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.**

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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.

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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Syllabus

B.Sc. 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

B.Sc. Three Year Undergraduate Degree Program for Chemistry with effect from June 2022

Semester I

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1A) Core Courses	CHE-111	Core Course (Theory Paper-I)	2 hours	2	50	10	40	20
	CHE -112	Core Course (Theory Paper-II)	2 hours	2	50	10	40	20
	CHE -121	Lab course 1 (based on CHE -111 and CHE -112)	3 hours	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 time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1B) Core Courses	CHE -211	Core Course (Theory Paper-III)	2 hours	2	50	10	40	20
	CHE -212	Core Course (Theory Paper-IV)	2 hours	2	50	10	40	20
	CHE -221	Lab course 2 (based on CHE -211 and CHE -212)	3 hours	1.5	50	10	40	20

Total Credits for Semester II : 5.5 (Theory : 04 ; Laboratory : 1.5)

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Semester III

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1C) Core Courses	CHE 311	Core Course (Theory Paper-V)	2 hours	2	50	10	40	20
	CHE-312	Core Course (Theory Paper-VI)	2 hours	2	50	10	40	20
	CHE -321	Lab course 3 (based on CHE -311)	3 hours	1.5	50	10	40	20
	CHE -322	Lab course 4 (based on CHE -312)	3 hours	1.5	50	10	40	20

Total Credits for Semester III : 07 (Theory : 04 ; Laboratory : 03)

Semester IV

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1D) Core Courses	CHE -411	Core Course (Theory Paper-VII)	2 hours	2	50	10	40	20
	CHE -412	Core Course (Theory Paper-VIII)	2 hours	2	50	10	40	20
	CHE -421	Lab course 4 (based on CHE -411)	3 hours	1.5	50	10	40	20
	CHE -422	Lab course 5 (based on CHE -412)	3 hours	1.5	50	10	40	20

Total Credits for Semester IV : 07 (Theory : 04; Laboratory : 03)

24/7/22

Semester V

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSE-1 A) Discipline Specific Elective	CHE -511	DSE-1A(1) (Theory Paper-IX) (Select any one paper from A1/B1/C1/D1)	2 hours	2	50	10	40	20
	CHE -512	DSE-1A(2) (Theory Paper-X) (Select any one paper from A2/B2/C2/D2)	2 hours	2	50	10	40	20
	CHE -521	Lab course 6 (based on CHE -511)	3 hours	1.5	50	10	40	20
	CHE -522	Lab course 7 (based on CHE -512)	3 hours	1.5	50	10	40	20

Total Credits for Semester V : 07 (Theory : 04 ; Laboratory : 03)

Semester VI

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSE-1 B) Discipline Specific Elective	CHE -611	DSE-1B(1) (Theory Paper-XI) (Select any one paper from A1/B1/C1/D1)	2 hours	2	50	10	40	20
	CHE -612	DSE-1B(2) (Theory Paper-XII) (Select any one paper from A2/B2/C2/D2)	2 hours	2	50	10	40	20
	CHE -621	Lab course 8 (based on CHE -611)	3 hours	1.5	50	10	40	20
	CHE -622	Lab course 9 (based on CHE -612)	3 hours	1.5	50	10	40	20

Total Credits for Semester VI : 07 (Theory : 04 ; Laboratory : 03)

Total Credits for three years: Sem. I (05.5) + Sem. II (05.5) + Sem. III (07) + Sem. IV (07) + Sem. V (07) + Sem. VI (07) = 39 Credits

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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 Semesters

Core course (Theory Paper V)

CHE-311 Organic Chemistry

Credits 02 Lectures 45

Aldehydes and Ketones **[10 L]**

Introduction, IUPAC nomenclature, Preparation: from acid chlorides and nitriles. Reactions of aldehydes and ketones with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test, Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemenson reduction, Wolff-Kishner reduction and Meerwein-Pondorff Verley reduction.

Carboxylic acids and their derivatives **[7 L]**

Carboxylic acids (aliphatic and aromatic): Introduction and IUPAC nomenclature, factors affecting acidity of carboxylic acids. *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell–Vohlard – Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (up to 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion. Reaction: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts: **[6L]**

Amines (Aliphatic and Aromatic): Introduction and IUPAC nomenclature, *Preparation* from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination. Nitration, bromination and sulphonation of aniline. Preparation of p-bromo aniline from aniline, Diazotization reaction, Sandmeyer reaction.

