ROYAL SCHOOL OF APPLIED & PURE SCIENCES (RSAPS)

DEPARTMENT OF CHEMISTRY

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (LOCF)

FOR UNDERGRADUATE PROGRAMME IN

B.Sc. (HONOURS) IN CHEMISTRY

W.E.F AY 2022-2023

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Preamble

Role of higher education is vital for the development of any society. Over the past decades, the higher education system of our country has experienced considerable structural and functional changes to prepare the students for the society at large. Quality education in general enables the student's fraternity to acquire humanistic skill and sound knowledge in order to enhance their thinking and creativity so that they can compete, succeed and excel globally. The introduction of Choice Based Credit System (CBCS) has provided different choices to the students to opt for the subjects of their interest. Further University Grants Commission (UGC) has initiated nation-wide adoption and implementation of Learning Outcome-based Curriculum Framework (LOCF) in the structure of the undergraduate programs to be offered by the Higher Educational Institutions to provide a focused, outcome- based syllabus with well-defined aims, objectives and goals to achieve. LOCF approach involves teacher-students interactions so that the students can easily recognize the purpose of each course and can understand their learning need.The key components planned in LOCF are the detailed description of the Graduate Attributes (GA), Qualification Descriptors (QD), Program Learning Outcomes (PLO) and Course Learning Outcomes (CLO) that to be achieved at the end of the successful completion of each undergraduateprogram.

The curriculum of B.Sc. (Hons.) Chemistry is focused on developing comprehensive understanding of the subject matter in terms of defined objectives and Learning Outcome. LOCF approach in B.Sc. (Hons.) Chemistry is adopted to make the course more flexible and to provide more options for the students to broaden their skills in the field of chemistry and interdisciplinary areas. The curriculum is designed not only to provide the personal and social skills to students but also to make them fit for academics and industry with sound theoretical and experimental knowledge.

1. Introduction to B.Sc. (Hons.)Chemistry

The curriculum of B.Sc. (Hons.) Chemistry has been designed to train learners with conceptual and practical knowledge of the subject under CBCS. It also offers sound skills to pursue research in the field of chemistry or in any other interdisciplinary areas. The learning outcomes are designed to help the students understand the objectives of studying the course which enable them to realize the various perspectives of applied sciences that benefit themankind.The course contents include fundamentals as well as

upcoming developments in the discipline of chemistry and interfacial sciences.

2. Programme, Duration and Design

The B.Sc. (Hons.) Chemistry course is a three years six semesters course which includes Core theory papers and corresponding practical papers along with Discipline Selective Elective (DSE) subjects. Ability Enhancement Compulsory Course(AECC) has also been introduced in the course that will empower the students to develop their communication skill to face the world. Along with the conventional teaching-learning method, Information and Communication Technology (ICT) method like use of power point presentations will be used. Students will carry out their research projects as per the curriculum and will also participate in different industrial and institutional visits, seminars and workshops to further boost their careerprospects.

Nature and Extent of Bachelor's Degree Programme in Chemistry (Honours)

Sl. No.	Year	No of Credits
1	1st year	48
2	2nd year	48

3. Outcome-based Curriculum Framework in B.Sc. (Hons.)Chemistry

The curriculum and syllabus for bachelor degree conform to outcome based teaching learning process. Each course in the program is designed with clear instructional objectives which are mapped to the student outcomes. The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. (Hons.) degree in chemistry offers a broad and balanced structural framework that includes all the current curricular needs. The LOCF in chemistry has designed courses in the light of graduate attributes, description of qualifications, courses and programme learningoutcomes.

An integrated curriculum allows the students to pursue learning in a holistic way, without the restrictions often imposed by subject boundaries. The flexibility of the curriculum enables students to pursue their coursework to best match their career interests. A more flexible programme, coupled with strong academic advising structures, allows students to find their strengths and interests and also to change direction if needed. An extensive range of advanced elective courses is available within

the department and across the University. The program of the course is designed to give students the opportunity to pursue other academic or extracurricular interests. Our innovative skills-based curriculum will give the student the tools to succeed in their degree and will assist them in making choices for theirfuture.

3.1 Nature and Extent of B.Sc. (Hons.)Chemistry

The curriculum has been designed to have insight in almost all the aspects of chemistry and to build a solid foundation in the subject to choose a career in industry or academics. The syllabus of the core subject very well covers most of the important areas of

chemistry. The curriculum also provides a good measure of flexibility and gives choices to select elective subjects. The B.Sc. (Hons.) chemistry programme provides an opportunity for the students to choose from the prescribed courses comprising core, inter-disciplinary, intra- disciplinary courses, department selective courses, electives and skill enhancement courses.

3.2 Aims of the Bachelor's Degree Programme in B.Sc. (Hons.)Chemistry

The aim of the curriculum is to provide the students an in-depth understanding of the basic concepts of chemical sciences. The core courses of the curriculum are designed to provide a sound education in the fundamental areas of modern chemistry. Students will develop a firm understanding in the general principles of chemistry. The students will understand how chemical principles are applied to address current problems in a variety of fields. They will develop and apply the appropriate lab skills and instrumentation techniques in performing various experiments. The curriculum offers flexibility for students to choose skill enhancement courses which will help the students to become more capable, competent as well asconfident in their performances.

4. Graduateattributes

GA1: Disciplinary knowledge: Capable of demonstrating knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

GA2: Problem solving: Capacity to induce from what one has learned and apply their knowledge to solve non-familiar problems, rather than replicate curriculum content knowledge; also apply one's learning to real life circumstances.

GA3: Critical thinking: Capability to apply analytic thought; analyse and evaluate evidence, claims, beliefs on the basis of empirical evidence; identify appropriate implications; formulate coherent arguments; evaluate practices, principles and theories through scientific approach to knowledge development.

GA4: Scientific reasoning and reflective thinking: Ability to interpret and draw conclusions from quantitative/qualitative data; and evaluate ideas and understandings from an open-minded perspective, critical sensibility to lived experiences, with reflexivity of both self and society.

GA5: Moral and ethical awareness/reasoning: Ability to hold ethical values in conducting one's life, formulate argument about an ethical issue from multiple perspectives. Capable of demonstrating the ability to avoid unethical behaviour such as fabrication, committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and unbiased and truthful actions in all aspects of work.

GA6: Ethics: would be made aware of the ethical practices such as copying, plagiarism and reproducing similar work. Importance should be given on originality of the work.

GA7: Cooperation/Team work: Ability to work respectfully with diverse teams; facilitate cooperative effort on the part of a group to act together as a team to work efficiently as a member of a team.

GA8: Research-related skills: A sense of inquiry and capability for asking relevant questions, synthesising and articulating; ability to recognise, define problems, formulate and test hypotheses, interpret and draw conclusions from data, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment.

GA9: Leadership qualities: Capability for mapping out the tasks of an organization, and setting direction, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination in an efficient way.

GA10: Lifelong learning: Ability to acquire knowledge and skills that are necessary for participating in learning activities, through self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place.

5. Programme Outcomes

PO1: **Knowledge of Chemistry**: The students shall gain the foundation and concepts in Chemistry in general. The students shall be able to relate the basic knowledge of Chemistry to the broad understanding of life and industrial processes.

PO2: **Problem analysis:** Identify, formulate, review literature, and analyze complex problems of chemistry and also think methodically, independently and draw a logical conclusion using the principles of chemical and basic sciences.

PO3: Design/development of solutions: The student shall have the ability for appreciating, understanding and developing strategies to address problem requiring knowledge and skills of Chemistry and come forward with innovative solutions.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Environment and sustainability: Understand the impact of chemical synthesis and find out the green route for chemical reaction for sustainable developmentsolutions in environmental context, and demonstrate the knowledge and need of sustainable development.

PO6: Ethics: A student should refrain himself/herself from the unethical input like plagiarism, and manipulation of data/information.

PO7: Teamwork: Though students may come from diverse fields but they must work in team when needed. The student should behave with fellow classmates in an accommodative as well as meaningful way. There should be some positive outcome from the team against the concerned issues

PO8: Project Management: One shouldgrow the ability to manage and demonstrate the experiment within the set limit. One should be capable to identify and organize proper resources required for a project for completion with ethical scientific conduct, safety and chemical hygiene is practiced.

PO9: Leadership Quality: Leadership quality is a very coveted characteristic for students which will lead to a very effective class of environment.

PO10: Lifelong learning: Each student should be motivated and groomed such that they become life-long learners which will make them a responsible and contributing citizen to the society.

6. Programme Specific Outcomes:

PSO1: Will get the clear understanding of the fundamental concepts in different branches of chemistry like analytical, organic, inorganic, physical, etc. and its applications through various laboratory experiments.

PSO2: Students will understand nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions and will learn to predict the products of unknown reactions.

PSO3: Students will learn to synthesize the chemical compounds by the required knowledge of various reagents under optimum reaction conditions and research oriented skills will be developed among the students.

PSO4: Understand good laboratory practices and safety and will be able to perform scientific experiments skillfully by applying required knowledge of analytical chemistry.

7. Teaching – learningprocess:

Effective teaching learning process lays strong foundation for achieving academic success. Teaching and learning are the two interconnected processes in imparting quality education. The objective of this teaching learning process is to strengthen student's overall skills and to get good university results. B.Sc. (Hons) chemistry offers the students a three- year degree programme. The programme includes foundational as well as in-depth core subject materials of chemistry. Along with the above core courses there are discipline specific elective courses, generic elective courses and ability enhancement courses, etc.

The main method of sharing knowledge is through lectures, the associated hand-outs and supporting materials. Regular lectures are supported by associated problem solving sessions. The course materials are delivered through classroom, laboratory work, field visits, projects, case studies and field work in a challenging, engaging, and inclusive manner using various teaching learning styles and tools (PowerPoint presentations, audio visual aids, e- resources, seminars, workshops, models, varioussoftware's etc.). Various innovative approaches are also adopted by University in teaching learning process like guest lectures or expert lectures by eminent persons from industry & academic, faculty exchange programs in collaboration with various renowned Universities in various parts of the country etc.

The faculty member takes personal care to improve the student's skill and learning abilities. Students are encouraged to work together in groups or in team work which leads to development of interpersonal skills. University modify and upgrade their curriculum from time to time to provide the up to date knowledge and skills to our students. To improve their communication skills and confidence level, they are provided with a platform to give presentations, participate in group discussions and debates. The training and placement cell conducts necessary training sessions on a regular basis to impart logical, interpersonal, communication and technical skills. Through proper training, students get exposure to new technologies,industrial environment thereby securing placements in the best industries. Majority of the lecture modules are assessed on the basis of written exams and practical exams at the end of the academic session. Student project work is assessed by oral presentation, written reports etc. The faculty member interacts with assigned student group at regular intervals and records studentdetails.

8. Programme Evaluation

8.1 The Programme structures and examinations shall normally be based on Semester System. However, the Academic Council may approve Trimester/Annual System for specified programmes.

8.2 In addition to end term examinations, student shall be evaluated for his/her academic performance in a Programme through, presentations, analysis, homework assignments, term papers, projects, field work, seminars, quizzes, class tests or any other mode as may be prescribed in the syllabi. The basic structure of each Programme shall be prescribed by the Board of Studies and approved by the Academic Council.

8.3 Each Programme shall have a number of credits assigned to it depending upon the academic load of the Programme which shall be assessed on the basis of weekly contact hours of lecture, tutorial and laboratory classes, self-study. The credits for the project and the dissertation shall be based on the quantum of work expected.

8.4 Depending upon the nature of the programme, the components of internal assessment may vary. However, the following suggestive table indicates the distribution of marks for various components in a semester: -

	Component of Evaluation	Marks	Frequency	Code	Weightage (%)
A	**Continuous Evaluation**				
	Analysis/Class test	ombination of any three from (i) to (v) with 5 marks each	1-3	C	25%
	Home Assignment		1-3	H	
	Project		1	P	
	Seminar		1-2	S	
	Viva-Voce/Presentation		1-2	V	
	MSE	SE shall be of 10 marks	1-3	Q/CT	
	Attendance	tendance shall be of 5 marks	100%	A	5%
	Semester End Examination		1	SEE	70%
					100%

9. Course Structure of B.Sc. (Hons.)Chemistry

Semester wise Details of B.Sc. (Hons.) Chemistry Course & Credit Scheme

1st Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	CHY012C101	Physical Chemistry I	3	1	0	4	4
2	CHY012C102	Inorganic Chemistry I	3	1	0	4	4
3	CHY012C113	Chemistry Lab I	0	0	8	4	8
Skill Enhancement Courses (SEC)							
4	CHY012S111	Preparation and Estimation Techniques	0	0	4	2	4
Value Addition Courses (VAC)							
5		Select one course from a basket of course	2	0	0	2	2
Generic Elective (GE)							
6	CHY012G101	Chemistry I	2	0	1	3	3
7	CHY012G102	Basic Analytical Chemistry	3	0	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
9	CEN982A101	Communicative English-I	1	0	0	1	1
10	BHS982A102	Behavioural Science-I	1	0	0	1	1
Total Credit:24							

2nd Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	CHY012C201	Physical Chemistry-II	3	1	0	4	4
2	CHY012C202	Organic Chemistry-I	3	1	0	4	4
3	CHY012C213	Chemistry Lab II	0	0	8	4	8
Skill Enhancement Courses (SEC)							
4	CHY012S211	Basic Preparative Techniques in Chemistry and Food Analysis	0	0	4	2	4
Value Addition Courses (VAC)							
5	CHY012V201	Chemistry of the Environment	2	0	0	2	2
Generic Elective (GE)							
6	CHY012G201	Chemistry II	3	0	0	3	3
7	CHY012G202	Environmental & Green Chemistry	3	0	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
8	CEN982A201	Communicative English-II	1	0	0	1	1
9	BHS982A202	Behavioural Science-II	1	0	0	1	1

Total Credit:24							
3rd Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	CHY012C301	Inorganic Chemistry II	3	1	0	4	4
2	CHY012C312	Chemistry Lab III	0	0	8	4	8
Discipline Specific Courses (DSE) (Any one)							
3	CHY012D301	Organic Chemistry II	3	1	0	4	4
	CHY012D302	Chemistry of Life	3	1	0	4	4
Generic Elective (GE)							
4	CHY012G301	Chemistry III	2	0	1	3	3
5	CHY012G102	Basic Analytical Chemistry	3	0	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
6	CEN982A301	AECC5 (CEN3)	1	0	0	1	1
7		AECC6 (ILD)	1	0	0	1	1
Internship							
8		4 weeks internship after 2nd sem	**0**	**0**	**0**	**4**	**4**
Total Credit:24							

4th Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	CHY012C401	Physical Chemistry III	3	1	0	4	4
2	CHY012C412	Chemistry Lab IV	0	0	8	4	8
Discipline Specific Courses (DSE) (any one)							
3	CHY012D401	Inorganic Chemistry III	3	1	0	4	4
	CHY012D402	Chemistry of Natural Products	3	1	0	4	4
Skill Enhancement Courses (SEC)							
4	CHY012S411	Analytical Laboratory Methods	0	0	4	2	4
Value Addition Courses (VAC)							
5	CHY012V401	Chemistry in Everyday Life	2	0	0	2	2
Generic Elective (GE)							
6	CHY012G401	Chemistry IV	3	0	0	3	3
7	CHY012G202	Environmental & Green Chemistry	3	0	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
8	CEN982A401	AECC7 (CEN4)	1	0	0	1	1
9		AECC8 (Functional Language)	1	0	0	1	1
Total Credit:24							

Legend: L: Lecture Class; T: Tutorial Class; P: Practical Class: C: Total Credits

5th Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	CHY012C501	Organic Chemistry III	3	1	0	4	4
2	CHY012C512	Chemistry Lab V	0	0	8	4	8
Discipline Specific Courses (DSE) (Any Two)							
3	CHY012D501	Spectroscopy	3	1	0	4	4
	CHY012D502	Supramolecular Chemistry	3	1	0	4	4
	CHY012D503	Physical Chemistry IV	3	1	0	4	4
	CHY012D504	Polymer Chemistry	3	1	0	4	4
Value Addition Courses (VAC)							
4	CHY012V501	Green Chemistry	2	0	0	2	2
Ability Enhancement Compulsory Courses (AECC)							
5		AECC9	1	0	0	1	1
6		AECC10	1	0	0	1	1
Internship							
7		6 weeks internship after 4th sem	**0**	**0**	**12**	**6**	**6**
		Total Credit:26	**Total**			**26**	**30**

6th Semester							
Core							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
1	CHY012C601	Quantum Chemistry	3	1	0	4	4
2	CHY012C622	Project (Review Writing/Experimental)	0	0	8	4	8
Discipline Specific (DSE) (any Three)							
3	CHY012D601	Inorganic Chemistry IV	3	1	0	4	4
	CHY012D602	Food Chemistry	3	1	0	4	4
	CHY012D603	Analytical Chemistry	3	1	0	4	4
	CHY012D604	Chemistry of Cosmetics and Antioxidants	3	1	0	4	4
	CHY012D605	Organic Chemistry IV	3	1	0	4	4
	CHY012D606	Nanochemistry	3	1	0	4	4
Skill Enhancement Course (SEC)							
4	CHY012S611	Chemistry of Biomolecules	0	0	4	2	4
Value Addition Course (VAC)							
5	CHY012V601	Medicinal & Pharmaceutical Chemistry	2	0	0	2	2
Ability Enhancement Compulsory Courses (AECC)							
6		AECC11	1	0	0	1	1
7		AECC12	1	0	0	1	1
		Total				**26**	**28**

SYLLABUS (1st Semester)

Subject Name: Physical Chemistry I Subject Code: CHY012C101
L-T-P-C: 3-1-0-4 Credit Units: 4 Scheme of Evaluation: T

Objective: The objective of **Physical Chemistry I** is To understand and apply the concepts of classicalthermodynamics and kinetics of chemical reactions to measure the rate and feasibility of a reaction.

