Maharani Lakshmi Ammanni College for Women Autonomous
Affiliated to Bengaluru City University
Re-accredited by NAAC with "A" grade, Recognised by UGC
under Section 2(f) and 12(b) of the UGC Act 1956
Conferred the Status of 'College with Potential for Excellence' by UGC

Syllabus for

B.Sc. / B.Sc. (Honors) Chemistry

I & II Semester

Framed According to the National Educational Policy (NEP 2020)

(To be implemented from the academic year 2021-22)

Department of Chemistry

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN AUTONOMOUS

FOREWORD

National Education policy 2020 has been one among the intensely debated Policies in the recent times. Given the long range of Education as a social and economical transformation tool more so for a developing nation like ours, the traction it has garnered in public domain is no surprise.

Karnataka is the first state in the country to implement NEP in higher education. But playing the role of a pioneer is no child's play. Transforming the policy into a working framework and befitting a competent curriculum and syllabus is an ever challenging task. The state has come up with the NEP framework for all the UG programs starting from the academic year 2021.

Undergraduate programs were traditionally conceived as preparation for post graduation. Since decades its structure remained unchanged and was long due for an overhaul. The rigidity in choosing subjects through fixed combinations had to be reconsidered. The aspects of all-round development of the students, skill acquisition beyond chosen subjects and research were undermined and treated as mere extra-curricular activities. But NEP has changed all these in one stroke.

The conspicuous features of the NEP framework are:

I. Flexibility in choosing subjects and even disciplines for the graduate programs
II. Vertical and horizontal mobility across subjects throughout the program
III. Multiple entry and exit points
IV. Main-streaming of skill based courses
V. Credit based evaluation system
VI. Integration of research into 4^{th} year of the program leading to Honors degree

Such landslide modifications have put the learner at the center of the education system. The framework has nudged the academic faculty to work out syllabi aligned with national standards, if not global.

The road map is in place. It is the implementation of NEP in its letter and spirit that would provide a booster to raise the bar for the quality in Higher Education.

Proceedings of the Meeting of Board of Studies in Chemistry (UG) held on **12th October 2021** at 11am in the Department of Chemistry, Maharani Lakshmi Ammanni College for Women Autonomous Campus, Bengaluru -12.

The Chairman welcomed all the BOS members on behalf of Management,Principal and staff members of chemistry department of mLAC.

The following BOS members were present.

Sl.No	**Name**	**Name of the college**	**Member**	Signature
01	Prof. Dr.P.R.Chethana Professor PG Department of Chemistry	Central College Campus Dr.B.R Ambedkar Veedhi Bengaluru City University Bengaluru-560001	External Member **(BCU Nominee)**	Sd/-
02	Prof.Prasanna Kumar S.G Associate Professor &HOD Department of Chemistry(UG&PG)	Ramaiah College of Arts, Science and Commerce. MSR Nagar, MSRIT post Bangalore-560054	External Member **(Subject expert)**	Sd/-
03	Mikhail Rajaram Kolinjavadi Assistant Professor Department of Chemistry	Jyothi Nivas College Autonomous Bengaluru-560095	External Member **(Subject Expert)**	Sd/-
04	Dr.G Byre Gowda Sr.Group Leader-R	R L Fine Chem Pvt.Ltd C-10,Ist Cross, KSSIDC Industrial Area Yelahanka,Bengaluru.	External Member **(Industry Person)**	Sd/-
05	Dr. Kavitha.R Assistant Professor	Vijaya College PG Department of Chemistry RV Road Bengaluru-560004	External Member **(mLAC Alumni Representative)**	Sd/-
05	Dr.Nagalaxmi.B.N	mLAC Autonomous	Internal Member Chairperson	Sd/-
06	Sumanjali.K	mLAC Autonomous	Internal Member	Sd/-
07	Divya.B.N	mLAC Autonomous	Internal Member	Sd/-
08	AfshanIzzathMab	mLAC Autonomous	Internal Member	Sd/-
09	Swathi.N	mLAC Autonomous	Internal Member	Sd/-
10	Sushma.C	mLAC Autonomous	Internal Member	Sd/-
11	Rakshitha.B.K	mLAC Autonomous	Internal Member	Sd/-
12	Shravanakumara.K.N	mLAC Autonomous	Internal Member	Sd/-
13	Shubha Acharya	mLAC Autonomous	Internal Member	Sd/-

Minutes of Meeting

The Chairman welcomed the members of the Board to the meeting and placed the agenda before them for discussion.
Agenda: 1. Scrutiny and approval of the NEP Syllabus for the B. Sc., Degree, Chemistry Course of I and II semester of mLAC Autonomous College.
2. Scrutiny of syllabus for Open elective in Chemistry.
3. Preparation of the BOE (UG) for the Academic Year 2021-23.

The Chairman informed the members that, as per the directive from the Principal, the Chemistry syllabus for the B.Sc., degree has been prepared by National Education Policy Chemistry Syllabus Draft committee and the required modifications will be made by the chairperson with the help of the Chemistry Teachers of Chemistry Department of mLAC Autonomous, proposed to be introduced from **2021-22** onwards.

In this connection, the teachers prepared a Draft syllabus. The draft syllabus was then placed before the Board of Studies for Scrutiny and approval. Discussion regarding course pattern, scheme of examination, blow up syllabus of I and II semesters both theory and practicals along with scheme of valuation was discussed in detail before lunch. In post lunch session, Question paper pattern and its blue print was discussed. The Board of Studies (UG) approved the Syllabus after some modifications. The modifications are as follows:

B.Sc I semester CHE. T1-1 CHEMISTRY PAPER-I

Sl. No.	**Chapter Title as per NEP Syllabus of BCU.**	**Changes made by mLAC**	**Title of new chapter incorporated by mLAC**	**% Changes**	**Remarks**
1.	Unit-I Analytical Chemistry	**-NIL-**	**-NIL-**	------	_____
2.	Unit-II Inorganic Chemistry	**Shifted to unit-III**	**-NIL-**	------	----------
3	Unit-III Physical Chemistry	**Shifted to unit-IV**	**-NIL-**	------	----------
4.	Unit-IV Organic Chemistry Shifted to II Semester in Chemistry P-II as Unit-I	Is replaced by **Analytical Chemistry from Unit -I of Chemistry P-II** from II Semester **as Unit-II**	Red-Ox titration	2%	Since Practical Part involves all types of titrations, it will be useful for students to correlate both theory and practicals to get indepth knowledge in Analytical Chemistry.
5.	Chemistry Practicals P-I	Part B of Chemistry Practicals P-I practicals **is replaced by** Part B of Chemistry Practicals P-II	Determination of percentage of manganese dioxide from pyrolusite ore. **(in Part A)**		To align theory with the practicals As a procedure writing component.
6.	OPEN ELECTIVE-1 CHEMISTRY IN DAILY LIFE	-NIL-	-NIL-	_____	_____

B.Sc I semester CHE. T2-2 CHEMISTRY PAPER-II

Sl.NO	Chapter Title as per NEP Syllabus of BCU	Changes made by mLAC	Title of new chapter incorporated by mLAC	% Changes	Remarks
1.	Unit-I Analytical Chemistry	Unit-I is replaced by Organic Chemistry from Unit-IV of Chemistry P-I of I semester.	In nomenclature of Organic compounds examples of bifunctional groups, Heterocyclics, and Bridge compounds is introduced	**1%**	Since Practical part involves Preparation of Organic compounds, it will be easy for students to corelate both theory and practicals to get indepth knowledge in Organic Chemistry.
2	Unit-II Organic Chemistry	-NIL-	-NIL-	_____	_____
3	Unit-III Gaseous State and Liquid State	Solids State is shifted from Unit-IV	-NIL-	_____	To consider the entire unit as Inorganic chemistry
4.	Unit-IV Dilute solutions and Solids	Liquid state is shifted to Unit-IV	-NIL-	_____	To consider the entire unit as Physical chemistry.
5.	Chemistry Practicals P-II	Part B of Chemistry Practicals P-II practicals **is replaced by** Part B of Chemistry Practicals P-I	-NIL-	_____	To align theory with the practicals
6.	OPEN ELECTIVE-2 Molecules of Life	-NIL-	-NIL-	_____	_____

The meeting ended with the vote of thanks by the Chairperson. The following members were present. 1. Dr. P.R. Chethana **Bangalore City University Nominee** 2. Prof. Prasanna Kumar S. G. 3. Dr. Kavitha R 4. Mikhail Rajaram Kolinjavadi 5. Dr. G. Byre Gowda and all staff members of department of chemistry mLAC autonomous.

The Chairman records his thanks to the teachers involved in the preparation of this syllabus.

NOTE: Changes made after the consent by BOS members was incorporated in mLAC Autonomous syllabus and sent for approval on **19 -10-2021**.

Dr.Nagalaxmi.B.N
Chairman BOS(UG)
Department of Chemistry
mLAC Autonomous.

Model Curriculum

Name of the Degree Program: B.Sc. / B.Sc. (Honors) Chemistry

Discipline Core : Chemistry.

Total Credits for the Program: 186

Starting year of implementation: 2021-22

Program Outcomes:

By the end of the program the students will be able to:

PO.1: Create enthusiasm among students for chemistry and its application in various fields of life.

PO. 2: Provide students with broad and balanced knowledge and understanding of key concepts in chemistry.

PO. 3: Develop students with a range of practical skills so that they can understand and assess risks and work safety measures to be followed in the laboratory.

PO. 4: Develop in students the ability to apply standard methodology to the solution of problems in chemistry.

PO. 5: Provide students with knowledge and skill towards employment or higher education in analytical chemistry, inorganic, physical and organic chemistry.

PO. 6: Provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes and to cater to the demands of chemical industries.

PO. 7: Find out the green route for chemical reaction for sustainable development.

PO. 8: Instill critical awareness of advances at the forefront of chemical sciences, to prepare students effectively for professional employment or research degrees in chemical sciences and to develop an independent and responsible work ethics.

Assessment: Weightage for assessments (marks)

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40	60
Practical	25	25
Projects	-	-
Experiential Learning (Internships etc.)	-	-

Curriculum Structure for the Undergraduate Degree Program

Name of the Degree Program : B.Sc. / B.Sc. (Honors) Chemistry

Discipline/Subject : Chemistry

Total Credits for the Program: 186

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internships etc. Elective courses may be listed separately

Semester	Title / Name Of the course	Program outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy##	Assessment$
1	**DSC-1: Analytical, Inorganic and Physical Chemistry-I** **Credits-4**	• Understand the concepts of chemical analysis, accuracy, precision, statistical data treatment, volumetric and gravimetric analysis. • Knowledge to handle toxic chemicals, concentrated acids and organic solvents and practice safety procedures. • The Bohr's theory of atomic structure, quantum numbers and their necessity in explaining the atomic structure • To study s,p,d and f block elements with respect to trends in properties.	P.U.C /12th standard/ or equivalent with Chemistry	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams
	DSClab-1: Analytical and Inorganic Practical-I **Credits-2**	• The students will be able to learn how to handle the glassware, prepare and dilute solutions and perform the experiments with prepared reagents • The students will be able to determine the analyte through various volumetric and gravimetric analysis and understand the chemistry involved in each method of analysis.	-	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams

2	**DSC-2: Physical, Inorganic and Organic Chemistry-II Credits-4**	• Understand the preparation of alkanes, alkenes and alkynes and the mechanism of nucleophilic, electrophilic reactions their reactions, etc. • Gaseous state of molecules. • Understand the properties of solutions in liquid state. • The concept of unit cell, symmetry elements, Nernst distribution law.	-	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams
	DSC Lab -2: Organic and Physical Practicals-II Credits-2	• Techniques like precipitation, filtration, drying and ignition • Preparation of organic compounds in both conventional and green methods • The students will be able to deduce the conversion factor based on stoichiometry and in turn use this value for calculation.		Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams
3	DSC-3: **Credits**-4 DSC Lab-3 **Credits**-2		DSC-1 and DSC-2	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams
4	DSC-4: **Credits**-4 DSC Lab-4: **Credits**-2			Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams
5.	DSC-5: **Credits**-3 DSCLab-5: **Credits**-2 DSC-6: **Credits**-3 DSC Lab-6: **Credits**-2 DSE-A1: **Credits**-3	:	DSC-3 and DSC-4	MOOC, Problem solving	Internal tests, Assignments, Quiz
6.	DSC-7: **Credits**-3 DSC Lab-7: **Credits**-2.			MOOC, Problem solving	Internal tests, Assignments, Quiz

	DSC-8: **Credits**-3 DSC Lab-8: **Credits**-2 DSE-A2: **Credits**-3				
7.	DSC-9: **Credits-3** DSC Lab-9: **Credits=2** DSC-10: **Credits**-3 DSC Lab-10 : **Credits** -2 DSC-11: **Credits**=4 DSE-A3: **Credits**-3 **And** **Research methodology** **Or** **DSE.** **Credits**-3		DSC-5, DSC-6, DSC-7 and DSC-8	MOOC, Problem solving	Internal tests, Assignments, Seminar, Debate, Quiz
8.	DSC-12: **Credits**=4 DSC-13:. **Credits**-4 DSC-14: **Credits**-3 DSE-A4: **Credits**=3 Research Project. **Credits**=6 **Or** Two Papers. **Credits**=3Each.			Project work, Industrial Visit	Internal tests, Assignments, Seminar, Debate, Quiz

- Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. The list includes active learning/ course projects/ problem or project based learning/ case studies/self-study like seminar, term paper or MOOC.
- Every course needs to include assessment for higher order thinking skills (Applying/ Analyzing/ Evaluating/ Creating). However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for learning)

B.Sc. / B.Sc. (Honors) Chemistry- I Semester

Course Title: DSC-1: Analytical/Physical and Inorganic Chemistry.	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 3 hrs.
Model Syllabus Authors: BOS.	Summative Assessment Marks: 60

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
1. Explain basic laboratory practices like calibration of glassware, sampling, handling acids and safety precautions	X	X	X		X			
2.Describe the concepts of chemical analysis, accuracy, precision and statistical data treatment.	X	X	X	X				
3. Deep knowledge on stoichiometric conversions.	X	X	X					
4.Understand the principles and concepts related to titrimetric analysis with reference to acid-base, precipitation and complexometric titrations.				X	X			X
5. Outline the limitations of classical mechanics and justify the need for quantum mechanics.				X	X			X
6. Solve the Schrodinger's equation to obtain wave function for a basic type of particle in one dimension and predict the shapes of orbitals as well as probability distributions				X	X			X
7. Discuss the periodic properties in s and p block elements.					X	X		X
8. Gain the knowledge of formation of hydrides, carbides, oxides and halides with respect to group 13 to 17 elements.					X	X		X

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

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B.Sc. / B.Sc. (Honors) Chemistry-I semester
2021 – 2022 onwards
ANALYTICAL/INORGANIC/PHYSICAL CHEMISTRY

Title of the Course: DSC-1: **Course Code: CHE.T1-1**

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	56	2	56

Course Objectives:

- To strengthen the basics of laboratory practices and to adopt safety measures in chemical laboratory.
- To learn the concepts of chemical analysis, accuracy, precision and statistical data treatment.
- To strengthen the concepts in stoichiometry.
- To explain the principles and concepts related to titrimetric analysis with reference to acid-base, precipitation and complexometric titrations.
- To introduce quantum mechanics, quantum numbers and their necessity in explaining the atomic structure.
- To describe the shapes of different atomic orbitals based on probability diagram.
- To describe the periodicity in physical and chemical properties of elements in the Periodic table.
- Compare the compounds of hydrides, carbides, oxides and halides of p-block elements.

