

# Swami Ramanand Teerth Marathwada University, Nanded



**B. O. S. In Chemistry**

**B. Sc. Second Year (Analytical Chemistry)  
Revised Syllabus**

**In force from June - 2009**

**B. Sc. Second Year  
Analytical Chemistry  
June-2009**

Paper	Course No.	Course	Periods/ week	Total Periods	Marks
IV	CHAC-201	Inorganic and Organic Analysis	3	80	100
V	CHAC-202	Instrumental Methods of Chemical Analysis	3	80	100
VI	CHAC-203	Laboratory Course II	4	120	100
VII	CHAC-204	Laboratory Course III	4	120	100

**B. Sc. Second Year (Theory) Course Structure  
Paper-IV, Inorganic and Organic Analysis  
(CHAC-201)**

**Time: 3 Hrs.**

**Marks: 100**

Unit No.	Topic No.	Title of Topic	Periods
I	1	Principles of semimicro qualitative analysis of inorganic salts	15
	2	Semi-micro determination of elements (C,H,N,S and X) in the organic compounds	6
II	3	Metallurgical analysis	15
	4	Principles and methods of analysis of saponifiable Oils and Fats	10
III	5	Analysis of cement, fertilizers and pesticides	18
IV	6	Quality assurance and quality control	16
		<b>Total Periods</b>	<b>80</b>

**B. Sc. Second Year (Theory) Course Structure**  
**Paper-V, Instrumental Methods of Chemical Analysis (CHAC-202)**

**Time: 3 Hrs.**

**Marks: 100**

Unit No.	Topic No.	Title of Topic	Periods
I	1	Spectroscopic methods (UV Visible)	20
II	2	Spectroscopic methods (FES and AAS)	8
	3	Electron Microscopy	10
III	4	Radio Chemical Methods	8
	5	Thermal Methods of Analysis	12
IV	6	Optical Methods	8
	7	Chromatographic Techniques	14
		<b>Total Periods</b>	<b>80</b>

Note:

1. Question number one should be on Unit-I syllabus.
2. Question number two should be on Unit-II syllabus.
3. Question number three should be on Unit-III syllabus.
4. Question number four should be on Unit-IV syllabus.
5. Question number five should be on all units syllabus.
6. Multiple choice Questions should be from each topics to be covered.
7.  $\pm 3$  marks adjustment in given weightage should be allowed.

**B. Sc. Second Year**  
**Paper-IV [CHAC-201]**  
**Inorganic and Organic Analysis**

**Marks: 100**

**Periods: 80**

**Unit I**

- 1.1 Principles of Semimicro Qualitative Analysis of Inorganic Salts: 15P**  
Chemical analysis, types of Qualitative inorganic analysis. Theoretical principles involved in separation of cations into groups – Law of mass action, solubility product, common ion effect, complex formation. Limits of identification. Spot test analysis – spot test procedures.
- 2.2 Semi-micro Determination of Carbon, Hydrogen Sulphur, Nitrogen and Halogens in the Organic Compounds (one method for each element) 06P**  
Estimation of the following functional groups in the organic compounds – Hydroxy (alcoholic and phenolic) carbonyl, ester, Nitro, Amino and Carboxylic acid

**Unit II**

- 2.1 Metallurgical Analysis : 15P**  
Principles of ore dressing, estimation of main constituents in the following ores – Haematite, Pyrolusite, Bauxite and Limestone. Analysis of copper, aluminium, silicon and uranium metals for their percentage purity.  
Composition and analysis of following alloys - stainless steel, brass and solder
- 2.2 Principles and Methods of Analysis of Saponifiable Oils and Fats : 10P**  
Definition, classification of oils and fats. Analysis by physical, and chemical methods – Density, Specific Gravity, Colour, Smoke point, Acid value, Peroxide value, Iodine value, Saponification value, self stability value. Determination and significance of these aspects in quality control.

**Unit III**

- 3.1 Analysis of Cement, Fertilizers and Pesticides: 18P**  
**Cement** : definition, types of cements. Composition and analysis of portland cement  
**Fertilisers** : Definition, Classification, Characteristics of good fertiliser, Analysis of Nitrogenous, Phosphate and Potash fertilisers.  
**Pesticides** : Definition, Classification, Characteristics of good pesticides, Analysis of DDT, Malathion and Diazinon.

