**Dr.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD**

## CIRCULAR NO.SU/B.Sc./CBC&GS /67/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies, Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following syllabi of Bachelor of Science with Practical Pattern of Question Paper under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

| Sr.No. | Courses | Semester |
|---|---|---|
| 1. | B.Sc. Biotechnology (Degree) | IIIrd & IVth semester |
| 2. | B.Sc. Automobile Technology (Degree) | IIIrd & IVth semester |
| 3. | B.Sc. Workshop Technology (Degree) | IIIrd & IVth semester |
| 4. | B.Sc. Refrigeration and Air Conditioning (Degree) | IIIrd & IVth semester |
| 5. | B.Sc.Physics (Optional) | IIIrd & IVth semester |
| 6. | B.Sc.Chemistry (Optional) | IIIrd & IVth semester |
| 7. | B.Sc.Analytical Chemistry (Optional) | IIIrd & IVth semester |
| 8. | B.Sc. Statistics (Optional) | IIIrd & IVth semester |

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2023/ 670-77
Date:- 03.06.2023.

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Deputy Registrar,
Academic Section

**Copy forwarded with compliments to :-**

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

**Copy to :-**

1] **The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.**

2] The Section Officer,[B.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.

3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.

4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.

5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.

6] The Public Relation Officer, Dr.BAMU,A'bad.

7] The Record Keeper, Dr.BAMU,A'bad.

# Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Syllabus

# B.Sc. Analytical Chemistry

## Semester III & IV

**With effect from 2023-24**

Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad (M.S)

# Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Choice Based Credit System (CBCS) Curriculum

For Faculty of Science and Technology

Course Structure and Scheme of Examination

BSc. Three year Undergraduate Degree Program

## Subject : **Analytical Chemistry**

| Semester I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Course Code | Course Title | Teaching hr/ Week | Credits | Scheme of Examination | | | |
| | | | | | Max Marks | CIA | UA | Min Marks |
| Optional (DSC-1C) Core Courses | ACH 111 | Core Course (Theory Paper I) **Fundamentals Of Analytical Chemistry** | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 112 | Core Course (Theory Paper II) **Basic Concepts Of Analytical Chemistry** | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 121 | Lab Course 1 (CHE-111 -CHE-112) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| **Total Credits for Semester I: 5.5 (Theory:04 ; Laboratory: 1.5)** | | | | | | | | |

| Semester II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Course Code | Course Title | Teaching hr/ Week | Credits | Scheme of Examination | | | |
| | | | | | Max Marks | CIA | UA | Min Marks |
| Optional (DSC-1D) Core Courses | ACH 211 | Core Course (Theory Paper III) **Statistical Treatment And Modern Methods Of Analysis** | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 212 | Core Course (Theory Paper IV) **Classical And Spectral Methods Of Analysis** | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 221 | Lab Course 2 (CHE-211 CHE-212) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| **Total Credits for Semester IV: 5.5 (Theory:04; Laboratory: 1.5)** | | | | | | | | |

Practicals exam of both I and II semester will be conducted at the end of second term

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# Analytical Chemistry

| Semester III | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Course Code | Course Title | Teaching hr/ Week | Credits | Scheme of Examination | | | |
| | | | | | Max Marks | CIA | UA | Min Marks |
| Optional (DSC-1C) Core Courses | ACH 311 | Core Course (Theory Paper V) **Concepts of Analytical chemistry** | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 312 | Core Course (Theory Paper VI) **Electroanalytical Techniques** | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 321 | Lab Course 3 (CHE-311) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| | ACH 322 | Lab Course 4 (CHE-312) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| SEC | CHE 313 Select any one from SEC-1A & SEC-1B | CHE 313 SEC-1A **Laboratory safety and Laboratory Practices** | 2 | 2 | 50 | 10 | 40 | 20 |
| | | CHE 313 SEC-1B **Water Analysis** | 2 | 2 | 50 | 10 | 40 | 20 |
| **Total Credits for Semester III: 07+02 (Theory:04+02; Laboratory: 03)** | | | | | | | | |