Course Outcomes:

On completion of the course the student will learn and be able to:

1. Explain basic laboratory practices like calibration of glassware, sampling, handling acids and safety precautions.
2. Describe the concepts of chemical analysis, accuracy, precision and statistical data treatment.
3. Deep knowledge on stoichiometric conversions.

4. Understand the principles and concepts related to titrimetric analysis with reference to acid-base, precipitation and complexometric titrations.
5. Outline the limitations of classical mechanics and justify the need for quantum mechanics.
6. Solve the Schrodinger's equation to obtain wave function for a basic type of particle in one dimension and predict the shapes of orbitals as well as probability distributions.
7. Discuss the periodic properties in s and p block elements.
8. Gain the knowledge of formation of hydrides, carbides, oxides and halides with respect to group 13 to 17 elements.

Contents of Theory Course Semester- 1	**56 Hrs**
Unit – I	**14 hrs**
Basic laboratory practices, calibration of glassware (pipette, burette and volumetric flask), Sampling (solids and liquids), weighing, drying, dissolving, Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric), Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents. **Language of analytical chemistry**: Definitions of analysis, determination, measurement, techniques and methods. Significant figures, Classification of analytical techniques. Choice of an analytical method. Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, some important terms replicate, outlier, Accuracy, precision, ways of expressing accuracy, absolute error, relative error, minimization of errors. Statistical treatment of random errors, mean, median, range, standard deviation and variance. External standard calibration. Numerical problems. Regression equation (least squares method), correlation coefficient (R2), limit of detection (LOD), limit of quantification (LOQ), linear dynamic range (working range), sensitivity, selectivity, method validation, figures of merit of analytical methods (no problems).	**(4hrs)** **(6 hrs)** **(4 hrs)**
Unit – II	**14 hrs**

Titrimetric analysis: Basic principle of titrimetric analysis. Classification, preparation and dilution of reagents/solutions. Equivalent masses of compounds Normality, Molarity and Mole fraction. Use of $N_1V_1 = N_2V_2$ formula, preparation of ppm level solutions from source materials (salts), conversion factors. Numerical problems.	**(2 hrs)**
Acid-base titrimetry: Titration curves for strong acid vs. strong base, weak acid vs. strong base and weak base vs. strong acid titrations. Titration curves, quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity.	**(3hrs)**
Redox titrations: Nernst equation-Theory of redox indicators	
Complexometric titrimetry: Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application-determination of hardness of water.	**(3hrs)**
Precipitation titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate - Volhard's and Mohr's methods and their difference.	**(2hrs)**
Gravimetric Analysis: Requisites of precipitation, mechanism of precipitation, factors influencing precipitation, co-precipitation, post-precipitation. Advantages of organic reagents over inorganic reagents, reagents used in gravimetry : 8-hydroxy quinoline (oxine) and dimethyl glyoxime (DMG).	**(4hrs)**
Unit – III	**14 hrs**
Limitations of classical mechanics. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance. Quantum Mechanics- ..Schrödinger's wave equation, derivation (time independent) significance of ψ and ψ^2. Eigen values and functions Applications of Schrödinger's wave equation - Particals in one-dimension box	**(5hrs)**
Quantum numbers and their significance. Quantum mechanical operators- (i) Hamiltonian operator; (ii) Laplacean operator Normalized and orthogonal wave functions. Sign of wave functions. Postulates of quantum mechanics Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's	**(6hrs)**

principle and its limitations- Electronic configurations of the elements (Z=1-30), effective nuclear charge, shielding/screening effect, Slater's rules. Variation of effective nuclear charge in Periodic table**.**	**(3hrs)**
Unit – IV	**14hrs**
s, p, d and f-block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block elements: (a) Atomic radii (van der Waals) (b) Ionic and crystal radii. (c) Covalent radii (d) Ionization enthalpy, successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy (e) Electron gain enthalpy; trends of electron gain enthalpy. (f) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Trends in the chemistry of the compounds of groups 13 to 17 (hydrides, carbides, oxides and halides) are to be discussed.	(**8 hrs)**

Recommended Books/References:

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt. Ltd.(2007).
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
3. Basic Inorganic Chemistry, F A Cotton, G Wilkinson and P. L. Gaus, 3rd Edition. Wiley. India December 1994
4. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
5. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.
6. Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.
7. Concise Inorganic Chemistry: J D Lee, 4thEdn, Wiley, (2021)
8. Fundamentals Concepts of Inorganic Chemistry, Vol 1 and 2, 2nd Edition, Asim K Das, CBS Publishers and Distributors, (2013)

9. Inorganic Chemistry, 2ndEdn. Catherine E. Housecroft and A.G. Sharpe, Pearson Prentice Hall (2005)

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, MOOC

Formative Assessment (Internal assessment) Theory.	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and class test	20
Seminars/Class work	10
Assignments/Discussions	10
Total	40

Practicals Chemistry -I Semester

Formative Assessment (Internal assessment) Practicals.	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and class test	20
Record/viva voce	05
Total	**25**

PART- A Analytical Chemistry (Titrimetric Analysis)

Course objectives:

- To prepare the standard/working solutions from source materials
- To standardize the reagents and determination of analytes
- To familiarize the student about filtration, drying, incineration and ignition of the precipitates

Course outcomes:

- The students will be able to learn how to handle the glassware, prepare and dilute solutions and perform the experiments with prepared reagents
- The students will be able to determine the analyte through volumetric and gravimetric analysis and understand the chemistry involved in each method of analysis.
- The students will be able to deduce the conversion factor based on stoichiometry and in turn use this value for calculation.

List of Experiments:

1. Calibration of glassware, pipette, burette and volumetric flask.
2. Estimation of sodium carbonate and sodium bicarbonate in a mixture by acid-base titration method.
3. Estimation of alkali present in soaps/detergents/antacids.

4. Estimation of iron (II) using potassium dichromate by redox titration method.
5. Estimation of oxalic acid using potassium permanganate solution by redox titration method.
6. Estimation of chlorine in bleaching powder using iodometric method.
7. Standardization of silver nitrate and determination of chloride in a water sample.
8. Determination of percentage of manganese dioxide from pyrolusite ore.

PART-B Inorganic Chemistry

Course Objectives:

- To strengthen the concepts of mole and stoichiometry.
- To develop analytical skills of determination through titrimetry and gravimetry.

Course outcomes:

The student will gain knowledge on

- Calculations on basis of mole concept and stoichiometry and preparation of standard solutions.
- Various titrimetric techniques and gravimetric methods.

List of experiments to be conducted:

TITRIMETRY

1. Estimation of carbonate and hydroxide present in a mixture.
2. Estimation of oxalic acid and sodium oxalate in a given mixture using standard $KMnO_4$/NaOH solution.
3. Standardization of potassium permanganate solution and estimation of nitrite in a water sample.
4. Standardization of EDTA solution and estimation of hardness of water.

GRAVIMETRY

1. Determination of Ba^{2+} as $BaSO_4$.
2. Estimation of Ni^{2+} as $Ni(DMG)_2$ complex.
3. Determination of Cu^{2+} as CuSCN.
4. Estimation of Fe^{2+} as Fe_2O_3

Recommended Books/References:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
2. Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson,

India, 2012.
3. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
5. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

BSc., Chemistry- I Semester

OPEN ELECTIVE-1

Title of the Course: OE-1: CHEMISTRY IN DAILY LIFE

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
3	42	-	42

Course Objective: The objective of this paper is to equip the non-chemistry students with knowledge about chemistry of some of the products which are commonly used in daily life.

Course outcomes:

At the end of this course, student should be able to:

1. Describe the analysis of important constituents in food items such as fat content in dairy products, caffeine in coffee/tea, methanol in alcoholic beverages, etc.
2. Give details of possible food additives, preservatives, colorants and adulterants commonly used in processed food.
3. Explain the nutritional aspects of macro and micronutrients, namely oils/fats and vitamins respectively.
4. Explain the chemistry of daily used products like soaps/detergents, batteries/fuel cells and polymers.

Contents of Theory Course 1 Elective	42 Hrs
Unit – 1	**14 hrs**
Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages. **Food additives, adulterants, and contaminants** - Food preservatives like benzoates, propionates, sorbates, and disulphites. Artificial sweeteners: aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: vanillin, alkyl esters (fruit flavors), and monosodium glutamate. **Artificial food colorants:** Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food.	
Unit - 2	**14 hrs**
Vitamins: Classification and nomenclature. Sources, deficiency diseases, and structures of vitamin A1, vitamin B1, vitamin C, vitamin D, vitamin E & vitamin K1. **Oils and fats**: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test. **Soaps & Detergents**: Definition, classification, manufacturing of soaps and detergents, composition and uses	
Unit - 3	**14 hrs**
Chemical and renewable energy sources: principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer. Polymers: basic concept of polymers, classification and characteristics of polymers. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management. Strategies for the development of environment-friendly polymers.	

Recommended Books/References:

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. The chemical analysis of foods. . Pearson, David, 1919-1977. Cox and Pearson. 7th ed. Published Edinburgh; New York: Churchill Livingstone, 1976.
3. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
4. Odian; George, Principles of Polymerization, McGraw-Hill Book Co., New York (1970).
5. W. Billmeyer, Text book of polymer science, 3rd Edn., 2007, Wiley.
6. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
7. Subalakshmi, G and Udipi, SA (2006):Food processing and preservation, 1st Ed. New Age International (P)Ltd.
8. SrilakshmiB (2018): Food Science, 7th Colour Ed. New Age International (P) Ltd
9. Potter NN and Hotchkiss JH(1999): Food science,5th Ed , Spinger.
10. M.P. Stevens, Polymer Chemistry: An Introduction 3rd ed. Oxford University Press (2005).

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, MOOC

Formative Assessment (Internal assessment) Theory.	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and class test	20
Seminars/Class work	10
Assignments/Discussions	10
Total	40

B.Sc. / B.Sc. (Honors) Chemistry-II Semester

Course Title: DSC-2: Physical, Inorganic and Organic Chemistry.	
Total Contact Hours: 56	**Course Credits: 4**
Formative Assessment Marks: 40	**Duration of ESA/Exam: 3 hrs**
Model Syllabus Authors: BOS	**Summative Assessment Marks: 60**

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Describe the nature of bonding in organic compounds using concepts such as conjugation, resonance, etc	X				X	X		X
2. Learn methods of synthesis of alkanes, alkenes and alkynes along with their reactions and mechanisms	X		X		X	X		X
3. Illustrate types of aromatic electrophilic and aromatic nucleophilic substitution reactions with examples					X		X	X
4. Write the mechanisms of S_N1 and S_N2 reactions taking suitable examples					X		X	X
5. Describe the crystalline state in detail using the terms unit cell, Bravias lattices, Miller indices, Crystal systems, symmetry elements and lattice planes		X			X			X
6. To describe the gaseous state in terms of molecular velocity, their distribution based on Maxwell-Boltzmann law, types of molecular velocities, molecular collision parameters, critical phenomena and liquefaction of gases		X		X	X			X
7. Explain important properties of liquid state such as viscosity, surface tension, refraction and parachor by defining them and elaborating on their experimental determination	X	X	X		X	X		
8. Learn methods of determining molecular weights of solutes by measuring colligative properties and the concept of distribution law along with its applications	X	X	X		X	X		

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

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B.Sc. / B.Sc. (Honors) Chemistry- II Semester
ORGANIC/PHYSICAL/INORGANIC CHEMISTRY

Title of the Course: DSC – 2 **Course Code:CHE.T2-2**

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/ semesters
4	56	2	56

Course Objectives:

- To explain the nature of bonding in organic compounds using concepts such as conjugation, resonance, etc.
- To emphasize methods of synthesis of alkanes, alkenes and alkynes along with their reactions and mechanisms.
- To illustrate the types of aromatic electrophilic and aromatic nucleophilic substitution reactions with examples.
- To describe the mechanisms of S_N1 and S_N2 reactions taking suitable examples.
- To discuss the crystalline state in detail using the terms unit cell, Bravias lattices, Miller indices, Crystal systems, symmetry elements and lattice planes.
- To give a comprehensive description of the gaseous state in terms of molecular velocity, their distribution based on Maxwell-Boltzmann law, types of molecular velocities, molecular collision parameters, critical phenomena and liquefaction of gases.
- To discuss the important properties of liquid state such as viscosity, surface tension, refraction and parachor by defining them and elaborating on their experimental determination.
- To learn the methods of determining molecular weights of solutes by measuring colligative properties and the concept of distribution law along with its applications

Course outcomes:

On completion of the course the students will learn and able to explain

- Describe the nature of bonding in organic compounds using concepts such as
- Learn methods of synthesis of alkanes, alkenes and alkynes along with their reaction

mechanisms.

- Illustrate types of aromatic electrophilic and aromatic nucleophilic substitution reactions with examples
- Write the mechanisms of S_N1 and S_N2 reactions taking suitable examples
- Describe the crystalline state in detail using the terms unit cell, Bravias lattices, Miller indices, Crystal systems, symmetry elements and lattice planes.
- To describe the gaseous state in terms of molecular velocity, their distribution based on Maxwell-Boltzmann law, types of molecular velocities, molecular collision parameters, critical phenomena and liquefaction of gases.
- Explain important properties of liquid state such as viscosity, surface tension, refraction and parachor by defining them and elaborating on their experimental determination
- Learn methods of determining molecular weights of solutes by measuring colligative properties and the concept of distribution law along with its applications

Content of Theory Course 2	**56Hrs**
Unit – I	**14hrs**
Classification and nomenclature of organic compounds (bifunctional, heterocyclics and bridged compounds), hybridization, shapes of organic molecules, influence of hybridization on bond properties.	**(2hrs)**
Nature of bonding in Organic molecules Formation of covalent bond, types of chemical bonding, localized and delocalized, conjugation and cross conjugation, with examples. Concept of resonance. Electronic displacements: Inductive effect, electrometric effect, resonance and hyper conjugation, aromaticity, Huckel's rule, anti-aromaticity explanation with examples.	**(4hrs)**
Strengths of organic acid and bases: Comparative study with emphasis on factors effecting pK values. Relative strength of aliphatic and aromatic carboxylic acids - acetic acid and chloroacetic acid, acetic acid and propionic acid, acetic acid and benzoic acid. Steric effect - relative stability of trans and *cis*-2-butene. Types of bond cleavages- homolytic and heterolytic cleavages. Types of reagents - electrophiles, nucleophiles, nucleophilicity and basicity. Types of organic reactions - substitution, addition, elimination, and rearrangement explanation with examples.	**(4hrs)**
Chemistry of Aliphatic hydrocarbons, **carbon - carbon sigma bonds** Formation of alkanes: Wurtz reaction, free radical substitution, halogenation	