## **Unit IV**

### **4.1 Quality Assurance and Quality Control :**

**16P**

#### **Quality and Objectives of Analytical Chemistry**

Definitions and General Considerations, Quality of Analytical Data and Adapted Information

#### **Analytical Method :**

Method selection and definitions, Types of methods, Traceability, Conclusion

#### **Validation of the Method :**

Validation of Instruments, Computer Hardware and Software, Validation of Analytical Method, Literature Search, Validation of Final Detection, Matrix Influence, Solid Material, Roggedness / Robustness, Control Points, Control Charts and Chemometric tools

#### **How to achieve accuracy:**

Need for Accuracy, Comparison with a Different Method, Certified Reference Material (CRM), Types of Certified Reference Materials, Use of CRMs.

#### **Regulator Aspects of QA and QC**

Evaluation of Laboratories, Good Laboratory Practice (GLP), Accreditation System, ISO 9000 / EN 29000 Standards, Accreditation of RM and CRM Producers, Certification of Chemists, Standardization, Written Standards, Standardization Bodies and Conclusion

**B. Sc. Second Year**  
**Paper-V [CHAC-202]**  
**Instrumental Methods of Chemical Analysis**

**Marks: 100**

**Periods: 80**

**Unit I**

- 1.1 Spectroscopic Methods (UV Visible) : 20P**  
Nature and properties of electromagnetic radiations, Process of emission, absorption and fluorescence. UV and visible spectroscopy - Theory, Instrumentation, Lambert-Beer's law, deviations. Analysis of single component and multi component mixture. Spectrophotometric methods of investigation of complex ions. Photometric titrations.

**Unit II**

- 2.1 Spectroscopic Methods (FES and AAS) 08P**  
Flame Emission and Atomic Absorption Spectroscopy – Theory, Instrumentation, and applications of these techniques.
- 2.2 Electron Microscopy: 10P**  
**Introduction, Electron lenses, Electrostatic lenses, Transmission Electron Microscope (TEM):**  
Electron Sample Interactions and Electron Spectroscopy, Instrumentation General Design, Resolution, Electron Sources, TEM grids.  
**Scanning Electron Microscope (SEM) :**  
Introduction and Instrumentation.  
**Scanning Transmission Electron Microscope (STEM):**  
Introduction and Instrumentation.  
**General Applications of the above techniques.**

**Unit III**

- 3.1 Radiochemical Methods: 08P**  
Detection and measurement of nuclear radiations, Tracer technique, Isotope dilution analysis, and Neutron activation analysis.
- 3.2 Thermal Methods of Analysis: 12P**  
Thermogravimetry (TG): Theory, Instrumentation, and applications. Thermometric titrations. Differential Thermal Analysis (DTA) : Theory, Instrumentation and applications

## **Unit IV**

### **4.1 Optical Methods :**

**08P**

Theory, Experimental techniques of measurement and application of each of the following properties in chemical analysis :

- 1) Refractive Index
- 2) Optical activity

### **4.2 Chromatographic Techniques:**

**14P**

#### **Gas chromatography (GC):**

Introduction, Types of Gas chromatography.

#### **Gas Liquid Chromatography (GLC) :**

Principle, Instrumentation and Applications.

#### **Gas Solid Chromatography (GSC) :**

Principle, Instrumentation and Applications.

#### **High Performance Liquid Chromatography (HPLC) :**

Introduction, Principle, Instrumentation Solvent Delivery system Pumping Systems, Sample Injection Systems, Columns, Detectors, Recorder, Mobile Phases, Column Efficiency and Applications.

**B. Sc. Second Year**  
**Paper-VI [CHAC-203]**  
**Laboratory course-I Analytical Chemistry**

**Marks: 100**

**Periods: 120**

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**Note:** Out of 30 experiments atleast 16 experiments should be completed.