| Semester IV | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Course Code | Course Title | Teaching hr/ Week | Credits | Scheme of Examination | | | |
| | | | | | Max Marks | CIA | UA | Min Marks |
| Optional (DSC-1D) Core Courses | ACH 411 | Core Course (Theory Paper VII) **Advanced Analytical techniques** | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 412 | Core Course (Theory Paper VIII) **Applied Analytical Chemistry** | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 421 | Lab Course 5 (CHE-411) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| | ACH 422 | Lab Course 6 (CHE-412) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| SEC | CHE 413 Select any one from SEC-2A & SEC-2B | CHE413 SEC-2A **Pharmaceuticals Chemistry** | 2 | 2 | 50 | 10 | 40 | 20 |
| | | CHE413 SEC-2B **Industrial Fermentation & Alcohol Technology** | 2 | 2 | 50 | 10 | 40 | 20 |
| **Total Credits for Semester IV: 07+02 (Theory:04+02; Laboratory: 03)** | | | | | | | | |

Practicals exam of both III and IV semester will be conducted at the end of second term

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# Analytical Chemistry

| Semester V | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Course Code | Course Title | Teaching hr/ Week | Credits | Scheme of Examination | | | |
| | | | | | Max Marks | CIA | UA | Min Marks |
| Optional (DSC-1C) Core Courses | ACH 511 | Core Course (Theory Paper IX) | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 512 | Core Course (Theory Paper X) | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 521 | Lab Course 7 (CHE-511) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| | ACH 522 | Lab Course 8 (CHE-512) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| SEC | ACH 513 | Select any one from SEC-3A & SEC-3B | 2 | 2 | 50 | 10 | 40 | 20 |
| | | | | | | | | |
| **Total Credits for Semester III: 07+02 (Theory:04+02; Laboratory: 03)** | | | | | | | | |

| Semester VI | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Course Code | Course Title | Teaching hr/ Week | Credits | Scheme of Examination | | | |
| | | | | | Max Marks | CIA | UA | Min Marks |
| Optional (DSC-1D) Core Courses | ACH 611 | Core Course (Theory Paper XI) | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 612 | Core Course (Theory Paper XII) | 2 | 2 | 50 | 10 | 40 | 20 |
| | ACH 621 | Lab Course 9 (CHE-411) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| | ACH 622 | Lab Course 10 (CHE-412) | 3 | 1.5 | 50 | 10 | 40 | 20 |
| SEC | ACH 613 | Select any one from SEC-4A & SEC-4B | 2 | 2 | 50 | 10 | 40 | 20 |
| | | | | | | | | |
| **Total Credits for Semester IV: 07+02 (Theory:04+02; Laboratory: 03)** | | | | | | | | |

Practicals exam of both V and VI semester will be conducted at the end of second term

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Important Notes:

i) **Nomenclature**: DSC- Discipline Specific Core course, SEC – Skill Enhancement Course, AECC- Ability Enhancement compulsory course, DSE- Discipline Specific Elective, UA- University Assessment ( Semester End), CIA-Continuous Internal Assessment

ii) **Assessment**: 80% for University Assessment ( Semester End Examination) and 20 % for Continuous Internal Assessment ( CIA)

iii) Continuous Internal Assessment (CIA): **Theory** (10 Marks): Internal Test 05 Marks (Two Internal Tests of 05 marks each and average of the two test will be considered) and 05 Marks for Assignment/tutorials.

iv) Continuous Internal Assessment ( CIA): **Practical** ( 10 Marks): 07 Marks for Internal Practical Examination and 03 Marks for record book/submission of collection and field survey report and excursion report

v) Practical examination : Annual examination

# BSc III Semester Analytical Chemistry

**Core Course (Theory Paper V)**

**ACH-311 - Concepts of Analytical Chemistry**

Credits 02 Lectures 45

**Unit-I: Statistical Analysis and analytical Figure of Merit [12L]**

Introduction, Errors (gross errors, systematic errors, random errors), validation para meters: calibration, (linear response functions (linear regression-errors in slope and the intercept, error in the estimate of concentration, standard additions), non-linear response functions and weighted regression analysis, internal standards), selectivity and specificity (chromatographic methods), limits of detections (spectrophotometric methods, chromatographic methods and related techniques, receptor binding assay), limit of quantification, sensitivity, ruggedness and robustness, analyte stability in the sample matrix, how to reduce systematic errors, mean and standard deviation, reliability of results, confidence interval, comparison of results, comparison of two means of two samples, experimental design

**Unit-II: Automated method of analysis [08L]**

Principles of automation, automated instruments, process control, automatic instruments, continuous analyzer, centrifugal analyzer, flow injection analysis, application.