Carbon-carbon pi bonds: Formation of alkenes and alkynes by elimination reaction. Mechanism of E1, E2, reactions. Saytzeff and Hofmann eliminations. Addition of HBr to propene, free radical addition of HBr to propene. Addition of halogens to alkenes-carbocation and halonium ion mechanism. Ozonolysis - ozonolysis of propene, hydrogenation, hydration, hydroxylation and epoxidation of alkenes, explanation with examples, addition of hydrogen halides to alkynes. Conjugated Dienes - 1,2 and 1,4- addition reactions in conjugated dienes. Diels-Alder reaction.	**(4hrs)**
Unit – II	**14hrs**
Nucleophilic substitution at saturated carbon. Mechanism of S_N1 and S_N2 reactions with suitable examples. Energy profile diagrams, stereochemistry and factors effecting S_N1 and S_N2 reactions. Aromatic electrophilic substitution reactions, mechanisms, σ and π complexes, halogenation, nitration, sulphonation, Friedel Crafts alkylation and acylation with their mechanism. Activating and deactivating groups. Orientation influence, *ortho* - *para* ratio (Cl, NO_2, CH_3, NH_2, OH). Aromatic nucleophilic substitution reaction: S_NAr mechanism*, ipso* substitution. Example -conversion of 2,4-dinitrochlorobenzene to 2,4-dinitrophenyl hydrazine. Introduction to benzyne. Stability based on Huckel rule of aromaticity. Generation of benzyne with mechanism. Green Chemistry- Principles.	**(4 hrs)** **(5 hrs)** **(5hrs)**
Unit – III	**14hrs**
Solids: Forms of solids**:** Unit cell and space lattice, anisotropy of crystals, size and shape of crystals. Laws of Crystallography: Law of constancy of interfacial angles, law of rational indices, law of symmetry (symmetry elements), crystal systems, Bravais lattice types and identification of lattice planes. Miller indices and its calculation, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, single crystal and powder diffraction methods. Defects in crystals, glasses and liquid crystals. Numerical problems. **Gaseous state:** Molecular velocity, collision frequency, collision diameter, collision cross section, collision number and mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure.	**(7hrs)**

Maxwell-Boltzmann distribution law of molecular velocities (most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies. (mathematical derivation not required), law of equipartition of energy. Behaviour of real gases: Deviation from ideal gas behaviour. Compressibility factor (Z) and its variation with pressure for different gases. Causes of deviation from ideal behaviour, vander Waals equation of stat (No derivation) and application in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO_2, critical constants and their derivation from van der Waals equation, Experimental determination of critical constants. Continuity of states, Law of corresponding states. Joule Thomson effect. Inversion temperature, application of J-T effect, liquification of air by Linde's process. Numerical problems.	**(7hrs)**
UNIT-IV	
Liquid state **Surface tension**: Definition and its determination using stalagmometer, effect of temperature and solute on surface tension. **Viscosity**: Definition, coefficient of viscosity. Determination of viscosity of a liquid using Oswald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces. **Refraction**: Specific and molar refraction- definition and advantages. Determination of refractive index by Abbes Refractometer. Additive and constitutive properties. **Parachor:** Definition, atomic and structure parachor, elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure. Molar refraction and chemical constitution. Numerical problems**.**	**(7hrs)**
Dilute solutions. Review of colligative properties. Experimental determination of molar mass of solute by: 1.Berkely-Hertely method 2. Beckmann method 3. Landsberger method and Numerical problems	**(3hrs)**
Distribution Law: Nernst distribution law - Statement. Distribution coefficient, factors affecting distribution coefficient, validity of distribution law, modification of distribution law when molecules undergo a) association b) dissociation. Application of distribution law in Solvent extraction. Derivation for simple and multiple extractions. Principles of distribution law in Parke's process of desilverisation of lead. Numerical problems**.**	**(4hrs)**

Recommended Text books/references:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).
2. Physical Chemistry by Samuel Glasstone, ELBS (1982).
3. A Text book of Physical Chemistry, A S Negi& S C Anand, New Age International Publishers (2007).
4. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
5. A Text Book of Physical Chemistry P.L.Soni , O.P. Dharmarhaand and U.N.Dash, Sultan Chand and Sons.
6. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House (2018)
7. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
8. Finar, I. L. Organic Chemistry (Volume I), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
9. McMurry, J. E. *Fundamentals of Organic Chemistry,* 7th Ed. Cengage Learning India Edition, 2013
10. Organic Reaction mechanism by V. K. AhIuwalia and K. Parashar Oxford, U.K. : Alpha Science International, 2011.
11. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. New age publishers Publication Date.2 February 2017
12. A Guide book to mechanism in Organic Chemistry by Peter Sykes. Pearson. (January 2003)
13. F. A. Carey, Organic Chemistry, Seventh Edition, Tata McGraw Hill (2008).
14. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd Ed., (2012), Oxford University Press.

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, MOOC

Formative Assessment (Internal assessment) Theory.	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and class test	20
Seminars/Class work	10
Assignments/Discussions	10
Total	40

Practicals Chemistry-II Semester

Formative Assessment (Internal assessment) Practicals.	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and class test	20
Record/viva voce	05
Total	**25**

PART A: Organic Chemistry

Course Objectives:

- To get training on how to plan and execute single step synthesis of small organic molecules.
- To learn and to get trained on how to how to purify a compound and to learn the crystallization techniques.
- To understand the mechanism involved in the transformation, calculate the percentage yield and report the physical constant

Course outcomes:

- Students would learn the importance of green methods over conventional methods.
- Students gain the basic knowledge as how to select a solvent for crystallization of organic compounds and get trained as how to purify a compound.
- Students would understand the mechanism behind the reaction and role of catalysts in enhancing reaction rate and yield.

List of experiments to be conducted.

1. Selection of suitable solvents for purification/crystallization of organic compounds.
2. Preparation of acetanilide from aniline using Zn/acetic acid (green method).
3. Synthesis of *p*-nitro acetanilide from acetanilide using nitrating mixture.
4. Bromination of acetanilide (i) Conventional method and/or (ii) With ceric ammonium nitrate and potassium bromide (green method).
5. Preparation of methyl *m*-nitro benzoate from methyl benzoate by nitration method.
6. Hydrolysis of methyl *m*-nitro benzoate to *m*-nitro benzoic acid (conventional method).

7. Bromination - preparation of tribromophenol from phenol.
8. Preparation of dibenzalacetone (green method).

PART – B: Physical Chemistry

Course Objectives:

- To learn techniques for the measurement of viscosity, surface tension and refractive index
- To determine the composition of a liquid mixture by Refractometry
- To understand the concept of distribution coefficient and Nernst Distribution law

Course outcomes:

The student will be able to

- Determine the density, viscosity, surface tension, refractive index of liquids
- Determine the percentage composition of liquid mixtures using Abbe's Refractometer
- Explain the concept of distribution coefficient and Nernst Distribution law

List of experiments to be conducted.

1. Safety practices in the chemistry laboratory, knowledge about common toxic chemicals and safety measures in their handling, cleaning and drying of glasswares.
2. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (ethyl acetate, toluene, chlorobenzene or any other non-hazardous liquids).
3. Study of the variation of viscosity of sucrose solution with the concentration of a solute
4. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (ethyl acetate, toluene, chlorobenzene or any other non-hazardous liquids).
5. Determination of molar mass of non-electrolyte by Walker-Lumsden method.
6. Determination of specific and molar refraction by Abbes Refractometer (ethyl acetate, methyl acetate, ethylene chloride).
7. Determination of the composition of liquid mixture by refractometry (toluene & alcohol, water & sucrose).
8. Determination of partition/distribution coefficient - i) Acetic acid in water and cyclohexane. ii) Acetic acid in water and butanol iii) Benzoic acid in water and toluene.

Note:

1. Questions from both sections should be given in each batch.

2. In the first 20 minutes the Teacher should discuss in detail the theory, principle, procedure and calculations.

3. Instructions to be given for operating instruments, weighing chemicals and precautions while handling chemicals.

Recommended Books/References

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
2. Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.
3. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
4. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
5. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
6. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).
7. Athawale V. D. amd Mathur P. Experimental Physical Chemistry, New Age International (2001)

BSc Chemistry-II Semester – OPEN ELECTIVE - 2

Title of the Course: OE – 2: Molecules of Life

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/ semesters
3	42	-	42

Course Objective:

To make the non-chemistry students aware of various biochemicals/biomolecules involved in various biological processes.

Course Outcomes:

At the end of this course, student should be able to:

1. Describe the biomolecules, namely carbohydrates, amino acids, lipids and nucleic acids on the basis of their classification and structure.
2. Explain enzyme action, factors influencing enzyme action, co-enzymes and enzyme specificity.
3. Depict the action of drugs in biological systems based on Receptor theory, SAR studies and binding action of various groups.
4. Study the energy dynamics of biological systems in terms of calorific values of macronutrients, their metabolic pathways and ATP as energy currency.

Content of Theory Course 2	42 Hrs
Unit – 1	**14 hrs**
Carbohydrates Classification of carbohydrates, reducing and non-reducing sugars, general properties of glucose and fructose, their open chain structures. Epimers, mutarotation and anomers. Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation. **Amino acids, peptides and proteins** Classification of amino acids, Zwitter ion structure and isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of peptides.	
Unit - 2	**14 hrs**

Enzymes and correlation with drug action Mechanism of enzyme action, factors affecting enzyme action, co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity). Enzyme inhibitors and their importance, phenomenon of inhibition (competitive and non-competitive inhibition including allosteric inhibition). **Drug action** - receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH_2 group, double bond and aromatic ring. **Lipids** Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).	
Unit - 3	**14 hrs**
Nucleic acids Components of nucleic acids: Adenine, guanine, thymine and cytosine (structure only), other components of nucleic acids, nucleosides and nucleotides (nomenclature), structure of polynucleotides: structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic code, biological roles of DNA and RNA: replication, transcription and translation. **Concept of energy in bio systems** Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of carbohydrate - Glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fats and proteins. Interrelationships in the metabolic pathways of Proteins, fats and carbohydrates.	

Recommended Books/References

1. W. H. Freeman. Berg, J.M., Tymoczko, J. L. &Stryer, L. Biochemistry, 2002.
2. Morrison R. T. and Boyd R. N. Organic Chemistry, Sixth Edition Prentice Hall India, 2003.
3. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VI the Edition. W.H. Freeman and Co.
4. Nelson, D. L., Cox, M. M. and Lehninger, A. L. (2009) principles of Biochemistry.IV Edition. W.H. Freeman and Co.

5. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange medical Books/ McGraw-Hill*Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Crichton R. H. Biological Inorganic Chemistry – An Introduction, Elsevier, 2008.
7. Berg J. M., Tymoczeko J. L., Stryer l. Biochemistry, W. H. Freeman, 2008.
8. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed. 2006.

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, MOOC.

Formative Assessment (Internal assessment) Theory.	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and class test	20
Seminars/Class work	10
Assignments/Discussions	10
Total	40

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B.Sc.CHEMISTRY Paper- I &II

End Semester Examination
QUESTION PAPER PATTERN

(2021-22 & onwards) (NEP-CBCS SCHEME)

CHEMISTRY-PAPER-1 & 2 (CHE.T1-1 and CHE.T2-2)

Time: 3 Hours **Max. Marks: 60**

Instructions:

1. Question paper has two Parts. Answer both the Parts
2. Write chemical equations and diagrams wherever necessary.

PART– A

Answer any **FIVE** of the following questions. Each question carries **TWO** marks**:(5 x 2 =10).**

1.
2.
3.
4.
5.
6.

PART–B

Answer any **FOUR** of the following questions. Each question carries **FIVE** marks:

(4 x 5 = 20).

7.
8.
9.
10.
11.
12.

PART– C

Answer any **THREE** of the following questions. Each question carries **TEN** marks:

(3 x 10 = 30).

13.

14.

15.

16.

17.

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B.Sc. I semester Examination
END SEMESTER B.SC. EXAMINATION

QUESTION PAPER PATTERN

(2021-22 & onwards) (NEP-CBCS SCHEME)
-CHEMISTRY
(OPEN ELECTIVE -1 and 2)

Time: 3 Hours **Max. Marks: 60**

Instructions:

1. Question paper has two Parts. Answer both the Parts
2. Write chemical equations and diagrams wherever necessary.

PART– A.

Answer any **FIVE** of the following questions. Each question carries **TWO** marks**:(5 x 2 =10).**

1.
2.
3.
4.
5.
6.
7.

PART– B.

Answer any **FOUR** of the following questions. Each question carries **FIVE** marks:

(4 x 5 = 20).

8.
9.
10.
11.
12.
13.
14.

PART– C.

Answer **ALL** the questions. Each question carries **TEN** marks:

(3 x 10 = 30).

15. UNIT – 1 (TWO questions to be given for choice)
16. UNIT – 2 (TWO questions to be given for choice)
17. UNIT – 3 (TWO questions to be given for choice)

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B.Sc. Chemistry Practicals I & II Semester

End Semester Examination

QUESTION PAPER PATTERN FOR PRACTICAL EXAMINATION

(2021-22 & onwards) (NEP-CBCS SCHEME)

CHEMISTRY PRACTICALS(CHE.P1-1 & CHE. P2-2)

TIME: 4 HOURS **MAX. MARKS: 25**

SCHEME

- **Marks for Procedure writing** **05 M**
- **Marks for Record/viva-voce** **05 M**
- **Marks for performmg experiment** **15 M**

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Syllabus for

B.Sc. / B.Sc. (Honors) Chemistry

III & IV Semester

Framed According to the National Educational Policy (NEP 2020)

(2022 – 2023 onwards)

Department of Chemistry

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN AUTONOMOUS

B.Sc. / B.Sc. (Honors) Chemistry- III Semester

Course Title: CHE-301T ANALYTICAL and ORGANIC CHEMISTRY II	
Total Contact Hours: 56	**Course Credits: 4**
Formative Assessment Marks: 40	**Duration of ESA/Exam: 2.5 hrs.**
Syllabus Authors: BOS.	**Summative Assessment Marks: 60**

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Understand the importance of fundamental law and validation parameters in chemical analysis	X	X	X					
2. Know how different analytes in different matrices (water and real samples) can be determined by spectrophotometric, nephelometric and turbidometric methods.	X	X	X			X		X
3. Understand the requirement for chemical analysis by paper, thin layer and column chromatography.	X		X		X			X
4. Apply solvent extraction method for quantitative determination of metal ions in different samples.	X		X		X			X
5. Utilize the ion-exchange chromatography for domestic and industrial applications	X		X		X			X
6. Explain mechanism for a given reaction.	X	X				X		
7. Predict the probable mechanism for an reaction, explain the importance of reaction intermediates, its role and techniques of generating such intermediates.		X		X		X		
8. Explain the importance of		X		X	X	X		

Stereochemistry in predicting the structure and property of organic molecules.								
9. Predict the configuration of an organic molecule and able to designate it.				X	X			X
10. Identify the chiral molecules and predict its actual configuration		X		X	X			

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

B.Sc. / B.Sc. (Honors) Chemistry-III semester
2022 – 2023 onwards

Title of the Course: ANALYTICAL and ORGANIC CHEMISTRY II
Course Code: CHE-301T

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	56	2	56

Course Objectives:

1. Interrelationship among frequency, wavelength and wave number and importanceof validation parameters of an instrumental method will be taught
2. Principle, instrumentation and applications of spectrophotometry, nephelometry and turbidometry will be taught
3. Fundamentals of separation methods and principles of paper, thin layer and columnchromatography will be taught
4. Principle, types and applications of solvent extraction will be taught
5. Principle and mechanism of ion-exchange, types of resins and domestic andindustrial applications of ion-exchange chromatography will be taught
6. The concept of mechanism and its importance will be taught to the student
7. Concept and importance of intermediates in organic chemistry will be taught takingproper examples
8. The various techniques for identification of reaction mechanism will be taught to thestudent taking proper examples
9. Concept of stereochemistry and its importance will be taught.
10. The various projection formulae and the techniques of designating the moleculesinto R, S, D, L will be taught taking proper examples
11. The theory and concept of Cis-, Trans- isomerism and its importance and thetechniques to differentiate between them will be taught taking examples

Course Outcomes

After the completion of this course, the student would be able to

1. Understand the importance of fundamental law and validation parameters inchemical analysis
2. Know how different analytes in different matrices (water and real samples) can

be determined by spectrophotometric, nephelometric and turbidometric methods.