Heteronuclear Aromatic Compounds **[10 L]**

Introduction, Classification of heterocyclic compounds, Structures of pyrrole, thiophene, furan and pyridine and their aromaticity. Basicity of pyrrole , furan thiophene, pyridine and pyrrolidine Preparation and electrophilic substitution of Furan, Pyrrole, Thiophene, and Pyridine. Chichibabin reaction

Stereochemistry of Cyclohexane: **[6 L]**

Bayer's strain theory, structure of cyclohexane, axial and equatorial H atoms, heat of combustion of cycloalkanes, conformations and stabilities of methyl cyclohexane, t-butyl cyclohexane, 1,1 dimethyl cyclohexane, 1,2 dimethyl cyclohexane, 1,3 dimethyl cyclohexane, 1,4 dimethyl cyclohexane

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Active Methylene Compounds **[06 L]**

Definition, Preparation of Ethyl acetoacetate and Synthetic uses of ethylacetoacetate. Preparation of Diethyl malonate and Synthetic uses of diethyl malonate.

REFERENCE BOOKS

1. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Prentice Hall of India, Sixth Edition,
2. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers *Organic Chemistry* - Oxford University Press, USA, 2nd Ed.
3. Bahl, A. and Bahl, B.S. *Advanced Organic Chemistry,* S. Chand,
4. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley and Sons
5. Mc Murry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition,
6. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi
7. Finar, I. L. *Organic Chemistry* (Vol. I and II), E.L.B.S.

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BSc III Semesters

Core course (Theory Paper VI)

CHE-312 (Physical Chemistry)

Credits 02 Lectures 45

Surface Chemistry **[8L]**

Introduction to surface chemistry - some basic terms related to surface chemistry adsorption, adsorption materials, factors affecting adsorption, characteristics of adsorption, types of adsorption, classification of adsorption isotherms, Langmuir adsorption isotherm, Freundlich's adsorption isotherm, BET theory (only introduction), application of adsorption, Numericals.

Phase equilibrium **[8L]**

Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, Numericals.

Quantum Chemistry **[10 L]**

Introduction, de Broglie hypothesis, The Heisenberg's uncertainty principle, quantization of energy, Operators, Schrodinger wave equation, well behaved function, Particle in a one-, two and three-dimensional box (no derivation), Physical interpretation of the ψ and $\psi 2$, sketching of wave function and probability densities for 1D box, degeneracy, applications to conjugated systems, zero-point energy and quantum tunnelling, Numerical

Photochemistry **[8 L]**

Introduction, Difference between thermal and photochemical processes, Laws of photochemistry: i) Grothus - Draper law ii) Stark-Einstein law, Quantum yield, Reasons for high and low quantum yield., Factors affecting Quantum yield, Experimental method for the determination of quantum yield, types of photochemical reactions - photosynthesis, photolysis, photocatalysis, photosensitization, Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence, Chemiluminescence, Numericals

Conductometry **[6 L]**

Introduction, Electrolytic Conductance, Resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, variation of equivalent and specific

conductance with concentrations, Kohlrausch's law and its applications, conductivity cell, conductivity meter, Whetstone Bridge, determination of cell constant conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base) and Numericals.

Colorimetry: **[5 L]**

Introduction, interaction of electromagnetic radiation with matter, essential terms: radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter: *Principle, Construction and components, Working*. Applications–unknown conc. By calibration curve method, Determination of unknown concentration of Fe(III) by thiocynate method, Numericals

REFERENCE BOOKS

1 Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of Physical chemistry by B.R. Puri, L.R. Sharma, M.S. Pathania
3. Essentials of Physical chemistry by Bahl Tuli-Revised, S. Chand and Company Ltd.
4. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
5. Physical-Chemistry-4th Edition - Gilbert W. Castellan (Narosa Publication)
6. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, Longman Scientific and Technical,.
7. Basic Concept of Analytical Chemistry, S. M. Khopkar, New Age International (UK) Ltd, United Kingdom
8. Analytical Chemistry, G.R. Chatwal, Sham Anand.
9. Instrumental Methods of Chemical Analysis, Chatwal and Anand

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BSc IV Semesters

Core course (Theory Paper VII)

CHE-411 Inorganic Chemistry

Credits 02 Lectures 45

Coordination Compounds [10 L]

Double salt, coordination compound, coordinate bond, ligand, types of ligands, chelate, central metal ion, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio; Werner's theory, Effective atomic number, equilibrium constant. chelate effect, IUPAC nomenclature. Cationic and anionic complexes, Isomerism in coordination compounds: polymerization isomerism, ionization isomerism, hydrates isomerism, linkage isomerism, coordination isomerism, coordination position isomerism, geometric isomerism, optical isomerism.