**Unit-III: Measurement of pH [08L]**

Introduction, determination of pH, Ion selective electrodes, instrumentation, application of pH measurement, Numerical problems based on pH and hydrogen ion concentration.

**Unit-IV: Radioanalytical techniques [10L]**

Radio chemical technique, source of neutron, neutron capture and γ-emission, principles of neutron activation analysis, application of activation analysis, principles of isotope dilution method, application of isotope dilution method.

**Unit-V Refractometry [07L]**

Introduction, Principles of refractometry, refractometer, qualitative and quantitative measurement, analytical applications of refractometer.

**Reference Books:**


1) Instrumental method of chemical analysis by B.K Sharma
2) Instrumental methods of analysis by Anand & Chatwal
3) Principles of instrumental analysis by F. J Holler & J. A Nieman
4) Introduction to instrumental analysis R D Braun.
5) Analytical chemistry by J.D Christian
6) Analytical chemistry by B.K Sharma
7) Analytical chemistry by Alka Gupta
8) Analytical chemistry by H Kaur
9) Analytical Chemistry by S. M Khopkar


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# BSc III Semester Analytical Chemistry

**Core Course (Theory Paper VI)**
**ACH-312 Electroanalytical Techniques**

Credits 02 Lectures 45

**Unit-I General Introduction** **[10L]**
Over view of electrode process, ion selective electrodes: types and construction of electrode, glass electrode, precipitate electrode, liquid-liquid membrane electrode, enzyme electrode, Weston cell, application of ion selective electrode.

**Unit-II Conductance measurement** **[10L]**
Introduction, some important laws, Definition and relation, effect of dilution, conductance measurement, application of conductance measurement, application of conductance measurement, type of conductometric titration, disadvantages of conductometric titration.

**Unit-III Potentiometry** **[05L]**
Introduction, Instrumentation, electrodes used in potentiometry, reference electrode, types of potentiometric titration, variation in potentiometric titration, Limitations, Numerical

**Unit-IV Voltametric techniques** **[08L]**
Introduction, Instrumentation, charging or capacitive current, linear potential sweep voltammetry, potential step methods, cyclic potential sweep voltammetry, hydrodynamic method, stripping voltammetry, voltametric application.

**Unit-V Polarography** **[12L]**
Introduction, principle, the Ilkovic equation, apparatus, Diffusion limiting current, factor affecting the limiting current, cells, form of wave, concept of half wave potentials, Rapid scan polarography, organic polarography, pulse polarography, applications of polarography, voltammetry, chronopotentiometry, tensimetry.

**Reference Books:**

1) Electroanalytical chemistry by H. W Nierenberg
2) Instrumental method of chemical analysis by B.K Sharma
3) Instrumental methods of analysis by Anand & Chatwal
4) Analytical chemistry by B.K Sharma
5) Analytical chemistry by Alka Gupta
6) Analytical chemistry by H Kaur
7) Analytical Chemistry by S. M Khopkar

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# BSc III Semester Analytical Chemistry

**Core Course (Theory Paper III)**

**ACH-411 Advanced analytical technique**

Credits 02 Lectures 45

**Unit-I Modern method of solvent extraction** **[10L]**

Principle of solvent extraction, classification of extraction, extraction by solvent, extraction equilibria for salvation, Supercritical fluid, working of supercritical fluid, selection of supercritical fluid, application, microwave assisted extraction.

**Unit-II Thermal analysis** **[10L]**

Introduction to thermal analysis, thermogravimetry, thermobalance, block diagram of modern thermobalance, derivative of thermogravimetry (DTG), differential thermal analysis (DTA), application,

**Unit-III X-ray spectrometry** **[12L]**

General theory, basic principles of x-ray spectroscopy, x-ray source, interaction of x-rays with matter, diffraction, Bragg's law, Bragg's ionization spectrometer, general instrumentation, miller indices, application of x-ray diffraction.

**Unit-IV Atomic absorption spectroscopy** **[07L]**

Introduction, principles, instrumentation, flame and non-flame atomization, source of Atomic absorption spectroscopy (EDL, TGL, HCL), interference and applications, advantages of Atomic absorption spectroscopy.

**Unit-V Atomic Emission spectroscopy** **[06L]**

Introduction, principles of emission spectroscopy, source of excitation, instrumentation of atomic emission spectroscopy, analysis by emission spectroscopy, principles of flame photometry, applications.