3. Understand the requirement for chemical analysis by paper, thin layer and columnchromatography.
4. Apply solvent extraction method for quantitative determination of metal ions indifferent samples
5. Utilize the ion-exchange chromatography for domestic and industrialapplications
6. Explain mechanism for a given reaction.
7. Predict the probable mechanism for an reaction, explain the importance of reaction intermediates, its role and techniques of generating such intermediates.
8. Explain the importance of Stereochemistry in predicting the structure and propertyof organic molecules.
9. Predict the configuration of an organic molecule and able to designate it.
10. Identify the chiral molecules and predict its actual configuration

Contents of Theory Course Semester- III	**56 hrs**
Unit I	**14 hrs**
Quantitative analysis-Instrumental methods Electromagnetic spectrum, absorption of electromagnetic radiation, Definition and units of frequency, wavelength, wave number, Beer's law, Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration), Evaluation Procedures- standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range, Instrumentation, single beam and double beam spectrophotometers, quantitative applications of colorimetry (determination of Fe, Ti, Cu, Ni, and $PO4^{3-}$) and numerical problems on application of Beer's law.	**10 hrs**
Nephelometry and Turbidimetry: Introduction, principle, instrumentations of nephelometry and turbidimetry; effects of concentration, particle size and wavelength on scattering; choice between nephelometry, applications of nephelometry and turbidimetry (determination of $S04^{2-}$ and $PO4^{3-}$)	**4 hrs**
Unit II	**14 hrs**
Separation methods **Fundamentals of chromatography**: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase and nature of adsorbents. **Column chromatography**: Principle, column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version. **Paper chromatography**: Principle, theory and applications **Thin layer chromatography (TLC)**: Principle, mechanism, Rf value,	**3 hrs** **4 hrs**

efficiency of TLC plates, methodology–selection of stationary and mobile phases, development, spray reagents, identification and detection, qualitative applications. **Ion exchange chromatography:** Principle, resins, types with examples- cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion- exchange chromatography (softening of hard water, separation of lanthanides, industrial applications). **Solvent Extraction:** Principle, types- batch, continuous, efficiency, selectivity, distribution coefficient, Nernst distribution law, derivation, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper.	**3hrs** **4hrs**
UNIT III	**14 hrs**
Stereochemistry of Organic Compounds: Fischer projection, Newmann and Sawhorse projection formulae and their interconversions. Geometrical isomerism: Cis-trans and syn-anti isomerism, E/Z notations. Optical Isomerism: Optical activity, Specific rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral centres, Diasteroisomers, meso structures, Racemic mixtures and Resolution, Relative and absolute configuration, D/L and R/S designations (for single carbon stereo centres) with C.I.P rules.	14 hrs
UNIT IV	**14 hrs**
Reaction Intermediates: Generation, Stability and Reactions of, **i) Carbocations ii) Carbanions iii) Free Radicals iv) Carbenes and Nitrenes v) Arynes.** **Applications:** **i)** Carbocations: Dienone-phenol; and Pinacol-Pinacolone Rearrangement. **ii)** Carbanions: Perkin Reaction, Aldol condensation, Claisen-Schmidth condensation. **iii)** Free Radicals: Sand Meyer Reaction, Benzene to benzene hexachloride **iv)** Carbenes and Nitrenes: Singlet and Triplet states, relative stability and reactions: addition to C-C double bond. **iv)** Arynes: Formation, Diels-alder reaction to dienes **Methods for Identifying Reaction Mechanism:** Product analysis- Isolation and Identification of Intermediates, Stereochemical Evidences, Effect of Catalyst, crossover Experiments, Isotopic studies, Kinetic Studies.	8 hrs 6 hrs

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch Ninth edition. Saunders College Publishing, New York (2014).
2. Analytical Chemistry, G.D. Christian, 6th edition, John Wiley & Sons, (2007)
3. Analytical Chemistry, 7th Edition: Seventh Edition Gary D. Christian, Purnendu (Sandy) Dasgupta, Kevin Schug Wiley Global Education, (2013)
4 Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, PHI Learning Pvt Ltd. New Delhi (2015).
5 Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt. Ltd. (2007).
6. Organic Reaction Mechanism by V.K. Ahluwalia and R.K. Parashar (Narosa Publishers) [2002], Organic Chemistry by S.M. Mukherji, S.P. Singh and R.K. Kapoor New age publishers (Feb 2017)
7. Organic Chemistry by Robert T. Morrison, Robert N. Boyd Dorling Kindersley (India) Pvt Ltd. Pearson Education India; 7th edition (1 January 2010)
8. F. A. Carey, Organic Chemistry, Seventh Edition, Tata McGraw Hill (2008)
9. Organic Chemistry by FINAR (Vol I and II) Pearson Education India; 6th edition (1 January 2002)
10. Introduction to Organic Chemistry by John E. McMurry CENGAGE LEARNING (RS); 1st edition (1 January 2008)
11. Stereochemistry of Organic Compounds Ernest L. Eliel, Samuel H. Wilen. Wiley publishers; 1st edition (1 January 2008)
12. P Sykes, A Guide Book to Mechanism in Organic Chemistry, 6th Edition (1997), Orient Longman, New Delhi.
13. 1 Solomons, T.W G., Fryhle, B. Craig. Organic Chemistry, John Wiley & Sons, Inc (2009).

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, MOOC

Formative Assessment (Internal assessment) Theory.	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and class test	20
Seminars and SSR	10
Assignments and Attendance	10
Total	40

PRACTICALS- III Semester

Title of the Course: ANALYTICAL and ORGANIC CHEMISTRY Lab-II

Course Code: CHE-301P

Credit Points: 2	**Teaching Hours:4 hrs**
Semester End Examination :25 marks	**Continuous Internal Assessment-25 marks**

Course Objectives

1. To impart skills related to preparation of stock and working solutions and handling ofinstrumental methods
2. To know the principle of colorimetric analysis and construction of calibration plot
3. To understand the chemistry involved in colorimetric determination of metal ions andanions
4. To determine Rf values of different metal ions present in a mixture
5. To impart knowledge on the importance of functional groups in organic compounds.
6. Techniques to identify the functional groups in an compound by performing physical andchemical tests
7. To record its melting point/boiling point.
8. To prepare suitable derivative for that compound and to characterize it.

Course Outcomes

After the completion of this course, the student would be able to

1. Understand the importance of instrumental methods for quantitative applications
2. Apply colorimetric methods for accurate determination of metal ions and anions in wateror real samples
3. Understand how functional groups in an compound is responsible for its characteristicproperty
4. Learn the importance of qualitative tests in identifying functional groups.
5. Learn how to prepare a derivative for particular functional groups and how to purify it'

PART-A (Analytical Chemistry)

1. Colorimetric determination of copper using ammonia hydroxide
2. Colorimetric determination of iron using thiocyanate solution
3. Colorimetric determination of nickel using DMG solution
4. Colorimetric determination of titanium using hydrogen peroxide
5. Colorimetric determination of nitrite in a water sample (diazo coupling Reaction using Griess reagent)
6. Colorimetric determination of phosphate as ammonium phosphomolybdate
7. Determination of Rf values of two or three component systems by TLC

8. Separation of different metal ions by paper chromatography (Cu, Ni and Cu) or Solvent extraction of ironusing oxine solution **(demonstration)**

PART-B (Organic Chemistry)

Qualitative analysis of bifunctional Organic compounds such as

1) Salicylic acid,2) Glucose 3) Methyl salicylate

4)p-Amino benzoic acid, 5) p-Chloro benzoic acid 6) Salicylaldehyde,

7)Acetophenone, 8) Benzoic acid 9) Salicylamide 10) Benzamide etc.

(Atleast 6-8 compounds to be analyzed in a semester)

References

1) Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007)
2) Vogels Text Book of Qualitative Chemical Analysis, ELBS

Formative Assessment (Internal assessment) Practicals	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and Attendance	05
Class Test	15
Record	05
Total	**25**

B.Sc. / B.Sc. (Honors) Chemistry- IV Semester

Course Title: CHE-401T Inorganic and Physical Chemistry-II	
Total Contact Hours: 56	**Course Credits: 4**
Formative Assessment Marks: 40	**Duration of ESA/Exam: 2.5 hrs.**
Model Syllabus Authors: BOS.	**Summative Assessment Marks: 60**

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
1.Predict the nature of the bond formed between different elements				X		X		X
2.Identify the possible type of arrangements of ions in ionic compounds			X	X			X	X
3.Write Born - Haber cycle for different ionic compounds	X				X			X
4.Relate different energy parameters like, lattice energy, entropy, enthalpy andsolvation energy in the dissolution of ionic solids				X	X		X	X
5.Explain covalent nature in ionic compounds								
6.Write the M.O. energy diagrams for simple molecules				X		X	X	
7.Differentiate bonding in metals from their compounds				X		X		
8.Learn important laws of thermodynamics and their applications to variousthermodynamic systems			X				X	
9.Understand adsorption processes			X		X			

and their mechanisms and the function andpurpose of a catalyst								
10. Apply adsorption as a versatile method for waste water purification.			X					
11. Understand the concept of rate of a chemical reaction, integrated rate equations, energy of activation and determination of order of a reaction based on experimental data								
12. Know different types of electrolytes, usefulness of conductance and ionic mobility measurements			X		X		X	
13. Determine the transport numbers		X	X			X		X

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

B.Sc. / B.Sc. (Honors) Chemistry-IV semester
2022 – 2023 onwards

Title of the Course: Inorganic and Physical Chemistry-II
Course Code: CHE-401T

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	56	2	56

Course Objectives:

1. Different types of bonding in molecules/compounds/ions
2. The structures of molecules/compounds/ions based on differentmodels/theories
3. Properties of compounds based on bonding and structure
4. The fundamentals of thermodynamics including the laws, the concept ofentropy and free energy functions and their applications.
5. The concepts of surface chemistry, catalysis and their applications.
6. The theoretical and experimental aspects of chemical kinetics including basictheories of reaction rates and methods of determining order.
7. Electrochemistry dealing with electrolytes in solution. Conductance measurements and applications. Concept of ionic mobility and their determination.

Course Outcomes:

After the completion of this course, the student would be able to

1. Predict the nature of the bond formed between different elements
2. Identify the possible type of arrangements of ions in ionic compounds
3. Write Born - Haber cycle for different ionic compounds
4. Relate different energy parameters like, lattice energy, entropy, enthalpy and solvation energy in the dissolution of ionic solids
5. Explain covalent nature in ionic compounds
6. Write the M.O. energy diagrams for simple molecules
7. Differentiate bonding in metals from their compounds
8. Learn important laws of thermodynamics and their applications to various thermodynamic systems
9. Understand adsorption processes and their mechanisms and the function and purpose of a catalyst

10. Apply adsorption as a versatile method for waste water purification.
11. Understand the concept of rate of a chemical reaction, integrated rate equations, energy of activation and determination of order of a reaction based on experimental data
12. Know different types of electrolytes, usefulness of conductance and ionic mobility measurements
13. Determine the transport numbers

Contents of Theory Course Semester- 1V	**56 Hrs**
Unit – I	**14 hrs**
Structure and Bonding -I The ionic bond :Structures of ionic solids Radius ratio rules, Calculation of some limiting radius ratio values, Coordinationnumber 3 (planar triangle), Coordination number 4 (tetrahedral), Coordination number 6 (octahedral), Close packing (CCP).	**(3hrs)**
Classification of ionic structures: Ionic compounds of the type AX (ZnS, NaCl, CsCI) Ionic compounds of the type AX_2 (Calcium fluoride (fluorite) and Rutile structureLayer structures CdI_2 , Cadmium iodide structure Limitations of radius ratio concept Lattice energy and Born-Haber cycle,(MgO & $CaCl_2$) Born-Lande equation and its drawbacks, Kapustinskii equation, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules with applications. Numerical problems	**(7 hrs)**
Covalent bond: Valence bond theory, The Lewis theory, The octet rule, Exceptions to the octet rule, Sidgwick- Powell theory. Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs, electronegativity, isoelectronic principle, Examples using VSEPR theory: BF_3 and BF_4^-, $NH_3$and NH_4^+, H_2O, PCl_5, ClF_3, SF_4, $I_3^-$and I_3^+, SF_6, and IF_7. Limitations of VSEPR	**(4 hrs)**
Unit – II	**14 hrs**
Structure and Bonding -II Concept of resonance, resonance energy, hybridisation, types of hybridization, Review on sp, sp^2 &sp^3. Hybridisation of dsp^2 dsp^3, d^2sp^3, sp^3d^2 with examples and energetics of hybridization. Bent's rule, Limitations of Valence Bond Theory.	**(3 hrs)**
Molecular Orbital theory: LCAO concept: s-s, s-p, p-p, p-d and d-combinations of orbitals, bonding, nonbonding and antibonding molecular orbitals, non-bonding combinations of orbitals, Rules for linear combination of atomic orbitals	

Examples of molecular orbital treatment for homonuclear diatomic molecules H_2 molecule, H^+ He_2 molecule, He^+ molecule ion, Li_2 molecule, Be_2 molecule B_2 molecule, C_2 molecule, N_2 molecule, N_2^+,O_2 molecule, $O^-$and O_2^{2-} M.O. energy diagrams of heteronuclear diatomic molecules with examples (NO, NO^+ CO and HCl). Calculation of bond order, relationship between bond order, bondenergy and bond length, magnetic properties based on MOT. **Metallic Bonding**: General properties of metals : Conductivity, Lustre, Malleability and cohesive forceCrystal structures of metals and Bond lengths Theories of bonding in metals: Free electron theory, Valence bond theory, Molecular orbital or band theory of solids Prediction of conducting properties of conductors. insulators and semiconductors, extrinsic and intrinsic semiconductors using M.O. theory.	**(7hrs)** **(4hrs)**
Unit – III	**14 hrs**
First Law of Thermodynamics Thermodynamic Processes, Reversible and Irreversible Processes, Nature of Heat and Work, Internal Energy, First Law of Thermodynamics, Enthalpy of a System, Work done in isothermal and adiabatic expansion of an ideal gas, Numerical problems, Joule -Thomson Expansion, Relation between Joule-Thomson coefficient and other thermodynamic parameters. **Second law of Thermodynamics** Concept of entropy, thermodynamic scale of temperature, Statements of the Second Law of Thermodynamics, molecular and statistical interpretation of entropy, Calculation of entropy change for reversible and irreversible processes, Free Energy Functions: Gibbs and Helmholtz energy, Variation of S, G, A with T, V and P, Numerical problems, Free energy change and spontaneity, Gibbs-Helmholtz equation. **Third Law of Thermodynamics** Statement of third law, concept of residual entropy, calculation of absolute entropy ofmolecules. **Surface Chemistry** **Adsorption** Types of adsorption isotherms. Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm (derivation to be done) and BET equation(derivation not included). **Catalysis**	**(9hrs)**

Types of Catalysis and theories with examples (intermediate compound theory and adsorption theory), Theory of acid base catalysis, Michaelis-Menten mechanism. Heterogeneous catalysis: surface reactions, unimolecular, bimolecular surface reactions. Autocatalysis with examples. Applications: Design process to removal of toxic compounds from industrial wastewater and treatment of portable water requirements.	**(5hrs)**
Unit – IV	**14hrs**
Chemical Kinetics Differential and integrated form of rate expressions up to second order reactions, Derivation of expression of rate constant of second order reaction (a=b and a ≠ b), Problems on rate constant (a=b), Methods of determination of order of a reaction: Method of half life period and differential method. Temperature dependence of reaction rates; Arrhenius equation, activation energy, Numerical problems on Arrhenius equation in calculating energy of activation and rate constants. Collision theory of reaction rates, Lindemann's mechanism, qualitative treatment of the theory of absolute reaction rates. Experimental determination of kinetics of (i) inversion of cane sugar by polarimetricmethod (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide. **Electrochemistry – I** Arrhenius theory of electrolytic dissociation. Merits and Demerits, Conductance, Specific conductance, equivalent and molar conductivity and their variation with dilution. Molar conductivity at infinite dilution. Numerical problems. Kohlrausch's law of independent migration of ions and its applications, Debye-Huckel-Onsager equation. Ionic mobilities and their determinations, transference numbers and their relation to ionic mobility's, determination of transference numbers using Hittorf and MovingBoundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems.	**(7 hrs)** **(7 hrs)**

Recommended Books/References:

1. Peter Atkins & Julio De Paula, Physical Chemistry, 9th Ed., Oxford University Press(2010)
2. G W Castellan, Physical Chemistry, 4th Ed., Narosa (2004)
3. R G Mortimer, Physical Chemistry 3rd Ed., Elsevier: Noida, UP (2009)
4. B R Puri, L R Sharma and M S Pathania, Principal of Physical Chemistry, VishalPublishing Co.
5. B S Bahl, G D Tuli and Arun Bahl, Essentials of Physical chemistry, S Chand &Company Ltd.