Valance Bond Theory of Coordination Compounds [6 L]

Aspects and assumptions of VBT, applications of VBT. Hybridization, structure and bonding in Inner orbital complexes $[Ag(NH_3)_2]^+$, $[Ni(Cl_4)]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Cr(H_2O)_6]^{3+}$, $[Fe(CN)_6]^{3-}$ and outer orbital complex $[Cr(H_2O)_6]^{3+}$, $[Cu(NH_3)_6]^+$, $[FeF_6]^{3-}$. limitations of VBT

Crystal Field Theory [12 L]

Shapes of d-orbitals, Assumption of Crystal field Theory (CFT), splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, spectrochemical series, crystal splitting energy, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu(II) complexes. Crystel field splitting in octahedral, tetrahedral and square planner complexes, application of CFT.

Oxidation and Reduction [06 L]

Introduction, oxidation number, Galvanic cells, Single electrode potential, Signs of Single electrode potential, Standard electrode potentials, Electrochemical series, Nernst equation, Application of Electrochemical series, Source of electric energy in a Galvanic cell, Hydrogen over voltage, Oxygen over voltage, Redox stability in water, Oxidation by atmospheric oxygen, Latimer diagram, Frost diagram, Pourbaix diagram.

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Volumetric analysis **[07 L]**

Introduction, Terminology, Basic requirement of titration reaction, Standard solution, Primary Standards, Expressing concentration of Standard solution, Volumetric titration co-relation, P-Function, Acid-base titration, Theory of acid-base indicators, Mathematical treatment, Redox titration, Complexometric titration, Polydentate titrants for complexometric titration, EDTA titration, Indicators for EDTA titration, Titration curves, EDTA titration methods, Cautions of volumetric titrimetry, Correction for unavoidable errors.

The Chemistry Of Elements In Medicine **[04 L]**

1) Introduction, Chelation Therapy, Cancer Treatment, Anti-arthritis drugs, Imaging agents.

Books:

1. Principles of Inorganic Chemistry by Puri, Sharma and Kaliya.
2. Advanced inorganic chemistry by Gurudeep Raj and Chatwal Anand.
3. Advanced inorganic chemistry vol. II by Satyaprakash, Tuli, Basu and Madan.
4. Inorganic Chemistry by Huheey, Keiter and Keiter.
5. Nuclear Chemistry by Arnikar,
6. Concise Inorganic Chemistry by J. D. Lee.
7. Vogel's Qualitative Inorganic Analysis (Seventh Eddition),
8. A text book of Practical Chemistry for B. Sc. By V. V. Nadkarny, A. N. Kothare and Y. V. Lawande.
9. Advanced practical inorganic Chemistry by O. P. Agarwal

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BSc IV Semesters

Core course (Theory Paper VIII)

CHE-412 Applied Chemistry

Credits 02 Lectures 45

Infrared Spectroscopy: **(10L)**

Introduction, Simple Harmonic oscillator, Modes of vibration, force constant, Vibrational spectrum of a diatomic molecules: Vibrational Energy expression, Allowed vibrational energies, zero-point energy, Selection rule, Vibration- rotation Spectra: Born-Oppenheimer approximation, Energy expression for vibrational rotor, Interpreting IR Spectra: functional group and fingerprint region. Infra-red spectroscopy in organic molecules, IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions. Numericals.

Raman Spectroscopy: **(4 L)**

Introduction, Classical and Quantum theory of Raman Effect, Rayleigh, Stokes and anti-stokes lines, pure rotational Raman spectra of linear diatomic molecules

Dyes and Pigments **(9 L)**

Dyes: Introduction, qualities of good dye, Colour constituents (Chromophore, auxochrome), classification of dyes according to their application, Synthesis and uses of following dyes: Nitroso dye-martius yellow, Azo dyes-Methyl orange and aniline yellow, Triphenylmethane dye-Crystal violet, Phthalein dye- Phenolphthalein, Xanthane Fluorescein, Anthraquinone Alizarin and Indigo dyes - Indigo.

Pigments: Introduction, classification and general properties of pigments. Inorganic pigments: i) Zinc oxide pigments (Fundamentals and properties, Raw materials, Direct process (American process), Precipitation process) ii) Iron oxide pigments (Fundamentals and properties, Production of iron oxide pigment by precipitation process .

Polymerization **(6 L)**

Classification of polymerization processes, mechanism of- step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations. Polymerization techniques: bulk, solution, suspension, emulsion and interfacial condensation.