Course Outcomes:

After successful completion of the course, student will be able to

Sl No	Course Outcome	Bloom's Taxonomy Level
CO1	**Define** and gain the knowledge from laws of thermodynamics to solve the complex problems of physical chemistry	BT1
CO2	**Explain** the concept of thermodynamical parameters and their importance to interpret the spontaneity of reaction.	BT2
CO3	**Apply** the knowledge of chemical kinetics and analyze chemical reactions and reaction mechanism.	BT3
CO4	**Analyze** the different energy exchange processes.	BT4

Prerequisites:

- Concept of Differential Calculus and Integral Calculus from HS (10+2) level.
- Concept of Ordinary Differential Equation from HS (10+2) level.

Detailed Syllabus:

Modules	Topics & Course Content	Periods
I	**Chemical Thermodynamics-I** Terminology used in thermodynamics (system, surroundings,extensive and intensive properties, state and path functions), concept of heat and work. *First law:* Internal energy, statement first law, Calculation of w, q, ΔU &ΔH for expansion of ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes, heat capacity and relation between C_p&C_v, Joule-Thomson experiment, relation between P,V and T in adiabatic processes, limitations of first law. *Thermochemistry:* Heats of reactions: standard enthalpy changes, Hess's Law of heatsummation and its applications, calculation of bond dissociation energy from thermochemical data, effect of temperature on enthalpy of reactions (Kirchhoff's equation).	**12**

II	**Chemical Thermodynamics-II** *Second Law*: Different statements of the law, Cornot's cycle and its efficiency, Carnot's theorem *Concept of entropy*: Entropy as a criteria of spontaneity and equilibrium,entropy change for an ideal gas, entropy of phase transitions, entropy of mixture of ideal gas, entropy of mixing. *Gibbs and Helmholtz functions:* Gibbs function (G) and Helmhotz (work) function (A) as thermodynamic quantities, criteria of spontaneity, variation of G with T and P, Maxwell relations, Gibbs-Helmholtz equation	**12**
III	**Third Law of Thermodynamics &Chemical Equilibrium** *Third law*: Nernst heat theorem, statement of third law, residual entropy. Equilibrium constant, thermodynamic derivation of law of mass action, equilibrium constant of a reaction in terms of standard Gibb's free energy, relation between K_p and K_c, Le Chatelier principle, van't Hoff isotherm and isochore, Clapeyron-Clausius equation and its applications.	**12**
IV	**Chemical Kinetics** Reaction rate, factors influencing the rate of a reaction, rate law, order and molecularity of a reaction, differential and integrated form of rate expressions for zero, first and second order reactions, half-life period, determination of the order of reaction by various methods, effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Consecutive, concurrent and opposing reactions, differential rate equations and steady-state approximation in reaction mechanisms, problems on steady-state approximation. Kinetics of chain reaction (Rice-Herzfeld mechanism), H_2-Br_2 reaction.	**12**
TOTAL		**48**

Text Books:

1. *Physical Chemistry*, Atkins P. W.andPaulaJ. de; 11th edition; 2018; Oxford UniversityPress.
2. *Principles of Physical Chemistry*; Puri, B.R.; Sharma, L.R.; Pathania, M.S.; 48th edition; 2020; Vishal PublishingCompany.

Reference Books:

1. Glasstone, S.; *Text book of Physical Chemistry;* 11th edition; 2011; Van Nostrandcompany.
2. Atkins, P.W. and Paula, J. de; *Elements of Physical Chemistry;*7th edition; 2018; Oxford UniversityPress.
3. Kapoor, K. L.; *A textbook of Physical chemistry*; 8th edition,; 2018; Macmillan, India

Ltd.
4. Bokris, J.A. and Reddy, A.K.N; *Modern Electrochemistry*; Vols. 1&2; Kluwer AcademicPublishers

SYLLABUS (1stSemester)

Subject Name: Inorganic Chemistry I		**Subject Code: CHY012C102**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Inorganic Chemistry I** is to provide basicunderstanding and application of structure of atom and periodicity of atoms along with their bonding prospective to form compounds, also a brief idea of their acid and base properties.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** and get the detailed idea of atomic structure, their periodicity and chemical bonding along with acid base properties.	BT1
CO2	**Explain** the principle and apply the knowledge for solving the problems related to their structure and bonding.	BT2
CO3	**Apply** the idea to interpret changes of properties along the periods and group.	BT3
CO4	**Analyze** the details of acidic and basic nature of compounds formed by chemical boding as well as to critically determine titrimetric behaviour.	BT4

Detailed Syllabus:

Modules	Topics & Course Content	Periods

I	**Fundamentals of Atomic Structure** Basic quantum mechanical ideas and principles leading to atomic structure, black body radiation, Planck's hypothesis, wave character of particles-electrondiffraction, discrete nature of energy levels of atomic and molecular systems,line spectra of atoms and molecules, de Broglie hypothesis, uncertainty principle. Schrödinger wave equation, significance of ψ and ψ^2, quantum numbers, radial and angular distribution curves, shapes of *s*, *p*, *d* and *f* orbitals, probability diagrams, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle, variation of orbital energy with atomic number.	**12**
II	**Periodicity of Elements** s, p, d, f block elements, the long form of periodic table, detailed discussion of the following properties: effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table, atomic radii (van der Waals), ionic and crystal radii, covalent radii, ionization enthalpy, electron gain enthalpy, electronegativity: Pauling's, Mulliken's, Allred Rachow's and Mulliken-Jaffe's electronegativity scales, variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.	**12**
III	**Chemical Bonding I** Ionic bonding: size effects, packing of ions in crystals, lattice energy, Born-Lande equation and its applications, Born-Haber cycle and its applications. Solvation energy, polarizing power and polarizability, ionic potential, Fazan's rule. Covalent bonding: Lewis structures, formal charge. Valence bond theory, directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs, bond moment and dipole moment, concept of resonance, resonance energy, resonancestructures.	**12**
IV	**Acid-Base Concept** Arrhenius concept, theory of solvent system (H_2O, NH_3, SO_2 and HF), Bronsted- Lowry's concept, relative strength of acids, Pauling rules, amphoterism, Lux- Flood concept, Lewis concept. superacid, HSAB principle. acid base equilibria in aqueous solution and pH, acid-base neutralisation curves, indicator, choice of indicators.	**12**
TOTAL		**48**

Text Books:

1. *Concise Inorganic Chemistry*; Lee, J.D.; 5th edition; 2013; John Wiley and Sons Ltd.; Indian Edition.
2. *Inorganic Chemistry Principles of Structure and Reactivity*; Huheey, J.E., Keiter, E. A., Keiter, R. L. and Medhi, O. K. ; 4th edition; 2007; PearsonEducation.

ReferenceBooks:

1. *Inorganic Chemistry*; Atkins, P., Overtone, T., Rourke, J., Weller, M. and Armstrong, F.; 6th edition; 2014; Oxford University Press; Indianedition.
2. Cotton F.A., Wilkinson, G., Murillo A., BochmannM.;*Advanced Inorganic Chemistry;*6th edition; 2007; Wiley Interscience; NewYork.

SYLLABUS (1stSemester)

Subject Name: Chemistry Lab I		**Subject Code: CHY012C113**
Laboratory L-T-P-C–0-0-8-4	**Credit Units:4**	**Scheme of Evaluation: P**

***Objective*:The objective of Chemistry Lab I**isto provide the knowledgeof estimation of chemical species with titrimetric, viscometric and kinetic analysis as well as practical experience of inorganic compound synthesis.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Show** the preparation of inorganic compounds and salt.	BT1
CO2	**Demonstrate** the estimation the impurities in water and inorganic compounds in solutions.	BT2
CO3	**Experiment** with various techniques to determine the chemical elements present in sample.	BT3
CO4	**Compare** the viscosity, surface tension of unknown solutions and to inspect the rate of reaction.	BT4

Detailed Syllabus:

1. Preparation of following Inorganic compounds:
   a) Chrome alum, $K_2SO_4.Cr_2(SO_4)_3.24H_2O$
   b) Ferrous ammonium sulfate or Mohr salt, $FeSO_4.(NH_4)_2SO_4.6H_2O$
2. To determine the total hardness of water by titration with EDTA
3. Estimation of Ferrous ionFe(II) using $KMnO_4$ solution
4. Estimation of copper by using standard solution of sodium thiosulphate
5. To determine the water of crystallization of green vitriol by titration of its prepared solution with $KMnO_4$ solution
6. To determine the coefficient of viscosity of a given liquid by Ostwald viscometer.
7. To determine the composition of a given mixture by viscosity method.

8. To determine the surface tension of a liquid by stalagmometer.
9. To determine the composition of a given mixture by surface tension method.
10. To determine the specific reaction rate of hydrolysis of methyl acetate catalysed by hydrogen ions at room temperature.
11. To study the rate of acid catalysed iodination of acetone.

Text Books:

1. *A text Book of Practical Chemistry*, Barua, S, 2th edition; 2016; KalyaniPublishers.
2. *Vogel's Qualitative Inorganic Analysis;* Svehla G. and Sivasankar B.; 7thedition; Pearson.

Reference Books:

1. Mendham J., Denney R.C., Barnes J.D. and. ThomasM.J.K.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th edition, 3rd Indian Reprint, 2003, Pearson Education Pvt. Ltd., NewDelhi
2. Halpern,M.;*Experimental Physical Chemistry*, 6th edition, 2008; Prentice Hall, Upper Saddle River, NJ07458

SYLLABUS (1stSemester)

Subject Name: Preparation and Estimation Techniques		**Subject Code: CHY012S111**
L-T-P-C–0-0-4-2	**Credit Units:2**	**Scheme of Evaluation: P**

Objective:

The objectives of **Preparation and Estimation techniques** are to make students familiar with organic and inorganic preparation methods with hands on practical. It will also improve the understanding of the concepts of estimation and separation processes.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** and gain the preparation knowledge of inorganic compounds.	BT1

CO2	**Explain** the concept of organic synthesis methods	BT2
CO3	**Apply** the knowledge of chromatography in separation of compounds.	BT3
CO4	**Analyse** and **Estimate** the species present by gravimetry.	BT4

1. **Preparation of following Inorganic compounds**:
   I. Potash alum
   II. Sodiumtrioxalatoferrate(III)
2. **Preparation of following Organic compounds**:
   I. Aspirin
   II. *p*-Bromoaniline
3. **Chromatography**:
   I. To separate and identify the amino acids by ascending paper chromatography.
   II. To separate and identify the sugars by ascending paper chromatography.
   III. Separation of a mixture of dyes by column chromatography.

4. **Gravimetry**
   I. Estimation of Silver
   II. Estimation of Barium
   III. Estimation of Sulphate
5. **Demonstration of UV-Vis Spectrophotometer**
6.

Text Books:

1. A text Book of Practical Chemistry, Barua, S, 2th edition; 2016; KalyaniPublishers.

2. Vogel's Qualitative Inorganic Analysis; Svehla G. and Sivasankar B.; 7th edition; Pearson.

Reference Books:

1. Mendham J., Denney R.C., Barnes J.D. and. ThomasM.J.K.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th edition, 3rd Indian Reprint, 2003, Pearson Education Pvt. Ltd., NewDelhi
2. V*ogel's Textbook of Practical Organic Chemistry*, Vogel A.I., Aurther I., 5th Edition, 2005,Pearson

SYLLABUS (1st Semester)(Generic)

Subject Name: Chemistry I (Generic) List-I **Subject Code: CHY012G101**
L-T-P-C: 2-0-1-3 **Credit Units: 3** **Scheme of Evaluation: (T)**

Objective: The objective of **Chemistry I (Generic)** is to make students familiar with origin of quantum theory and atomic structure. It will help students to understand the bonding and structure of molecules, and also evaluate acidic-basic character of compounds.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the concepts of quantum theory.	BT1
CO2	**Explain** the theories of chemical bonding.	BT2
CO3	**Apply** the concept of hybridization to geometry.	BT3
CO4	**Examine**the compounds to determine the chemical components present in sample.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Fundamentals of atomic structure** Origin of Quantum theory (black body radiation, heat theory, H-atom spectra, photo-electric effect), calculations based on Bohr's theory of H-atom – atomic spectra of hydrogen atom, wave-particle duality, de Broglie hypothesis, Heisenberg's uncertainty principle. Schrödinger wave equation, significance of ψ and ψ^2, quantum numbers, radial and angular distribution curves, shapes of *s*, *p*, *d* and *f* orbitals, probability diagrams, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle, variation of orbital energy with atomic number.	**6**

II.	**Chemical Bonding** Ionic bonding: Size effects, radius ratio rules and their limitations, lattice energy, Born-lande equation and its applications, Born-Haber cycle. Covalent bonding: Valence bond theory, hybridizations, VSEPR theory, shapes of molecules and ions containing lone pairs and bond pairs, dipole moment, electronegativity.	**6**
III.	**Structure and bonding of Organic compound** Hybridization, localized and delocalized chemical bond, resonance, conditions of resonance, Electronic displacements: inductive effect, electrometric effect, mesomeric effect &hyperconjugation, nature of fission of covalent bond, type of reagents: nucleophiles and electrophiles, Reaction intermediates: carbocations, carbanions, free radicals, carbenes, nitrenes, and benzynes.	**6**
IV.	**Acid-Base concept** Arrhenius concept, Bronsted-Lowry's concept, relative strength of acids, Pauling rules, amphoterism, Lewis concept, superacids, HSAB principle, acid base equilibria in aqueous solution and pH, acid-base neutralisation curves.	**6**
Total		**24**

List of Experiments:

1) To determine the strength of the given glucose solution by titrating with Fehling's solution.
2) Estimation of Ferrous Iron, Fe (II) using potassium permanganate solution.
3) Estimation of copper by using standard solution of sodium thiosulphate ($Na_2S_2O_3$)
4) To determine the coefficient of viscosity of the given liquid at a given concentration by using Ostwald's viscometer.

Text Books:

1. *Organic Chemistry*, MorrisonR. T. and BoydR.N., Bhattacharjee S.K.B.,6th edition, 2011, published by Prentice Hall.
2. *A text Book of Practical Chemistry*, Barua, S, 2th edition; 2016; Kalyani Publishers.

Reference Books:

1. Huheey, J.E. Keiter, E.A. Keiter, R.L Medhi, O.K.; *Inorganic Chemistry Principles of Structure and Reactivity*; 4th edition, 2006; Pearson Education.
2. Sen, B.K.; Quantum Chemistry Including Spectroscopy; 4th edition; 2018; KakyaniPublisheres, New Delhi.
3. Vogel's Qualitative Inorganic Analysis; Svehla G. and Sivasankar B.; 7thedition Pearson.

SYLLABUS (1stSEMESTER)(Generic)

Subject Name: Basic Analytical Chemistry (Generic) (List-II)Subject Code: CHY012G102
L-T-P-C : 3-0-0-3 Credit Units: 3 Scheme of Evaluation: (T)

Objective: The objective of **Basic Analytical Chemistry** isto provide the basic concept of chemical analysis through separation Techniques and titrimetric analysis. The students will also be able analyse the experimental data using data analysis knowledge.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Relate** the importance of chemical analysis withinstrumental techniques	BT1
CO2	**Explain** the concept of separation techniques and chromatographic techniques.	BT2
CO3	**Apply** titrimetric analysis in quantitative sample determination	BT3
CO4	**Analyze** the accuracy and types of errors in experimental data.	BT4

Detailed Syllabus:

Modules	Topics/ Course content	Hours
I	**Chemical analysis:** Introduction, stages of analysis, qualitative and quantitative analysis, importance of instrumental techniques, factors affecting the choice of analytical method.	**9**
II	**Separation Techniques:** Introduction, bulk separation, instrumental separation, filtration, solvent extraction, crystallisation and precipitation. Basic principles of chromatographic separation- Gas chromatography, liquid chromatography and thin layer chromatography.	**9**
III	**Titrimetric analysis:** Introduction, classification of reactions in titrimetric analysis, standard solution- primary and secondary standard. Principles of potentiometric titration, conductometric titration and complexometric titration.	**9**

IV	**Errors and accuracy**:Definition of Significant figures, accuracy and precision, mean, median, variance, deviation, relative mean deviation, standard deviation. Error-Determinate and indeterminate error, absolute errors, relative errors.	**9**
Total		**36**

Text Books:

1. *Fundamentals of Analytical Chemistry,* Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch,Cengage Learning, **2013**
2. *Vogel's Quantitative Chemical Analysis,* J Mendham, R C Denney, J D Barnes and M J K Thomas, 6th Edition, **2009**

Reference Books:

1. *Analytical Chemistry,*Gary D. Christian, 6ed Paperback – **2007**

SYLLABUS (2nd Semester)

Subject Name: Physical Chemistry-II **Subject Code: CHY012C201**
L-T-P-C–3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Course Objective:The objective of **Physical Chemistry-II** is to learn the concepts of different states of matter, colligative properties ofsolutions and principles ofelectrochemistryand to apply it in different chemical reactions.