6. A S Negi and S C Anand, A textbook of Physical Chemistry, New Age InternationalPublishers.
7. B N Bajpai, Advanced Physical chemistry, S Chand and Company ltd.
8. R L Madan, Chemistry for Degree Students, Semester I, II, III and IV, S Chand andCompany Ltd.
9. P L Soni, O P Dharmarha and U N Dash, Textbook of Physical Chemistry, SultanChand and Sons.

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, MOOC

Formative Assessment (Internal assessment) Theory.	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and class test	20
Seminars and SSR	10
Assignments and Attendance	10
Total	40

Practical Chemistry -IV Semester

Title of the Course: Inorganic and Physical Chemistry Lab-II

Course Code: CHE-401P

Credit Points: 2	**Teaching Hours: 4 hrs**
Semester End Examination : 25 marks	**Continuous Internal Assessment: 25 marks**

Course objectives:

To attain practical knowledge about:

1. Analytical skills in detecting the constituents present in unknown samples bysystematically carrying out the qualitative analysis.
2. The methods of determining rates of chemical reactions.
3. Designing electrochemical cells and making measurements related to it.
4. Determination of physical characteristics of electrolytes using conductivitymeasurements in solution.
5. Adsorption phenomenon, mechanism and basic models to explain adsorption.
6. Simple techniques like conductometry to obtain physicochemical parameters ofelectrolytes.

Course outcomes:

At the end of the course student would be able to

1. Understand the chemical reactions involved in the detection of cations and anions.
2. Explain basic principles involved in classification of ions into groups in semi-microqualitative analysis of salt mixture
3. Carryout the separation of cations into groups and understand the concept of common ion effect.
4. Understand the choice of group reagents used in the analysis.
5. Analyse a simple inorganic salt mixture containing two anions and cations
6. Use instruments like conductivity meter to obtain various physicochemical parameters.
7. Apply the theory about chemical kinetics and determine the velocity constants of various reactions.
8. Learn about the reaction mechanisms.
9. Interpret the behaviour of interfaces, the phenomena of physisorption and chemisorptions and their applications in chemical and industrial processes.
10. Learn to fit experimental data with theoretical models and interpret the data

List of Experiments:

Part A- Inorganic Chemistry Practicals

Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations. Emphasis should be given to the understanding of different reactions.

The following cations and anions are suggested.

Cations: NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}, Na^+, K^+ and Li^+.

Anions: CO_3^{2-}, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, SO_4^{2-}, $C_2O_4^{2-}$ and PO_4^{3-}

Spot tests and flame tests to be carried out wherever possible.

Part B- Physical Chemistry Practicals

1. Determination of the enthalpy of neutralization of a strong acid with strong base.
2. Verification of Freundlich and Langmuir isotherms for adsorption of acetic acid onactivated charcoal.
3. The study of kinetics of potassium persulphate and potassium iodidevolumetrically.
4. Determination of velocity constant for acid catalyzed hydrolysis of methyl acetate.
5. Determination of velocity constant for the saponification of ethyl acetate ($a=b$) volumetrically.
6. Determination of equivalent conductivity of strong electrolyte and verification of DHO equation.
7. Determination of dissociation constant of weak acid by conductivity method.
8. Conductometric titration of strong acid and strong base.
9. Conductometric titration of weak acid and strong base.
10. Determination of the hydrolysis constant of aniline hydrochloride conductometrically.
11. Determination of solubility product of sparingly soluble salt conductometrically.

Recommended Books/References:

1. Vogel's Qualitative analysis, Revised by G. Svehla, Pearson education,2002
2. J B Yadav, Advanced Physical Chemistry, Krishna Prakashan Media (P) Ltd,Meerut.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R.Chand & Co.: New Delhi (2011).
4. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry8th Ed.; McGraw-Hill: New York (2003).
5. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H.Freeman & Co.: New York (2003).

Formative Assessment (Internal assessment) Practicals	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and Attendance	05
Class Test	15
Record	05
Total	**25**

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B.Sc. III and IV Semester Examination
END SEMESTER B.Sc. EXAMINATION

QUESTION PAPER PATTERN

(2021-22 & onwards) (NEP-CBCS SCHEME)
-CHEMISTRY
(OPEN ELECTIVE -3 and 4)

Time: 3 Hours **Max. Marks: 60**

Instructions:

1. Question paper has two Parts. Answer both the Parts
2. Write chemical equations and diagrams wherever necessary.

PART– A.

Answer any **FIVE** of the following questions. Each question carries **TWO** marks**:(5 x 2 =10).**

1.
2.
3.
4.
5.
6.
7.

PART– B.

Answer any **FOUR** of the following questions. Each question carries **FIVE** marks:

(4 x 5 = 20).

8.
9.
10.
11.
12.
13.
14.

PART– C.

Answer **ALL** the questions. Each question carries **TEN** marks:

(3 x 10 = 30).

15. UNIT – 1 (TWO questions to be given for choice)
16. UNIT – 2 (TWO questions to be given for choice)
17. UNIT – 3 (TWO questions to be given for choice)

B.Sc. Chemistry Practicals III & IV Semester

End Semester Examination

QUESTION PAPER PATTERN FOR PRACTICAL EXAMINATION

(2021-22 & onwards) (NEP-CBCS SCHEME)

CHEMISTRY PRACTICALS

TIME: 4 HOURS **MAX. MARKS: 25**

SCHEME

- **Marks for Viva-voce** **05 M**
- **Marks for performing experiments (10x2)** **20 M**

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B.Sc., CHEMISTRY

BLOW UP SYLLABUS

V and VI Semester (CBCS)

(w.e.f. 2021)

Department of Chemistry

Maharani Lakshmi Ammanni College for Women (Autonomous)

Bangalore-560 012

Structure of B. Sc., Degree Course (Triple major)

Choice Based Credit System (CBCS)

The B.Sc. degree program is a three year course consisting of six semesters. Each semester is of 18 weeks duration, excluding the examination period. In chemistry there shall be 8 theory papers and 8 practical papers. Each theory paper will consist of **52 hours (from I to IV semesters)** and **40 hours (V and VI semesters)** of instruction. Each practical will consist of **10 to 12** experiments.

SCHEME OF INSTRUCTION AND EXAMINATION

SEMESTER	Title of the paper	Teaching Hours Per week	Duration Of exam	Internal Assessment marks	End Semester Exam marks	Total marks
I	Chemistry -1	4	3	30	70	100
	Practical – 1	3	3	15	35	50
II	Chemistry -2	4	3	30	70	100
	Practical – 2	3	3	15	35	50
III	Chemistry -3	4	3	30	70	100
	Practical – 3	3	3	15	35	50
IV	Chemistry -4	4	3	30	70	100
	Practical – 4	3	3	15	35	50
V	Chemistry -5	3	3	30	70	100
	Practical - 5	3	3	15	35	50
	Chemistry -6	3	3	30	70	100
	Practical – 6	3	3	15	35	50
VI	Chemistry -7	3	3	30	70	100
	Practical - 7	3	3	15	35	50
	Chemistry -8	3	3	30	70	100
	Practical - 8	3	3	15	35	50

B. Sc., - V Semester (CBCS)

Paper V- Organic Chemistry – (2021 onwards)

Chapter No.	Title	Number of Teaching hours
1	Stereochemistry	08
2	Amines	05
3	Heterocyclic compounds	04
4	Chemistry of Natural Products	09
5	Spectroscopy of Organic compounds	10
6	Industrial Organic Chemistry	04
	Total	**40**

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B.Sc., V Semester

Chemistry Paper – V (Organic chemistry)

(Blow up syllabus w.e.f. 2021 - CBCS)

UNIT - I

Stereochemistry **8 hours**

Introduction,Elements of symmetry (plane of symmetry: 2, 3-dichrolobutane, tartaric acid, center of symmetry: trans-2, 4-dimethyl-trans-1,3-cyclobutanedioic acid, axis of symmetry:1,2,3,4-tetramethylcyclobutane).Chiral molecules and achiral molecules (2-chloropropanol, 3-chloropentane).Chirality, stereogenic center (example: lactic acid, tartaric acid and 2, 3-dichlorobutane). Fischer projection formulae (lactic acid, 2-chlorobutane, tartaric acid and 2, 3-dichlorobutane).

Meso compounds: Explanation with examples of tartaric acid and 2,3-dichlorobutane.

Optical isomerism due to free rotation about single bonds**:** Enantiomers, optical activity (conditions for optically active compounds); absolute configuration of enantiomers (use of +/–, d/l, D/L notations (Examples: glyceraldehyde and lactic acid). Cahn-Ingold-Prelog sequence rules(R and S system) of nomenclature with suitable examples. Properties of enantiomers.

Diastereomers: Explanation with examples of tartaricacid,2-bromo-3-chlorobutane) and properties. Relative Configuration of threo and erythro nomenclature (using above examples).

Racemisation: Definition and explanation using lactic acid as an example.

Resolution of racemic mixture: definition, explanation of resolution of racemic mixture of tartaric acid by chemical method and biochemical method.

Optical isomerism due to restricted rotation about single bonds- diphenyl systems: Explanation using 6, 6'-dinitrodiphenic acid as an example.

Geometric isomerism in alkenes: Definition, conditions and explanation using 2-butene and 1,2-dichloroethene as examples. Determination of configuration of

geometric isomers: cis and trans by (i) Physical methods (melting and boiling points, dipole moments, solubility) (ii)Spectroscopic methods (UV, IR evidences (iii) chemical methods (cyclisation method: Ex-maleic acid to maleic anhydride, pKa values: Ex maleic and fumaric acids).
E and Z system of nomenclature (rules with suitable examples).
Geometric isomerism in oximes: Nomenclature of syn and anti-isomers in oximes using benzaldoxime and acetophenone oxime as examples.
Alicyclic compounds: Conformations of four to eight membered cycloalkanes and disubstituted cyclohexanes (1,2, 1,3 and1,4 dimethylcyclohexanes as examples).
Bicylic systems: cis and trans- nomenclature and conformations of decalins and norbornane.

UNIT – II

Amines **5 hours**

Classification and nomenclature. Chirality in amines (pyramidal inversion)
Preparation of alkyl and aryl amines-reductive amination of carbonyl compounds (ethyl amine, isopropyl amine).Gabriel phthalimde synthesis (ethyl amine).
Basicity of amines in aqueous solution: Inductive, resonance, steric and solvation effects on the basicity of amines. Reaction of amines as nucleophiles (methylation and acylation).
Hofmann elimination reaction. Hoffmann's exhaustive methylation, and Cope elimination with mechanism. Distinguishing reactions of 1^0, 2^0 and 3^0 amines (Reactions with equations for Hinsbergs test).
Diazotization: formation of benzenediazonium chloride.
Synthetic applications of benzenediazonium chloride in the preparation of
(i) chlorobenzene, bromobenzene and benzonitrile by Sandmeyer's reaction
(ii) phenol (iii) phenyl hydrazine and aniline by reduction reaction and
(iv) p-hydroxyazobenzene and 1- phenylazo-2-naphthol by coupling reaction.

Heterocyclic compounds **4 hours**

Introduction (Review of heterocyclic compounds in biological systems), classification (based on size of heterocyclic ring - 5 and 6 membered) with examples,

orbital structures, resonance and aromatic character (Huckel's rule) of furan, pyrrole, thiophene and pyridine.

Methods of preparation of pyrrole (from acetylene and from ammonium mucate), furan (from mucic acid and furfural),thiophene (from acetylene and butane).

General mechanism of electrophilic substitution reactions and nitration reaction of pyrrole, furan and thiophene. Preparation of pyridine (from acetylene and from nicotinic acid) and reaction with sodamide (Chichibabin reaction). Comparison of basicity of pyrrole, pyridine and piperidine (pKb).

Fused heterocyclic compounds (i) Indole - preparation by Fischer synthesis and nitration reaction,(ii) Quinoline-preparation by Skraup synthesis and properties - nitration.

UNIT –III

Chemistry of Natural Products **9 hours**

Carbohydrates: Introduction and classification (based on number of monosaccharide units and sugars and non-sugars) with examples. Monosaccharides: Definition with examples, classification of mono saccharides (based on functional group).

Aldoses: Structures of D-aldohexoses (glucose, galactose and mannose). Open and Haworth structures. Epimers (Example: D-galactose and D-glucose, D-glucose and D-mannose). Elucidation of open chain structure of D-glucose. Limitations of open chain structure of glucose. Mechanism of mutarotation and anomeric effect.

Elucidation of ring structure and size of D-glucose by oxidation with HIO_4 and HNO_3.

Ketoses: Structure of fructose-pyranose and furanose forms. Inter-conversion of glucose and fructose

Disaccharides: Definition with examples. Formation of glycosidic bond with examples. Haworth and conformational structures of maltose, lactose and sucrose.

Terpenes and terpenoids: Occurrence, isoprene rule and classification (on the basis of number of isoprene units, acyclic and cyclic). Elucidation of structure and synthesis of citral (from methyl heptenone).

Structures of limonene, menthol, α-terpineol, camphor, β-carotene, Vitamin-A and their uses.

Alkaloids: Introduction, classification (based on heterocyclic ring present) and general characteristics. Structural elucidation and synthesis of nicotine (from succinimde).Structures and uses of ephedrine, caffeine, cocaine, atropine, quinine and morphine.

Steroids:
Introduction, classification, basic skeleton, Importance of Diel's hydrocarbons, structure of cholesterol and ergosterol.

UNIT –IV

Spectroscopy of Organic compounds **10 hours**

Introduction: Electromagnetic radiation, electromagnetic spectrum, advantages of spectroscopic techniques, basic principle of spectroscopy, types of spectroscopic techniques (UV-Visible spectroscopy, IR spectroscopy, NMR spectroscopy).

UV-Visible spectroscopy: Introduction - basic principles of UV-Visible spectroscopy. Types of electronic transitions with suitable examples. Chromophores and auxochormes (with suitable examples).Blue shift and red shift (with suitable examples). Influence of conjugation on λ max absorption in UV - Visible region. Comparison of UV spectra of acetone and methyl vinyl ketone. Graphical representation of spectra of 1,3-butadiene, benzene and lycopene. Distinction between cis and trans isomers by UV. Advantages of UV-Visible spectroscopy.

