# Swami Ramanand Teerth Marathwada University, Nanded

Choice Based Credit System (CBCS) Course Structure
Faculty of Science

## B. Sc. Second Year Syllabus

## Semester Pattern effective from June 2017

## **Subject:** Analytical Chemistry

| Semester | Course No. | Name of the Course | Instruction Hrs / week | Total period | CA | ESE | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|
| III | CCAC III (Section A) | Inorganic and Organic Analysis – I | 03 | 45 | 10 | 40 | 50 | 2 |
| | CCAC III (Section B) | Instrumental Methods of Chemical Analysis – I | 03 | 45 | 10 | 40 | 50 | 2 |
| | CCAC PII [CCACIII & IV (Section A)] | Laboratory Course – II | 03<br>03 | Practicals<br>08<br>08 | 05<br>05 | 20<br>20 | 25<br>25 | 1<br>1 |
| | SECAC I | Mineral Analysis Water Quality Analysis | 02 | 02 | 25 | 25 | 50 | (02)* |
| IV | CCAC IV (Section A) | Inorganic and Organic Analysis – II | 03 | 45 | 10 | 40 | 50 | 2 |
| | CCAC IV(Section B) | Instrumental Methods of | 03 | 45 | 10 | 40 | 50 | 2 |
| | CCAC PIII [CCAC III & IV (Section B)] | Laboratory Course – III | 03<br>03 | Practicals<br>08<br>08 | 05<br>05 | 20<br>20 | 25<br>25 | 1<br>1 |
| | SECAC II | Soil Analysis Food Analysis | 02 | 02 | 25 | 25 | 50 | (02)* |
| **Total credits semester III and IV** | | | | | | | | **12(04)*** |

~Note: ESE of CCACII, CCACIII & SECC I, SECAC II should be evaluated at annual

# Swami Ramanand Teerth Marathwada University Nanded

**Faculty of Science**
**B.Sc. II (Second) Year; Semester - III**
**Analytical Chemistry; Paper - VI**
**Inorganic and Organic Analysis – I**
**Paper Code – CHAC-201**
**Periods:** 45 per semester; 03 per week **Marks:** 50

Credits: 02 (Marks: 50) Periods: 45

**Unit – I Principles of Semi micro Qualitative Analysis of Inorganic Salts: 15 Periods**
**1.1** 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 and complex ion formation.

**1.2 Spot – Test Analysis:** Definition, Advantages, and spot test procedures.

**Unit –II Semi–micro Determination of Elements in the Organic Compounds: 12 Periods**
**2.1** Semi micro determination of Carbon, Hydrogen, Sulphnr, Nitrogen and Halogens in the Organic Compounds.

**2.2 Functional Group Analysis:** Estimation of the following functional groups in the organic Compounds: Hydroxy ( phenolic only), carbonyl, ester, Nitro, Amino and Carboxylic acid.

**Unit – III Metallurgical Analysis: 08 Periods**
**3.1** Estimation of main constituents in the following ores- Haematite, Pyrolusite, Bauxite and Lime stone.

**Unit – IV Analysis of Metals and Alloys: 10 Periods**
4.1 Analysis of Copper, Aluminum, Silicon and Uranium metals for their percentage purity.
4.2 Composition and analysis of following alloys- Stainless steel, Brass and Solder.

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# Swami Ramanand Teerth Marathwada University Nanded

**Faculty of Science**
**B.Sc. II (Second) Year; Semester - III**
**Analytical Chemistry; Paper - VII**
**Instrumental Methods of Chemical Analysis – I**
**Paper Code – CHAC-202**
**Periods:** 45 per semester; 03 per week **Marks:** 50

Credits: 02 (Marks: 50) Periods: 45

**Unit – I Spectroscopic Methods - Visible Spectroscopy: 13 Periods**

1.1 Spectroscopy-Definition,Electromagnetic Radiation-introduction, Properties of electromagnetic radiation: Wave properties –Wavelength,Frequency, Wave number, Velocity, Relation between frequency, velocity and wavenumber. Particle properties- Relation between wavelength and particle properties of electromagnetic radiation.Electromagnetic spectrum.Interaction of electromagnetic radiation with matter-process of emission, absorption and fluorescence of radiations. Visible spectrophotometry and colorimetry–Difference between photometer,spectrophotometer and colorimeter. Theory of visible spectrophotometry and colorimety, Lambert Beer's law, nature of molar absorptivity and absorbance,deviations from Beer's law. Instrumentation:radiation sources,filters and monochromators,slits, cells and detection of radiation.Double beam photoelectric colorimeter-schematic diagram and working.Direct reading double beam recording spectrophotometer-schematic diagram and working.Applications-Molar composition of complexes:Job's method of continuous variation.Quantitative analysis-calibration curve showing relationship between absorbance and concentration.

