BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM

(Semester Scheme with Multiple Entry and Exit Options for Under Graduate Course)

Syllabus for B.Sc. / B.Sc. (Honors) Chemistry (I & II Semester)

2021-22 onwards

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.

PREAMBLE (FOREWORD)

As per the directive from the Bengaluru City University, the Chemistry syllabus for the B. Sc., degree programme (According to NEP) had to be prepared for the 1st year. The University proposed and asked to follow NEP syllabus II A model programme structure for the undergraduate programs in universities and colleges [subjects with practicales] with one major and one minor: B.Sc. (Honors) Chemistry course and introduce to B. Sc. Programme from the academic year 2021-22. The guidelines are prepared by the task force committee constituted by the University for this purpose was provided.

The Department of Studies in Chemistry, Central College Campus, Bengaluru City University with the help of the Core Group involving the Teachers of the Affiliated colleges were constituted. This Core Group participated in virtual meetings held on **25.09.2021and 27.09.2021** and prepared a draft syllabus keeping in view the aims of the NEP IIA model curriculum in developing interdisciplinary skills in students linking general studies with professional courses and allowing both vertical and horizontal mobility and also catering to local needs.

Chemistry Course in the BSc degree Programme is a choice based subject in (CBCS) Semester Scheme spread over all Semesters .The course seeks to familiarize students from basic level to high level chemistry which connects PG programme. Due importance is also given to the study of application oriented topics which is very much essential and useful for present science students.

Faculties of different branches of Chemistry, namely Inorganic, Organic, Physical and Biochemistry had separate and joint brain storming sessions and arrived at a Draft Syllabus in Chemistry for **two** semesters.
The final draft incorporating the suggestions was placed before the Department Council and then to the Board of Studies in Chemistry (UG) on **28.09.2021** for approval.

Gayathri

Dr. V Gayathri.
Professor and Chairperson
Department of Chemistry
Bengaluru City University
Bengaluru-560001

Proceedings of the Meeting of Board of Studies in Chemistry (UG) Bengaluru City University held on 28th Sep 2021 at 11.00 am in the Department of Chemistry, Central College Campus, Bengaluru-560 001

The Chairperson welcomed the members of the Board to the meeting and placed the agenda before the Committee for discussion.

Agenda 1: The Chairperson informed the members that, as per the directive from the Bengaluru City University, the Chemistry syllabus for the B. Sc., degree programme as per NEP model II A model programme structure for the undergraduate programs in universities and colleges [subjects with practicals]: B.Sc. (Honors) Chemistry course was prepared. The proposed syllabus is to be introduced from 2021-22 onwards after the approval from different bodies.

Agenda 2: Basic minimum qualification of the candidate for joining B.Sc with Chemistry as major must have studied mathematics at 10+2 level.

Agenda 3: Chairperson informed that syllabus has to be made in such a way that,

- The rules governing the NEP II A model (semester scheme) for UG program to be followed are as per the university guidelines.
- We have to equip and strengthen students with analytical skills needed for their careers in teaching, industry, and research.
- with the changing trends and latest developments in research updating of the curriculum is a necessary exercise.
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Agenda 4: Scrutiny and approval of the Syllabus (theory and practical) and Scheme of examination under NEP model (Semester Scheme) for the Chemistry Course in B.Sc., Degree Programme is to be finalized and approved in the final BOS meeting.

The Board of Studies (UG) approved the Syllabus after some modifications for the Chemistry Course in B. Sc., Degree Programme starting from the academic year 2021-22.

Agenda 5: Approval of Board of Examiners list (Chemistry UG) for the academic year 2021-22.

The Chairperson records her thanks to the teachers involved in the preparation of this syllabus.