IR spectroscopy: Introduction - Basic principles of IR spectroscopy. Conditions for IR active organic compounds. Vibrational transitions: Stretching and bending modes of vibrations. Factors affecting on position of IR absorption peak (atomic mass and force constant-electronic effects and hydrogen bonding). Types of IR region functional group region and finger print region -and its significance.
Explanation of Stretching frequencies of −OH (free and H-bonded), alkyl −C−H, C≡C, C=C, C−C, C=O and C−O groups (formaldehyde, acetaldehyde, acetone, ethanol, ethylene, benzene, acetylene, acetic acid and phenol). Graphical

representation (interpretation) of IR spectra of benzoic acid and methyl benzoate in comparison with FTIR. Advantages of IR spectroscopy.

NMR spectroscopy: Basic principles of proton magnetic resonance: Nuclear magnetic spin quantum number, influence of the magnetic field on the spin of nuclei, spin population, saturation using radio frequency. Nuclear magnetic resonance. Chemical shift (δ values), uses of TMS as reference.

Nuclear shielding and deshielding effects. Equivalent and non-equivalent protons. Effect of electronegativity of adjacent atoms on chemical shift values.

Spin-spin splitting and spin-spin coupling (qualitative treatment only).Graphical representation (interpretation) of NMR spectra of simple organic compounds (i) methane (ii) CH_3-Cl (iii) CH_2Cl_2 and (iv) $CHCl_3$ using shielding and deshielding effects, (iv) Cl_2CHCHO (v) 1,1,2-trichloroethane and (vi) CH_3CH_2Cl using spin-spins plitting and spin-spin coupling. Applications of NMR in medical diagnostics.

Mass spectrometry: Theory, basic principles, isotope abundance, base peak, nitrogen rule, recognition of molecular ion; meta stable ions – calculation of apparent mass – significance –mass spectrometer; fragmentation: general rules for predicting prominent peaks in mass spectra mass spectra and fragmentation pattern of the following classes of organic compounds: Aliphatic hydrocarbons, aromatic hydrocarbons.

Industrial Organic chemistry **4 hours**

Synthetic dyes: Introduction: Colour and constitution (modern theory). Classification of dyes: (based on methods of application to the fibre: direct dyes, vat dyes, mordant dyes, azoic dyes and dispersive dyes with examples). Synthesis of congo red (from benzidine), malachite green (from benzaldehyde), alizarin (from anthracene) and indigo (from aniline). **Edible Dyes with examples.**

Drugs: Chemotherapy, classification of drugs (i) drugs used for the treatment of diseases due to infection (antimalarial, sulpha drugs, anthelmentics, antileprotic, antitubercular, amoebicides, antibiotics and antiseptic drugs with examples) (ii) drugs used for the treatment of diseases not due to infection (antipyretics, analgesics,

anesthetics, tranquilizers and hypnotics, narcotics, anticonvulsants, cardiac or cardiovascular and diuretics drugs with examples**).**

Medicinal Chemistry: Definition and examples-Pharamacodynamic agents, Pharmacophore, Metabolites and Anti-metabolites, Agonist, Anti-agonist, Lead compounds and Analogues, Generics, Prodrugs, Hard and Soft drugs, Isosterism and Biosterism. Drugs Toxicity testing- Infectious dose-50, Inhibitory capacity-50, Lethal dose-50 and Effective dose-50.

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B. Sc., - V Semester (CBCS)

Paper VI-Physical Chemistry – (2021 onwards)

Chapter No.	Title	Number of Teaching hours
1	Electrochemistry-I	10
2	Electrochemistry-II	05
3	Ionic equilibria	03
4	Photovoltaics	02
5	High Pressure Liquid Chromotography	02
6	Electroanalytical Methods	04
7	Thermal Analysis	02
8	Molecular Spectroscopy-I	05
9	Molecular Spectroscopy-II	04
10	Raman Spectroscopy and Electronic Spectroscopy	03
	Total	**40**

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B.Sc., V Semester

Chemistry Paper – VI (Physical chemistry)

(Blow up syllabus W.e.f. 2021 - CBCS)

UNIT-I

Electrochemistry-I — 10 hours

Review of electrolytes and Conductance related terms
Definition of molar conductance, Conductometric titrations: Definition and advantages over other conventional titrations. Principles involved in conductometric titrations with graph for strong acid- strong base, strong acid-weak base, weak acid-strong base and weak acid-weak base titrations.
Ionic mobility, absolute ionic mobility and transport number-definitions. Relationship between transport number and ionic mobility of an ion (no derivation). Determination of transport number of an ion (H^+ ion in HCl) by moving boundary method. Abnormal transport numbers- definition with an example like Cd^{2+} in CdI_2.
Numerical problems on (i) transport number calculation by moving boundary method(ii) relationship between transport number and ionic mobility
(iii) molar conductance and specific conductance.
Kohlrausch's law: Statement and its applications (i) Evaluation of $\lambda\infty$ from $\lambda+$ and $\lambda-$ for CH_3COOH and NH_4OH (ii) evaluation of degree of dissociation of a weak electrolyte - monochloro acetic acid (iii) evaluation of $\lambda\infty$ a weak electrolyte
(iv) determination of solubility from conductance of saturated solutions of sparingly soluble salts (AgCl). Numerical problems based on these.
Arrhenius theory and its limitations. Qualitative account of Debye-Huckel theory - postulates, asymmetric effect (with diagram) and electrophoretic effect.
Debye-Huckel-Onsagar equation for aqueous solutions of strong electrolytes. Verification of DHO equation.

Galvanic cell: Conventions of representing galvanic cells-reversible and irreversible cells, requirements and examples for reversible (Daniel cell) and irreversible cells, representation, cell reaction. Electrode potential, Standard electrode potential, Derivation of Nernst equation for single electrode potential (free energy concept).
Numerical problems on single electrode potential of a metal and emf of cells.

UNIT-II

Electrochemistry- II 5 hours

Weston-cadmium cell: Diagram involving the representation of anode, cathode and the electrolyte. Requirements to decide Weston cadmium cell as standard cell. Construction and working of Weston cell and its numerical value of EMF.
Determination of EMF of a cell by compensation method.
Determination of EMF of Zn/Zn^{2+} and Cu/Cu^{2+} electrodes. Liquid junction potentials, elimination of liquid junction potential using a salt bridge and conditions required for preparing a salt bridge.
Types of electrodes: (i) Metal and gas electrodes-Pt/H_2 and Pt/Cl_2 (ii) metal/metal insoluble salt electrodes-Ag/AgCl. (iii) redox electrodes-Pt/Fe^{2+}, Fe^{3+}.
Reference electrodes: Standard hydrogen electrode- representation and limitations.
Calomel electrode: Representation, construction and working.
Quinhydrone electrode and glass electrode. Determination of pH using these electrodes. Numerical problems involving the calculation of pH using hydrogen and quinhydrone electrodes.
Concentration cells: (i) emf of concentration cells (ii) determination of solubility of sparingly solublesalt taking silver chloride as example. Numerical problems: (i) calculation of emf (ii) solubility and solubility products. Redox electrodes: emf of redox electrodes. Potentiometric titration involving only redox systems. Example: Fe^{2+}/Fe^{3+}.

Ionic Equilibria 3 hours

Hydrolysis of salts of weak acids and weak bases. Ionic product of water. Deriving the relationship between Kh, Kw, Ka and Kb. Degree of hydrolysis and its relationship with Kh. Effect of temperature and dilution on degree of hydrolysis of

salt of weak acid and weak base. pH expression for the salt of weak acid - bases. Numerical problems on the calculation of Kh, h and pH of salts of weak acid and weak bases only. Common ion effect: statement and example (ammonium hydroxide - ammonium chloride and acetic acid - sodium acetate).
Buffers: Types and examples. Buffer action and buffer capacity. pH of buffers Henderson's equation and its derivation for acidic buffer.
Problems in calculating the pH of buffers. Solubility product and ionic product definitions and their applications in the precipitation of II and IV group basic radicals in the qualitative analysis of simple salt mixtures. Analytical and biological applications of buffers.

UNIT-III

Photovoltaics **2 hours**

Solar cells- Principle, preparation and applications.

High Pressure Liquid Chromatography **2 hours**

Basic Principle and types
(i) Normal phase HPLC- Principle and Separation of the mixture containing Acetic acid, ethanol, ethyl amine, acetone, chloroform and carbon tetra chloride. (Stationary phase/Mobile phase- Silica gel/Hexane).
(ii) Reverse phase HPLC -Principle and separation of the mixture containing Acetic acid, ethanol, ethyl amine, acetone, chloroform and carbon tetra chloride. (Stationary phase/Mobile phase- C_{18} Alkylated silica gel/Water+Methanol).
(iii) Size Exclusion HPLC-Principle and determination of relative molecular weight of synthetic polymers.Stationary phase and mobile phase used.
(iv) Ion exchange HPLC- Principle and separation of a mixture of amino acids (acidic pH).(Stationary phase/Mobile phase- Charged surface (cation or anion)/Water, buffer.

Electro analytical Methods **4 hours**

Voltametry at a dropping mercury electrodes (DME)- Types of current obtained at DME. Ilkovic equation and its applications. Current - potential relation for a cathodic process - half wave potential and its significance. Cyclic Voltametry:

Principles- Experimental set up- Quantitative analysis, determination of diffusion coefficients and its significance.

Thermal Analysis **2 hours**

Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

UNIT-IV

Molecular Spectroscopy-I **5 hours**

The interaction of radiation with matter. Regions of electromagnetic spectrum and associated spectroscopic techniques. Origin of molecular spectra:
Born Oppenheimer approximation.
Rotational spectra of diatomic molecules: Relationship between inter-nuclear distance and moment of inertia derivation.
Expression for rotational energy. Numerical problems involving moment of inertia and bond length. Rotational energy for different quantum levels- J=0, J=1, J=2 etc. Criterion for absorption of radiation- selection rule.

Molecular Spectroscopy- II **4 hours**

Vibrational spectroscopy: Introduction, degree of freedom of polyatomic molecules - calculating the number of modes of vibration for CO_2 and H_2O molecules,
Hooke's law- Expression for the frequency and wave numbers of SHO-force constant and its significance. Expression for vibrational energy levels of SHO. Zero point energy - definition, mathematical expression and its significance. Numerical problems based on (i) zero point energy(ii) wave number and (iii) force constant.

Raman spectroscopy and electronic spectroscopy **3 hours**

Concept of polarisability. Pure rotation, vibration - qualitative study. Stokes and anti-Stoke's lines selection rules. Advantages of Raman spectroscopy over IR spectroscopy.

Electronic spectroscopy: Potential energy curves for bonding and antibonding molecular orbitals. Electronic transitions - qualitative description of non-bonding orbitals and transitions between them.
Selection rules and Franck-Condon principle

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B. Sc., - VI Semester (CBCS)

Paper VII- Inorganic Chemistry – (2021 onwards)

Chapter No.	Title	Number of Teaching hours
1	Coordination and Organometallic compounds –I	10
2	Coordination and Organometallic compounds – II	04
3	Industrial Materials – I	06
4	Industrial Materials – II	05
5	Analytical Chemistry-II	05
6	Chemistry of Newer materials	10
	Total	**40**

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B.Sc., VI Semester
Chemistry Paper – VII (Inorganic chemistry)
(Blow up syllabus w.e.f. 2021 - CBCS)

UNIT-I

Coordination and Organometallic compounds -I **10 hours**

Coordination compounds- difference between double salts and complex salts with examples. Ligands-definition and their classification (mono, bi, tri, tetra, penta,hexadentate ligands and ambidentate ligands), examples for each class. Coordination number- definition with examples.Nomenclature of coordination compounds in detail. Theories of structure and bonding: explanation for the formation of complexes by Werner's Theory in detail and its limitations.

EAN rule- statement with illustrations. Valence bond theory: postulates, low spin and high spin complexes with examples$[CoF6]^{3-}$, $[Co(NH3)6]^{3+}$, $Fe(CN)6]^{4-}$,$[Fe(CN)6]^{3-}$,$[Ti(H2O)6]^{3+}$, $[CoCl4]^{2-}$,
limitations of VBT.

Crystal field theory: (octahedral, tetrahedral and square planar complexes)$[CoF6]^{3-}$, $[Co(NH3)6]^{3+}$, $Fe(CN)6]^{4-}$,$[Fe(CN)6]^{3-}$,$[Ti(H2O)6]^{3+}$, $[CoCl4]^{2-}$.

Crystal field splitting and crystal field stabilization energies- definition and illustrations with examples. Limitations of CFT.

Magnetic properties of [CoF6]3−, [Co(NH3)6]3+, Fe(CN)6]4−,[Fe(CN)6]3−. Spectral properties of [Ti(H2O)6]3+, [Co(H2O)6]3+, [CoCl4]2−. Isomerism in complexes: Structural isomerism - ionization, linkage, hydrate and coordination isomerism with examples. Stereoisomerism- geometrical and optical isomerism of coordination compounds with coordination number 4 and 6 with examples.

Organometallic compounds - ligands, classification (hapticity). Synthesis and structure of $K[PtCl_3(\eta2\text{-}C_2H_4)]$ and $[Fe(\eta5 - C_5H_5)2$

UNIT-II

Coordination and Organometallic compounds – II **4 hours**

Metal carbonyls: Structures of Cr(CO)6, Co2(CO)8, Mn2(CO)10; eighteen electron rule and its deviations with examples. Applications of coordination/organometallic compounds: cis-platin in cancer therapy,

Na_2Ca EDTA in the treatment of heavy metal (Pb, Hg) poisoning ,Wilkinson's Catalyst in alkene hydrogenation, Monsanto acetic acid process.

Industrial Materials- I **6 hours**

Refractories: Definition**.** Properties of a good refractory, classification, determination of PCE values.

Abrasives: Definition and classification with examples, applications, hardness-definition and magnitude of hardness, manufacture and importance of carborundum and tungsten carbide.

Glass: Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical glasses and polycarbonate glass, safety glass, fire and bullet proof glasses.

Ceramics: Raw materials and their roles, varieties of clay, production of ceramic ware, glazing, ceramic insulators.

Cement: Raw materials, manufacture of Portland cement (by wet process), setting of cement, grades, their significance.

UNIT-III

Industrial Materials – II **5 hours**

Paints and Varnishes: Constituents of oil and emulsion paints and their role. Constituents of varnishes.

Fuels: Characteristics, calorific value - definition and its determination using bomb calorimeter.

Coal – varieties. Liquid fuels- Petrol and diesel- antiknocking properties, octane number and cetane number- definition and significance. Gaseous fuels- advantages, constituents and their significance. Production of Coal gas, composition of LPG.

Explosives: Classification, preparation of dynamite and TNT.

Propellants: Characteristics, classification and their applications.

Analytical Chemistry-II **5 hours**

Solvent Extraction- definition, types and efficiency of extraction, sequence of extraction process, factors affecting extraction- pH, oxidation state, modifiers, synergistic masking and salting of agents, techniques- batch, continuous extraction and counter current extraction, applications.

Ultracentrifugation- Centrifugation, centrifugal force, sedimentation, centrifugal decantation, centrifuges, selection of centrifuge tubes, preparative, density gradient and isopycinic centrifugation. Analytical sedimentation, sedimentation co-efficient, sedimentation velocity- application of the technique in biological separation; membrane separation- principles and applications.

Ultrafilteration Zone refining techniques- Principles, instrumentation and applications.

UNIT-IV

Chemistry of Newer materials **10 hours**

Conducting polymers: Introduction, definition and examples- polyaniline, polyacetylene.Mechanism of conduction. Qualitative treatment of doping. Properties: elasticity with high electrical conductivities, Engineering and biological applications.