- 1) Estimation of Iron in haematite ore volumetrically.
- 2) Estimation of manganese in Pyrolusite ore
- 3) Estimation of calcium in Lime stone volumetrically
- 4) Determination of percentage purity of aluminium metal
- 5) Determination of percentage purity of copper metal
- 6) Determination of Nickel in stainless steel by gravimetric method
- 7) Determination of percentage purity of silver metal
- 8) Determination of Copper in Brass
- 9) Determination of Nickel in german silver
- 10) Estimation of sulphur in the organic compound by semi-micro method.
- 11) Estimation of phenolic hydroxy group in the organic compound.
- 12) Estimation of ester group in the organic compound.
- 13) Estimation of SiO<sub>2</sub> in the given sample of Portland cement.
- 14) Estimation of CaO in the given sample of Portland cement by gravimetric method.
- 15) Determination of total nitrogen in a fertiliser sample.
- 16) Estimation of phosphorus in a phosphate fertilizer sample.
- 17) Estimation of potassium ion in a potash fertiliser sample (solid / liquid)
- 18) Determination of acid value of an oil sample
- 19) Determination of saponification value of an oil sample.
- 20) Preparation and standardisation of acetic acid from the data of specific gravity and percentage by weight.
- 21) Determination of Iodine value of an oil sample.
- 22) Determination of volatile thinner in a paints sample.
- 23) Separation and determination of total pigment in a paint sample.
- 24) Determination of specific gravity of an oil sample
- 25) Determination of loss on ignition of Portland cement
- 26) Estimation of combined oxides of Fe and Al in a cement sample.
- 27) Determination of halogen in the organic compound.
- 28) Determination of density of Cu / Al / Zn / Ag / Ni metal powder using density bottle
- 29) Determination of nitrogen in urea.
- 30) Determination of percentage of phenol in household disinfectant (e.g. black phenyl)



**B. Sc. Second Year**  
**Paper-VII [CHAC-204]**  
**Laboratory course-II Analytical Chemistry**

**Marks: 100**

**Periods: 120**

**Note: Out of 24 experiments atleast 16 experiments should be completed.**

- 1) Analysis of permanganate and dichromate mixture
- 2) Determination of pK<sub>a</sub> value of acid base indicator.
- 3) Determination of molar extinction coefficient of potassium permanganate / Potassium dichromate.
- 4) Determination of stability constant of iron-orthophenanthroline complex by mole-ratio method.
- 5) Determination of formula of ferric sulpho-salicylic acid complex colorimetrically by Job's method.
- 6) Photometric titration of copper by EDTA.
- 7) Colorimetric estimation of Iron by Ortho Phenanthroline.
- 8) Determination of fluoride in a given solution / tooth past by Zirconyl-Alizarin red method colorimetrically.
- 9) Colorimetric estimation of titanium in the given solution by hydrogen peroxide
- 10) Determination of solubility and solubility product of sparingly soluble salt by conductance measurement.
- 11) Assay of boric acid by conductometry
- 12) Estimation of the amount of hydrochloric acid and oxalic acid in the given mixture by conductometry.
- 13) Determination of pK<sub>a</sub> values of Phosphoric acid by Potentiometry.
- 14) Estimation of chloride and Iodine in the given mixture by Potentiometry.
- 15) Determination of the concentration of an optically active compound in the given unknown solution by Polarimetry.
- 16) Turbidimetric determination of traces of chloride / sulphate.
- 17) Colorimetric estimation of proteins by biuret method.
- 18) Determination of transport number of Ag<sup>+</sup> and NO<sub>3</sub><sup>-</sup> by Hittorf's method by Potentiometry.
- 19) Determination of refractive index of a given organic liquid by Abbe's Refractometer.
- 20) Titration of phosphate mixture by potentiometry.
- 21) To study the variation of viscosity with composition of the mixture of liquids
- 22) Determination of percentage purity of an optically active compound by polarimetry.
- 23) Estimation of boric acid by potentiometry.
- 24) Estimation of aminoacids by colorimetry.

