

## **The M.Sc. Analytical Degree Program**

The program of studies for the M.Sc. Analytical degree aims at equipping the students with adequate theoretical foundation for subsequent specialization in any area of pure & applied chemistry and giving them a fairly comprehensive practical training to make them self-reliant in their work. The principal motivation of the course is an understanding of the interactions of matter, based on knowledge of its ultimate structure, the principles of relationship behind chemical, biological & physical phenomenon and its analysis. The course offer exclusive specialization in a particular branch of chemistry named “Analytical Chemistry “.

**M.Sc. ANALYTICAL CHEMISTRY Semester – III**  
**CCCH-301: Spectroscopic Techniques**

**Total Marks: 70**

**Time: 3 hours**

**Unit-1: 14 hours**

**Raman spectroscopy**

Introduction, History, Theoretical basis, Raman shift, Instrumentation, Comparison between infrared spectroscopy and Raman spectroscopy, Comparison between fluorescence and Raman spectroscopy, Nature of Raman spectra, Advantages and limitations, Applications.

**Unit-2: 14 hours**

**Inductively coupled plasma mass spectrometry (ICP - MS)**

Introduction to Inductively coupled plasma and Mass spectrometry, Instrumentation, Sample Preparation, Applications.

**Unit-3: 14 hours**

**Atomic absorption spectroscopy (AAS)**

Introduction, Principles, Preparation of samples, Instrumentation, Flame emission, Graphite furnace, Advantages and Limitations, Applications.

**Unit-4: 18 hours**

**Carbon-13 Nuclear Magnetic Resonance Spectroscopy**

Introduction, Comparison between Proton and Carbon 13 NMR, Correlation chart of Chemical shift, Chemical shifts calculation for branched, terminal, Aromatic compounds, Instrumentation, coupling constants, two dimension NMR spectroscopy – COSY, NOESY, DEPT, TOCSY, HETCOR, HMQC HMBC, and INADEQUATE techniques.

**Reference Books:**

- (1) Bartt L et al : Vogel's Textbook of Quantitative Inorganic Analysis, ELBS 6th Ed.
- (2) Sharma B K : Instrumental methods of Chemical Analysis, Goel Publishing House.
- (3) Silverstein R M, Bassler G C : Spectrometric Identification of Organic Compounds, John Wiley.

- (4) Sharma Y R : Elementary Organic Spectroscopy, Jalandhar.
- (5) Kalsi P S : Spectroscopy of Organic Compounds, New Age International Ltd.
- (6) Sethi P D, High Performance Liquid Chromatography.
- (7) Skoog D A., Loary J I and Saunder W B, Principles of Instrumental Analysis.
- (8) Skoog D A, West D M, Holler F J and Saunder W B, Fundamentals of Analytical Chemistry.

## M.Sc. ANALYTICAL CHEMISTRY Semester – III

### CCCHA-302: SELECTED TOPICS IN ANALYTICAL CHEMISTRY

**Total Marks: 70**

**Time: 3 hours**

**Unit – 1: Scope of Analytical Chemistry:**

**16 hours**

Role of Analytical chemistry, Classification of analytical methods-classical and instrumental, Types of Instrumental Analysis, Selecting an Analytical Method, Neatness and cleanliness, Laboratory operations and practices, Analytical balance, Techniques of weighing, Errors, Volumetric glassware-cleaning and calibration of glassware, Sample preparations – dissolution and decompositions, Gravimetric techniques, Selecting and handling of reagents, Laboratory notebooks, safety in analytical laboratory, treatment of analytical data, errors, sources of errors, deviation, absolute errors, accuracy and precision, literature of Analytical Chemistry.

**Unit- 2: Regulatory Affairs**

**16 hours**

Concept of total quality management (QC and QA), requirements of GMP, GLP, Regulatory requirements of drugs and Pharmaceutical (USFD-NDA/ANDA & ICH guide line), SOP of SOP, Standard operating procedures (SOP) and documentation.

**Unit – 3: Supercritical fluids separation technique:**

**14 hours**

Introduction, Instrumentation, sample preparation, Mobile phase, Drawbacks and applications

**Unit-4: Size Exclusion Chromatography (GPC):**

**14 hours**

Principle, Separation mechanism, and Applications

#### Reference Books:

- (1) Skoog D A, West D M : Fundamentals of Analytical Chemistry, Thomson Asia Pvt Ltd. 8<sup>th</sup> Ed, (2004).
- (2) Bartt L et al : Vogel's Textbook of Quantitative Inorganic Analysis, ELBS 6<sup>th</sup> Ed.
- (3) Sharma B K : Instrumental methods of Chemical Analysis, Goel Publishing House.
- (4) Silverstein R M, Bassler G C : Spectrometric Identification of Organic Compounds, John Wiley.
- (5) Sharma Y R : Elementary Organic Spectroscopy, Jalandhar.
- (6) Kalsi P S : Spectroscopy of Organic Compounds, New Age International Ltd.
- (7) Mahindru S N : Food Analysis, Swan Publishing House, 23<sup>rd</sup> Ed.
- (8) Dyer J R : Application of Spectroscopy of Organic Compounds, Prentice Hall.
- (9) Khopkar S M: Basics concepts of Analytical Chemistry, Wiley Eastern