Course Outcomes:

After successful completion of the course, student will be able to

Sl No	Course Outcome	Bloom's Taxonomy Level
CO1	**Relate** the ideal and non- ideal behaviors of (real)gas, critical phenomena ofgases, solutions properties and electrolytic conduction	BT1
CO2	**Explain** the properties of liquid and conductivity of strong and weak electrolytes.	BT2
CO3	**Apply** the concept of colligative properties to determine the molar mass of solutes.	BT3
CO4	**Compare** the critical phenomena of gases, buffer action, pKa and pKb, buffer solution	BT4

Detailed Syllabus:

Modules	Topics & Course content	Periods
I	**Gaseous State** Postulates of kinetic theory of gases, derivation of the kinetic gas equation, Maxwell's distribution of molecular velocities, root mean square, average and most probable velocities, collision number, collision frequency, mean free path and collision diameter. *Behaviour of real gases:* Deviations from ideal gas behaviour,compressibility factor (Z),causes of deviation from ideal behaviour der Waals equation of state. *Critical phenomena:* P-V isotherm of real gases, principle ofcontinuity of states, critical constants, relationship between critical constants and van der Waals constants, law of corresponding states.	**12**
II	**Liquid State** Qualitative treatment of the structure of liquid state, physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination, effect of temperature on surface tension and viscosity, explanation of cleansing action of detergents. *Liquid crystals*: An introduction to liquid crystals, classification and properties of liquid crystals.	**12**
III	**Solutions and Colligative Properties** Dilute solutions, Raoult's law and Henry's law, definition of colligative properties: lowering of vapour pressure, elevation of boiling point, freezing point depression and osmotic pressure, thermodynamic treatment of colligative properties, abnormal colligative properties due to dissociation and association, van't Hoff factor, applications in calculating molar masses of normal, dissociated and associated solutes in solution.	**12**

IV	**Electrolytic Conduction** Conductivity, equivalent and molar conductivity, dependence of molar conductivity on concentration and temperature, Kohlrausch's law of independent migration of ions, Debye-Hückel-Onsager equation, activity of ions, DebyeHuckel theory (elementary ideas) of strong electrolytes, transport number of ions and itsdetermination. Arrhenius theory of electrolytic dissociation, strong and weak electrolytes, degree of dissociation of weak acids and bases, Ostwald's dilution law, ionic product of water, solubility product of sparingly soluble salts, conductometric titrations, concept of pKa and pKb, buffer solution, derivation of Henderson equation, buffer action.	**12**
	Total	**48**

Text Books:

1. *Physical Chemistry*, Atkins P. W. and Paula J. de; 10th edition; 2014; Oxford UniversityPress
2. *Principles of Physical Chemistry*; Puri, B.R.; Sharma, L.R.; Pathania, M.S.; 47th edition; 2016; Vishal PublishingCompany

Reference Books:

1. Glasstone, S.; *Text book of Physical Chemistry;* 11th edition; 2011; Van Nostrandcompany.
2. Atkins, P.W. and Paula, J. de; *Elements of Physical Chemistry;* 6th edition; 2018; Oxford UniversityPress.
3. Kapoor, K. L.; *A textbook of Physical chemistry*; 6th edition,; 2018; Macmillan, India Ltd.
4. Bokris, J.A. and Reddy, A.K.N; *Modern Electrochemistry*; Vols. 1&2; Kluwer AcademicPublishers

SYLLABUS (2ndSEMESTER)

Subject Name: Organic Chemistry-I		**Subject Code: CHY012C202**
L-T-P-C: 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Course Objective:the objective of **organic chemistry I** is to provide in-depth knowledge related to the fundamental concepts on organic parameters which is required to rationalize and predict the chemical reactivity

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy**

		Level
CO1	**Illustrate** different parameters like aromaticity, inductive effect, etc. which is vital to understand the chemical reaction	BT1
CO2	**Apply** the concept of chemical kinetics in the field organic reaction mechanism.	BT2
CO3	**Analyse** the stereochemistry of different synthetic molecules.	BT3

Detailed Syllabus:

Module	Topics & Course Content	Periods
I	**Introduction to organic compounds** Unique properties of organic compounds, sources of organic compounds, classification of organic compounds on the basis of their functional groups, homologous series, IUPAC nomenclature for organic compounds with single and multiple functional groups, chain, position and functional group isomerism, special types of organic compounds. Covalent bond, hybridization of carbon in organic compounds, orbital representation of methane, ethane, ethyne and benzene.	**12**
II	**Chemical Bonding and structure of organic molecules** Bond angles, bond length and bond energies, resonances or mesomeric effect and aromaticity, tautomerism, hydrogen bonding and its effect on the properties, polarity of bonds. Structural effects like inductive, resonance, hyper conjugation, steric effect and their influence on acidity and basicity of organic compounds, pKa and pK values of common organic acids and bases.	**12**
III	**Stereochemistry-I** Isomerism, types of stereoisomerism - conformational and configurational isomers, enantiomers &diastereomers. Classification of molecular symmetry. Optical isomerism – optical activity, Criteria for showing optical activity, stereogenic centre, molecular chirality, racemic modification, methods of resolution of racemic modification, D, L and R, S configuration for asymmetric and dissymmetric molecules, Cahn-Ingold-Prelog rules. Conformational isomerism, conformation of acyclic systems, projection formula-Newman projections and Sawhorse formulae, Fischer and flying wedge formulae.	**12**
IV	**Organic reaction mechanism I** Idea of driving force, activation energy, transition state, energy profile diagrams, concept of kinetic and thermodynamic control of reactions, types of bond fission, types of reagents – electrophiles and nucleophiles, types of reaction intermediates - carbocations, carbanions, free radicals, carbenes, arynes and nitrenes, methods of determination of reaction mechanism. Elimination reaction: ß-elimination reaction - base catalyzed and pyrolytic elimination.	**12**

TOTAL	48

Text Books:

1. *Organic Chemistry*, Morrison R. T. and Boyd R.N., BhattacharjeeS.K.B., 6thedition, 2017, published by PrenticeHall.
2. *Organic Chemistry*, Finar I.L.6th edition, (Low price), 2017, PearsonEducation.
3. *Organic Chemistry*, Stanley H. Pine, 5th edition,2014, McGraw-Hill Bool.
4. *Organic Chemistry*, Solomons T.J., 11th Revised edition,2013, John Wiley & Sons Inc.

Reference Books:

1. Sykes, P. *A guide book to mechanisms in Organic Chemistry*, 6th edition, 2003, Pearson India.
2. Kalsi P.S., *Organic Reactions and their Mechanisms*, 4thdition, 2017, New Age International.
3. Nasipuri, *Stereochemistry of Organic Compounds: Principles and Applications*, 3rd edition, 2018, Wiley &sons.

SYLLABUS (2ndSEMESTER)

Subject Name: Chemistry Lab II **Subject Code: CHY012C213L-T-P-C: 0-0-8-4** **Credit Units: 4** **Scheme of Evaluation: P**

Course Objective: The objective of **Chemistry Lab II**is to improve the understanding of the theoretical concepts and application of organic chemistry as well as to grow the practical knowledge.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Relate** the techniques that are useful in modern applied chemistry.	BT1
CO2	**Interpret** analytical abilities for independent thinking.	BT2
CO3	**Make use** of the functional group analysis of simple organic compounds tosynthesize different derivatives of simple organic molecules	BT3
CO4	**Distinguish** different methods for the preparation of complexes	BT4

Detailed Syllabus:

A. Qualitative analysis of organic sample should be done by eachstudent.

1. Detection of special elements (N, Cl, S) by Lassaigne'stest
2. Solubility and Classification (solvents: H_2O, 5% HCl, 5% $NaHCO_3$, 5%NaOH)
3. Detection of the following functional groups by systematic chemical tests: Aromatic amino ($-NH_2$), aromatic nitro ($-NO_2$), amido ($-CONH_2$, including imide), Phenolic – OH, Carboxylic acid (-COOH), Carbonyl (>C=O); only one test foreach functional group is to be reported along with confirmatory test, if any existsthere.
4. Preparation of derivative and purification bycrystallization
5. Determination of M.P. of the given sample and itsderivative

   Each student, during laboratory session, is required to carry out qualitative chemical tests for all the special elements and the functional groups in known and unknown (at least 5)

B. The following preparations are to be done by each student in class. Any one of these will be required to be done in theexamination.

1. Acetylation: Preparation of acetanilide from aniline OR preparation of aspirin from salicylic acid (any oneonly).
2. Nitration: Preparation of m-dinitrobenzene from nitrobenzene OR preparation of p- nitro acetanilide from acetanilide (any oneonly).
3. Preparation of benzanilide fromaniline

C. Purification of mixture of amino acids by PaperChromatography

D. To determine the strength of a given glucose solution by Fehling'ssolution

Text Book:

1. *Vogel's Qualitative Inorganic Analysis;* Svehla G. and Sivasankar B.; 7th edition; Pearson.
2. V*ogel's Textbook of Practical Organic Chemistry*, Vogel A.I., Aurther I., 5th Edition, 2005,Pearson.

Reference Books:

1. Agarwal O. P.,*Advanced Practical Organic Chemistry*, 2nd Edition, 2014, GoelPublishing.

SYLLABUS (2nd Semester)(SEC)

Subject Name: Basic Preparative Techniques in Chemistry andFood Analysis **Subject Code: CHY012S211**
L-T-P-C: 0-0-4-2 **Credit Units: 2 Scheme of Evaluation: P**

Objective: The **Basic preparative techniques in chemistry and food analysis** is to provide the practical knowledge of synthesis of inorganic and organic compounds as well as some basic techniques for determination the adulterants in food stuffs

Course outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Relate** the techniques that are useful in preparation of inorganic and organic compounds.	BT1
CO2	**Demonstrate** the synthetic methods for preparation of inorganic and organic compounds of practical importance.	BT2
CO3	**Make use** of the synthetic techniques to prepare different derivatives of simple organic molecules as well as coordination compounds.	BT3
CO4	**Demonstrate**different methods for finding the adulterants in food stuffs.	BT4

Detailed Syllabus:

12. Preparation of following inorganic compounds:
    c) Potassiumtrisoxalatoferrate(III) $K_3[Fe(C_2O4)_3].3H_2O$
    d) Potassiumtrisoxalatoaluminate(III) $K_3[Al(C_2O4)_3].3H_2O$
    e) Hexamminenickel(II) chloride, $[Ni(NH_3)_6]Cl_2$
    f) Hexammincobalt(II) chloride, $[Co(NH_3)_6]Cl_2$
2. Preparation of following organic compounds:
    a) Osazone from glucose.
    b) Aspirin from salicylic acid and acetic anhydride.
    c) Two step preparation:
        i) Aniline to acetanilide to p-nitroacetanilide
        ii) Benzoin to benzil to benzilic acid.
3. To determine the adulterants in food stuffs:
    a) To detect adulterants in milk

b) To detect adulterants in turmeric powder

c) To detect vanaspati in pure ghee.

Text Books:

1. Vogel's Qualitative Inorganic Analysis; Svehla G. and Sivasankar B.; 7th edition; Pearson.

2. V*ogel's Textbook of Practical Organic Chemistry*, Vogel A.I., Aurther I., 5th edition; Pearson.

Reference Books:

1. Agarwal O. P.,*Advanced Practical Organic Chemistry*, 2nd Edition, 2014, Goel Publishing.

2. A text Book of Practical Chemistry, Barua, S, 2th edition; 2016; KalyaniPublisher

SYLLABUS (2ndSemester)(VAC)

Subject Name: Chemistry of the Environment		**Subject Code: CHY012V201**
L-T-P-C: 2-0-0-2	**Credit Units: 2**	**Scheme of Evaluation: T**

Objective: The objective of **Chemistry of the Environment** is to provide the knowledge ofair,water and soil pollution and their control measures as well as principle and application of green chemistry.

Course outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the sources of air, water and soil pollution and explain their mitigation methods as well as basic principles and application of green chemistry	BT1
CO2	**Demonstrate** green methods for mitigation of pollution caused by application of hazardous chemicals	BT2
CO3	**Apply** the knowledge for critically analyze the applications that leads to environmental pollution	BT3
CO4	**Examine** amiable solutions for the problems related to environmental pollution.	BT4

Detailed Syllabus:

Modules	**Topics & Course content**	**Periods**

I	**Atmospheric Chemistry** Composition of atmosphere: Major regions of atmosphere, Air pollution, Major air pollutants: Oxides of carbon, Oxides of nitrogen, Oxides of sulphur, Photochemical smog, Ozone layer depletion, Acid rain, Greenhouse effect, Global warming, Depletion of ozone, Control of airpollution.	**6**
II	**Hydrosphere Chemistry** Criteria and standards of water quality, safe drinking water, types of water pollutants: Biological agents, Chemical agents, Physical agents, Toxic metals in water, Water purification for drinking and industrial purposes, disinfection techniques, demineralization and reverse osmosis.	**6**
III	**Soil Chemistry** Composition of soil, types of soil, Chemical properties of soil, Wastes from mining and metal production, Hazardous wastes and their disposal, Biodegradation of waste-anaerobic and aerobic treatment, Incineration.	**6**
IV	**Chemical Analysis of Wastewater, Solid wastes and Air Pollutants** General Aspects of Environmental Chemical analysis. Measurement of Total Organic Carbon, Radioactivity and Biological Toxins in Water. Elemental Analysis of solid waste, Bioassay and Immunoassay Screening. Atmospheric Monitoring for air pollutants, Determination of Sulfur Dioxide, Nitrogen Oxides and Analysis of Oxidants	**6**
Total		**24**

Text books:

1. *Air Pollution: its Origin and Control*; K. Wark, C. F. Warner & W. T. Davis, 3rd edition, 2006,Pearson
2. *Environmental Pollution*, A.K. De, 6th edition, 2009, New Age International, New Delhi.
3. *Environmental Chemistry*, B.K. Sharma & H. Kaur, 2nd edition, 2016, Goel Publishing house,Meerut

Reference books:

1. Rao C.S., *Environmental Pollution Control Engineering*, 2nd edition, 2016, New Age International
2. Sanghi R. and Srivastava M. M., *Green Chemistry: Environment Friendly alternatives*, 2nd edition, 2017, Narosa Publishing House, New Delhi, India.