**Unit –II Spectroscopic Methods (Photometric Titrations,AAS & FES): 20 Periods**

**2.1 Photometric Titrations:** Principle, Photometric titration curves, instrumentation and applications. **: 05 Periods**

**2.2 Atomic Absorption Spectroscopy(AAS) : 08 Periods**

Introduction,principle, Instrumentation : Radiation source-Hollow cathode lamp, chopper, flame atomizer, nebulisations of liquid sample, monochromators, detectors, amplifier and readout system; schematic diagram and working of single beam atomic absorption spectrophotometer, interferences, typical analysis. Applications.

**2.3 Flame Emission Spectroscopy(FES) : 07 Periods**

**Intro**duction : Difference between Original flame photometry and the present flame emission methods. Limitations of flame photometry. General principle of flame photometry, Instrumentation: burners, mirrors, slits, monochromators, filters and detectors, schematic diagram and working of first type- simple modified flame spectrophotometer and applications of flame photometry.

**Unit – III Electron Microscopy: 06 Periods**

**3.1** Transmission Electron Microscope (TEM): Instrumentation, General Design, Resolution, Electron Sources,s , TEM grids electron lenses. General Applications.

**Unit – IV AtomicForce Microscope (AFM): 06Periods**

4.1 Introduction, Instrumentation and General Applications .

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# Swami Ramanand Teerth Marathwada University Nanded

**Faculty of Science**
**B.Sc. II (Second) Year; Semester - IV**
**Analytical Chemistry; Paper - VIII**
**Inorganic and Organic Analysis – II**
**Paper Code –CHAC- 203**
**Periods:** 45 per semester; 03 per week **Marks:** 50

Credits: 02 (Marks: 50) Periods: 45

**Unit – I Principles and Methods of Analysis of Saponifiable Oils and Fats: 13 Periods**

1.1 Definition, Classification, Nomenclature & Fatty acid composition of oils and fats. Analysis by physical and chemical methods- Density, Specific gravity, colour, smoke point, acid value, peroxide value, iodine value, Saponification value and shelf stability value. Determination and significance of these aspects in quality control.

**Unit –II Analysis of Cement: 10 Periods**

2.1 Definition, types of cements, manufacturing processes, raw materials. Composition and analysis of Portland cement.

**Unit – III Analysis of Fertilisers and Pesticides: 12 Periods**

**3.1 Fertilisers :** Definition, Classification, Characteristics of a good fertiliser. Analysis of Nitrogenous, Phosphatic and potash fertilisers.

**3.2 Pesticides:** Definition, Classification, Characteristics of a good pesticide. Analysis of DDT and Malathion.

**Unit – IV Introduction toQuality Assurance and Quality Control: 10 Periods**

**Quality and objectives of Analytical Chemistry:**

**4.1** Definitions of the terms: Quality policy, Quality Management, Quality system, Quality Control, Quality Assurance and Quality. General considerations quality assurance and quality control spiral, parameters influencing the quality spiral.

**4.2Validation of the Method:** Validation of instrument, Validation of analytical method.

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# Swami Ramanand Teerth Marathwada University Nanded

**Faculty of Science**
**B.Sc. II (Second) Year; Semester - IV**
**Analytical Chemistry; Paper - IX**
**Instrumental Methods of Chemical Analysis – II**
**Paper Code – CHAC- 204**
**Periods:** 45 per semester; 03 per week **Marks:** 50

Credits: 02 (Marks: 50) Periods: 45

**Unit – I Radiochemical Methods: 09 Periods**

1.1 Introduction to nuclear radiations ,detection and measurement of nuclear radiations by Gieger Muller(G.M.)Counter and scintillation counter.s Tracer technique, Isotope dilution analysis and Neutron activation analysis.

**Unit –II Thermal Methods of Analysis : 12 Periods**

**2.1 Thermal gravimetric (TG):** Theory, instrumentation and applications. Thermometric titrations.

**2.2 Differential Thermal Analysis (DTA):** Theory, instrumentation and applications.

**Unit – III Optical Methods: 08 Periods**

**3.1** Theory, Experimental techniques of measurement and application of each of the following properties in Chemical analysis: (i) Refractive Index (ii) Optical Activity.

**Unit – IV Chromatographic Teclriques -1: 16 Periods**

**4.1 Gas Chromatography (GC): I**ntroduction, Types of Gas Chromatography: Gas Liquid Chromatography (GLC), GasSolid Chromatography (GSC), Principle of Gas Solid Chromatography (GSC).