**Reference Books:**


1) Instrumental method of chemical analysis by B.K Sharma
2) Instrumental methods of analysis by Anand & Chatwal
3) Analytical chemistry by J.D Christian
4) Principles of instrumental analysis by F. J Holler & J. A Nieman
5) Introduction to instrumental analysis R D Braun.
6) Instrumental method of chemical analysis by Willard, Merritt and Dean
7) Analytical chemistry by B.K Sharma
8) Analytical chemistry by Alka Gupta
9) Analytical chemistry by H Kaur
10) Analytical Chemistry by S. M Khopkar


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# BSc III Semester Analytical Chemistry

**Core Course (Theory Paper IV)**
**ACH-412 Applied Analytical Chemistry**

Credits 02 Lectures 45

**Unit-I Introduction to food analysis** **[10L]**

Nutrient value of food, physical characteristics and chemical constituents, proximate composition of food and its analysis, legislation related to food, general idea regarding food processing and preservation, food contamination, food safety consideration, adulteration, types of adulteration, test for adulteration, control.

**Unit-II Analysis of food** **[10L]**

Introduction and estimation of food preservatives, estimation of food emulsifier, food stabilizer, food thickener, Introduction, standard composition and analysis of the following: Milk, tea, coffee, cereal and flour, Honey.

**Unit-III Carbohydrate** **[10L]**

Introduction, Classification and general properties, structures of Monosaccharide (glucose and fructose), disaccharides (sucrose, maltose, lactose, polysaccharides, starch and cellulose), sample extraction and estimation of sugars, estimation of reducing sugar, estimation of non-reducing sugar, estimation of total soluble sugar.

**Unit-IV Vitamins** **[08L]**

Introduction, classification of vitamins, water soluble and oil soluble vitamins, estimation of ascorbic acid (vitamin C) Volumetric and colorimetric method, estimation of vitamin A, Estimation of vitamin $D_2$ and $D_3$, estimation of tocopherol (Vitamin E).

**Unit-V Oils and Fats** **[07L]**

Introduction to natural oil and fats, difference between oil and fats. Classification of fats (saturated and unsaturated fats), softing point, cogent point, Iodine value, saponification value, estimation of saponification value, introduction and estimation of acidic value.

**Reference Books:**


1) Analytical chemistry by B.K Sharma
2) Analytical chemistry by Alka Gupta
3) Analytical chemistry by H Kaur
4) Analytical Chemistry by S. M Khopkar
5) Food analysis by Pearson
6) Food analysis by S. S. Neilson.
7) Standard methods of biochemical analysis by S. R Thimmaiah
8) Biophysical chemistry (Principles and techniques), Upadhyay, Upadhyay and Nath

# BSc III Semester Analytical Chemistry

**Core Course (Practical Paper)**
**ACH-321 Lab Course-3**

Credits 1.5 4 Lectures per week

1. Detection of nitrogen, sulphur and halogens from packed food sample.
2. Estimate the amount of carbon and hydrogen from packed food sample.
3. Estimate the amount of protein from egg albumin by biuret method.
4. Quantitative estimation of reducing sugar from Jam and Jelly.
5. Calculate the amount of starch from given sample.
6. Estimate the amount of sucrose from cane sugar.
7. Estimate the amount of glucose and sucrose in cane juice.
8. Estimate the amount Na+ and K+ from tomato sauce by flame photometer.
9. Estimation of polyphenols in tea sample.
10. Estimate the percentage of ash in milk powder.
11. Determination of phosphoric acid content in soft drinks.
12. Separation of amino acid by TLC. (Glycine & Glutamic acid)
13. Separation of amino acid by TLC. (Alanine & Glutamic acid)
14. Separation of amino acid by TLC. (Glycine & Glutamine)
15. Separation of amino acid by TLC. (Alanine & Glutamine)

**Reference Books**

1) Food analysis by Pearson
2) Food analysis by S. S. Neilson.
3) Standard methods of biochemical analysis by S. R Thimmaiah
4) Biophysical chemistry (Principles and techniques), Upadhyay, Upadhyay and Nath
5) Instrumental method of chemical analysis by B.K Sharma
6) Instrumental methods of analysis by Anand & Chatwal

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# BSc III Semester Analytical Chemistry