- Abraham R J, Fisher J and Loftus P, Introduction to NMR spectroscopy, Wiley Eastern.
- (10) United state Pharmacopeia
  - (11) Principles of Instrumental Analysis, 6th Edition 2006, by Douglas A. Skoog, F. James Holler, Timothy A. Nieman.
  - (12) Instrumental Methods of Analysis, 6th Edition, by Willard, Merritt, Dean, Settle, CBS Publishers and Distributors.
  - (13) Contemporary Chemical Analysis, by J. F. Rubinson and K. A. Rubinson, Princtice-Hall International Inc. 1998.
  - (14) Introduction to Instrumental Analysis, by Robert D. Braun, McGraw-Hill Book company, New Delhi..

**M.Sc. ANALYTICAL CHEMISTRY Semester – III**  
**CCCHA-303: Advanced Analytical techniques**

**Total Marks: 70**

**Time: 3 hours**

**Unit-1: Matrix Assisted Laser Desorption/Ionization - MALDI: 12 hours**

Methods for the separation of biomolecules: Principles, theory, Instrumentation and applications.

**Unit-2 A) Time of flight (TOF): 12 hours**

Principles, theory, advantages, Instrumentation and applications

**B) Triple Quadrupole mass detector 12 hours**

Introduction, Principles, theory, Instrumentation and applications

**Unit-3: Microscopic Technique SEM 12 hours**

Introduction to scanning electron microscopy (SEM); basic principles and theory; instrumentation and operating parameters and applications.

**Unit-4: Nano particle size analyser with Zeta potential 12 hours**

Introduction, Principles, theory, Instrumentation and applications

**Reference Books:**

- (1) Skoog D A, West D M : Fundamentals of Analytical Chemistry, Thomson Asia Pvt Ltd. 8<sup>th</sup> Ed, (2004).
- (2) Bartt L et al : Vogel's Textbook of Quantitative Inorganic Analysis, ELBS 6<sup>th</sup> Ed.
- (3) Sharma B K : Instrumental methods of Chemical Analysis, Goel Publishing House.
- (4) Mahindru S N : Food Analysis, Swan Publishing House, 23<sup>rd</sup> Ed.
- (5) Khopkar S M: Basics concepts of Analytical Chemistry, Wiley Eastern
- (6) Physical Methods in Chemistry, R.S. Drago, Saunders College.
- (7) Modern Spectroscopy, J.M. Hollas, John Wiley.
- (8) Instrumental Methods of Analysis, H.H. Willard, East West Press

## M.Sc. Analytical Chemistry Semester – III

### CECHA-304A: Analysis of Waste Water, Food and Pharmaceutical Drugs

**Total Marks: 70**

**Time: 3 hours**

**Unit-I: Classification of Analytical Methods**

**14 hours**

Types of samples, Preparation of sample for analysis, effect of sampling uncertainties, sample treatment, moisture in sample, decomposition of organic & inorganic compounds, procedure of sampling of solids, liquids and gases.

**Unit-2: Analysis of Food and Food additives**

**16 hours**

Analysis of dairy products, Analysis of caffeine in Tea and Coffee.

Analysis of Chemical additives: Division of colour additives (Coal-tar dyes, vegetable colours and mineral colours), chromatographic identification of colours, and quantitative estimation of added dyes in foods.

**Unit-3: Industrial Waste Water Analysis:**

**14 hours**

**Chemical analysis:**

Procedure, preservation of sample, sampling characterization of waste water, analysis of DO, COD, BOD, Arsenic, Mercury, Chromium-hexavalent, Lead cyanide, total suspended solids.

**Unit-4: Pharmaceutical Analysis:**

**16 hours**

Definition, classification of drugs on the basis of their effects, therapeutic action and structure. Definition and analysis of followings classes of drugs with one specific example of each : (i) Narcotics, (ii) Antiseptics and Disinfectants, (iii) Analgesics, (iv) Antipyretics, (v) Antibiotics

**Reference Books:**

- (1) Skoog D A, West D M : Fundamentals of Analytical Chemistry, Thomson Asia Pvt Ltd. 8<sup>th</sup> Ed, (2004).
  - (2) Bartt L et al : Vogel's Textbook of Quantitative Inorganic Analysis, ELBS 6<sup>th</sup> Ed.
  - (3) Sharma B K : Instrumental methods of Chemical Analysis, Goel Publishing House.
  - (4) Mahindru S N : Food Analysis, Swan Publishing House, 23<sup>rd</sup> Ed.
  - (5) Khopkar S M: Basics concepts of Analytical Chemistry, Wiley Eastern
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  - (7) Modern Spectroscopy, J.M. Hollas, John Wiley.
- Instrumental Methods of Analysis, H.H. Willard, East West Press



**M.Sc. ANALYTICAL CHEMISTRY Semester – III**  
**CECHA-304 B: Selected Topics in Modern Analytical Chemistry**

**Total Marks: 70**

**Time: 3 hours**

**Unit-1: Fundamentals of Biochemistry 16 hours**

Introduction of Biochemistry, Amino acids: peptides, primary, secondary, tertiary, and quaternary structure of proteins. Nucleic acids: Base pairing, double helices, Chemical and enzymatic hydrolysis of nucleic acids; Structure and function of mRNA, tRNA, rRNA; DNA replication, transcription and translation, Amino acid sequencing; amino acid metabolism (biosynthesis and degradation).