SYLLABUS (2ndSEMESTER)(Generic)

Subject Name: Chemistry II	**Subject Code: CHY012G201**	
L-T-P-C: 3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: T**

Objective: The objective of **Chemistry II**isto understand and apply the concepts of thermodynamics, electrochemistry, stereochemistry of chemical reactions to measure feasibility of a reaction.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Relate** the concept on stereochemistry, organic synthesis, thermodynamics and electrochemistry	BT1
CO2	**Explain** the electrochemical reaction, stereochemistry for organic synthesis .	BT2
CO3	**Apply**the concept in problem solving related to electrochemistry and thermodynamics	BT3
CO4	**Compare** different isomers of organic compounds and thermodynamical properties of a chemical reaction.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Stereochemistry** Concept of isomerism, types of isomerism,classification – geometrical (simple examples involving alkenes, *cis-trans* and *E-Z* nomenclature) optical and conformational isomers, asymmetry, enantiomerism, diastereomerism, dissymmetry,meso structures, chirality, racemization, racemic mixtures, D-L and R-S notation.	**9**

II.	**Hydrocarbons I** Alkanes: preparation, properties and reactions. Cycloalkanes: preparation of cyclopropane, cyclobutane, cyclopentane, cyclohexane. Strain theory and stability. Alkenes: preparation (elimination of alkyl halides, alcohols, Wittig reaction, pyrolysis of esters), reactions of alkenes, Markownikoff's and anti-Markownikoff's addition rules, Saytzeff rule, Mechanism of electrophilic addition reaction. Alkynes: preparation, properties, reactions of alkynes, addition reactions of alkynes with polar reagents, ozonolysis, catalytic hydrogenation.	**9**
III.	**Electrochemistry** Electrochemical cells, electrode potential and cell potential (EMF), representation of a cell, electrochemical series and its application. Nernst's equation, numericals on electrode and cell potentials, reference electrodes (H_2 electrode, calomel electrode), glass electrode, concentration cell. Batteries: its classification, Lead – acid battery, Ni – Cd battery, alkaline battery, wind energy, fuel cell, solar cell.	**9**
IV.	**Chemical Thermodynamics** Terminology used in thermodynamics (system, surrounding, extensive and intensive properties),work, heat, energy and enthalpy, first law of thermodynamics and its limitations, reversible, adiabatic and isothermal expansion of an ideal gas, heat capacity and relation between C_p& $C_{v.}$ Carnot theorem, entropy, entropy change for an ideal gas, reversible and irreversible processes, entropy of phase transitions,free energy and work function: Helmholtz and Gibbs free energy functions, Gibbs-Helmholtz equation,Clausius-Clapeyronequation, Gibbs-Duhem equation,chemical potential.	**9**
Total		**36**

Text Books:

1. *Organic Chemistry*, MorrisonR. T. and BoydR.N., Bhattacharjee S.K.B.,6th edition, 2017, published by Prentice Hall.
2. *Organic Chemistry*, Solomons T. J.,11th Revised edition,2014, John Wiley & Sons Inc.
3. *Principles of Physical Chemistry*; Puri, B.R.; Sharma, L.R.; Pathania, M.S.; 47th edition; 2016; Vishal Publishing Company

Reference Books

1. Kapoor, K. L.; *A textbook of Physical chemistry*; 6th edition,; 2011; Macmillan, India

2. Kalsi P.S.; *Stereochemistry of organic compounds*; 2015; New age international Ltd.

SYLLABUS (2nd SEMESTER)(Generic)

Subject: Environmental & Green Chemistry		**Subject Code: CHY012G202**
L-T-P-C: 3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: T**

Objective: The objective of **Environmental and Green Chemistry is** to provide the knowledge of major pollutants and different ways of control of air, water and soil pollutions. The students will be able to understand the fundamental concepts of green chemistry and to know the utility of green chemistry in modern synthesis.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the twelve principles of green chemistry and will build the basic understanding of toxicity, hazard, and risk of chemical substances.	BT1
CO2	**Summarize** the innovative approaches to solve the problems related to environmental and societal challenges.	BT2
CO3	**Build** the knowledge of green chemistry in problem solving skills, critical thinking and valuable skills to innovative and find out solution to environmental problems.	BT3
CO4	**Analyze** various chemical products and processes that are less toxic, than current alternatives.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Atmospheric Chemistry** Composition of atmosphere – major regions of atmosphere**,** depletion of ozone in the stratosphere, causes and remedial measures, the green-house effect and its consequences, acid rain, photochemical smog, treatment of sewage and industrial effluents, major air pollutants and their harmful effects, air pollution controls	**9**

II.	**Hydrosphere and Soil Chemistry** Criteria and standards of water quality- safe drinking water, water pollutants, waste water treatment processes, water purification for drinking and industrial purposes. Composition of soil, types of soil, waste matters and pollutants in soil, waste classification, treatment and disposal, control measures of soil pollution.	**9**
III.	**Introduction and principles of Green Chemistry** Introduction and definitation of green chemistry, need and goal of green chemistry, limitations and obstacles of green chemistry, twelve principles of green chemistry with examples, prevention and minimization of generation of hazardous byproducts in chemical processes.	**9**
IV.	**Green Chemistry synthesis** Designing of green synthesis using principles of green chemistry, selection of green solvents, basic idea of microwaveand ultrasound assisted reactions, preliminary idea of solvent free reactions (solid phase reactions),biocatalysis in organic synthesis.	**9**
Total		**36**

Text Book:

1. *Environmental Chemistry*, De A.K., 6th edition, 2016, New Age International, New Delhi.
2. *Environmental Chemistry*, SharmaB.K. and Kaur H., 2nd edition, 2013,Goel Publishing house, Meerut.

Reference Books:

1. *Environmental Pollution Control Engineering*, Rao C.S., 2nd edition, 2016, New Age International
2. *Green Chemistry: Environment Friendly alternatives*, Sanghi R. and Srivastava M. M., 2ndedition, 2018, Narosa Publishing House, New Delhi, India.
3. Green Chemistry, Ahluwalia V.K., 2nd edition, 2018, Narosa Publishing House, New Delhi.

SYLLABUS (3rdSEMESTER)

Subject Name: Inorganic Chemistry II **Subject Code: CHY012C301**
L-T-P-C: 3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Objective: The objective of **Inorganic Chemistry-II**is to provide an understanding of the details of molecular orbital theory as well as elaborated discussion on non-transition elements and solid statechemistry.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the molecular orbitaltheory and understand chemistry of non-transition elements as well as solid state	BT1
CO2	**Illustrate** molecular orbital theory to critically analyze bonding of homonuclear diatomic and hetero nuclear diatomic molecules.	BT2
CO3	**Apply** the chemistry of non-transition elements for understanding of their synthesis and chemical application.	BT3
CO4	**Analyze** the knowledge of chemical bonding for understanding of structure of solids	BT4

Detailed Syllabus:

Modules	**Topics & Course content**	**Periods**
I.	**Chemical Bonding II** Molecular orbitals of diatomic molecules: LCAO approximation, bonding, antibonding and non-bonding orbitals, MO configurations of simple homonuclear diatomic and hetero nuclear diatomic molecules, bond order and bond strength. Weak chemical forces: van der Waals forces, ion- dipole forces, dipole-dipole interactions, induced dipole interactions, instantaneous dipole-induced dipole interactions. Hydrogen bonding.	**12**
II.	**Chemistry of Non Transition Elements I** Preparation, properties, bonding and structure of the following: ortho and para hydrogen, hydrides, clathrates and inclusion compounds, binary metallic hydrides, allotropes of carbon (including fullerenes), graphite, intercalation compounds, carbides, cyanogens, oxides and oxy-acids of carbon.	**12**
III.	**Chemistry of Non Transition Elements II** Allotropes of phosphorous, hydrazine, hydroxylamine and hydrogen azide, clinical use of NO and N_2O, allotropes of sulphur, oxides, oxyacids and per-acids of sulphur, interhalogen compounds, polyhalides, pseudo halogen, oxides and oxyacids of halogens. Inorganic chains, ring and cages: silicate, zeolites, silicones, borazine, phosphazine, S_4N_4, P_4, P_4O_6, P_4O_{10}, diborane, boron cage compounds, carboranes and metallocarboranes.	**12**

IV.	**Solids** Types of solids, unit cells; crystal lattices, crystal system and Bravais lattices for elemental crystals, close- packed structures of elemental solids, ionic solids: ionic radii; radius ratio. Structures of common binary ionic crystals: CsCl structure, NaCl structure, ZnS structure, fluorite structure, common ionic crystals.	**12**
Total		**48**

Text Books

1. *Concise Inorganic Chemistry*; Lee, J.D.; 5th edition; 2017; John Wiley and Sons Ltd.; Indian Edition.
2. *Inorganic Chemistry Principles of Structure and Reactivity*; Huheey, J.E., Keiter, E. A., Keiter, R. L. and Medhi, O. K. ; 4th edition; 2017; PearsonEducation.

Reference Books

1. *Inorganic Chemistry*; Atkins, P., Overtone, T., Rourke, J., Weller, M. and Armstrong, F.; 6th edition; 2018; Oxford University Press; Indianedition.
2. Cotton F.A.,Wilkinson, G.,Murillo A., BochmannM.;*Advanced Inorganic Chemistry;*6th edition; 1999; Wiley Interscience; NewYork.

SYLLABUS (3rd SEMESTER)

Subject Name: Chemistry Lab III Subject Code: CHY012C312

L-T-P-C: 0-0-8-4 Credit Units: 4 Scheme of Evaluation: P

Objective: The objective of **Chemistry Lab III**is to provide the knowledge of conductometric, pH metric and photophysicalprinciples as well as practical experience of inorganic compound synthesis.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Show** the conductometric and pH-metric titrations that are useful in modern applied chemistry	BT1
CO2	**Demonstrate** the preparation of various inorganic compounds.	BT2
CO3	**Apply** spectrophotometric technique to verify Beer-Lambert's law.	BT3

CO4	**Inspect** and determine the strength of glucose solution, acetic acid in commercial vinegar and percentage of calcium carbonate by various methods.	BT4

Detailed Syllabus:

1. Preparation of following Inorganic compounds:
   a) Tetraamminecopper(II)sulfate,$[Cu(NH_3)_4]SO_4.H_2O$
   b) Potassiumtrioxalatochromate(III),$K_3[Cr(C_2O_4)_3].3H_2O$
   c) Sodium trioxalatochromate (III),$Na_3[Fe(C_2O_4)_3].9H_2O$
2. Estimation of strength of glucose solution by titrating with Fehling'ssolution
3. Determination of acetic acid in commercial vinegar usingNaOH.
4. To determine the percentage of calcium carbonate in precipitated chalk by using HCl and NaOHsolution.
5. Conductometric titration
   i. HCl vs NaOH
   ii. Oxalic acid vs NaOH
   iii. Acetic acid vs NaOH.
6. To verify Debye, Huckel, Onsagar equation for sodium chloride.
7. To test the validity of Beer-Lambert's law using spectrophotometer.
8. pH metric titration of (i) strong acid with strong base, (ii) weak acid with strong base.
9. Determine the dissociation constant of acetic acid/ oxalic acid using Hendersen's equation.

Text Books:

1. *A text Book of Practical Chemistry*, Barua, S, 2th edition; 2016; KalyaniPublishers.

Reference Books:

1. Mendham J., Denney R.C., Barnes J.D. and. ThomasM.J.K.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th edition, 3rd Indian Reprint, 2003, Pearson Education Pvt. Ltd., NewDelhi.
2. Halpern,M.; *Experimental Physical Chemistry*, 6th edition, 2014; Prentice Hall, Upper Saddle River, NJ07458.

SYLLABUS (3rd SEMESTER)

DSE Paper I/Subject Name: Organic Chemistry-II **Subject Code: CHY012D301**

L-T-P-C: 3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Objective: The objective of **Organic Chemistry II** is to provide concept related to synthetic organic reactions and their mechanism along with information related to reagents used for reaction.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Understand**the concept involved in the reaction via analysis of reaction mechanism related to nucleophilic addition and substitution reaction on aromatic compounds.	BT1
CO2	**Explain** the mechanisms of various chemical reactions of alkanes, alkyl halides, alcohols, alkenes and alkynes.	BT2
CO3	**Apply** the reagents for the conversion of one functional group into other functional group in one or more number of steps.	BT3
CO4	**Analyze** the structures knowledge of commercially important molecules.	BT4

Detailed Syllabus:

Modules	**Topics / Course content**	**Periods**
I.	**Reaction mechanism II** Substitution reactions: Electrophilic, nucleophilic and free radical mechanism. Nucleophilic aliphatic substitution – S_N1, S_N2 reactions and free radical mechanism, energy profile diagram of S_N1 and S_N2 reactions and their stereochemistry, ambidentnucleophiles and substrates. Mechanism of electrophilic aromatic substitution, directive influence of groups, activation and deactivation of aromatic rings, o/p ratio, mechanism to begiven with examples. Mechanism of nucleophilic aromatic substitution, intermediate complex mechanism, benzyne mechanism. Directive influences in benzyne mechanism, cine substitution, methods of trapping benzyneintermediates.	**12**
II.	**Chemistry of organic compounds – I** Alkanes –IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, methods of preparation of alkanes with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids, physical properties and chemical reaction of alkanes. Cycloalkanes – Baeyer's strain theory and its limitations, ring strain in small rings (cyclopropane and cyclobutane), theory of stainless rings, shapes of cyclopentane and cyclohexane rings,the case of	**12**

	cyclopropane ring: bananabonds.	
III.	**Chemistry of organic compounds – II** Alkyl halides–Methods of preparation and reactions, elimination vs. substitution reactions – controlling factors, mechanisms and stereochemistry of nucleophilic substitution reactions of alkyl halides. Alcohols – Preparation with special reference to reduction of aldehyde and ketones, hydroboration and oxymercuration, conversions to and from alcohols, hydrogen bonding, acidic nature and reaction of alcohol. Glycols and their reactions with lead tetra-acetate and per- iodic acid.	**12**
IV.	**Chemistry of organic compounds – III** Alkenes – Methods of preparation of alkenes, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, mechanism of elimination reactions: Saytzeff and Hoffmann elimination, properties of alkenes and relative stabilities of alkenes, mechanism involved in hydrogenation, electrophilic and free radical additions to alkenes , Markownikoff's rule, hydroboration-oxidation, epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, reactivities at the allylic and vinylic positions of alkenes. Alkynes – Methods of preparation of alkynes, chemical reactions of alkynes, acidity of alkynes, mechanism of electrophilic and nucleophilic addition reactions.	**12**
Total		**48**

Text Books:

1. *Organic Chemistry*, Morrison R. T. and Boyd R.N., Bhattacharjee S.K.B., 6th edition, 2011, published by PrenticeHall.
2. *Organic Chemistry*,FinarI. L. 6th edition, (Low price), 2017, PearsonEducation.

Reference Books:

1. Peter Sykes, *A guide book to mechanisms in Organic Chemistry*, 6th edition, 2003, published by PearsonIndia.
2. KalsiP.S.,*Organic Reactions and their Mechanisms*, 3nd edition, 2017, New Age International.
3. Nasipuri, *Stereochemistry of Organic Compounds: Principles and Applications*,

3rd edition, 2014, Wiley &sons
4. Organic Chemistry, Stanley H. Pine, 5th edition, 2010, McGraw-Hill Bool .
5. Organic Chemistry, Solomons T. J., 11th revised edition, 2013, John Wiley & Sons Inc.

SYLLABUS (3rd SEMESTER)		
DSE Paper II/Subject Name: Chemistry of Life		**Subject Code: CHY012D302**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: (T)**

Objective: The objective of Chemistry in Daily Life is to provide the knowledge on materials in practice, their utility, as well as their impact on the Environment if no proper measure.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Find** the knowledge on different classes of pollution, regarding material in practice along with their impact on day to day life.	BT1
CO2	**Relate** the influence of materials in daily life.	BT2
CO3	**Apply** the various phenomenons in the field of biochemistry and material chemistry.	BT3
CO4	**Compare** the knowledge associated with material chemistry to solve the problems of day to day life.	BT4

Detailed Syllabus:

Module	Topics & Course Content	Periods
I	**Metal Toxicity**: Metal ion toxicity like hemosiderosis, hemochromatosis, Wilson's disease and their treatment. Heavy metal like Hg, Pb, Cd, As and their toxic effects. **Chelation therapy**: chelating agents for Hg, Pb, Cd, As toxicity. Metal complexes as drugs: cis-platin as anticancer agent: gold complexes as antiarthritic drugs- chrysotherapy. Metal complexes in diagnosis- Gd complexes in magnetic resonance imaging (MRI). **Toxic organic dyes and fertilizers**: Definition, uses, and their negative impact-eutrophication.	**12**

II	**Carbohydrates:** Chemistry of important derivatives of monosaccharides- ethers, esters, acetals, ketals, deoxysugars and aminosugars. Polysaccharides- starch,glycogen. Biological importance of carbohydrates. **Vitamins:** Classification, sources, deficiency diseases and structures of Vitamin A1, B1, C, D, E & K1.	**12**
III	**Lipids**: Introduction, Classes, Fatty acids. Physical and chemical properties. Saponification value, acid value, iodine number, rancidity. Tests for adulterants like argemone oil and mineral oils. Glycerolipid, Sphingolipid. **Macromolecules and polymers**: Source of natural polymers/biopolymers. Introduction to biocompatible and biodegradable polymers. Self-assembly, micelles, vesicles, drug cargo.	**12**
IV	**Enzymes and co-enzymes**: Basic concept, active site, energy of activation. Lock and key hypothesis, induced fit hypothesis. Co-enzymes: Niacin, Folic acid, Cynocobalamine. **Hormones**: Steroidal & non-steroidal hormones. Steroidal and non-steroidal hormones: Brief account on the non-steroidal hormones and their functions – estrogens, progestogens, androgens, thyroid, pituitary and pancreas hormones.	**12**
Total		**48**

Text Books:

1. Principles of Biochemistry: JefforyZubey,WCB Publishers
2. Outlines of Biochemistry: Conn and Stumpf

Reference Books:

1. Polymer Science and Technology, J. R. Fired (Prentice Hall).
2. Principles and Applications of Electrochemistry, D R Crow, Chapman & Hall, 2014.
3. Biochemistry: L. Stryer
4. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New AgeInternational (2018).
5. Principles of biochemistry-Lehninger ,Nelson,Cox,CBS Publishers.
6. Fundamentals of Biochemistry-Voetetal.,John Wiley and sons ,Inc.
7. B.K. Sharma: introduction to Industrial Chemistry, Goel Publishing, Meerut (2016)
8. Essentials of medicinal chemistry, eds., Korolkovas and Burkhaltar, J.H., John wiley& amp; sons