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Bengaluru City University

Board of Studies in Chemistry(UG)

Sl No	Name of the staff	Responsibilities	Phone No.	Signature
01	Dr. V Gayathri. Professor and chairman. Department of Chemistry.Bangalore City UniversityBengaluru-560001	Chairman	+91 99805 14446	Gayathri
02	Dr. Mahesh Aravind Associate Professor Department of Chemistry Vijaya College, R V Road, Bengaluru - 560004	Member	080-26933221 +91 99805 14446	Absent
03	Dr. Rita Battacharjee Associate Professor Department of Chemistry BMSCW, Basavanagudi Bengaluru -560004	Member	+91 9845647969	Rita B
04	Dr. Vasundara D E Assistant Professor Department of Chemistry BMSCW, Basavanagudi Bengaluru -560004	Member	+91 9900779809	
05	Dr. S Kantharaju Associate Professor Department of Chemistry SJRcollege, Anand Rao circle Bengaluru -560001	Member	+91 8660833161	
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07	Mr. Nanjundappa V S Associate Professor Department of Chemistry. Jnanajyothi Degree College, , Yelahanka Bengaluru -56064,	Member	+91 99805 14446	Absent
08	Mr. Prasanna Kumar S G Associate Professor Department of Chemistry M S Ramaiah College of Arts, Science & Commerce, Bengaluru -560054	Member	+91 8197132950	

09	Dr. Ramakrishna reddy. K Associate Professor PG Department of Chemistry Nrupathunga University, Bengaluru -560001	External Member	+91 9886730374	Received on 28/09/21
10	Ronald J Mascarenhas Associate Professor Department of Chemistry St. Joseph's College (Autonomous), Lalbhag road, Bengaluru -560027	External Member	+91 9448756584	
11	Prof. R V Devaraj Professor, Dean of Sciences. PG Department of Bio–Chemistry, Bengaluru City University, Bengaluru - 560001	Co – opt member	+91 9886494428	
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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:

(Refer to literature on outcome based education (OBE) for details on Program Outcomes)

1. **PO. 1:** To create enthusiasm among students for Analytical chemistry and its application in various fields of life.
2. **PO. 2:** To provide students with broad and balanced knowledge and understanding of key concepts in Analytical chemistry
3. **PO. 3:** To develop in students a range of practical skills so that they can understand and assess risks and work safely measures to be followed in the laboratory.
4. **PO. 4:** To develop in students the ability to apply standard methodology to the solution of problems in chemistry
5. **PO. 5:** To provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.
6. **PO. 6:** To 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 of well-trained graduates
7. **PO. 7:** To develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.
8. **PO. 8:** To instil 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 (in percentage)

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

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 Organic Chemistry-I **Credits**-4	• The concepts of chemical analysis, accuracy, precision and statistical data treatment • Understand the preparation of alkanes, alkenes and alkynes, their reactions, etc. • The Bohr's theory of atomic structure and how it was developed • Quantum numbers and their necessity in explaining the atomic structure	P.U.C /12th standard/ or equivalent with Chemistry (WithMaths in 10+2 Level)	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams
	DSClab-1: Analytical, Inorganic and organic 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 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		Assignment Desk work	Internal Exams, Continuous Evaluation, SemExams
2	DSC-2: Analytical, Physical and Organic Chemistry-II **Credits**-4	• Know the concept of volumetric and gravimetric analysis • And handle toxic chemicals, concentrated acids and organic solvents and practice safety procedures. • The concept of unit cell, symmetry elements, Nernst distribution law. • Understand the preparation of alkenes and alkynes, their reactions, and the mechanism of nucleophilic, electrophilic reactions.	-	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams
	DSC Lab -2: Inorganic,an	• To prepare standard solutions • Techniques like precipitation,		Assignment Desk work	Internal Exams,

	d Physical Practicals-II **Credits**-2	filtration, drying and ignition • Various titrimetric techniques and gravimetric methods.			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. DSC-8: **Credits**-3 DSC Lab-8: **Credits**-2 DSE-A2: **Credits**-3			MOOC, Problem solving	Internal tests, Assignments, Quiz
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 and DSC-6 DSE-A1: DSC-7 and DSC-8 DSE-A2:	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 work, Industrial Visit	Internal tests, Assignments, Seminar, Debate, Quiz

	Project. **Credits**=6 **Or** Two Papers. **Credits**=3Each.				