**4.2 Gas liquid Chromatography (GLC):** Principle, instrumentation and Applications.

**4.3 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.

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# Swami Ramanand Teerth Marathwada University Nanded

**Swami Ramanand Teerth Marathwada University, Nanded**
**Faculty of Science**
**B.Sc. II (Second) Year; Semester - IV**
**Analytical Chemistry; Paper - X**
**Laboratory Course - II**
**Paper Code – CHAC-P**

**Periods:** 120 per year; 04 per week **Marks: 50**
**Note:** Out of 30 experiments at least 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 aluminum 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 SiO2 in the given sample of Portland cement.
14) Estimation 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 fertiliser 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 paint 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)

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# Swami Ramanand Teerth Marathwada University Nanded

**Faculty of Science**
**B.Sc. II (Second) Year; Semester - IV**
**Analytical Chemistry; Paper - XI**
**Laboratory Course - III**
**Paper Code –CHAC- P**

**Periods:** 120 per year; 04 per week **Marks: 50**
**Note:** Out of 24 experiments at least 16 experiments should be completed.

1) Analysis of permanganate and dichromate mixture.
2) Determination of pKa 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-ration method calorimetrically.
5) Determination of formula of ferric sulpho-salicylic acid complex calorimetrically 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 paste 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 pKa values of Phosphoric acid by Potentiometer.
14) Estimation of chloride and Iodide 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 $Ag^{+}$ and $NO_3$ by Hittorf's method by Potentiometry.
19) Determination of refractive index of a given organic liquid by Abbe's Refrctometer.
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 amino acids by colorimetry.

**Recommended books for Papers VI, VII, VIII, IX, X & XI.**


1. Text book of micro and semi micro qualitative inorganic analysis by A.I.Vogel.
2. Spot tests in inorganic analysis-Feigl.
3. Text book of quantitative inorganic analysis by A.I.Vogel (3rd edition).
4. Principles of Instrumental Analysis by DA Skoog 3rd Edition.
5. Principles and methods of chemical analysis of H.F. Walton.
6. Quantitative chemical analysis by Cumming and Key.
7. Tex book 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 A.L. Godbert.
10. Elementary practical organic chemistry by A.I. Vogel.
11. Quantitative organic analysis by Sidney Siggia 2nd Edition.
12. Standard methods of chemical analysis by Welcher.
13. Fundamentals of analytical chemistry by D.A Skoog D.M West & FJ Holler (7th Ed.)
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 (First Edition & Reprint 2008).
20. Introduction to instrumental Analysis by R.D. Braun.
21. An introduction to Metallurgical 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 VII, Unit III & IV, Electron Microscopy &STEM].
31. Methods in Modern Biophysics-Bengt Nolting, Springer International Edition, Springer ( India ) Private Limited, New Delhi (2004) [For Paper VII, Unit III & IV, Electron Microscopy &STEM].
32. Biophysics-G.R. Chatwal, Edited by Madhu Arora, Himalaya Publishing House, New Delhi, First Edition, 2005. [For Paper VII, Unit III & IV, Electron Microscopy SETM].
33. Elements of Analytical Chemistry-R.Gopalan, P.S. Subramanian, K.Rengrajan, Sultan Chand and Sons, New Delhi , 2007.

**34.** Analytical Chemistry Principles, John H.Kennedy, 2nd 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-R.A Day and A.L 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 VIII, Unit IV, Quality Assurance and Quality Control].
**40.** ProgressiveInorganicChemistry-Suratkar,ThatteAndPandit.

# Swami Ramanand Teerth Marathwada University Nanded

Choice Based Credit System (CBCS) Course Structure
B. Sc. second year (Semester- III)
Semester Pattern effective from June -2017

## Analytical Chemistry

Skill Enhancement Course SECAC-I

**50 Marks 2 Credits**

**CA 25**

**EAC 25**

## A) Mineral Analysis

Objective: Chemical Analysis of Mineral found in the region.

Skill component: Exploration, collection, identification and chemical characterization of various mineral resources found in the region. So that relevant industries can be established in the region.

## B) Water Quality Analysis

# Swami Ramanand Teerth Marathwada University Nanded

Choice Based Credit System (CBCS) Course Structure
B. Sc. second year (Semester- IV)
Semester Pattern effective from June -2017

## Analytical Chemistry

Skill Enhancement Course SECAC-II

**50 Marks 2 Credits**

**CA 25**

**EAC 25**

## A) Soil Analysis

Objective: To carryout the physical and chemical analysis of the soil of the region so as to provide advisory services to farmers.

Skill components: Survey, collection of soil sample, preparation and presentation, physico chemical analysis of soil, advise to the farmer, regarding the soil quality.

## B) Food Analysis