SYLLABUS (3rd SEMESTER) (Generic)

Subject Name: Chemistry III (Generic) Subject Code: CHY012G301
L-T-P-C: 2-0-1-3Credit Units: 3Scheme of Evaluation: T& P

Course Objective: To provide the basic principles of catalysis and surface chemistry as well as synthesis, property and application of hydroxyl compounds and carboxylic acids. Also to provide the in-depth knowledge of synthesis, property and application of non-transition elements as well as chemistry of coordination compounds.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the concepts of catalysis and understand non-transition elements, hydrocarbons and coordination compounds	BT1
CO2	**Explain** the different theories of coordination compouds and allotropes of phosphrous and nitrogen	BT2
CO3	**Apply** Langmuir, Freundlich, Adsorption isotherms for surface phenomenon.	BT3
CO4	**Examine**the compounds to determine the chemical components present in sample.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Catalysis and surface chemistry** Homogeneous heterogeneous catalysis, acid-base catalysis catalytic promoter, poisoning, negative catalysis, enzyme catalysis, effect of temperature and pressure on enzyme catalysis, auto catalysis. Types of adsorption. Differences between chemisorptions and Physical adsorption; Freundlich adsorption isotherm and Langmuir adsorption isotherm, application of adsorption. Colloids-Classification, structure and stability.	**6**

II.	**Hydrocarbon-II** Aliphatic and aromatic hydroxyl compounds: Classification of alcohols, 1°, 2° and 3° alcohols and their distinguishing reactions. General methods of preparation, properties and general reactions of primary alcohols. Benzyl alcohol-preparation and reaction. Synthesis and reactions of phenols. Acidity of phenols. Electrophilic aromatic substitution of phenol. Aliphatic and aromatic carboxylic acids: Acidity of carboxylic acids, and substituted carboxylic acids. General methods of preparation , properties and reactions of aliphatic carboxylic acid Synthesis, properties and reactions of benzoic acid.	**6**
III.	**Chemistry of non-transition elements** Allotropes of phosphorous. Hydrides, oxides and oxy-acids of nitrogen and phosphorous. Allotropes of sulphur, oxides, hydrides, oxyacids and per-acids of sulphur. Interhalogen compounds, polyhalides, pseudohalogen, oxides and oxyacids of halogens. Noble gas compounds – xenon oxides and fluorides. Inorganic chains, ring and cages: Silicate, borazine, phosphazine, diborane, boron cage compounds.	**6**
IV.	**Coordination compounds** Types of ligands: monodentate, bidentate, ambidentate, polydentate and macro cyclic ligand. Nomenclature of complex compounds, Isomerism in 4- and 6-coordinate compounds, effective atomic number rule, valence bond, crystal field and introduction to ligand field theories, colour and magnetism . Spectroscopic terms, RS coupling, Mullikan's symbol (A, B, E, T), spectrochemical series, Electronic spectra of simple tetrahedral and octahedral complexes, selection rules and Orgel diagram (d^1 to d^9system).	**6**
Total		**24**

List of Experiments:

1) Qualitative organic analysis:
   a) Detection of N, S, and halogens in organic compounds
   b) Detection of functional groups
2) To determine the strength of the given glucose solution by titrating with Fehling's solution.
3) To determine the coefficient of viscosity of the given liquid at a given concentration by using Ostwald's viscometer.
4) To determine the surface tension by stalagmometer.

Text Books:

1. Huheey J. E., Keiter E. A., Keiter R. L. andMedhi O. K., "*Inorganic Chemistry Principles of Structure and Reactivity*'', 4th edition, 2016,. Pearson Education

2. *A text Book of Practical Chemistry*, Barua, S, 2th edition; 2016; Kalyani Publishers.

Reference Books:

1. Peter Sykes, "*A guide book to mechanisms in Organic Chemistry*", 6th edition, 2012, published by Pearson India.
2. "Concise Inorganic Chemistry", Lee J. D., 5th edition, 2008, John Wiley and Sons Ltd., Indian Edition.
3. *Vogel's Qualitative Inorganic Analysis;* Svehla G. and Sivasankar B.; 7thedition; Pearson.

SYLLABUS (3rdSEMESTER)(Generic)

Subject Name: Basic Analytical Chemistry (Generic) (List-II)		**Subject Code: CHY012G102**
L-T-P-C : 3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: (T)**

Objective: The objective of **Basic Analytical Chemistry** isto provide the basic concept of chemical analysis through separation Techniques and titrimetric analysis. The students will also be able analyse the experimental data using data analysis knowledge.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Relate** the importance of chemical analysis withinstrumental techniques	BT1
CO2	**Explain** the concept of separation techniques and chromatographic techniques.	BT2
CO3	**Apply** titrimetric analysis in quantitative sample determination	BT3
CO4	**Analyze** the accuracy and types of errors in experimental data.	BT4

Detailed Syllabus:

Modules	**Topics/ Course content**	**Hours**

I	**Chemical analysis:** Introduction, stages of analysis, qualitative and quantitative analysis, importance of instrumental techniques, factors affecting the choice of analytical method.	**9**
II	**Separation Techniques:** Introduction, bulk separation, instrumental separation, filtration, solvent extraction, crystallisation and precipitation. Basic principles of chromatographic separation- Gas chromatography, liquid chromatography and thin layer chromatography.	**9**
III	**Titrimetric analysis:** Introduction, classification of reactions in titrimetric analysis, standard solution- primary and secondary standard. Principles of potentiometric titration, conductometric titration and complexometric titration.	**9**
IV	**Errors and accuracy**: Definition of Significant figures, accuracy and precision, mean, median, variance, deviation, relative mean deviation, standard deviation. Error-Determinate and indeterminate error, absolute errors, relative errors.	**9**
Total		**36**

Text Books:

3. *Fundamentals of Analytical Chemistry,* Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch,Cengage Learning, **2013**
4. *Vogel's Quantitative Chemical Analysis,* J Mendham, R C Denney, J D Barnes and M J K Thomas, 6th Edition, **2009**

Reference Books:

1. *Analytical Chemistry,*Gary D. Christian, 6ed Paperback – **2007**

SYLLABUS (4thSEMESTER)

Paper I/Subject Name: Physical Chemistry-III		**Subject Code: CHY012C401**
L-T-P-C -3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Physical Chemistry III** is to make students understand the solids state, phase, co-existence of phases, phase diagrams, concepts of electrochemical cells, electrode potential, electrochemical series and learn about catalyst and surface phenomenon.

Course Outcomes:

After successful completion of the course, student will be able to

Sl No	Course Outcome	Bloom's Taxonomy Level
CO1	**Recall** the concepts of solid state, phase equilibria, electrochemistry and catalysis	BT1
CO2	**Explain** basic principles of crystallography, phase rule, chemical potential, catalysis and surface phenomenon.	BT2
CO3	**Apply** electrochemical series to explain reactivity of electrodes as well as apply Langmuir, Freundlich, BET equations to attainment of Adsorption isotherms	BT3
CO4	**Analyze** different crystallographic structures according to their co-ordination number and packing factors, and examine distillation process using phase diagram.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Electrochemistry** Electrochemical cells: measurement of e.m.f. and electrode potentials, representation of a cell, electrochemical series and its application. concept of SHE, electrode-potential sign convention, different classes of electrodes, calomel electrodes and glass electrode and their applications, Nernst's equation, equilibrium constants and activity coefficients from standard electrode potentials, chemical cells and concentration cells, cells with and without transference, numerical on electrode and cellpotentials. Batteries: its classification, zinc-graphite dry battery, Lead – acid battery, fuel cell. Electrochemical basis of corrosion in metals causes and effects, differential aeration corrosion, prevention of corrosion	**12**
II.	**Solid State** Laws of Crystallography, definition of unit cell and space lattice, Bravais lattices, Miller indices, Symmetry in solids, Bragg's law, Introduction to X-ray crystallography and determination of structure of solids. Packing in solid – octahedral hole, tetrahedral hole, radius ratio. Dislocation in solids – Schottky and Frenkel defects, Dielectric property of solids, Concept of piezo and ferro electricity, electrical property of solids (conductor, insulator, n type and p type semiconductors. Super conducting materials. Magnetic properties of solids (dia-, para-, ferro- and antiferro magnetism).	**12**
III.	**Phase Equilibria** Definition of phase, meaning of components and degrees of freedom.	**12**

	Derivation of phase rule. Phase diagram of one component system (water). Phase diagram of two component system – eutectics, congruent and incongruent melting points, solidsolutions. Interpretation of liquid-vapour, liquid-liquid and liquid-solid phase diagrams. Distillation of partially miscible liquids. ClausiusClapeyron equation for different phases. Systems of variable composition, partial molar quantities, Gibbs Duhem equation, Thermodynamics of mixing. Chemical potential, chemical potential of a component in an ideal mixture – fugacity, activity coefficients. Dependence of chemical potential on temperature and pressure.	
IV.	**Catalysis and Surface Chemistry** Definition, characteristics of catalyst, promoter and inhibitor, types of catalysis (homogeneous and heterogeneous), auto-catalytic reaction. Homogeneous catalysis: oxidation of SO_2 to SO_3 catalyzed by NO, acid-base catalysis, enzyme catalysis with Michaelis–Menten equation, turnover frequency, catalytic efficiency, effect of pH and temperature on enzyme catalysis, Heterogeneous catalysis: zeolites and their use as catalysts in cracking of petroleum. Introduction to solid surfaces, adsorption on surfaces – physisorption and chemisorption. Adsorption isotherms – Langmuir, Freundlich, BET equation. Determination of surface area, Catalytic activity at surface withexamples	**12**
Total		**48**

Text Books:

1. Physical Chemistry, Atkins P. W. and Paula J. de; 10th edition; 2014; Oxford UniversityPress
2. Principles of Physical Chemistry; Puri, B.R.; Sharma, L.R.; Pathania, M.S.; 47th edition; 2016; Vishal PublishingCompany

Reference Books:

1. Glasstone, S.; *Text book of Physical Chemistry;* 11th edition; 2011; Van Nostrandcompany.
2. Atkins, P.W. and Paula, J. de;*Elements of Physical Chemistry;*6th edition; 2018; Oxford UniversityPress.
3. Levine, I.; *Physical Chemistry*; 6th edition; 2017; Tata McGrawHill
4. Negi, A.S. and Anand, S.C. *A Textbook of Physical Chemistry*, 2nd edition, 2016, New AgeInternational

SYLLABUS (4thSEMESTER)		
Subject Name: Chemistry Lab IV	**Subject Code: CHY012C412**	
L-T-P-C -0-0-8-4	**Credit Units: 4**	**Scheme of Evaluation: P**

Objective: The objective of **Chemistry Lab IV** is

To make the students understand the application of theoretical concept in the practical application of qualitative inorganic analysis as well as determination of ionic conductivity and specific rotation.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** advanced experimental techniques in separation and determination of inorganicions	BT1
CO2	**Show** purification and qualitative analysis techniques for analysis of organic liquidsamples	BT2
CO3	**Apply** different instruments related to optical property inchemistry	BT3
CO4	**Examine** some modern instrumentation techniques.	BT4

Detailed Syllabus:

1. Qualitative inorganic analysis: Identification of the following in an inorganicsalt:
Cations: Hg^{2+}, Pb^{2+}, Cu^{2+}, Bi^{3+}, As^{3+}, Sb^{3+}, Sn^{2+}/Sn^{4+}, Fe^{2+}/Fe^{3+}, Cr^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}

Anions: Cl^{-}, Br^{-}, I^{-}, NO^{2-}, NO^{3-}, S^{2-}, SO_3^{2-}

2.Determine the equivalent conductivity of acetic acid at infinite dilution by Kohlrausch's method and hence find out the degree of dissociation of theacid.

3. To determine the specific rotation of an optically active substance by polarometric method.

4. Qualitative analysis of organic liquid sample (Purification by fractional distillation, determination of boiling point, functional groupanalysis).

At least three samples should be done.

Text Book:

1. *Advanced Practical Physical Chemistry*; Yadav, J.B.; 28th edition; 2019; Goel Publishing House

2. *Vogel's Qualitative Inorganic Analysis;* Svehla G. and Sivasankar B.; 7thedition; Pearson.

Reference Books:

1. Gurtu, J.N., Gurtu, A.; *Advanced Physical Chemistry Experiments*, 6th edition, 2014, PragatiPrakashan

2. Halpern, M.; *Experimental Physical Chemistry*, 2nd edition, 2008; Prentice Hall, Upper Saddle River, NJ07458

3. Agarwal O. P.,*Advanced Practical Organic Chemistry*, 2nd Edition, 2014, Goel Publishing.

4. V*ogel's Textbook of Practical Organic Chemistry*, Vogel A.I., Aurther I., 5th Edition, 2005,Pearson.

SYLLABUS (4thSEMESTER)

DSE Paper I/Subject Name: Inorganic chemistry IIISubject Code: CHY012D401

L-T-P-C -3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Objective: The objective of **Inorganic chemistry-III** is

- Toprovide an understanding of the structure and bonding of coordinationcompounds and organometallic compounds; chemistry of d- and f- blockelements and also basic and advanced idea of nuclear chemistry and metallurgy.

Course Outcomes:

After successful completion of the course, student will be able to

Sl No	Course Outcome	Bloom's Taxonomy Level
CO1	**Recall** the detailed idea of structure, bonding and property of coordinationcompounds and organometallic compounds.	BT1
CO2	**Demonstrate** the knowledge of coordination compounds to solve the problems related to their structure, stability and reactivity	BT2
CO3	**Apply**the knowledge of organometallic compounds to analyze their bonding and reactivity as well as their application in catalytic field.	BT3
CO4	**Inspect** critical thinking and analyze the concepts related to stability of nucleus, nuclear reactions and their application for human benefit.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Chemistry of coordination compounds I** Coordination Compounds: Werner's theory, EAN rule, structural and stereoisomers of complex compounds, survey of different types of ligands, IUPAC nomenclature of coordination compounds. Structure and bonding: valence bond theory, crystal field theory, factors affecting 10 Dq value, crystal field stabilization energy, magnetic properties from crystal field theory, spectrochemical series, high spin and low spin complexes, Jahn-Teller distortion, structural and thermodynamic effects of orbital splitting, octahedral versus tetrahedral coordination.	**12**
II.	**Organometallic Compounds** 18-electron rule and its applications, carbonyls (including carbonyl hydrides and carbonylates), nitrosyls, cyanides: preparation, structure and reactions, simple examples of metal-metal bonded compounds and metal clusters, metal- olefin complexes: Zeises salt (preparation, structure and bonding), Ferrocene (preparation, structure and reactions), hapticity(η) of organometallic ligands, examples of mono tri and penta-haptocyclopentadienyl complexesCoordinative unsaturation: oxidative addition, reductive elimination and insertion reactions. Homogeneous catalysis byorganometallic compounds: hydrogenation, hydroformylation and polymerization of alkenes (Ziegler-Natta catalysis).	**12**
III.	**Chemistry of d- and f- block elements** **d-block elements**: General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. **f-block elements**: electronic configuration, ionization energies, oxidation states, variation in atomic and ionic (3+) radii, lanthanide contraction, magnetic properties of lanthanides comparison between lanthanide and actinides, separation of lanthanides, sources of the actinide elements, their extraction andapplication. Chemistry of some representative compounds: $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, $K_2[Ni(CN)_4]$, H_2PtCl_6, $Na_2[Fe(CN)_5NO]$.	**12**
IV.	**Nuclear Chemistry & General Principles of metallurgy** **Nuclear Chemistry**: Physical properties of the proton and the neutron, structure of the nucleus, mass defect and binding energy. Radioactive decay and equilibrium. Nuclear reactions, Q value, nuclear cross sections. Theory of radioactive disintegration, rates of disintegration, the radiochemical series. Transmutation of elements and artificial radioactivity, fission and fusion. Nuclear reactions and their use, methods of measurement of radioactivity. Isotopes of elements, methods of separation of isotopes, application of isotopes (tracer	**12**

	technique, neutron activation analysis, radiocarbondating). **General principles of metallurgy**: Physico-Chemical methods involved in metallurgy (concentration, calcinations, reduction, roasting, zone refining, solvent extraction, hydrometallurgy and electrochemical methods) with reference to gold, nickel, thorium uranium and manganese (whichever is applicable).	
Total		**48**

Text Books:

1. *Concise Inorganic Chemistry*; Lee, J.D.; 5th edition; 2013; John Wiley and Sons Ltd.; Indian Edition.
2. *Inorganic Chemistry Principles of Structure and Reactivity*; Huheey, J.E., Keiter, E. A., Keiter, R. L. and Medhi, O. K. ; 4th edition; 2007; PearsonEducation.

ReferenceBooks:

1. Atkins, P., Overtone, T., Rourke, J.; Weller, M. and Armstrong, F.; *Inorganic Chemistry*; 6th edition; 2014; Oxford University Press; Indianedition.
2. Cotton F.A., Wilkinson, G., Murillo A., BochmannM.;*Advanced Inorganic Chemistry;*6th edition; 1999; Wiley Interscience; NewYork.