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/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 Pre-requisite(s): *Mention only course titles from the curriculum that are needed to be taken by the students before registering for this course.*

PUC/12th standard/ or equivalent with Chemistry

Course Outcomes (COs):

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

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

1. Explain basic laboratory practices like calibration of glassware, sampling, handlingacids and safety precautions.
2. Prepare the solutions after calculating the required quantity of salts in preparing the reagents/solutions and dilution of stock solution.
3. Describe the limitations of Classical Mechanics which necessitated thedevelopment of Quantum Mechanics.
4. Solve the Schrodinger's equation to obtain wave function for a basic type of Potential in one dimension and predict the shapes of orbitals as well as probability Distributions
5. To justify the need for quantum mechanical structure of atoms
6. Describe the periodicity in physical and chemical properties. Of elements in thePeriodic table.
7. Explain the nature of bonding in organic compounds using concepts such as Conjugation, resonance, etc.
8. Learn methods of syntheses of alkanes, alkenes and alkynes along with their

Reactions.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
1. Explain basic laboratory practices like calibration of glassware, sampling, handlingacids and safety precautions	X	X						
2. Prepare the solutions after calculating the required quantity of salts in preparing the reagents/solutions and dilution of stock solution	X	X		X				
3. Describe the limitations of Classical Mechanics which necessitated thedevelopment of Quantum Mechanics	X					X		
4. Solve the Schrodinger's equation to obtain wave function for a basic type ofPotential in one dimension and predict the shapes of orbitals as well as probabilitydistributions	X		X					
5. To justify the need for quantum mechanical structure of atoms	X			X				
6. Describe the periodicity in physical and chemical properties. Of elements in the Periodic table	X							X
7. Explain the nature of bonding in organic compounds using concepts such as Conjugation, resonance, etc.	X						X	
8. Learn methods of syntheses of alkanes, alkenes and alkynes along with their reactions	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.

Title of the Course: DSC-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 concepts of mole and stoichiometry
- To develop analytical skills of determination of analyte through titrimetric and gravimetric experiments
- To develop the ability to set-up apparatus, using the apparatus to collect data and analyze the data to determine the desired parameter or quantity.
- To impart skills of preparation of reagents/solutions from source materials
- Quantum numbers and their necessity in explaining the atomic structure
- Shapes of different atomic orbitals
- Historical development of periodic table.
- Periodic properties viz. atomic radii, ionization energy, electronegativity etc.
- To introduce the basic concepts of organic chemistry.

Course Specific Outcome:

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

- The concepts of chemical analysis, accuracy, precision and statistical data treatment
- Prepare the solutions after calculating the required quantity of salts in preparing the reagents/solutions and dilution of stock solution.
- Quantum numbers and their necessity in explaining the atomic structure
- Shapes of different atomic orbitals
- Historical development of periodic table
- Periodic properties viz. atomic radii, ionization energy, electronegativity etc.
- The Concept of aromaticity, resonance, hyper conjugation, etc.
- Understand the preparation of alkanes, alkenes and alkynes, their reactions, etc.
- Understand the mechanism of nucleophilic, electrophilic reactions
- Able to draw the energy profile diagrams
- Able to explain the factors affecting the orientation during aromatic substitution reactions.

Content of Theory Course 1	56hrs.

Unit – 1 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.**(4 hrs.)** **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.**(6 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 N1V1= N2V2 formula, preparation of ppm level solutions from source materials (salts), conversion factors. Numerical problems. **(2hrs)** 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. **(2hrs)**	**14hrs.**
Unit - 2	**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) Laplaceanoperator 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. (**6hrs**) Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's 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 - 3	**14 hrs.**
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.**(8 hrs)** Trends in the chemistry of the compounds of groups 13 to 17 (hydrides, carbides, oxides and halides) are to be discussed.**(6 hrs.)**	
Unit - 4	**14 hrs.**
Classification and nomenclature of organic 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,(Notations used to represent electron movements and directions of reactions- curly arrows, formal charges). localized and delocalized, conjugation and cross conjugation, with examples. Concept of resonance. Electronic displacements: Inductive effect, electrometric effect, resonance and hyper conjugation, aromaticity, Huckel rule, anti-aromaticity explanation with examples.**(4hrs)** Strengths of organic acid and bases: Comparative study with emphasis on factors effecting pKa 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 cleavagesTypes 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. **(4 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)
10. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)(2010)
11. Finar, I. L. *Organic Chemistry (Volume I),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) (2002)
12. McMurry, J. E. *Fundamentals of Organic Chemistry,* 7th Ed. Cengage Learning India Edition, 2013
13. Organic Reaction mechanism by V. K. AhIuwalia and K. Parashar Oxford, U.K. : Alpha Science International, 2011.
14. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. New age publishers Publication Date.2 February 2017
15. A Guide book to mechanism in Organic Chemistry by Peter Sykes. Pearson. (January 2003)
16. Pine S. H. Organic Chemistry, Fifth Edition, McGraw Hill, (2007)
17. F. A. Carey, Organic Chemistry, Seventh Edition, Tata McGraw Hill (2008).
18. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd Ed., (2012), Oxford University Press.
19. F. A. Carey, R. J. Sundberg, Advanced Organic Chemistry, Part A: Structure and mechanism, Kluwer Academic Publisher, (2000).