### **Recommended books for Papers IV, V VI, VII :**

1. Text book of micro and semi micro qualitative inorganic analysis by A.I.Vogel.
2. Spot tests in inorganic analysis – Feigl
3. Textbook of quantitative inorganic analysis by A.I.Vogel (3<sup>rd</sup> edition)
4. Principles of Instrumental Analysis by DA Skoog and DM West.
5. Principles and methods of chemical analysis of H.F.Walkton.
6. Quantitative chemical analysis by Cumming and Key
7. Textbook of practical organic chemistry by A.I.Vogel
8. Practical organic chemistry by Mann and Saunders
9. Semi-micro quantitative organic analysis by R.Belcher and AL Godbert
10. Elementary practical organic chemistry by AI Vogel
11. Quantitative organic analysis by Sidney Siggia 2<sup>nd</sup> Edition
12. Standard methods of chemical analysis by Welcher
13. Fundamentals of analytical chemistry by DA Skoog and DM West
14. Instrumental methods of chemical analysis by Willard HH, Merritt Jr.LL, Dean JA, Settle Jr FA
15. Instrumental methods of chemical analysis by GW Ewing.
16. Quantitative analysis Laboratory manual by Day and Underwood
17. Chemical separation methods by S.K.Dean
18. Instrumental methods of analysis by S.K.Sharma
19. Instrumental methods of analysis by Chatwal and Anand
20. Introduction to instrumental Analysis by R.D.Braun
21. An introduction to Metallurgy Analysis by S.K.Jain
22. College analytical chemistry by Baliga and Shetty
23. Basic principles in analytical chemistry by Raghuvaran Prabhu, Prabhu and Sathe, Sheth publication
24. Experiments in Chemistry by Dr.D.V.Jahagirdar
25. Systematic experimental physical chemistry by Dr.Chondhekar T.K. and S.W. Rajbhoj
26. Advanced practical inorganic chemistry by Gurdeep Raj
27. Practical physical chemistry by J.B.Yadav
28. Analytical chemistry by R.M.Verma
29. Commercial methods of analysis by Foster Dsnell and F.M.Biffen
30. Scanning Electron Microscopy and X-Ray Micro Analysis – Graham Laws, Analytical Chemistry by Open Learning, Wiley India Pvt. Ltd. (2008), [For Paper V, Topic 3, Electron Microscopy]
31. Methods in Modern Biophysics – Bengt Nolting, Springer International Ediction, Springer (India) Private Limited, New Delhi (2004) [For Paper V, Topic 3, Electron Microscopy]
32. Biophysics – G.R.Chatwal, Edited by Madhu Arora, Himalaya Publishing House, New Delhi, First Edition, 2005. [For Paper V, Topic 3, Electron Microscopy]
33. Elements of Analytical Chemistry – R.Gopalan, P.S.Subraminan, K.Rengrajan, Sultan Chand and Sons, New Delhi, 2007.
34. Analytical Chemistry Principles, John H.Kennedy, 2<sup>nd</sup> Edition, Saunders College Publishing, New York.

35. Analytical Chemistry – Theory and Practice UN Dash, Sultan Chand and Sons, New Delhi, 2005.
36. Instrumental Methods of Chemical Analysis – H.Kaur
37. Quantitative Analysis – RA Day and AL Underwood
38. Chromatography – Dr.Brown
39. Analytical Chemistry by R.Kellner, J.M.Mermet, M.Otto, H.M.Widmer  
Wiley – VCH Verlag GmbH, D-69469, Weinheim (Federal Republic of Germany) 1998. [For Paper-IV, Topic 6, Quality Assurance and Quality Control]

## Question Paper Pattern

### B.Sc. (Second Year) Examination Analytical Chemistry Paper-VI & VII

**Time : 3 Hours**

**Marks : 100**

- N.B. i) Attempt all questions  
ii) All Question carry equal Marks  
iii) Draw diagram wherever necessary  
iv) Scientific Calculator and log table is allowed

Q. No. I	Solve any two of the following	20 Marks
	a)	
	b)	
	c)	
Q. No. II	Solve any two of the following	20 Marks
	a)	
	b)	
	c)	
Q. No. III	Solve any Two of the following	20 Marks
	a)	
	b)	
	c)	
Q. No. IV	Solve any Two	20 Marks
	a)	
	b)	
	c)	
Q. No. V	A] Solve any one	10 Marks
	a)	
	b)	
	c)	
	B] Select the MCQ	10 marks