Superconductors: Introduction, definition, type-1, type-2 and atypical. Preparation of high temperature superconductor- YBCO. BCS theory (qualitative treatment only) and general applications of high temperature super conductors.

Nanomaterials: Introduction, definition and structure. Different methods of production: Sol gel synthesis, inert gas condensation, mechanical alloying (ball milling), plasma synthesis, electro deposition, and general applications.Nanofluids.

Fullerenes: Introduction, definition, preparation and isolation of C60. Structure and chemical reactions (redox reactions, electrophilic aromatic substitution and bromination) of C60.Commercial uses of C60. Carbon nanotubes (CNT) -definition, classification and applications- space crafts and race cars.

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B. Sc., - VI Semester (CBCS)

Paper VIII- Biochemistry – (2021 onwards)

Chapter No.	Title	Number of Teaching hours
1	Introduction to Biochemistry	02
2	Carbohydrates	04
3	Lipids	04
4	Proteins	05
5	Enzymes	04
6	Chemistry of Nucleic acids and molecular biology	07
7	Biological Oxidation	04
8	Hormones	02
09	Metabolism	06
10	Biochemical Techniques	02
	Total	**40**

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B.Sc., VI Semester

Chemistry Paper –VIII (Bio-chemistry)

(Blow up syllabus w.e.f. 2021 - CBCS)

UNIT – I

Introduction to Biochemistry **2 hours**

Contributions of Emil Fischer, Embden, Meyerhof, Parnas, Hans Kreb, Michaelis and Menton, Watson and Crick, Chargaff, H.G. Khorana, Knoop, Pauling, Hopkins and Miescher. Elemental and biochemical composition of living organisms.

Biophysics of water- dielectric constant, surface tension, heat of vaporization, MP and BP & specific heat. Role of water in biological systems.

Carbohydrates **4 hours**

Structure and biological importance of derivatives of monosaccharaides.

Amino sugars- β-D-glucosamine, galactosamine and N-acetyl muramic acid (NAMA); N-acetyl neuraminic acid (NANA).

Sugar acids- Structure and biological importance of D-gluconic acid, D-glucuronic acid and D-glucaric acid.

Sugar phosphates – Structure and biological importance of Glucose-6-P, Fructose-6-P, β-D-ribose-5-P and deoxyribose-5-P.

Structure and biological importance of oligosaccharides- Isomaltose, cellobiose, trehalose.

Polysaccharides- source, comparative account of partial structure and biological function of starch, glycogen, cellulose, chitin.

Determination of calorific value of carbohydrates, using oxygen bomb calorimeter.

Carbohydrates as informational molecules

Lipids **4 hours**

Introduction, Classification -simple, complex and derived with examples.

Fatty acids - Classification as saturated and unsaturated with examples and structure (lauric, myristic, palmitic, stearic, oleic, linoleic, linolenic and arachidonic acids). Essential fatty acids - definition with examples.

Triglycerides - Structure of simple and mixed glycerides, properties of triglycerides- acid and alkali hydrolysis, saponification number and its significance, iodine number and its significance, rancidity (Oxidative and hydrolytic), causes and prevention.

Biological importance of triglycerides.

Phosphoglycerides- General structure of 3-Sn–phosphatidic acid, lipid bilayer (as in cell membrane), micelles, liposomes and its applications, structure and biological importance of lecithin, cephalin, phosphatidyl serine, phosphatidylinositol.

Cholesterol- Structure and significance

Lipoproteins- definition, types (HDL, LDL and VLDL).

Sphingolipids- structure and biological significance of ceramide.

Lipids as signals.

UNIT-II

Proteins **5 hours**

α-amino acids: Introduction, structure (Glycine, Alanine, Valine, Cysteine, Aspartic acid, Lysine, Tyrosine and proline), classification on the basis of polarity of R-groups, essential and non-essential amino acids with examples, ionic properties and reactions of amino acids with alcohol, nitrous acid and Ninhydrin.

Levels of organizations of Protein: Primary structure, Secondary structure (α-helix, β-pleated structure& triple helix-Collagen), tertiary structure (forces stabilizing it) and quaternary structure.

Denaturation and renaturation- Anfinsen's experiment with ribonuclease.

Classification of proteins based on structure, composition and biological function (enzymes, hormones, transport agents, structural & antibodies with examples).

Biological oxidation **4 hours**

Bioenergetics- Introduction, stages of energy transformation. Exergonic and endergonic reactions. Energy coupling in biological reactions. Relationship between ΔG_0 and K_{eq}.

Structural features of ATP as a high energy phosphate (electrostatic repulsion, opposing resonance, solvation of ATP). Examples of high energy phosphates other than ATP with their free energy values.

Biological oxidation- comparison of oxidation with combustion using glucose as an example. Redox potentials of some biologically important half reactions. Calculation of energy yield for the oxidation of NADH by oxygen, reduction of acetaldehyde by NADH. Mitochondrial electron transport chain, oxidative phosphorylation and substrate level phosphorylation.

UNIT-III

Chemistry of Nucleic acids and Molecular Biology 7 hours

Types of nucleic acids, components of nucleic acids, bases, nucleosides and nucleotides with structures. Chargaff's rule of base equivalence. Polynucleotide-partial structure, structure of DNA (Watson-Crick model) and RNA. Biological roles of DNA and RNA. Tm of DNA. Protein-nucleic acid interaction- chromatin.

Central dogma of molecular biology, semi conservative replication and mechanism of DNA replication, Genetic code: general features. Transcription and Translation with mechanism. Mutation- Definition and types with example (Sickle cell anaemia) DNA finger printing- Definition and its applications.

Enzymes 4 hours

Introduction, holoenzyme (apo enzyme and co-enzyme). Active site, specificity (Group, absolute and stereo selectivity with examples).

Classification of enzymes (EC code number not required) with examples.

Enzyme substrate interaction- Fischer and Koshland models.

Enzyme kinetics - factors affecting rate of enzymatic reactions - enzyme concentration, pH, temperature and substrate concentration, (mention M.M. equation). Allosteric enzymes - definition and example

Enzyme inhibitions- Competitive and non-competitive with one example for each.

UNIT-IV

Hormones 2 hours

Definition. Classification–(i) amino acid derivatives (epinephrine and thyroxine) (ii) peptide (oxytocin and vasopressin) and polypeptide hormones (insulin and glucagon) (iii) Steroid hormones (progesterone, testosterone) with functions. Role

of insulin and glucagon in glucose homeostasis. Mediators of hormone action- Ca^{2+} and cyclic AMP.

Metabolism **6 hours**

Catabolism and anabolism: explanation with an example.

Carbohydrate metabolism: Glycolysis, fate of pyruvate (Pyruvate to lactate, acetyl CoA, OAA and ethanol). TCA cycle, energetics. Gluconeogenesis: definition, synthesis of glucose from lactate.

Fatty acid metabolism: activation of fatty acids, role of carnitine, β-oxidation pathway (C16-Palmiticacid), energetics. Formation of ketone bodies Starve-Feed cycle

Protein metabolism: Transamination, deamination and decarboxylation. Urea cycle. Integration of carbohydrates, lipids and protein metabolic pathways.

Biochemical techniques **2hours**

Chromatography- Adsorption and ion exchange Chromatography. Electrophoresis– SDS-PAGE

RT- PCR- Principle and applications

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B.Sc. V Semester Examination – Nov 2021(onwards)

CHEMISTRY –P-V (Organic Chemistry)

Time:3Hours **Max.Marks: 70**

Instructions: (i) The question paper has three parts.

(ii) Answer all the Parts.

(iii) Structures and equations are to be given wherever necessary

PART – A

Answer any eight questions (12 Q will be given). Each question carries two marks.

(2x8=16)

PART – B

Answer any nine questions (13 Q will be given). Each question carries six marks.

(6x9=54)

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B.Sc. V Semester Examination –Nov 2021(onwards)

CHEMISTRY – P-VI (Physical Chemistry)

Time:3Hours **Max.Marks: 70**

Instructions: (i) The question paper has three parts.

(ii) Answer all the Parts.

(iii) Structures and equations are to be given wherever necessary

PART – A

Answer any eight questions (12 Q will be given). Each question carries two marks.

(2x8=16)

PART – B

Answer any nine questions (13 Q will be given). Each question carries six marks.

(6x9=54)

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B.Sc. VI Semester Examination – May 2022 (onwards)

CHEMISTRY –P-VII (Inorganic Chemistry)

Time:3Hours **Max.Marks: 70**

Instructions: (i) The question paper has three parts.

(ii) Answer all the Parts.

(iii) Structures and equations are to be given wherever necessary

PART – A

Answer any eight questions (12 Q will be given). Each question carries two marks.

(2x8=16)

PART – B

Answer any nine questions (13 Q will be given). Each question carries six marks.

(6x9=54)

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B.Sc. VI Semester Examination –May 2022 (onwards)

CHEMISTRY –P-VIII (Biochemistry)

Time:3Hours **Max.Marks: 70**

Instructions: (i) The question paper has three parts.

(ii) Answer all the Parts.

(iii) Structures and equations are to be given wherever necessary

PART – A

Answer any eight questions (12 Q will be given). Each question carries two marks.

(2x8=16)

PART – B

Answer any nine questions (13 Q will be given). Each question carries six marks.

(6x9=54)

BLUE PRINT OF V SEMESTER

CHEMISTRY – P-V (Organic Chemistry)

UNIT	CHAPTER	TITLE	Number of Teaching Hours	PART-A 2M	PART-B 6M
I	1.	Stereochemistry	8	02	03
II	2.	Amines	5	02	01
	3.	Heterocyclic compounds	4	02	01
III	4.	Chemistry of Natural Products	8	02	02
IV	5.	Spectroscopy of Organic compounds	8	02	03
	6.	Industrial Organic Chemistry	7	02	03
			Total=40hrs	Total=24M	Total=78M

BLUE PRINT OF V SEMESTER

CHEMISTRY – P-VI(Physical Chemistry)

UNIT	CHAPTER	TITLE	Number of Teaching Hours	PART-A 2M	PART-B 6M
I	1.	Electrochemistry-I	10	02	03
II	2.	Electrochemistry-II	5	01	01
	3.	Ionic Equilibria	3	01	01
III	4.	Photovoltaics	2	01	01
	5.	HPLC	2		01
	6.	Electroanalytical Methods	4	02	01
	7.	Thermal Analysis	2	01	
	6.	Chemical Spectroscopy-I	5	02	02
IV	7.	Chemical Spectroscopy-II	4	01	02
	8.	Raman Spectroscopy and Electronic Spectroscopy	3	01	01
			Total=40hrs	Total=24M	Total=78M

BLUE PRINT OF VI SEMESTER

CHEMISTRY – P-VII (Inorganic Chemistry)

UNIT	CHAPTER	TITLE	Number of Teaching Hours	PART-A 2M	PART-B 6M
I	1.	Coordination and Organometallic Compounds-I	10	02	03
II	2.	Coordination and Organometallic Compounds-II	4	02	01
	3.	Industrial Materials-I	6	02	02
III	4.	Industrial Materials-II	5	02	02
	5.	Analytical Chemistry-II	5	02	02
IV	6.	Chemistry of Newer Materials	10	02	03
			Total=40hrs	Total=24M	Total=78M

BLUE PRINT OF VI SEMESTER

Chemistry Paper VIII (Biochemistry)

UNIT	CHAPTER	TITLE	Number of Teaching Hours	PART-A 2M	PART-B 6M
I	1.	Introduction to Biochemistry	2	02	
	2.	Carbohydrates	4	01	01
	3.	Lipids	4	01	01
II	4.	Proteins	5	01	02
	5.	Enzymes	4	01	01
III	6.	Chemistry of Nucleic Acids and Molecular Biology	7	01	03
	7.	Biological Oxidation	4	02	02
IV	8.	Hormones	2	02	
	9.	Metabolism	6	01	02
	10.	Biochemical techniques	2		01
			Total=40hrs	Total=24M	Total=78M

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B. Sc., Chemistry Practicals

V & VI Semesters (CBCS) (w. e. f. 2021)

Department of Chemistry

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN AUTONOMOUS

Bangalore - 560012

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BSc- V Semester (CBCS) w.e.f 2021

CHEMISTRY PRACTICALS

P- V (Organic Chemistry)

List of experiments:

1. Qualitative analysis of organic compounds through functional group analysis. Determination of physical constant. Preparation and characterization (m pt) of a suitable derivative.
2. Isolation of lycopene from tomatoes.
3. Isolation of caffeine from tea leaves.

****

B.Sc., V Semester (CBCS)

Scheme of Valuation

Chemistry Practicals –V (Organic Chemistry)

Max. Marks: 50 **Duration: 3 hours**

Internal assessment: 15 marks

Practicals : 35 marks

I. Assignment of marks for internal assessment

(i) Attendance : 5 marks

(ii) Practical test : 10 marks (2 tests to be conducted, best one to be considered)

II. Assignment of marks for practicals

(i) Record: 5 marks

(ii) Procedure Writing Experiment: 5 marks

(iii) Performing Experiment: 20 marks

III. Viva voce: 5 marks

(Five questions can be asked to each student on performing experiments only).

Assignment of marks for practical record

Recording of 10-8 different experiments: 5 marks

Recording of 7 - 6 different experiments: 4 marks

Recording of 5 - 4 different experiments: 3 marks

Recording of less than 4 experiments: zero

Note: # Record should be valued only if it has been certified by the Teacher-in-charge and

Head of the Department.

2 marks may be deducted if there are adverse remarks marked by the Teacher-in-charge.

Procedure Writing Experiments:

Any one of the following experiments shall be given for procedure writing. The students should answer this question at the beginning of the practical examination. Maximum time allowed shall be 20 minutes.

1. Isolation of Lycopene from tomatoes.
2. Isolation of Caffeine from tea leaves.

Scheme of evaluation for procedure writing experiments:

Principle or equation: 2 marks

Procedure with calculations if any: 3 marks

Performing Experiment:

Qualitative analysis of organic compound: identification of mono-functional organic compounds through functional group analysis, determination of physical constant, preparation of a suitable derivative and characterization (m pt) of the derivative.

Any one of the following organic compounds shall be given for analysis. Not more than twostudents in a batch should be given the same compound for analysis.