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

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

PRACTICALS (I SEMESTER)

Course outcome:

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

- Calibrate common laboratory glassware like pipette, burette and volumetric flask.
- Conduct a variety of volumetric estimations such as acid-base, redox andiodometric titrations.
- Purify/crystallize organic compounds by proper selection of suitable solvents.
- Synthesize different organic compounds such as *p*-nitro acetanilide, *m*-nitrobenzoic acid, tribromophenol, dibenzalacetone, etc., using conventional/greenmethods.

PART- A Analytical Chemistry

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 specific outcome:

- 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 determinetheanalyte 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.
3. Estimation of alkali present in soaps/detergents.
4. Estimation of iron(II) using potassium dichromate.
5. Estimation of oxalic acid using potassium permanganate solution.
6. Estimation of chlorine in bleaching powder using iodometric method.
7. Estimation of alkali content in antacids.
8. Standardization of silver nitrate and determination of chloride in a water sample.

PART- B Organic Chemistry

Course objective:

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

Course specific outcome:

- 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.
- Students would learn the importance of green methods over conventional methods.
- The students would be exposed to the safety measures to be taken to conduct reactions in the laboratory. and also learn how to manage by products and disposal of waste.

List of Experiments:

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).

Note:Questions from both sections should be given in each batch.

1. In the first 20 minutes the Teacher should discuss in detail the theory, principle, procedure and calculations.
2. Instructions to be given for operating instruments, weighing chemicals and precautions while handling chemical.

Recommended Books/References:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
2. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

B.Sc I Semester

OPEN ELECTIVE-1

Title of the Course: OE-1:	CHEMISTRY IN DAILY LIFE
Number of Theory Credits	3
Number of lecture hours/ semester	42 hrs.

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.

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 specific outcome:

After studying this paper the student would be able to:

1. Describe the composition of the milk and dairy products.

2. Detect/determine the amount of caffeine, chicory in coffee and chloral hydrate in toddy.

3. Explain the preservatives used in food products and their effects and possible adulterants.

4. Acquire detailed information about the colorants used in food products.

5. Differentiate various vitamins, their sources and deficiencies.

6. Examine purity of the oils.

7. Explain how electrical energy is stored in batteries.

8. Classify commonly used polymers in our daily lives.

Content of Theory Course 1	42 Hrs
Unit – 1 **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.**(06hrs)** **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**.(06hrs)** **Artificial food colorants:** Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food. **(02hrs).**	**14 hrs.**
Unit - 2 **Vitamins:** Classification and nomenclature. Sources, deficiency diseases, and structures of vitamin A1, vitamin B1, vitamin C, vitamin D, vitamin E & vitamin K1. **(06hrs).** **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. **(05hrs).** **Soaps & Detergents**: Definition, classification, manufacturing of soaps and detergents, composition and uses**(03hrs)**	**14 hrs.**
Unit - 3 Chemical and renewable energy sources: principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer. (**06hrs).** 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. **(08hrs).**	**14 hrs.**

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: Analytical/Physical 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 Outcomes (COs): At the end of the course the student should be able to:

1. Explain the principles and concepts related to titrimetric analysis with reference to acid-base, precipitation and complexometric titrations.
2. Handling of toxic chemicals, concentrated acids and organic solvents and practice safety procedures.
3. Write the mechanisms of S_N1 and S_N2 reactions taking suitable examples.
4. Illustrate types of aromatic electrophilic and nucleophilic substitution reactions with examples.
5. Give a comprehensive description of the gaseous state in terms of molecularvelocity, their distribution based on Maxwell-Boltzmann law, types of molecularvelocities, molecular collision parameters, critical phenomena and liquefaction ofgases.
6. Explain important properties of liquid state such as viscosity, surface tension,refraction and parachor by defining them and elaborating on their experimentaldetermination.
7. Learn methods of determining molecular weights of solutes by measuringcolligative properties and the concept of distribution law along with its applications.
8. Describe the crystalline state in detail using the terms unit cell, Bravias lattices, Miller indices, Crystal systems, symmetry elements and lattice planes.