**Fatty acid metabolism:** Biological importance of fatty acids even chain and odd chain fatty acids, saturated and unsaturated fats, ketone bodies, fatty acid metabolism, biological membranes.

**Protein-related transformations:** urea cycle, uric acid and ammonia formation.

**Unit-2: Biochemistry of naturally occurring Macro molecules 16 hours**

**Classification:** classification based on chemical structure, physiological activity, taxonomy and biogenesis.

**Monoterpenes and sesquiterpenes:** bisabolene, juvabione, transchrysanthamic acid, logifolene, taxines, caryophyllene.

**Steroids:** Synthesis and functions of cholesterol, ergo sterol, progesterone, testosterone, cortisone.

**Plant Hormones:** gibberellins, gibberellic acid.

**Peptides:** bradykinin, oxytocin, vasopressins, gramicidins.

**Carbohydrates, proteins and lipids.**

**Unit-3: Natural Product Analysis 14 hours**

Classification, method of isolation, structure determination of alkaloids, vitamins, plant pigments, terpenoids, steroids, starch etc

**Unit-4: Industrial Skills 14 marks**

Basic concept, factors affecting the plant location, Plant layout, main objects of scientific layout, factors affecting layout, Management of Human Resources recruitment and selection, training and development, industrial safety, welfare of employees, Materials Management , Inventory Control and Introduction of patents.

## Reference Books:

1. Albert L. Lehninger, David L. Nelson, Michael M. Cox., Principles of Biochemistry, CBS Publishers and Distributors, 1993.
2. Lubert Stryer, Biochemistry, W. H. Freeman and Company, 4th edition, 1995.
3. Christopher K. Mathews and K. E. Von Holder, Biochemistry, Benjamin/Cummings, 1990.
4. 4Willing, S.W., & Stoker, Good Manufacturing Practices for Pharmaceuticals, Marcel Dekker, New York.
5. Federal Food, Drug & Cosmetic Act.
6. Pisano-FDA Regulatory Affairs.
7. Indian, Pharmacopoeia, British Pharmacopoeia and U. S. Pharmacopoeia.
8. B.K. Sharma, Industrial Chemistry.
9. Guidelines on GMP/GLP by S. Lyer.
10. Chemical process industries by N.D. Shreve.
11. Applied chemistry for Engineer by Diamont.
12. Engineering chemistry by B.K. Sharma.
13. Industrial Chemistry by BK Sharma, Goel Publishing house Meerut.
14. Dryden's outlines of Chemical Technology 2nd Edn., edited and revised by M. Gopala Rao, Marshel sitting – East West Press, 1973.

**M.Sc. ANALYTICAL CHEMISTRY Semester – III**  
**CEPRA - 305**  
**COMBINED PRACTICALS IN ANALYTICAL CHEMISTRY**  
**TOTAL MARKS 200**

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|--|-----------------|
| <b>1. Drug and Functional group Estimation</b> | <b>40 Marks</b> |
| <b>2. Spectral Analysis</b>                    | <b>40 Marks</b> |
| <b>3. Viva Voce</b>                            | <b>40 Marks</b> |
| <b>4. Any two analysis (in exam):</b>          | <b>80 Marks</b> |
1. Synthesis and characterization of Nano particles
  2. Natural plant extraction and separation
  3. Instrumental Analysis.
  4. Corrosion study of different metals.

**Exam Pattern:**

**Day 1.** Drug Estimation and Spectral analysis

**Day 2.** Analysis and Viva.

**Time: 7 hours daily.**

## **STYLE OF QUESTION PAPER**

### **Q.1 TO Q.4**

Each question from one unit of the syllabus. Each question carries **15 marks**. Sub question (a) answer any three out of 5, 3 marks each, 09 marks of sub question (a). Sub question (b) 6 marks.

**Q.5 To attempt any five out the eight short questions, 2 marks each. 2 questions from each unit.**

**Hence Q.1 to Q.5 will be of 70 marks.**

**Total 70 marks + 30 marks internal.**

## **FORMAT OF INTERNAL ASSESSMENT**

**TOTAL MARKS 30.**

Assignments, Mid Semester Exam, Skill, Seminar and Attendance.

**M.Sc. Semester – IV**  
**ANALYTICAL CHEMISTRY PROJECT/DISSERTATION WORK**

CCCHA-401 Industrial / Institutional Dissertation / Project Work

500 Marks

CCCHA-402 Theoretical Project work

200 marks

***Semester 4:***

<b>Type of Course</b>	<b>Name of the course</b>	<b>Hours per week</b>	<b>credits</b>
CCCHA-401: Industrial / Institutional Dissertation / Project Work	Report	24	16
CCCHA-402: Theoretical Project work	Report	24	10
		Total	26

***Total credits:*** 108