**Core Course (Practical Paper)**
**ACH-322 Lab Course-4**

Credits 1.5 4 Lectures per week

1. Estimation of boric acid conductometric method
2. Estimation of tin in solder alloy
3. Estimate the amount of haemitite ore
4. Estimation of calcium from dolomite ore
5. Estimate the amount of Mg from neem plant leaves
6. Estimate the amount of sodium carbonate in washing soda
7. Determination of active chlorine in the sample of bleaching powder
8. Assay of sulpha drug

Inorganic chemistry: Semi-microanalysis of inorganic salt mixture containing two acidic radical and two basic radical of same or different groups.
Following radicals to be given in carbonate, nitrile, sulphite, chloride, bromide, iodide, nitrate and sulphate. Silver(I), copper(II), bismuth(III), cadmium(II), tin(II), Arsenic(III), antimony(III), iron(III), chromium(III), aluminium(III), nickel(II), cobalt(II), manganese(II), zinc(II), calcium(II), strontium(II), barium(II), magnesium(II).

**Reference Books**

1) Inorganic chemistry by Satya Prakash
2) Advanced inorganic chemistry by J D Lee.
3) Qualitative inorganic analysis 5th edition A. I Vogel
4) Qualitative organic analysis by A. I Vogel
5) Practical organic chemistry 5th edition Vogel
6) Advanced practical in organic chemistry by O. P Agarwal

# BSc III Semester Analytical Chemistry

**Core Course (Practical Paper)**
**ACH-421 Lab Course-5**

Credits 1.5 4 Lectures per week

1. Determination of saponification value of coconut oil.
2. Determination of COD and dissolved oxygen from waste water sample.
3. Determination of amount chloride from bleaching powder.
4. Determination of amount of sodium bicarbonate in washing soda.
5. Estimation of Ni+ in the sample solution by EDTA titration.
6. Determine the amount of magnesium from Neem plant leave, volumetrically.
7. Estimation of phenol/aniline by bromination method.
8. Estimation of hardness of water by EDTA.
9. Estimate the amount of Mg from talcum powder.
10. Determination of volume strength of commercial hydrogen peroxide using $KMnO_4$.
11. Estimation of iron using 8-hydroxyl quinoline by solvent extraction.
12. Determination of acid value of given oil sample.
13. Determination of percentage of total salt from salted chips.
14. Determination ascorbic acid from given juice sample.
15. Estimate the percentage of moisture contained from sand sample.

**Reference Books**

1) Food analysis by Pearson
2) Food analysis by A. G Woodman. Mc Graw Hill
3) Food analysis by S. S. Neilson.
4) Standard methods of biochemical analysis by S. R Thimmaiah
5) Biophysical chemistry (Principles and techniques), Upadhyay, Upadhyay and Nath
6) Instrumental method of chemical analysis by B.K Sharma
7) Instrumental methods of analysis by Anand & Chatwal

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# BSc III Semester Analytical Chemistry

**Core Course (Practical Paper)**
**ACH-422 Lab Course-6**

Credits 1.5 4 Lectures per week

1. Estimate the amount of acetylsalicylic acid from aspirin tablet volumetrically.
2. Estimation of amount of Ibuprofen from brofen tablet.
3. Estimate the amount of ascorbic acid from vitamin-C tablet.
4. Determine the amount of Fe from given tablet.
5. Estimate the amount of phosphoric acid present in cold drink, conductometrically.
6. Estimate the amount of glucose present in fruits.
7. Determination of benzoic acid in soft drink by potentiometric method.
8. Determination of micronutrients from the given soil sample (Cu or Fe,)
9. Determination of micronutrients from the given soil sample Ni or Zn
10. Qualitative analysis of alkaloids from any leaves sample.
11. Determination of API from any anti-diabetic drugs.
12. Determination of API from any anta-acid drugs.
13. Assay of paracetamol syrup by UV-spectrophotometer.
14. Determination of Ni+ from given solution by colorimetric method.
15. Assay of sodium benzoate from the pharmaceutical drug sample.

**Reference Books**


1) Standard methods of biochemical analysis by S. R Thimmaiah
2) Biophysical chemistry (Principles and techniques), Upadhyay, Upadhyay and Nath
3) Instrumental method of chemical analysis by B.K Sharma
4) Instrumental methods of analysis by Anand & Chatwal
5) Practical organic chemistry 5th edition Vogel
6) Advanced practical in organic chemistry by O. P Agarwal
7) Indian Pharmacopeia
8) British Pharmacopeia


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