Course Articulation Matrix:
Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Explain the principles and concepts related to titrimetric analysis with reference to acid-base, precipitation and complexometric titrations.	X	X						
2. Handling of toxic chemicals, concentrated acids and organic solvents and practice safety procedures	X	X		X				
3. Write the mechanisms of S_N1 and S_N2 reactions taking suitable examples	X					X		
4. Illustrate types of aromatic electrophilic and nucleophilic substitution reactions with examples	X		X					
5. Give a comprehensive description of the gaseous	X			X				

state in terms of molecularvelocity, their distribution based on Maxwell-Boltzmann law, types of molecularvelocities, molecular collision parameters, critical phenomena and liquefaction ofgases								
6. Explain important properties of liquid state such as viscosity, surface tension,refraction and parachor by defining them and elaborating on their experimentaldetermination	X							X
7. Learn methods of determining molecular weights of solutes by measuringcolligative properties and the concept of distribution law along with its applications	X						X	
8. Describe the crystalline state in detail using the terms unit cell, Bravias lattices, Miller indices, Crystal systems, symmetry elements and lattice planes	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 Semester II – B.Sc. / B.Sc. (Honors) Chemistry

Title of the Course: DSC – 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:

- The concept of volumetric and gravimetric analysis and deducing the conversion factor for determination.
- Handling of toxic chemicals, concentrated acids and organic solvents and practice safety procedures.
- To make him familiarize with various states of matter.
- To learn the calculation of lattice parameters.
- To learn various theories of physical chemistry.
- To understand how liquid state and its physical properties are related to temperature and pressure variation.

- To develop the concept of solids, lattice parameters – its calculation, application of symmetry and solid characteristics of simple salts.
- Understand the mechanism of nucleophilic, electrophilic reactions.
- To understand the concept of aromaticity and Huckel rule.
- To familiarize the student with nucleophilic and electrophilic substitution reactions in aliphatic and aromatic compounds.

Course specific outcome:

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

- The concept of volumetric and gravimetric analysis and deducing the conversion factor for determination.
- Handling of toxic chemicals, concentrated acids and organic solvents and practice safety procedures.
- The concepts of organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming.
- .Various theories of gases and their significance.
- The concept of surface tension, viscosity, refraction and its significance.
- Different types of liquid crystals and their applications.
- The concept of unit cell, symmetry elements,Nernst distribution law.

Content of Theory Course 2	**56Hrs**
Unit – 1	
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 differences. **(2hrs)**	**14hrs**
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).. 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. **(4 hrs)** **(5hrs)**	

Unit – 2	
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.**(4hrs)** Aromatic electrophilic substitution reactions, mechanisms, σ and π complexes, halogenation, nitration, sulphonation, Friedal Crafts alkylation and acylation with their mechanism. Activating and deactivating groups. Orientation influence, ortho - Para ratio (Cl, NO_2, CH_3, NH_2, OH).**(5hrs)** Aromatic nucleophilic substitution reaction: S_NArmechanism, *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**.** **(5hrs)**	**14hrs**
Unit – 3	**14hrs**
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. 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, liquefaction of air by Linde's process. Numerical problems. **(8hrs)** **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.**(6hrs)**	
Unit - 4	**14hrs**
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)** **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. **(7hrs)**	

Recommended Text books/references:

1. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
2. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
3. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).
4. Physical Chemistry by Samuel Glasstone, ELBS (1982).
5. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
7. A Text book of Physical Chemistry, A S Negi& S C Anand, New Age International Publishers (2007).