(1) Resorcinol	(2) Urea	(3) Aniline	(4) Nitrobenzene
(5) Benzoic acid	(6) Salicylic acid	(7) Benzaldehyde	(8) Acetophenone
(9) Ethyl benzoate	(10) Toluene	(11) Chlorobenzene	(12) Benzamide

Scheme of Valuation

II. **Qualitative analysis of a simple organic compound. 20 marks**

<table>
<tr><td>1.</td><td>Preliminary examination:
Correct recording of the following four observations:
i)State ii) colour iii) odour iv)ignition test v)test for unsaturation</td><td>1 mark</td></tr>
<tr><td>2.</td><td>Determination of melting point or boiling point of the compound;
<table><tr><td>Range of error</td><td>± 3%</td><td>± 4%</td><td>± 5%</td><td>above± 6%</td></tr><tr><td>Marks</td><td>3</td><td>2</td><td>1</td><td>0</td></tr></table></td><td>2 marks</td></tr>
<tr><td>3.</td><td>Detection of elements:
(ONE mark for each test and one mark for procedure for preparation
of stock solution)</td><td>4 marks</td></tr>
<tr><td>4.</td><td>Solubility;
Recording the solubility table
:1 mark
For mentioning of the group
:1 mark
For mentioning the classes of compounds in the respective group:1 mark</td><td>3 marks</td></tr>
<tr><td>5.</td><td>Functional group identification</td><td>4 marks</td></tr>
<tr><td>6.</td><td>Writing of chemical equation for any one test used to identify functional group</td><td>2 marks</td></tr>
<tr><td>7.</td><td>Preparation of the derivative
(Procedure to be given by the examiner after reporting of the functional group by the student)</td><td>2 marks</td></tr>
<tr><td>8.</td><td>Writing the possible structure for the derivative and finding its melting point</td><td>2 marks</td></tr>
</table>

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B.Sc., V Semester (CBCS) w.e.f 2021

CHEMISTRY PRACTICALS P- VI

(PHYSICAL CHEMISTRY)

List of experiments:

1. Determination of percentage of sodium chloride by miscibility temperature method.
2. Estimation of Cu2+colorimetrically and verification of Beer-Lambert's law.
3. Estimation of iron by colorimetric method.
4. Determination of equivalent conductivity of 0.1 N sodium chloride and verification of DHO equation.
5. Determination of dissociation constant of monochloroacetic acid by conductivity method.
6. Conductometric titration of hydrochloric acid with sodium hydroxide.
7. Potentiometric titration of potassium dichromate with ferrous ammonium sulphate.
8. To construct the phase diagram of two component system (Ex diphenylaminebenzophenone) by cooling curve method.
9. Determination of pKa of a weak acid by pH metric method.
10. Determination of Oxidation and Reduction potential of $K_4Fe(CN)_6/K_3Fe(CN)_6$ system by cyclic voltammetry.

****

B.Sc., V Semester (CBCS)

Scheme of Valuation

Chemistry Practicals –VI (Physical Chemistry)

Max. Marks: 50 **Duration: 3 hours**

Internal assessment: 15 marks

Practicals : 35 marks

I. Assignment of marks for internal assessment

(i) Attendance: 5 marks

(ii) Practical test: 10 marks (2 tests to be conducted, best one to be considered)

II. Assignment of marks for practicals

(i) Record: 5 marks

(ii) Procedure writing: 5 marks

(iii)Performing Experiment and calculation: 20 marks

III. Viva voce: 5 marks

(Five questions can be asked to each student on performing experiments only).

Assignment of marks for practical record

Recording of 10-8 different experiments: 5 marks

Recording of 7 - 6 different experiments: 4 marks

Recording of 5 - 4 different experiments: 3 marks

Recording of less than 4 experiments: zero

Note: a. Record should be valued only if it has been certified by the Teacher-in-charge and Head of the Department.

b. 2 marks may be deducted if there are adverse remarks marked by the Teacher-in-charge.

Procedure Writing Experiments:
Any one of the following experiments shall be given for procedure writing.
The students should answer this question at the beginning of the practical examination. Maximum time allowed shall be 20 minutes.

i. To construct the phase diagram of two component system (Ex diphenylaminebenzophenone) by cooling curve method.
ii. Determination of pKa of a weak acid by pH metric method.
iii. Determination of Oxidation and Reduction potential of $K_4Fe(CN)_6/K_3Fe(CN)_6$ system by cyclic voltammetry.

Scheme of evaluation for procedure writing experiments:
Principle or equation: 1 mark
Procedure: 2 marks
Calculations: 2 marks

Performing Experiments:
The following Five experiments shall be set for the students to perform:
1. Determination of percentage composition of sodium chloride solution by miscibility temperature measurements of phenol-water system.
2. Estimation of the amount of hydrochloric acid present in the given solution using standardized decinormal sodium hydroxide by conductometric titration.
3. Dissociation constant of monochloroacetic acid by conductivity method.
4. Estimation of potassium dichromate using ferrous ammonium sulphate by potentiometric titration.
5. Estimation of Cu^{2+}colorimetrically and verification of Beer-Lambert's law.
(At least two students should be compulsorily allotted electrical experiments for the practical examination)

Scheme of evaluation

1. Determination of percentage composition of sodium chloride solution by miscibility temperature measurements of phenol and aqueous solution.

1% sodium chloride solution has to be prepared by the students. The miscibility temperature is determined for at least five different compositions such as 0.2%, 0.4%, 0.6%, 0.8% and 1% of NaCl.

Tabulating and recording of MST: 15 marks							**Graph: 5 marks**	
Error	$\pm$0.05	$\pm$0.06	$\pm$0.07	$\pm$0.08	$\pm$0.09	$\pm$0.1	$\pm$0.15	Any other value
Marks	15	13	11	09	07	05	03	02

2. Estimation of the amount of hydrochloric acid present in the given solution using standardized decinormal sodium hydroxide by conductometric titration.

Note: (i) Direct reading conductivity meter can be used.

(ii) The student has to prepare 100ml of an approximately decinormal solution of PHP by weighing about 2.042g. This solution is to be used to standardize the NaOH by direct titration method using phenolphthalein indicator.

(iii) Hydrochloric acid solution provided to the students for estimation must be at least ten times more concentrated than the base (For example, 1N HClvs 0.1N NaOH for conductometric titration).

Part I: Standardisation of sodium hydroxide using PHP
Calculation of Normality of PHP : **2mark** Concordant titre value: **6 marks** Calculation of Normality of NaOH: **2 marks**

Part II: Estimation of the amount of HCl by conductometric titration						
Titre value: **10 marks** Graph: **3 marks**Calculation:**2marks**						
Titre value error (cm^3)	$\pm$0.2	$\pm$0.3	$\pm$0.4	$\pm$0.5	$\pm$0.6	Any other value
Marks	10	09	08	06	04	02

3. Dissociation constant of monochloroacetic acid by conductivity method.

Note: Standard solution of weak electrolyte (0.1N acetic or monochloroacetic acid) has to be given.

Determination of cell constant of the given conductivity cell : 4 marks
((i) Preparation of 0.1N KCl and Determination of conductance:3(ii) Calculation : 1)
Determination of conductance of at least two different concentrations of acetic acid : 2 marks
Calculation of specific conductance : 1mark
Calculation of equivalent conductance : 1 mark
Calculation of degree of dissociation : 1 mark
Calculation of Ka : 1 mark

Standard value of K_a of $ClCH_2COOH$ at 25°C=$1.4x10^{-3}$; K_a of CH_3COOH at 25°C=$1.8x10^{-5}$						
Titre value: **10 marks**						
Titre value error (cm^3)	+0.05	+0.06	+0.08	+0.09	+0.1	Any other value
Marks	10	09	08	06	04	02
Calculation of λ, α and K_a: 5 marks						

4. Estimation of potassium dichromate using ferrous ammonium sulphate by potentiometric titration.

Note: Direct reading potentiometer can be used.

Preparation of standard 0.1N ferrous ammonium sulphate solution : 5 marks

(i) Weighing details: 2 (ii) Use of normality equation: 1 (iii) Calculation of normality: 2

Titre value: **10 marks** Graph: **5 marks** Calculation: **5 marks**						
Titre value error (cm^3)	$\pm$0.2	$\pm$0.3	$\pm$0.4	$\pm$0.5	$\pm$0.6	Any other value
Marks	10	09	08	06	04	02

5. Estimation of Cu^{2+}colorimetrically and verification of Beer-Lambert's law.
Note: Standard solution of copper sulphate is to be provided to the students for standardization.

Unknown value	14 Marks
Standard curve (graph)	3 Marks
Calculation	2 Marks
Conclusion of Beer-Lambert's law	1 Mark

Error %	Up to 09	10 to 12	13 to 15	16 to 18	19 to 20	Any other value
Marks	14	12	10	8	7	3

B.Sc., VI Semester (CBCS) w.e.f 2021

CHEMISTRY PRACTICALS P- VII

(INORGANIC CHEMISTRY)

List of experiments:

1. Estimation of percentage of iron in haematite using barium diphenylamine sulphonate as an internal indicator.
2. Estimation of calcium in lime stone.
3. Estimation of copper in brass.
4. Estimation of zinc using EDTA.
5. Estimation of Magnesium using EDTA.
6. Estimation of total hardness of water using EDTA.
7. Estimation of nickel using EDTA and standard zinc sulphate.
8. Gravimetric estimation of barium as barium sulphate.
9. Gravimetric estimation of nickel as nickel dimethyl glyoximate.
10. Preparation of cuprammoniumsulphate and determination of λ max and hence CFSE.
11. Preparation of ferrous oxalate and its analysis.
12. Analysis of Lithopone Pigment.

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B.Sc., VI Semester (CBCS)

Scheme of Valuation

Chemistry Practicals –VII (Inorganic Chemistry)

Max. Marks: 50 **Duration: 3 hours**

Internal assessment: 15 marks

Practicals : 35 marks

I. Assignment of marks for internal assessment

(i) Attendance: 5 marks

(ii) Practical test: 10 marks (2 tests to be conducted, best one to be considered)

II. Assignment of marks for practicals

(i) Record: 5 marks

(ii) Procedure writing: 5 marks

(iii)Performing Experiment and calculation: 20 marks

III. Viva voce: 5 marks

(Five questions can be asked to each student on performing experiments only).

Assignment of marks for practical record

Recording of 10-8 different experiments: 5 marks

Recording of 7 - 6 different experiments: 4 marks

Recording of 5 - 4 different experiments: 3 marks

Recording of less than 4 experiments: zero

***Note*:** a. Record should be valued only if it has been certified by the Teacher-in-charge and Head of the Department.

b. 2 marks may be deducted if there are adverse remarks marked by the Teacher-in-charge.

Procedure Writing Experiments:

Any one of the following experiments shall be given for procedure writing. The students should answer this question at the beginning of the practical examination. Maximum time allowed shall be 20 minutes.

1. Preparation of cuprammonium sulphate and determination of λmax and CFSE.
2. Gravimetric estimation of Barium as Barium sulphate.
3. Preparation of ferrous oxalate and its analysis.

Scheme of evaluation for procedure writing experiments:

Principle or equation : 1 mark
Procedure : 2 marks
Calculations : 2 marks

Any one of the following experiments shall be set

Sl.No.	**Experiment**	**Standard solution (to be prepared by the students)**	**Link solution (to be Given to students)**
1	Estimation of iron in Haematite (using diphenyl amine as internal indicator)	Ferrous ammonium sulphate (reduction by $SnCl_2$)	Potassium dichromate or ceric ammonium sulphate
2	Estimation of Zinc	Zinc sulphate	EDTA
3	Estimation of Magnesium	Zinc Sulphate	EDTA
3	Estimation of Nickel	Zinc sulphate	EDTA
4	Estimation of Calcium in limestone	Sodium oxalate	Potassium permanganate
5	Estimation of copper in brass	Potassium dichromate	Sodium thiosulphate
Gravimetric Analysis		Estimation of Nickel as nickel dimethyl Glyoximate	

Performing Experiments:

Scheme of valuation

Volumetric Analysis

Titrations:						**16 Marks**
Titre Value Error (ml)		± 0.2	± 0.3	± 0.4	± 0.5	Any other value
Marks	**Standardisation**	7	6	5	4	2
	Estimation	9	8	7	6	3

Calculations			**4 Marks**
Normality of solution prepared	1	Normality of solution to be estimated	1M
Normality of link solution	1	Amount of substance or percentage	1M

Gravimetric Analysis						
Experiment: 16 Marks			**Calculation: 4 Marks**			
Mass of the precipitate (mg)	± 20	± 30	± 40	± 50	± 60	Any other value
Marks	16	14	12	10	08	06

Note:

a. Any one experiment to be set either volumetric or gravimetric. A brief procedure must be provided by the examiner.

b. Examiners have to conduct the experiments and a comparative assessment has to be made.

c. The number of trials in volumetric analysis should not exceed four. The concordant valueshould be taken for valuation. If no concordant value is reported, the best value shall be taken and only 80% of eligible marks shall be awarded.

d. For estimation of calcium, the best value of two determinations shall be considered for comparative assessment.

e. In gravimetric analysis, one determination shall be sufficient.

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B.Sc., VI Semester (CBCS) w.e.f 2021

CHEMISTRY PRACTICALS P- VIII

(BIOCHEMISTRY)

List of experiments:

1. Preparation of buffers and determination of their pH values using pH meter.
2. Estimation of creatinine by Jaffe's method.
3. Estimation of inorganic phosphate by Fiske-Subbarow method.
4. Estimation of Reducing sugars by DNS (dinitrosalicylic acid) method.
5. Estimation of Proteins by FC method.
6. Isolation and estimation of casein from milk.
7. Separation of amino acids by TLC and paper chromatography.
8. Estimation of Haemoglobin by Wong's method.
9. Estimation of cholesterol by Zak's method.
10. Determination of calorific value of carbohydrates, using oxygen bomb calorimeter.

B.Sc., VI Semester (CBCS)

Scheme of Valuation

Chemistry Practicals –VIII (Biochemistry)

Max. Marks: 50 **Duration: 3 hours**

Internal assessment: 15 marks

Practicals : 35 marks

I. Assignment of marks for internal assessment

(i) Attendance: 5 marks

(ii) Practical test: 10 marks (2 tests to be conducted, best one to be considered)

II. Assignment of marks for practicals

(i) Record: 5 marks

(ii) Procedure writing: 5 marks

(iii)Performing Experiment and calculation: 20 marks

III. Viva voce: 5 marks

(Five questions can be asked to each student on performing experiments only).

Assignment of marks for practical record

Recording of 10-8 different experiments: 5 marks

Recording of 7 - 6 different experiments: 4 marks

Recording of 5 - 4 different experiments: 3 marks

Recording of less than 4 experiments: zero

Note: a. Record should be valued only if it has been certified by the Teacher-in-charge and Head of the Department.

b. 2 marks may be deducted if there are adverse remarks marked by the Teacher-in-charge

Procedure Writing Experiments:

Any one of the following experiments shall be given for procedure writing. The students should answer this question at the beginning of the practical examination. Maximum time allowed shall be 20 minutes. A schematic graph to be drawn wherever necessary.

1. Preparation of buffers and determination of their pH values using pH meter
2. Isolation and estimation of casein from milk.
3. Estimation of Haemoglobin by Wong method..
4. Separation of amino acids by TLC and paper chromatography.
5. Estimation of cholesterol by Zak method.

Scheme of evaluation for procedure writing experiments:
Principle or equation : 1 mark
Procedure : 2 marks
Calculations : 2 marks

Performing Experiments:

Colorimetric estimations:

1. Estimation of reducing sugar by dinitrosalicylate (DNS) Method
2. Estimation of inorganic phosphate by the modified Fiske –Subbarow method
3. Estimation of creatinine in urine(or given sample) by Jaffe' s method
4. Estimation of Proteins by FC method.

Scheme of evaluation for performing experiments:

Colorimetric/titrimetric estimations: 20 Marks

Protocol	**2Marks**
Unknown Value	**13 Marks**
Standard Curve (graph)	**3 Marks**

Calculations	2 Marks

For Unknown

Error (%)	Up to 09	10 to 12	13 to 15	16 to 18	19 to 20	Any other value
Marks	13	11	9	8	7	3

Note:

1. A brief procedure must be provided by the examiner before the students write the protocol.
2. A ten-fold concentrated stock solution is to be prepared by the examiners. From this: (i) a standard/working solution is to be prepared by diluting 10 fold and is to be given to the students.
(ii) The unknown solution is to be pipetted out into a 100/ 50 ml volumetric flask.
This is to be made up by the students and used for estimation in duplicate.
3. The concentration of the unknown should be chosen such that its value falls between 2^{nd} and 4^{th} points of the standard graph.
5. A blank experiment is to be conducted simultaneously by the student.

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