SYLLABUS (4thSEMESTER)

DSE Paper II/Subject Name: Chemistry of Natural Product Subject Code: CHY012D402

L-T-P-C – 3-1-0-4 Credit Units: 4 Scheme of Evaluation: (T)

Objective:

The objective of **Chemistry of natural product** is-

- To provide the basic concept of natural product compounds, their occurrence, structure, biosynthesis and properties.

Course Outcomes:

After successful completion of the course, student will be able to

Sl No	Course Outcome	Bloom's Taxonomy Level
CO1	**Find** the knowledge of plant's secondary metabolites and to analyze the new product isolated from plants.	BT1
CO2	**Demonstrate** strategies in organic synthesis for the synthesis of different natural product compounds	BT2
CO3	**Apply** the knowledge of natural pigments and analyze and explore the new herbal organic pigments	BT3

CO4	**Analyze** the synthesis and biosynthesis of natural products having medicinal properties.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Introduction to secondary metabolites:** Definition, classification of plant secondary metabolites. General introduction, composition, chemistry & chemical classes of following classes of compounds: Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins.	**12**
II.	**Natural Pigments:** Introduction to pigments,classification of pigments, introduction to carotenoids, classification of carotenoids, isolation and separation of carotenoids, characteristics and functions of carotenoids, general ideas of lycopene and flavones.	**12**
III.	**Hormones:** Definition; Classification - amino acid derivatives (epinephrine and thyroxine); peptide (oxytocin and vasopressin) and polypeptide hormones (insulin and glucagon); Steroid hormones (progesterone, testosterone) with basic functions, role of insulin and glucagon in glucose homeostasis.	**12**
IV.	**Coenzymes and prostaglandins:** Definition and General introduction of coenzymes, co-factor and prosthetic group.Vitamins as coenzymes and co-factors, prosthetic groups. NAD, FAD, TPP, and Co ASH. General introduction of prostaglandins; structure and biological role of Prostaglandins: PGE_2, $PGF_{2\alpha}$.	**12**
Total		**48**

Text Books:

1. *Principle of biochemistry*; Lehninger A. L.; 6th edition; 2016; W.H. Freeman and company.
2. *Outline of biochemistry*; Conn and Stumph; 9th edition; 2016; Wiley and sons, New York.
3. *Heterocyclic Chemistry*; Joule J. A., Mills K.; 5th Edition; Jun 2010; Wiley-Blackwell.

Reference Books:

1. Mann J., Davidson Fl.S., Hobbs J.B., Banthrope D.V. and Harborne J. B.; *Natural Products: Chemistry and Biological Significance*; Longmann. Essex.

SYLLABUS (4th SEMESTER) (SEC)

Subject Name: Analytical Laboratory Methods		**Subject Code: CHY012S411**
L-T-P-C: 0-0-4-2	**Credit Units: 4**	**Scheme of Evaluation: P**

Objective: The objective of **Instrumental methods of analysis** is to provide the knowledge of volumetric and gravimetric estimation and investigation of individual components after separation

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Show** the importance of analytical methods that are useful in modern chemistry	BT1
CO2	**Demonstrate** the chemistry of precipitation and estimate the inorganic precipitates.	BT2
CO3	**Apply**separation techniques to isolate organic and inorganic compounds from their mixtures.	BT3
CO4	**Inspect** the individual components via various spectroscopic techniques.	BT4

Detailed Syllabus:

1. Volumetric Analysis of inorganic salts
   a) To estimate the amount of calcium present in a given solution
   b) To determine iron content in an iron ore (haematite)
2. Gravimetric analysis
   a) To estimate silver as silver chloride in the given solution of silver nitrate
   b) To estimate sulphate as barium sulphate in the given solution of sodium sulphate or sulphuric acid.
3. Chromatographic separattion
   a) Thin layer chromatography
      i. Separation of lycopene from tomato extract

ii. Separation of benzene substituted compounds with different Rf factor

b) Column chromatography

i. Separation of mixture of alcoholic, aldehydic functional compounds into components

Text Books:

2. *A text Book of Practical Chemistry*, Barua, S, 2th edition; 2016; KalyaniPublishers.
3. *Advanced practical chemistry, Gurdeep Raj,* 2013, 20th edition, Krishna Prakashan Media

Reference Books:

3. Mendham J., Denney R.C., Barnes J.D. and. ThomasM.J.K.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th edition, 3rd Indian Reprint, 2003, Pearson Education Pvt. Ltd., NewDelhi.

4. Agarwal S. K. and Lal K.*Advanced inorganic analysis,* 13th edition, 2018, PragatiPrakashan

SYLLABUS (4thSEMESTER)(VAC)		
Paper I/Subject Name: Chemistry in Everyday Life		**Subject: CHY012V401**
L-T-P-C – 2-0-0-2	**Credit Units: 2**	**Scheme of Evaluation: T**

Objective:

The objective of **Chemistry in everyday life** is to provide the knowledge of material along with their influence on the Environment.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Find**the concepts of chemistry related to drugs, colloids and corrosion.	BT1
CO2	**Summarize** theknowledge on awareness on handling chemicals.	BT2
CO3	**Apply**the concepts of chemistry to solve the problems in day to day life.	BT3
CO4	**Analyze** the influence of chemistry in day to day life.	BT4

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	**Colloidsand Cleansing Agents**: Classification, preparation methods – Dispersion and Condensation, application of colloids.Detergents and its classification, Advantage and disadvantage of soap.	**6**
II.	**Corrosion:**Introduction, corrosion types – dry and wet corrosion, mechanism of corrosion, pitting, stress, intergranular and waterline corrosion, factors influencing corrosion, corrosion failure, corrosion control.	**6**
III.	**Toxic chemicals in the environment**: Detergents - pollution aspects, eutrophication. Impact of pesticides and insecticides. Heavy metal pollution. Solid pollutants - treatment and disposal. Treatment of industrial liquid wastes. Sewage and industrial effluent treatment.	**6**
IV.	**Chemistry of Drugs:** Introduction of Drugs, antacid, Tranquilizers (Psychotherapeutic Drugs),neurotransmitter, analgesics- narcotics and non-narcotics, antipyretics, anti-microbial	**6**
Total		**24**

Text Books:

1. Drugs and Pharmaceutical Sciences Series, Marcel Dekker, Vol.II, INC, New York.

2. Analysis of Foods – H.E. Cox; 13. Chemical Analysis of Foods- H.E. Cox and Pearson.

Reference Books:

1. B.K. Sharma: introduction to Industrial Chemistry, Goel Publishing, Meerut(2018)

2. Handbook on Fertilizer Technology by Swaminathan and Goswamy, 6 th ed. 2016, FAI.

3. Foods – Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age Internatl (2018).

SYLLABUS (4thSEMESTER) (Generic)		
Subject Name: Chemistry IV (Generic)		**Subject Code: CHY012G401**
L-T-P-C-3-0-0-3	**Credit Units: 3**	**Scheme of Evaluation: T**

Objective:The objectives of **Name: Chemistry IV**is to provide knowledge of chemistry of non-transition elements, fundamental concepts of kinetic theory of gases, liquids and solid.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Understand**the chemistry of organometallic compounds	BT1
CO2	**Demonstrate** the structural characteristics of various types of compounds.	BT2
CO3	**Apply** the knowledge of spectroscopy to analyze the structure of compounds.	BT3
CO4	**Analyze** and apply the knowledge of hydrocarbons for the synthesis of important organic compounds.	BT4

Detailed Syllabus:

Modules	**Topics / Course content**	**Periods**
I.	**Organometallic Compounds and Catalysis** Definition, electron count, 18 electron rule, isolobal analogy, structure and bonding in some organometallic compounds (Metal –Olefins compound, metal – ligand σ -bonded compounds, ferrocene, terminal and bridged carbonyls), oxidative addition and reductive elimination reaction. Uses of some organometallic compounds in catalysis (Wilkinson's catalyst, Vaska's compound and $HCo(CO)_4$)	**9**
II.	**States of Matter** Postulates of kinetic theory of gases – derivation of expression for pressure from kinetic theory. Calculation of rms speed and average kinetic energy. Maxwell's distribution of molecular speeds (no derivation) – effect of temperature and molar mass of gas. Deviation from ideal behaviour, Van der Waals equation of state. Structure of liquids, kinetic molecular model and properties of liquid, definition and experimental measurement of surface tension (drop number method) and viscosity (Ostwald method), variation of these properties with temperature. Crystal lattices, unit cells of the seven crystal systems. density of cubic unit cell, the fcc, bcc and simple cubic systems, closed packed structures, imperfections in solids (introduction to Schottky and Frenkel defects)	**9**
III.	**Hydrocarbon-III** Aliphatic and aromatic carbonyl compounds: General methods of preparation and reactions of carbonyl compounds. Difference in reactivity of aldehyde and ketones, polarization of carbonyl group. Preparation and reactions of benzaldehyde and acetophenone. Aliphatic amines and aniline:	**9**

	1°, 2° and 3° amines. Basicity of amines, preparation, properties and reactions of 1° amines. Synthesis, properties and reactions of aniline. Basicity of aniline and substituted aniline.	
IV.	**Introduction toSpectroscopy** The nature of electromagnetic radiation, the regions of electromagnetic spectrum. Introduction to molecular spectra. Infrared spectra: principle, modes of vibration (stretching, bending), absorption frequencies of functional groups and application. Proton magnetic resonance spectra: principle, chemical shift, interpretation of PMR spectra of simple molecules.	**9**
Total		**36**

Text Books:

1. "*Organic Chemistry*", Morrison R. T. and Boyd R.N., Bhattacharjee S.K.B., 6th edition, 2011, published by Prentice Hall.
2. "*Organic Chemistry Vol. I, II & III*", Mukherji S.M., Singh S.P. and Kapoor R.P., 6th edition, 2016, Wiley Eastern Ltd (New Age International).

Reference Books:

1. Peter Sykes, "*A guide book to mechanisms in Organic Chemistry*", 6th edition, 1995, published by Pearson India.
2. Huheey J. E., Keiter E. A., Keiter R. L. andMedhi O. K., "*Inorganic Chemistry Principles of Structure and Reactivity*'', 4th edition, 2006, Pearson Education.
3. "*Concise Inorganic Chemistry*", Lee J. D., 5th edition, 2008, John Wiley and Sons Ltd., Indian Edition.
4. "*Principles of Physical Chemistry*", Puri B. R., Sharma L.R., Pathania M.S., 7th edition, 2016, Vishal Publishing Company
5. "*Fundamentals of molecular spectroscopy*", Colin N. Banwell, Ellain M. McCash, 4th Edition, 2013, Tata-Macgraw-Hill.

SYLLABUS (5th SEMESTER)

Subject Name: Organic Chemistry III		**Subject Code: CHY012C501**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objectives of **Organic Chemistry III** areto provide knowledge of preparation, structure, bonding, properties of carbonyl compounds, carboxylic acids and their derivatives, ethers, aliphatic and aromatic amines, phenols, haloarenes and organo-sulphurcompounds.

Course Outcomes:

After successful completion of the course, student will be able to

Sl No	Course Outcome	Bloom's Taxonomy Level
CO1	**Understand**the chemistry of carbonyl and heterocyclic compounds	BT1
CO2	**Explain** the mechanisms of various types of reactions involving important functional groups.	BT2
CO3	**Apply** the knowledge of different functional groups to synthesize various commercially important compounds.	BT3
CO4	**Analyze** the role different heterocyclic compounds in natural product compounds	BT4

Detailed Syllabus:

Modules	Topics & Course content	Periods
I.	**Chemistry of organic compounds – IV** Carbonyl compounds: Preparation of carbonyl compounds. Nucleophilic addition to carbonyl compounds – redox reactions and condensation reactions. Mechanisms ofaldol condensation, Cannizzaro reaction, Claisen condensation, Reformatsky reaction,Oppeneauer reaction, Wolff-Kishner reduction, Benzoin condensation. Carboxylic acids and their derivatives: Preparation of carboxylic acids, acidity and effect of substituents. Derivatives of carboxylic acids – acid chlorides, amides and esters. Acidic and alkaline hydrolysis ofesters.	**12**

II.	**Chemistry of organic compounds – V** Ethers: preparation, cleavage and auto-oxidation reactions. Epoxides: preparation, acid and base catalysed ring opening, Amines (aliphatic and aromatic): Classification and preparation of amines, distinction between primary, secondary and tertiary amines. Hoffmann bromamide reaction, exhaustive methylation and Hoffmann elimination, Hinsberg test, carbylamine test, Mannich reaction. Formation of diazonium salts, Sandmeyerreaction. Synthesis, and reactivity of nitroalkanes, alkyl nitriles, isonitriles and aromatic nitro compounds.	**12**
III.	**Chemistry of organic compounds – VI** Phenols: Preparation and typical reactions, Kolbe's reaction, Reimer-Tiemann reaction. Haloarenes: Preparation, mechanism of nucleophilic aromatic substitution, benzyne mechanism, cine substitution, chichibabin reaction and methods of trapping benzyne intermediates. Polynuclear aromatic hydrocarbons: Structure, bonding, properties and reactivity of naphthalene, anthracene, phenanthrene and anthraquinone-important methods of synthesis.	**12**
IV.	**Chemistry of organic compounds – VII** Active methylene compounds: The active methylene group, synthesis of compounds containing active methylene groups (ethyl acetoacetate, diethylmalonate and ethyl cyanoacetate) and their use in organic synthesis. Organo-sulphur compounds: Preparation and reactions of thiols, thioethers. Heterocyclic compounds: Synthesis, structure, bonding, properties (basicity, aromaticity) and reactions of the following heterocycles: Furan, pyrrole, indole, thiophene, pyridine, quinoline and isoquinoline.	**12**
TOTAL		**48**

Text Books:

1. *Organic Chemistry*, Morrison R. T. and Boyd R.N.,

Bhattacharjee S.K.B., 6th edition, 2011, published by PrenticeHall.
2. *Organic Chemistry*,FinarI. L. 6th edition, (Low price), 2017, PearsonEducation.

Reference Books:

1. KalsiP.S.,*Organic Reactions and their Mechanisms*, 4thedition, 2017, New Age International.
2. Solomons T. J., *Organic Chemistry*, 11th revised edition,2013, John Wiley & Sons Inc.
3. *Organic Chemistry*, Stanley H. Pine, 5thedition, 2010, McGraw-Hill Book.

SYLLABUS (5th SEMESTER)

Subject Name: Chemistry Lab V		**Subject Code:CHY012C512**
L-T-P-C – 0-0-8-4	**Credit Units: 4**	**Scheme of Evaluation: P**

***Objective*:The objective of Chemistry Lab V** isto provide the knowledge of estimation of chemical species with titrimetric and kinetic analysis as well as practical experience of inorganic compoundsand Natural product extraction and estimation.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Show** the estimation of metal	BT1
CO2	**Demonstrate** the extraction of Natural compounds	BT2
CO3	**Experiment** with compounds to determine the chemical components present in sample.	BT3
CO4	**Compare** the conductivity of unknown solutions and to inspect the degree of dissociation of the acid.	BT4

Detailed Syllabus:

1. Determine the strength of the components of a mixture of CH_3COOH and HCl by conductometric titration.
2. To determine the equivalent conductivity of acetic acid at infinite dilution by Kohlrausch's method and hence to find degree of dissociation constant of the acid.
3. To study the variation of mutual solubility temperature (MST) with concentration of the phenol-water system and determine the critical solution temperature (CST) of given

partially miscible system i.e., Phenol-H_2O system and find the composition of the solution at C.S.T.

4. Estimation of

(a) Silver as silver chloride in the mixtures containing two components:

(b) Titrimetric analysis of iron(II) and calcium(II)

(c) Complexometric analysis calcium(II) and magnesium (II)

5. Gravimetric estimation of given sample of

(a) silver nitrate.

(b) Copper(II) and zinc(II) in a mixture.

6. Determination of acetic acid content in commercial vinegar.

7. Extraction of pigments from plant parts.

8. Extraction of Caffeine from tea/coffee leaves.

9. Preparation of soap from coconut oil/ olive oil by saponification.

Text Books:

1. A text Book of Practical Chemistry, Barua, S, 2th edition; 2016; KalyaniPublishers.
2. Vogel's Qualitative Inorganic Analysis; Svehla G. and Sivasankar B.; 7th edition; Pearson.

Reference Books:

1. Mendham J., Denney R.C., Barnes J.D. and. ThomasM.J.K.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th edition, 3rd Indian Reprint, 2003, Pearson Education Pvt. Ltd., NewDelhi

2. Halpern,M.; *Experimental Physical Chemistry*, 6th edition, 2008; Prentice Hall, Upper Saddle River, NJ07458

SYLLABUS (5th SEMESTER)

DSE Paper I/Subject Name: Spectroscopy		**Subject Code:CHY012D501**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of the course is to instill knowledge about the light matter interactions, principles of spectroscopic techniques and to give the preliminary idea about the applications of various spectroscopic techniques.