8. Principles of Physical Chemistry, Puri, Sharma &Pathania, Vishal Publishing Co.
9. A Text Book of Physical Chemistry P.L.Soni , O.P. Dharmarhaand and U.N.Dash, Sultan Chand and Sons.
10. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House (2018)
11. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
12. Finar, I. L. Organic Chemistry (Volume I), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)

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

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

PRACTICALS-(SEMESTER II)

Course Outcome

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

1. Estimate components in a mixture, nitrite in a water sample and hardness of water by volumetry.
2. Estimate presence of nickel, barium and copper in solutions by gravimetry.
3. Measure physical properties of a liquid such as density, viscosity, surface tension and refraction using specific instruments.
4. Study the distribution phenomena of different systems and evaluate the Corresponding distribution coefficient

PART-A (Inorganic Chemistry)

Course Objectives:

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

Course specific outcome:

The student will learn

- To prepare standard solutions.
- Techniques like precipitation, filtration, drying and ignition.
- Various titrimetric techniques and gravimetric methods.
- Calculation on basis of mole concept and stoichiometry.

LIST OF EXPERIMENTS:

a) 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.

b) 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.

PART-B (Physical Chemistry)

Course Objectives:

- To learn various techniques for the measurement of viscosity, surface tension and refractive index
- To study the effect of concentration on viscosity and surface tension
- To determine the composition of a liquid mixture by Refractometry
- To calibrate and operate Abbe's Refractometer
- To understand the concept of distribution coefficient and Nernst Distribution law

Course specific outcome:

The student will able to

- Determine the density of liquids
- Understand how viscosity and surface tension of liquids vary with concentrations
- Determine the percentage composition of liquid mixtures using Abbe's Refractometer.
- Explain the concept of distribution coefficient, and dissociation in a layer.
- Describe the conditions required for liquefaction of gases
- Understand cooling effect of gas on adiabatic expansion
- Explain properties of liquids in terms of intermolecular attraction

LIST OF EXPERIMENTS:

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 chemical.

Recommended Books/References

1. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
3. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
4. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).
5. Athawale V. D. amd Mathur P. Experimental Physical Chemistry, New Age International (2001)

B.Sc Semester II
OPEN ELECTIVE-2

Title of the Course: OE-2:	MOLECULES OF LIFE
Number of Theory Credits	3
Number of lecture hours/ semester	42 hrs.

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 andenzyme specificity.
3. Depict the action of drugs in biological systems based on Receptor theory, SARstudies 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.

Course Objective:

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

Course specific outcome:

After studying this paper, the student would be able to:

1. Acquire knowledge about different types of sugars and their chemical structures
2. Identify different types of amino acids and determine the structure of peptides.
3. Explain the actions of enzymes in our body and interpret enzyme inhibition..
4. Depict the importance of lipids in the metabolism.
5. Differentiate RNA and DNA and their replication..
6. Explain production of energy in our body.

Content of Theory Course 2	42 hrs.
Unit – 1	**14hrs.**
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. **(8hrs)** **Amino acids, peptides and proteins** Classification ofamino acids, Zwitterion structure and isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of peptides. **(6hrs)**	
Unit – 2. **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). **(10hrs)** **Drug action**-receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH_2 group, double bond and aromatic ring. **(2hrs) Lipids.** Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol) **(2hrs)**	**14hrs.**

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. **(6hrs)** **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.**(8hrs)**	

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, and 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

BENGALURU CITY UNIVERSITY
I Semester B.Sc. Examination
QUESTION PAPER PATTERN
(2021-22 & onwards) (NEP-CBCS SCHEME)
Paper-I-CHEMISTRY

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

Instructions:

1. Question paper has three Parts. Answer all 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.

BENGALURU CITY UNIVERSITY
I Semester B.Sc. Examination,
QUESTION PAPER PATTERN
(2021-22 & onwards) (NEP-CBCS SCHEME)
CHEMISTRY
(OPEN ELECTIVE)

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

Instructions:

1. Question paper has three Parts. Answer all 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 following 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)

BENGALURU CITY UNIVERSITY

END SEMESTER B.SC. EXAMINATION,

QUESTION PAPER PATTERN FOR PRACTICAL EXAMINATION

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

CHEMISTRY PRACTICALS.

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

SCHEME

- **Marks for Procedure writing** **04 M**
- **Marks for viva-voce** **05 M**
- **Marks for performing experiment** **16 M**