices (GLP)** Principle, Objective, OECD guidelines, The US FDA 21CFR58, Klimisch score		
2	**Unit 2: Calculations based on Chemical Principles** • Concentration of a solution based on volume and mass units. • Calculations of ppm, ppb and dilution of the solutions, concept of mmol. • Stoichiometry of chemical reactions, concept of kg mol, limiting reactant, theoretical and practical yield. • Solubility and solubility equilibria, effect of presence of common ion. • Calculations of pH of acids, bases, acidic and basic buffers. • Concept of formation constants, stability and instability constants, stepwise formation constants. • Oxidation number, rules for assigning oxidation number, redox reaction in term of oxidation number, oxidizing and reducing agents, equivalent weight of oxidizing and reducing agents, stoichiometry of redox titration (Normality of a solution of a oxidizing / reducing agent and its relationship with molarity).	01	15
3	**Unit 3: Optical Methods** **Recapitulation and FT Technique** • Recapitulation of basic concepts, Electromagnetic spectrum, Sources, Detectors, sample containers. • Laser as a source of radiation, Fibre optics • Introduction of Fourier Transform **Molecular Ultraviolet and Visible Spectroscopy** • Derivation of Beer- Lambert's Law and its limitations, factors affecting molecular absorption, types of transitions [emphasis on charge transfer absorption], pH, temperature, solvent and effect of substituents.	01	15

	• Applications of Ultraviolet and Visible spectroscopy: 1) On charge transfer absorption 2) Simultaneous spectroscopy 3) Derivative Spectroscopy • Dual spectrometry – Introduction, Principle, Instrumentation and Applications **Infrared Absorption Spectroscopy** • Instrumentation: Sources, Sample handling, Transducers, Dispersive, non-dispersive instrument • FTIR and its advantages • Applications of IR [Mid IR, Near IR, Far IR]: Qualitative with emphasis on "Finger print" region, Quantitative analysis, Advantages and Limitations of IR • Introduction and basic principles of diffuse reflectance spectroscopy.		
4	**Unit 4:** **Thermal Methods** • **Introduction,** Recapitulation of types of thermal methods, comparison between TGA and DTA. • **Differential Scanning Calorimetry-** Principle, comparison of DTA and DSC, Instrumentation, Block diagram, Nature of DSC Curve, Factors affecting curves (sample size, sample shape, pressure). • **Applications -** Heat of reaction, Specific heat, Safety screening, Polymers, liquid crystals, Percentage crystallinity, oxidative stability, Drug analysis, Magnetic transition. e.g., Analysis of Polyethylene for its crystallinity. **Automation in chemical analysis** • Need for automation, Objectives of automation, an overview of automated instruments and instrumentation, process control analysis, flow injection analysis, discrete automated systems, automatic analysis based on multilayered films, gas monitoring equipments, Automatic titrators.	01	15
	Total	**4**	**60**

Access to the Course

The course is available for all the students admitted for Master of Science.

Methods of Assessment

The assessment pattern would be 60:40, 60% for Semester End Examination (SEE) and 40% for Continuous Internal Assessment (CIA). The structure of the SEE and CIA would be as recommended by the Board of Studies and approved by the Board of Examination and the Academic Council of the college.

References:

1. Modern Analytical Chemistry by David Harvey, McGraw-Hill Higher Education
2. Principles of Instrumental Analysis - Skoog, Holler and Nieman, 5th Edition, Ch: 1.
3. Fundamentals of Analytical Chemistry, By Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, 9th Edition, 2004, Ch: 5.
4. Undergraduate Instrumental Analysis, 6th Edition, J W Robinson, Marcel Dekker, Ch:1.
5. ISO 9000 Quality Systems Handbook, Fourth Edition, David Hoyle. (Chapter: 3 & 4)
6. Quality in the Analytical Laboratory, Elizabeth Pichard, Wiley India, Ch:5,Ch: 6.
7. Quality in Totality: A Manager's Guide To TQM and ISO 9000, ParagDiwan, Deep & Deep Publications, 1st Edition, 2000.
8. Quality Control and Total Quality Management - P.L. Jain-Tata McGraw-Hill (2006)
9. Total Quality Management - Bester field - Pearson Education, Ch:5.
10. Industrial Hygiene and Chemical Safety, M H Fulekar, Ch:9, Ch:11 & Ch:15.
11. Safety and Hazards Management in Chemical Industries, M N Vyas, Atlantic Publisher, Ch:4, Ch:5 & Ch:19.
12. Staff, World Health Organization (2009) Handbook: Good Laboratory Practice (GLP)
13. OECD Principles of Good Laboratory Practice (as revised in 1997)". OECD
14. Environmental Health and Safety Publications. OECD. 1. 1998.
15. Klimisch, HJ; Andreae, M; Tillmann, U (1997). "A systematic approach for evaluating the quality of experimental toxicological and eco-toxicological