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Molecular weight of Polymers **(6 L)**

Average molecular weight of polymer, Number average molecular weight (Mn), Weight average molecular weight (M_W), Number average molecular weight by end group analysis, Viscosity average molecular weight by viscometric method, kl Molecular weight distribution and its significance, polydispersity index

Cosmetics **[10 L]**

A general study including chemical composition, preparation and uses of the following:
Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), Eye make-up (Mascara, Eyeshadow, Eyeliner, Eyebrow pencil), Antiperspirants, perfume

Reference Books

1. Fundamentals of molecular spectroscopy by C.N. Banwell and E. M. McCash
2. Industrial Chemistry, B. K. Sharma, Goel publishing House, 18th Ed. (2014)
3. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 458-463.
4. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 830-849
5. Inorganic Pigments by Gerhard Pfaff, Publisher-De Gruyter, 1st Ed.
6. Shreeve's chemical process industries 5th Edition, G.T. Austin, TATA McGraw-Hill
7. Edition, chemical engineering series
8. Industrial Chemistry, Part-II, R. K. Das, Kalyani Publisher, Second Ed.
9. Inorganic Pigments by Gerhard Pfaff, Publisher-De Gruyter, 1st Ed.
10. Polymer Science by V.R. Gowarikar, N.V.Vishvanathan, JaydevShreedhar New Age International Ltd. Publisher 1996. (Reprint 2012)
11. Textbook of Polymer Science by Fred Billmeyer, 3rd Edn. A Wiely-Interscience Publication
12. John Wiley& Sons New York 1984. (Reprint 2008)
13. Introductory Polymer Chemistry by G.S.Misra New Age International (P) Ltd. Publisher 1996

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BSc III Semesters

Core course (Theory Paper V)

CHE-321 Physical Chemistry

Credits 1.5 4 Lectures per week

Chemical Kinetics:

1. To Study the Acid catalysed hydrolysis of an ester (methyl Acetate) and determine the rate constant (k). (first order reaction)
2. To study the kinetics of saponification reaction between sodium hydroxide and ethyl acetate.
3. To compare the relative strength of HCl and H_2SO_4 or HNO_3 by studying the kinetics of hydrolysis of methyl acetate.
4. To determine Energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.
5. To determine the order of the reaction with respect to $K_2S_2O_8$ by fractional life method following the kinetics of per sulphate-iodide reaction

pH Metry:

6. To determine equivalence point of neutralisation of acetic acid by pH-metric titration with NaOH

Conductometry:

7. To determine the cell constant of the given cell using 0.01 M KCl solution and determine dissociation constant of a given monobasic weak acid.
8. To investigate the conductometric titration of Strong acid against strong base
9. To investigate the conductometric titration of weak acid against strong base

Colorimetry:

10. Prepare standard solutions of $KMnO_4$ / $CuSO_4$, record their absorbance and Verify Beer's Law and determine unknown concentration.
11. Prepare solution of Fe(III) and $SCN^-$of in different molar proportion, record their absorbance and calculate equilibrium constant of $[Fe(SCN)]^{2+}$ complex
12. Prepare solution of Fe(III)/Cu(II) and salicylic acid in different molar proportion and determine metal ligand ratio in Fe(III) or Cu(II)–Salicylic acid complex

Potentiometry:

13. Potentiometric titrations of Strong acid vs. strong base

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14. Potentiometric titrations of Weak acid vs. strong base
15. Potentiometric titrations of Potassium dichromate vs. Mohr's salt

Reference books

1. Vogel's Textbook Quantitative Chemical Analysis, 3rd, 6th Ed. A. I. Vogel J. Mendham, et al, Addison Wesley Publishing Co.
2. Experiments in Chemistry by D. V. Jahagirdar Himalaya publication 2014
3. Systematic experimental physical chemistry S. W. Rajbhoj, T. K. Chondekar Anjali publication
4. Practical Physical Chemistry, Vishwanathan and Raghwan Viva book
5. Practical Chemistry O.P. Pandey, D.N. Bajpai& S. Giri, , S. Chand & Company Ltd.
6. Senior Practical Physical Chemistry B. D. Khosla, V. C. Garg& A. Gulati, , S. Chand & Co. New Delhi (2011).
7. Experiments in Physical Chemistry C. W. Garland, J.W. Nibler, & D.P. Shoemaker, 8th Ed.; McGraw-Hill: New York (2003).
8. Experimental Physical Chemistry A.M. Halpern & G.C. McBane, 3rd Ed.; W.H. Freeman & Co.: New York (2003)
9. Advanced Physical Chemistry Experiment, Gurtu and Gurtu, Pragati Publication

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BSc IV Semesters
Core course (Practical Paper VI)
CHE-322 Organic Chemistry

Credits 1.5 4 Lectures per week

Organic Qualitative Analysis (Five mixtures: water insoluble solid-solid type)

Separation of Two Components from given binary mixture of organic compounds containing mono and di-functional group (carboxylic acid, phenols, amines, nitro, anilide etc.) and systematic identification of one component qualitatively.