Course Outcomes:

After successful completion of the course, the students will be able to		
S. No.	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** and learn the electromagnetic radiation and basics of spectra	BT1
CO2	**Explain** basic principles of Rotational, Vibrational and Raman Spectroscopy, Electronic Spectroscopy, Spin Resonance Spectroscopy and Mass Spectrometry.	BT2
CO3	**Integrate**, **compare** and **apply** various techniques in Structure Elucidation of molecules	BT3&4
CO4	**Evaluate** the importance of Selection rules, chemical shift, Chromophore and McLafferty Rearrangement in spectroscopy.	BT5

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	**Basic theory of spectroscopy** Particle Nature of light, Electromagnetic Radiation, Spectral region, Interaction of electromagnetic radiation with matter, Energy Levels, Born Oppenheimer Approximation, Types of spectra- absorption and emission, Signal to Noise ratio, Spectral line width, Spectral Broadening-Collisional Broadening, Doppler Broadening, Intensity of Spectral Transitions- Factors affecting the intensity. Beer-Lambert Law, Molar Absorption coefficient, transmittance, absorbance	**12**
II.	**Rotational, Vibrational and Raman Spectroscopy** Rotational Energy levels, Classification of molecules based on their moment of inertia, Rotational spectra of diatomic molecules – Rigid Rotator Concept, Selection rules, Intensities of Spectral Line, application of rotational spectra. Vibrational spectra of diatomic molecules – harmonic and anharmonic oscillators – Morse potential, Selection rules, calculation of force constants, dissociation energies, fundamental frequencies, overtones, Application IR spectra in structure elucidation- finger print region. Principle of Raman spectroscopy-Stokes and anti-Stokes lines, Classical Theory of Raman Spectra.	**12**
III.	**Electronic Spectroscopy** Electronic transitions and selection rules, Electronic Transitions in diatomic molecule- selection rule-	**12**

	Vibrational fine structure, Types of electronic transitions, Franck-Condon principle, Nature of electronic states-singlet and triplet states, fluorescence and phosphorescence, Structure Elucidation- Chromophore, Auxochrome, absorption and intensity shifts, Woodward-fieser rule for calculating absorption maxima (in conjugated diene system), Effect of solvents on electronic transition.	
IV	**Spin Resonance Spectroscopy and Mass Spectrometry** Principles of NMR spectroscopy, ^{1}H NMR Spectroscopy, presentation of the spectrum -chemical shift, chemical shift of simple organic molecules, spin-spin coupling and spectra of simple molecules. Mass spectroscopy-principle –ionization techniques-fragmentation pattern-nitrogen rule-McLafferty Rearrangement. Applications	**12**
TOTAL		**48**

Text Book:

1. *Fundamentals of molecular spectroscopoy*; Banwell Colin N., McCashEllain M; 4th edition; 2017; Tata Macgraw-Hill.
2. *Introduction to Spectroscopy,* Pavia, D.L; Lampman; Kriz, G.S.; 5th edition, 2015; Brooks/Cole Cengage Learning

Reference Books :

1. *Modern Spectroscopy*; Hollas, J.M; 4th edition, 2013, John Wiley & Sons
2. Organic Spectroscopy; Kemp, W.; 3rd edition, 2011; Palgrave

SYLLABUS (5thSEMESTER)

Paper DSE II/Subject Name:Supramolecular ChemistrySubject Code:CHY012D502

L-T-P-C – 3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Course Objective:

The objective of **Supramolecular Chemistry**is to understand the fundamental concepts of supramolecular compounds and their application to solve various real-life problems.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl. No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the basic concept, size and synthesis of supramolecular compounds and their practical importance.	BT1

CO2	**Illustrate**non-covalent interactions and self-assembly of molecules.	BT2
CO3	**Apply** the principle of supramolecular compounds for application in various fields of catalysis and molecular devices.	BT3
CO4	**Analyze** the concepts of supramolecular compounds and their applications to resolve scientific problems.	BT4

Detailed Syllabus:

Modules	Topics & Course Content	Periods
I	**Introduction to Supramolecular Chemistry** Basic concept and principles, history, molecular recognition, hydrogen bonds: definition, structure and stability, strength, secondary electrostatic interactions in hydrogen bonding arrays.	12
II	**Non-covalent interactions** Ion pairing, ion-dipole interactions, dipole-dipole interactions, dipole-induced, dipole and ion-induced dipole interactions, van der Waals or dispersion interactions, hydrogen bonding, halogen bonding, cation- interactions, anion-pi interactions, pi - pi interactions, closed shell interactions, aromatic-aromatic Interactions: benzene crystals, N-H- pi interactions.	12
III	**Self-Assembly of Molecules** Design, synthesis and applications of metallo-macrocycles, coordination polymers like metal organic frameworks (MOFs), catenanes, rotaxanes, helicates and knots. Biochemical self-assembly: surfactants, micelles and vesicles, supramolecular liquid crystals.	12
IV	**Supramolecular Catalysis and Molecular Devices** Relevance of supra-molecular chemistry to mimic biological systems: cyclodextrins as enzyme mimics, ion channel mimics, corands as ATPase Mimics, abiotic supramolecular catalysis. Philosophy of molecular devices, molecular and supramolecular photonic devices, Light conversion and energy transfer devices, molecular and supramolecular electronic devices, molecular wires, rectifiers, Molecular switches (Photo, electro, mechanical, etc.), molecular machines (gear, break, paddle wheel, shuttle etc.).	12
TOTAL		48

Text Books:

1. J. W. Steed, J. L. Atwood, Supramolecular Chemistry John Wiley, 2009.
2. K. Ariga, T. Kunitake, Supramolecular Chemistry–Fundamentals and Applications, Springer, 2006.

Recommended Books:

1. G.R. Desiraju, Crystal Engineering. The Design of Organic Solids, Elsevier, 1989.
2. J. M. Lehn, Supramolecular Chemistry: Concepts and Perspectives, Wiley India Pvt. Ltd., 1995

SYLLABUS (5th SEMESTER)

DSE Paper III/Subject Name:Physical Chemistry-IV		Subject Code:CHY012D503
L-T-P-C – 3-1-0-4	Credit Units: 4	Scheme of Evaluation: T

Objective: The objectives of **Physical Chemistry-IV** are to study theories of reaction rate, thermodynamic control ofreactions and to understand the properties of colloids and concept involved inpolymerization.

Course Outcomes:

After successful completion of the course, the students will be able to		
S. No.	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Understand** the theories of reaction rate for bimolecular and unimolecular reactions	BT1
CO2	**Demonstrate** the applications of statistical thermodynamics and colloidal materials	BT2
CO3	**Apply** the principle of photochemistry for the application in a chemical reaction	BT3
CO4	**Analyze** the laws of photochemical equivalence, polymerization kinetics	BT4

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	**Molecular Reaction Dynamics** Collision theory of bimolecular gaseous reactions, activated complex theory: Erying equation– thermodynamic formulation, theory of unimolecular reactions (Lindemann), molecular reaction dynamics: potential energy surfaces – molecular beam technique and results of molecular beam studies. Reactions in solution, Bronsted- Bjerrum equation, kinetic salt effect, introduction to lasers, flash photolysis.	**12**
II.	**Statistical Thermodynamics** Molecular energy levels and Boltzmann distribution, molecular partition function and itssignificance. Translational, rotational and vibrational partition functions. Significance of heat and work. Statistical thermodynamics of monatomic and diatomicgases. Statistical thermodynamics treatment for	**12**

	calculation of heat capacity,residual entropy and equilibrium constants.	
III.	**Macromolecules & Colloids** Colloids : Definition, sols, difference between lyophilic and lyophobic sols, preparation and purification of colloids, structure, surface and stability of colloids, properties of sols: electrical double layer and electrokinetic phenomena, gold number, surface-active agents, micelle formation, critical micellar concentration (CMC) Macromolecules: Number average and mass average molecular weight, determination of molecular weight of macromolecules, condensation and addition polymerization, introduction to polymerization kinetics .	**12**
IV	**Photochemistry** Franck-Condon principle, Nature of electronic states-singlet and triplet states, dissociation and pre-dissociation, Luminescence phenomenon – fluorescence, phosphorescence, Jablonski diagram,Delayed fluorescence, Quantum yieldQuenching of fluorescence-Stern-Volmer equation,Chemi and bio luminescence. Laws of photochemical equivalence, Photosensitised reactions, Chemical Kinetics of H_2-Br_2, H_2-Cl_2reactions, Dissociation of HI, Photostationary equilibrium, Dimerisation of anthracene. Photochemistry of air and air pollution.	**12**
TOTAL		**48**

Text Books:

1. *Physical Chemistry*, Atkins P. W. and Paula J. de; 11th edition; 2017; Oxford University Press
2. *Principles of Physical Chemistry*; Puri, B.R.; Sharma, L.R.; Pathania, M.S.; 47th edition; 2016; Vishal Publishing Company

Reference Books:

1. Atkins, P.W. and Paula, J. de;*Elements of Physical Chemistry;*11th edition; 2017 ; Oxford University Press.
2. Levine, I.; *Physical Chemistry*; 6th edition; 2011; Tata McGraw Hill
3. Negi, A.S. and Anand, S.C. *A Textbook of Physical Chemistry*, 2nd edition, 2016, New Age International.
4. *Fundamental of Photochemistry*; Mukherjee-Rohatgi, K.K.; 3rd edition, 2014, New age international (P) Ltd
5. Glasstone, S.; *Text book of Physical Chemistry;* 11th edition; 2011; Van Nostrandcompany

SYLLABUS (5thSEMESTER)

DSE Paper IV/Subject Name: Polymer Chemistry **Subject Code: CHY012D504**

L-T-P-C: 3-1-0-4 **Credit Units: 4 Scheme of Evaluation: T**

Objective*:* The objective of **Polymer Chemistry**is toprovide concepts, and explainhow polymer can be crucial which can be invoked to solve problems

Course Outcomes:

After successful completion of the course, student will be able to		
Sl. No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the classes of monomer, polymer and their importance	BT1
CO2	**Illustrate**the polymerization techniques, their mechanism for synthesis, and stereochemistry.	BT2
CO3	**Apply**the methods to calculate the average molecular weight using the equations.	BT3
CO4	**Analyze**the concepts of polymer theories and their applications to resolve scientific problems.	BT4

Detailed Syllabus:

Modules	Topics / Course Contents	Periods
I	**Basic principles of polymer chemistry** Historical development of polymer chemistry. Monomers, polymers, repeating units, functionality. Importance and applications of polymers –acrylic, vinyl, cellulose, fluorinated, poly ethylene, & SAN copolymer. Classification of polymers. Ladder and spiral polymers.	12
II	**Chain growth and step growth polymerization** Chain growth polymerization. Mechanism of chain growth polymerization. Initiation, propagation and termination. Step growth polymerization, extent of reaction, degree of polymerization, Carother's equation. Gel and gel point. Ring-opening & interfacial polymerization, Copolymerization: random, alternate, block and graft. Reactivity ratio, its determination. Q-e scheme. Polymerisation techniques (bulk, solution, suspension and emulsion).	12
III	**Ionic & stereo regular polymerization** Ionic polymerization – anionic and cationic catalysts, Solvent effects in ionic polymerizations. Mechanism and kinetics of anionic and cationic polymerizations. Termination modes. Living polymers. Coordination polymerization: stereo regularity, Ziegler-Natta catalysts.	12
IV	**Molecular mass and size of polymers** Degree of polymerization and molecular weight. Practical significance of molecular weight. Number average, weight average and z average molecular mass and their calculation. Viscosity	

	average molecular mass. Polydispersity and polydispersity index of polymers. Absolute and relative methods of molecular mass determination. Determination of No. average molecular mass using NMR spectroscopy, ultracentrifugation (principle only), Light scattering method (No experimental details expected), viscosity average molecular mass, Gel permeation chromatography.	12
TOTAL		48

Text Book:

1. F. W. Billmayer, Text book of Polymer Science, 3rd edition, John Wiley & Sons
2. PremamoyGhosh, Polymer Science & Technology, 3rd edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

Reference Books:

1. G. S. Misra, Introductory Polymer Chemistry New age International Publishers & Distributors, New Delhi
2. P. Bahadur&N. V. Sastry, Principles of Polymer Science, Narrora Publishing House, 2nd Edition, New Delhi.
3. V. R. Gowariker, N. V. Viswanathan&J. Sreedhar, Polymer Science, New Age International Publishers.
4. Malcon P. Steves, Polymer chemistry-An introduction, 3rd edition, Oxford University Press.
5. V. K. Ahluwalia& A. Misra, Polymer Science-A Text Book, AneBooks, India, New Delhi.
6. J. R. Fried, Polymer Science & Technology, Prentice Hall of India Pvt. Ltd, New Delhi.

SYLLABUS (5 thSemester)(VAC)

Subject Name: Green Chemistry		**Subject Code: CHY012V501**
L-T-P-C: 2-0-0-2	**Credit Units: 2**	**Scheme of Evaluation: T**

Objective: The objective of Green **Chemistry** is to provide the knowledge and importance of Green chemical approach in modern synthetic practices and its principles and challenges.

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the basic principles and application of green chemistry	BT1
CO2	**Demonstrate** green energy generation processes and catalytical methods for chemical synthesis.	BT2
CO3	**Apply** the knowledge green energy and solvents for sustainable synthesis of commercially important compounds	BT3

CO4	**Examine** green solutions for the problems related to chemical pollution.	BT4

Detailed Syllabus:

Modules	Topics & Course content	Periods
I	**Introduction to Principles of Green Chemistry** Meaning of green chemistry, Need for green chemistry, Goals of green chemistry, Limitations and obstacles in the pursuit of the goals of green chemistry, Twelve principles of Green Chemistry, Prevention of Waste/ byproducts, Atom economy, prevention and minimization of hazardous/ toxic products.	**6**
II	**Green Energy Sources and Designing Green Synthesis** Use of microwave and ultrasonic radiation for supplying energy to a reaction. Principle, mechanism and advantages. Importance of catalysts. Photocatlytic reactions. Designing a green synthesis: choice of starting materials, reagents, catalysts and promoters, and solvents.	**6**
III	**Energy Efficient Green Synthesis/Reactions** Microwave assisted coupling reactions, synthesis of adipic acids, catechol, citral, polymers, ibuprofrn and paracetamol. Ultrasound assisted esterification, saponification, substitution reactions, oxidations and reductions. Photo induced organic transformations, C-C and C-X bond forming reactions.	**6**
IV	**Role of Green Solvents** Introduction, types of green solvents, solvent selection guides, green solvents and their application: water, ionic liquids, supercritical CO_2, water extract of agrowaste, glycerol, Renewable Bio-based feedstock and Polyethylene glycol.	**6**
Total		**24**

Text books:

1. Introduction to Green Chemistry, A. Matlack, 2nd edition, 2016, CRC Press

2. Green Chemistry and the Environment, V K Ahluwalia, 2nd edition, 2019, Vishal publishing co.

Reference books:

1. Dar B. A. Butt. F. A., Green Chemistry: A Concise Course Kindle Edition2nd edition, 2022,

New Age International

After successful completion of the course, the students will be able to		
S. No.	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** the postulates and interpret the basic principles of quantum mechanics	BT1&2
CO2	**Apply** quantum mechanical treatment to various models	BT3
CO3	**Construct** atomic-orbital wave functions plot and **solve** spin-orbit interactions for Term symbols	BT3&4
CO4	**Evaluate** the various orbital theoriesto **solve** for energy values of different molecules	BT 4 & 5

2. Sanghi R. and Srivastava M. M., Green Chemistry: Environment Friendly alternatives, 2nd edition, 2017, Narosa Publishing House, New Delhi, India.

SYLLABUS (6thSEMESTER)

Subject Name:Quantum Chemistry **Subject Code:CHY012C601**

L-T-P-C – 3-1-0-4 **Credit Units: 4** **Scheme of Evaluation: T**

Course Objective:The basic objectives of this course are to impart quantum mechanical postulates in solving the Schrödinger equation and to apply LCAO-MO theory to real atoms/ions.

