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

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COURSE TITLE: ANALYTICAL CHEMISTRY  
SEMESTER-II  
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	:	Second
No. of Credits	:	04
Title of the Course	:	Analytical Chemistry
Course Code	:	S511CHT
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-II**

**Paper No.- II**

**Course Title: Analytical Chemistry**

**No. of Credits - 04**

**Type of Vertical: Compulsory Major**

**COURSE CODE: S511CHT**

**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	describe chromatographic techniques such as GC, HPLC and discuss instrumentation involved in X-ray spectroscopy.
CLO-03	Apply	illustrate principle and instrumentation of mass spectrometry and Atomic Absorption Spectroscopy
CLO-04	Analyse	compare different surface analytical techniques and differentiate between electrogravimetry and coulometry.

## Syllabus for First Year of Master of Science in Chemistry

(With effect from the academic year 2023-2024)

**SEMESTER-II**

**Paper No.- II**

**Course Title: Analytical Chemistry**

**No. of Credits - 04**

**Type of Vertical: Compulsory Major**

**COURSE CODE: S511CHT**

COURSE CONTENT			
Module No.	Content	Credits	No. of Hours
1	<p><b>Unit 1: Chromatography</b></p> <ul style="list-style-type: none"> <li>• <b>Recapitulation of basic concepts in chromatography:</b> Classification of chromatographic methods, requirements of an ideal detector, types of detectors in LC and GC, comparative account of detectors with reference to their applications (LC and GC respectively), qualitative and quantitative analysis.</li> <li>• Concept of plate and rate theories in chromatography: efficiency, resolution, selectivity and separation capability. Van Deemter equation and broadening of chromatographic peaks. Optimization of chromatographic conditions.</li> <li>• <b>Gas Chromatography:</b> Instrumentation of GC with special reference to sample injection systems – split/splitless, column types, solid/ liquid stationary phases, column switching techniques, temperature programming, Thermionic and mass spectrometric detector, Applications.</li> <li>• <b>High Performance Liquid Chromatography (HPLC):</b> Normal phase and reversed phase with special reference to types of commercially available columns (Use of C8 and C18 columns). Diode array type and fluorescence detector, Applications of HPLC. Chiral and ion chromatography.</li> </ul>	01	15
2	<p><b>Unit 2: Spectroscopy</b></p> <ul style="list-style-type: none"> <li>• <b>X-ray spectroscopy:</b> principle, instrumentation and applications of X-ray fluorescence, absorption and diffraction spectroscopy.</li> </ul>	01	15

	<ul style="list-style-type: none"> <li>• <b>Mass spectrometry:</b> recapitulation, instrumentation, ion sources for molecular studies, electron impact, field ionization, field absorption, chemical ionization and fast atom bombardment sources. Mass analyzers: Quadrupole, time of flight and ion trap. Applications.</li> <li>• <b>Radioanalytical Methods</b> – recapitulation, isotope dilution method, introduction, principle, single dilution method, double dilution method and applications.</li> </ul>		
3	<p><b>Unit 3: Analytical Techniques</b></p> <p><b>Surface Analytical Techniques</b></p> <ul style="list-style-type: none"> <li>• Introduction, Principle, Instrumentation and Applications of:</li> <li>• Scanning Electron Microscopy (SEM)</li> <li>• Scanning Tunneling Microscopy (STM)</li> <li>• Transmission Electron Microscopy (TEM)</li> <li>• Electron Spectroscopy (ESCA and Auger)</li> </ul> <p><b>Atomic Spectroscopy</b></p> <ul style="list-style-type: none"> <li>• Advantages and Limitations of AAS</li> <li>• Atomic Spectroscopy based on plasma sources – Introduction, Principle, Instrumentation and Applications.</li> </ul>	01	15
4	<p><b>Unit 4: Electro Analytical Methods</b></p> <ul style="list-style-type: none"> <li>• <b>Ion selective Potentiometry and Polarography</b> Ion selective electrodes and their applications (solid state, precipitate, liquid –liquid, enzyme and gas sensing electrodes), ion selective field effect transistors, biocatalytic membrane electrodes and enzyme-based biosensors.</li> <li>• <b>Polarography:</b> Ilkovic equation, derivation starting with Cottrell equation, effect of complex formation on the polarographic waves.</li> <li>• <b>Electrogravimetry:</b> Introduction, principle, instrumentation, factors affecting the nature of the deposit, applications.</li> <li>• <b>Coulometry:</b> Introduction, principle, instrumentation, coulometry at controlled potential and controlled current</li> </ul>	01	15
	<b>Total</b>	<b>4</b>	<b>60</b>

## 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. Instrumental Analysis by Douglas A. Skoog - F. James Holler - Crouch, Publisher: Cengage; Edition, (2003), ISBN-10: 8131505421, ISBN-13: 978-8131505427
2. Physical Principles of Electron Microscopy, An Introduction to TEM, SEM, and AEM
3. Authors: Ray F. Egerton, ISBN: 978-0- 387-25800- 3 (Print) 978-0- 387-26016- 7 (Online)
4. Modern techniques of surface science by D.P. Woodruff, T.A. Delchar, Cambridge Univ. Press, 1994.
5. Introduction to Scanning Tunneling Microscopy by C. J. Chen, Oxford University Press, New York, 1993.
6. Transmission Electron Microscopy: A text book for Material Science, David B Williams and C., Barry Carter, Springer
7. Modern Spectroscopy, by J.M. Hollas, 3rd Edition (1996), John Wiley, New York
8. Principles of Instrumental Analysis – Skoog, Holler, Nieman, 5th ed., Harcourt College Publishers, 1998.
9. Instrumental Analysis by Douglas A. Skoog - F. James Holler - Crouch, Publisher: Cengage; Edition (2003), ISBN10: 8131505421, ISBN-13: 978-8131505427
10. Principles of Instrumental Analysis – Skoog, Holler, Nieman, 5th Edition, Harcourt College Publishers, 1998. Chapters - 23, 24, 25.
11. Analytical Chemistry Principles – John H Kennedy, 2nd edition, Saunders College Publishing (1990).
12. Modern Analytical Chemistry David Harvey; McGraw Hill Higher education publishers, (2000).
13. Vogel's Text book of quantitative chemical analysis, 6th edition, Pearson Education Limited, (2007).
14. Electrochemical Methods Fundamentals and Applications, Allen J Bard and Larry R Faulkner, John Wiley and Sons, (1980).
15. Instrumental Methods of Analysis Willard, Merrit, Dean and Settle, 7th edition, CBS publishers.
16. Fundamentals of Analytical Chemistry, By Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, 9th Edition, 2004, Ch: 5.