Organic Preparations

(Confirmatory Test of functional group: M.P and purity by TLC)
(Preference should be given to green approach for following synthesis)

1. Preparation of benzoic acid from ethyl benzoate
2. Acetylation of primary amine
3. Base catalysed Aldol condensation
4. Preparation of Quinone from hydroquinone
5. Preparation of phthalimide from phthalic acid.

Organic estimations

6. Determine alcoholic OH groups by pthalation with pthalic anhydride in pyridine.
7. Determination of equivalent weight of a carboxylic acid by titration with standard aqueous alkali solution.
8. Estimation of amino acids by formol titration
9. Estimation of carbonyl compound with 2,4 dinitrophenyl hydrazine
10. Estimation of aldehyde/ketone by hydroxylamine -pyridine procedure

Reference books

1. Comprehensive Practical Organic Chemistry by V. K. Ahluwalia and Renu Aggarwal
2. A hand Book of Practical Chemistry, Dr. S. J. Naik, Phadake Prakashan.
3. Practical Organic Chemistry by Mann, F.G. & Saunders, B.C. Orient-Longman,1960.
4. Vogel's Textbook of Practical Organic Chemistry, Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,
5. Elementary practical organic chemistry Part III quantitative analysis by A I Vogel
6. Elementary practical organic chemistry Part I qualitative analysis by A I Vogel
7. Elementary practical organic chemistry Part II preparations by A I Vogel

BSc IV Semesters
Core course (Practical Paper VII)
CHE-421 Inorganic Chemistry

Credits 1.5 4 Lectures per week

Chromatography

1. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose of (Co + Al) mixture, Separation of cations must be confirmed by qualitative test
2. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose of (Cu + Mg) mixture Separation of cations must be confirmed by qualitative test
3. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose of (Zn + Mg) mixture. Separation of cations must be confirmed by qualitative test
4. Separation and Identification of metal ions Ni and Cr by Paper Chromatography

Synthesis of Coordination compounds

5. Synthesis of sodium cobaltinitrite from Co(II) salt and $NaNO_2$ salts.
6. Synthesis of potassium Tris(oxalate)aluminium(III) using Al metal powder(Scrap aluminium).
7. Synthesis of Tris(acetylacetone)iron(III) by green chemistry method by reaction between $Fe(OH)_3$ and acac.
8. Synthesis of Tris(ethylenediamine)nickel (II) from Ni(II) salt, ethylediamine and sodium thiosulfate.
9. Synthesis of $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate(III)
10. Synthesis of Tetra ammine copper(II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$

Gravimetric estimation

11. Estimation of nickel (II) using Dimethylglyoxime (DMG).
12. Estimation of copper as CuSCN
13. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
14. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminiumoxinate).

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

15. Estimation of Ba as Barium chromate

Reference books

A. I. Vogel's Quantitative Chemical Analysis Mendham, J., *6th Ed.,* Pearson, 2009
A Textbook of Quantitative Inorganic Analysis, Vogel, A.I. ELBS.

BSc IV Semesters
Core course (Practical Paper VIII)
CHE-422 Applied Chemistry

Credits 1.5 4 Lectures per week

1. Estimation of Aspirin from a given tablet and find errors in quantitative analysis.
2. Determination of acetic acid in commercial vinegar by titrating with standard NaOH. Express results as average ± standard deviation
3. Determination of Hardness of water from given sample by complexometric titration (Using E.D.T.A.) method
4. Removal of dyes / by Fenton's process or by adsorption on activated charcoal.
5. Removal of nitrophenols / by Fenton's process or by adsorption on activated charcoal.
6. Deionization water using cation and anion exchange resins / zeolites.
7. Estimation of paracetamol content in tablet
8. Estimation of the vitamin-c content in tablet
9. Estimation of Casein from milk sample
10. Estimation of Rhodamine B from chilli powder spectrophotometrically
11. Estimation of lead chromate in turmeric powder.
12. Estimation of Tannic acid from tea sample spectrophotometer/Colorimeter.
13. Estimation nutritive value of ghee sample (Desi Ghee)
14. To determine the molecular weight of a high polymer by using solutions of different concentrations
15. Quantitative estimation of reducing sugar from jam and jelly

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