Course Outcomes:

Detailed Syllabus:

Modules	Topics&Course Content	Periods
I	**Quantum Mechanics-I** Transition from classical mechanics to quantum mechanics: Black body radiation – Planck's hypothesis, Photoelectric effect – Einstein's explanation, Compton effect, Bohr's theory of atom: derivation for energy of an electron in hydrogen like species, de Broglie hypothesis, Heisenberg's uncertainty principle. Postulates of Quantum mechanics, wave functions, operators, eigen functions and eigen values, Schrodinger postulatesof operator transforms and the wave equation boundary conditions, normalization of the wave functions, expectation values,interpretation of the wave function – orthogonal and orthonormal wave functions.	**12**

II	**Quantum Mechanics-II** Model systems – particle in 1D and 3D boxes – particle in a ring, harmonic oscillator and rigid rotator (detailed mathematical treatment not necessary): Outline of solution of their Schrodinger equations, energy expression, wave functions and quantum numbers. Qualitative discussions of special features like degeneracy, energy level diagrams, plot of wave functions and their squares vs displacement from origin, zero point energy, quantum mechanical tunneling, force constant and bond strength (for harmonic oscillator), moment of inertia in 3D,angular momentum, space quantization of angular momentum (for rigid rotator).	**12**
III	**Atomic Structure** The Hamiltonian and Schrodinger equation for hydrogen and helium atoms, energy levels and quantum numbers, the radial and angular part of the wave functions, concept of atomic orbitals, plots of atomic-orbital wave functions and their squares vs. displacement from origin, construction of two-dimensional plots of probability density and calculation of radial probability functions, The orbitals of hydrogen and hydrogen-like atmos, contour diagrams of electron density, Stern-Gerlach experiment, electron spin and spin quantum number – spin orbitals, electron configuration of many electron atoms, Pauli's exclusion principle –illustration by He atom using wave functions, Spin-orbit interactions, Russel-Saunder's coupling, Term symbols. Effect of magnetic field on energy levels. Hund's rule.	**12**
IV	**The Nature of Chemical Bond** Schrodinger equation for a molecule, Born-Oppenheimer approximation, LCAO-MO theory as applied to $H_2^+$and H_2, drawback of MO theory. MO energy level diagram of homonuclear (O_2, N_2) and heteronuclear (HF, LiF, CO) diatomic molecules,HeitlerLondon theory – wave function and potential energy curve of H_2, concept of resonance and hybridisation from VB theory, term symbols of diatomic molecules. Huckel theory for ethene and benzene.	**12**
TOTAL		**48**

Text Books:

1. *Quantum Chemistry*; Levine, I.N.; 7th edition, 2016; Prentice Hall of India
2. *Quantum Chemistry;* Prasad, R.K.; 4threvised edition; 2010; New Age International Publishers Limited

Reference Books:

1. Chandra, A.K.; I*ntroductory Quantum Chemistry*; 4threvised edition; 2017; Tata McGraw Hill
2. Sen, B.K.; Quantum Chemistry Including Spectroscopy; 4th edition; 2011; KakyaniPublisheres, New Delhi

3. McQuarrie, D.A.; *Quantum Chemistry*; 2nd edition; 2011; Viva Books Pvt Ltd
4. Atkins, P.W and S.F. Ronald; *Molecular Quantum Mechanics;* 5thedition; Oxford University Press.

SYLLABUS (6thSEMESTER)

DSE Paper I/Subject Name: Inorganic Chemistry-IV		**Subject Code: CHY012D601**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of **Inorganic Chemistry-IV is** to provide an understanding of the electronic and magnetic properties of coordination compounds as well as inorganic reactionmechanism, bioinorganicChemistry and cover the idea of redox reaction and molecular symmetry of inorganiccompounds.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the concepts of spectral behaviour, magnetic property and reaction mechanism of coordination complexes.	BT1
CO2	**Explain** basic principles bioinorganic chemistry, redox behaviour and molecular symmetry	BT2
CO3	**Apply** concept of electronic spectra and magnetic behaviour to understand the spectral behaviour as well as magnetic properties of transition metal complexes	BT3
CO4	**Analyze** the redox reactions between species and as well as understand the symmetry of the compounds.	BT4

Detailed Syllabus:

Modules	Topics & Course content	Periods

I.	**Chemistry of Coordination Compounds II** Ligand field theory, molecular orbital theory of octahedral complexes (without and with pi bonding), metal-metal bonding and quadrupole-bonds, spectroscopic terms, R-S coupling, Mullikan's symbol, spectrochemical and naphelauxetic series, electronic spectra of simple T_d and O_h complexes, selection rules and qualitative Orgel diagram (d^1 to d^9 system). Orbital and spin magnetic moments, spin-only magnetic moments of d^n ions in weak and strong crystal fields of O_h and T_d symmetries, Orbital contribution and the effect of spin-orbit coupling, quenching of orbital angular momentum by crystal fields, ferromagnetism and anti-ferromagnetism with examples from metalcomplexes.	**12**
II.	**Inorganic reaction mechanism** Introduction to inorganic reaction mechanism, inert and labile complexes, association, dissociation and concerted paths, acid and base hydrolysis (with reference to cobalt complexes only), substitution reaction in octahedral and square planar complexes, trans effect, Irving-William series, electron transfer reactions- outer and inner spheremechanism	**12**
III.	**Bioinorganic Chemistry** Elements of life: essential major, trace and ultratrace elements, importance of Na^+ and K^+ ions in biology, Na-K pump, biochemistry of Ca^{2+} ions, biological functions of hemoglobin and myoglobin, cytochromes and ferredoxins, carbonic anhydrase and carboxypeptidase. Biological nitrogen fixation, Pt and Au complexes as anticancer drugs, toxicity due to metal ions (Hg, Pb, Cd, As).	**12**
IV.	**Redox reaction and molecular symmetry** Redox chemistry, standard electrode potentials, pH dependence of electrode potentials, redox stability of metal ions in water, oxidation by atmospheric oxygen, applications of Latimer and Frost diagrams, redox behaviour of non- transition elements based on electrode potentialdata. Symmetry elements and symmetry operations, definition of point groups, point groups of simple molecules, symmetry of octahedron, tetrahedron and square planar complexes, structure and symmetry of simple inorganiccompounds.	**12**
Total		**48**

Text Books:

1. *Concise Inorganic Chemistry*; Lee, J.D.; 5th edition; 2013; John Wiley and Sons Ltd.; Indian Edition.
2. *Inorganic Chemistry Principles of Structure and Reactivity*; Huheey, J.E., Keiter, E. A., Keiter, R. L. and Medhi, O. K. ; 4th edition; 2007; PearsonEducation.

Reference Books:

1. Atkins, P., Overtone, T., Rourke, J.; Weller, M. and Armstrong, F.; *Inorganic Chemistry*; 6th edition; 2014; Oxford University Press; Indianedition.
2. Cotton F.A., Wilkinson, G., Murillo A., BochmannM.;*Advanced Inorganic Chemistry;*6th edition; 1999; Wiley Interscience; NewYork.
3. *Bio-inorganic Chemistry;* Reddy, H. K.; 1st edition;Newagepublishers

SYLLABUS (6thSEMESTER)

DSE Paper II/Subject Name: Food Chemistry		**Subject Code: CHY012D602**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective:

The objectives of **Food Chemistry** are

The students will learn the basic knowledge in Food Chemistry and modern trends in the industry along with concept of the food adulteration and quality control in the food analysis.

Course Outcomes:

After successful completion of the course, the students will be able to		
S. No.	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** food and **identify** constituents of food.	BT1
CO2	**Explain** the types offood nutrients	BT2
CO3	**Understand** and **demonstrate the** importance of nutrition and balanced diet	BT2
CO4	**Apply** the food adulteration in quality control	BT3

Detailed Syllabus:

Modules	**Topic & Course Contents**	**Periods**

I	**Food and its constituents** Food source, functions of food – food groups – food guide – basic five food groups, usage of the food guide – food in relation to health – objectives of cooking. Calorific value of food. **Proteins**: amino acids – peptides – proteins, modification of food products through heat processing. Separation of amino acids by paper chromatography, separation of proteins by electrophoresis. **Carbohydrates:** Classification, structure and reactions of monosaccharides, glucose, fructose, structure of sucrose, maltose, lactose and starch. Principles involved in the analysis of carbohydrates – analysis of glucose, starch, Benedict method.	**12**
II	**Food nutrients** **Lipids:** Nomenclature and classification. Emulsions and emulsifiers, chemistry of fat and oil processing. Analysis of oils and fats – analysis of crude fats and determination of iodine number, RM value, acid number and saponification values. **Minerals and vitamins**: Sources, functions, bioavailability and deficiency of the following minerals (calcium, iron, iodine, fluorine, sodium and potassium (elementary treatment). Vitamins - classification, sources, functions and deficiencies of fat- soluble vitamins – A, D, E and K, water-soluble vitamins – C, thiamin, niacine, riboflavin, B-complex, - B_6, Folic acid and B_{12}.	**12**
III	**Nutrition and Balanced Diet** **Nutrition** – calorific value of food stuff – RQ of food (Respiratory quotient of food) – basal metabolic rate – factors influencing BMR, specific dynamic action (SDA) of food. **Thermogenic effect** – energy requirements of individuals – diet and its components – the protein requirements – biological value of proteins, supplementary value of proteins. Diseases associated with protein malnutrition. Nutritional value of carbohydrates. – Fibers in the diet, dietary sugars – nutritional aspects of lipids.	**12**
IV	**Food Adulteration** Adulterants: Common adulterants in different foods – milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages. Contamination with toxic chemicals – pesticides and insecticides. Principles involved in the analysis of detection and prevention of food adulteration. Quality control: Specifications and standards: PFA, FPO, FDA, drug license, WHO standards, ISI specifications, packing and label requirements, essential commodities act, consumer protection act. AGMARK.	**12**
Total		**48**

SYLLABUS (6TH SEMESTER)

Paper DSE III/Subject Name:Analytical Chemistry		**Subject Code:CHY012D603**
L-T-P-C – 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: (T)**

Objective: The objectives **Analytical Chemistry**isto offerthe students will learn the importance of analytical data and basic concepts of separation and analysis of organic and inorganic materials.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Define** and represent analytical data obtained from analytical methods.	BT1
CO2	**Demonstrate** importance of purification and identification of analytes.	BT2
CO3	**Apply** the knowledge of analysis to understand the nature and properties of individual components.	BT3
CO4	**Categorize** and estimate and the chemical species present in the sample.	BT4

Detailed Syllabus:

Modules	Topics&Course Content	Periods
I	**Data analysis** Evaluation of analytical data: Accuracy and precision, deviation, relative mean deviation, standard deviation, variance, significant figures in reporting measurements and calculation. Types of errors: determinate and indeterminate errors, various types of determinate errors, absolute errors, relative errors.	**13**
II	**Conventional purification techniques and gravimetric analysis** Purification of solid organic compounds – extraction, use of immiscible solvents, solvent extraction, recrystallization. Purification of liquids – distillation, vacuum distillation, fractional distillation,azeotropic distillation – principles and techniques. Gravimetry –Introduction, precipitation, properties of precipitates, co-precipitation and post precipitation, drying and ignition, role of precipitating agents in gravimetric analysis.	**13**

III	**Chromatography** Introduction to chromatography, principle of chromatography, retention time, classification of chromatographic methods, paper chromatography,thin layer chromatography, $R_f$value, column chromatography, choice of solvent system in chromatography, ion-exchange chromatography, applications of chromatographic methods.	**13**
IV	**Titrimetric analysis** Redox titrations – theory and feasibility of redox titrations, redox indicators, their choice and application. Acid-Base Titrations – theory of neutralisation titrations, indicators-theory and choice of indicators for acid/base titrations, neutralization curves. Complexometric titration – theory, titrations involving monodendate and multidendate ligands (EDTA), metallochromicindicators and their choice.	**13**
TOTAL		**52**

Text Books:

1. *Vogel's Qualitative Inorganic Analysis;* Svehla G. and Sivasankar B.; 7th edition; Pearson.

2. *Fundamental of Analytical Chemistry*, Skoog D.M.*;* 8th Edition, 2013; Saunders College Publishing, New York.

Reference Books:

1. MendhamJ., Denney R.C.,Barnes J.D. and. ThomasM.J.K.; *Vogel's Textbook of Quantitative Chemical Analysis*, 6th edition, 3rd Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.

2. Day R.A. and A.L., *Quantitative Analysis;* Underwood, 9th edition, 2015 Prentice Hall, Inc. New Delhi.

SYLLABUS (6thSEMESTER)

DSEPaper IV/Subject Name: Chemistry of Cosmetics and Antioxidants		**Subject Code: CHY012D604**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: (T)**

Objective:

The objectives of **Chemistry of Cosmetics and antioxidants** are

This module aims to provide an understanding of the concepts behind the cosmetics and their production.

Course Outcomes:

After successful completion of the course, the students will be able to		
S. No.	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Understand** cosmetics and their role in beauty and wellness.	BT1
CO2	**Discuss** the types ofpersonal care products	BT2
CO3	**Evaluate** the adverse effects of cosmeticsand emergence of herbal cosmetics	BT2
CO4	**Apply** the benefit of antioxidants in beauty products	BT3

Detailed Syllabus:

Modules	Topics & Course Content	Periods
I	**Introduction** History of cosmetics, classification of cosmetics, professional image of self grooming, beauty and wellness. Cosmetics emulsions: cream, cleansers, powders, moisturisers, sun screen, acne and anti-aging creams. Chemical peels and peeling agents, lasers and light devices, Electro Chemistry, bath salts, gels, soaps, bubble baths and scrubs.	**12**
II	**Personal care** **Skin Care**: General Anatomy and Physiology of skin, Structure of skin, Growth and nutrition, dermal fillers **Hair Care**: Structure of hair, growth of hair, Cosmetics used for hair – Shampoos, conditioners, Bleaches, hair dyes, hair gels, hair perms and hair relaxers/straighteners. **Nail Care**: Structure of nail, cosmetics used for nail – Nail lacquer, nail polish remover, Manicure and Pedicure, nail care techniques. **Eye Care**: Cosmetics used for eye – eye brow pencil, eye liner, eye shadows, mascaras. Eye concealer and eye creams	**12**
III	**Cosmetics Preparations** Preparation of Cold cream, Talcum Powder, Bath salt, Lip Balm, Nail Polish Remover, Hand Wash. Adverse effects of cosmetics on human and environment, Water and mineral based cosmetics. **Herbal Cosmetics**: A comprehensive study of the plant materials used in cosmetics. Use of herbs in different forms. Herbal cosmetics for skin (cleaning creams, moisturizing creams, masks, body lotions, massage preparations, nourishing creams). Herbal Cosmetics for hair (conditioners, oils, shampoo, dyes).	**12**
IV	**Antioxidants** Definition, antioxidants in cosmetics, Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin Synthetic antioxidants: Butylatedhydroxy Toluene, Butylatedhydroxy Anisole	**12**

TOTAL		**48**

Text Books:

1 *Introduction to cosmetic chemistry;*Ramesh K. Prestige Books., India, 2018.

2.*Antioxidants and the Skin; Second Edition;* McMullen R. L. CRC Press; 2nd edition, 2018

Reference Books:

1. Mahmood Dar A., *Cosmetic Chemistry: An Instant Approach;* Educreation Publishing, India, 2018.

2. Barel, André O., Paye, Marc, Maibach, Howard I.Handbook of *Cosmetic Science and Technology,* CRC Press, 2014

SYLLABUS (6th SEMESTER)

DSE Paper V/Subject Name: Organic Chemistry IV		**Subject Code: CHY012D605**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objectives of **Organic Chemistry IV**are:

- To provide an understanding of organic photochemical reactions
- To provide an understanding of structure, properties of carbohydrates, terpenes and alkaloids
- To provide the knowledge of molecular rearrangements

Prerequisites:

- Concept of reaction intermediates, orbitals, electronic excitation and mechanisms of common chemical reactions
- Concept of biomolecules and drugs molecules

Course Outcomes:

The student will

1. be able to know the theory and principle of photochemistry
2. be able to understand about carbohydrate chemistry and classification of drug molecules.
3. be able to understand about nucleophilic, electrophilic and free radical type of molecular rearrangements and pericyclic reactions

Detailed Syllabus:

Modules	Topics and Course content	Periods
I.	**Chemistry of polymers** Polymerization: Definition, classification of polymers on the basis of composition, degree of polymerization; mechanism of cationic, anionic and free radical polymerization. Photo polymerization, polymer degradation (chemical and photochemical). Biopolymers: Polysaccharides, structure of cellulose and starch, lignins, polypeptides and polynucleotides. Fabrics: Natural and synthetic (acrylic, polyamido, polyester). Rubbers: Natural; synthetic: Buna-S, Chloroprene and Neoprene; vulcanization.	**12**
II.	**Carbohydrate and Medicinal Chemistry** Carbohydrates: Definition, classification of carbohydrates, general idea of monosaccharides,configuration of the hydroxyl groups in the monosaccharides, open chain and ring structure of glucose, reactions of glucose: osazone formation, bromine – water oxidation etc., concept of mutarotation, anomers, epimers. Drugs: Basic classification. Analgesics: paracetamol and aspirin, their structure and preparation. Antibiotics: general idea including classification and structural variation. Sulpha drugs: general idea, mechanism of action, structure and preparation of sulphanilamide.	**12**
III.	**Molecular Rearrangements** (i)Nucleophilic or anionotropic: Wagner-Meerwein rearrangement, Whitmore 1, 2-shift, Wolff, Curtius, Hoffmann, Lossen, Schmidt, Favorskii, Beckmann, Benzil-benzilic acid, Baeyer–Villiger rearrangements. (ii) Electrophilic or cationotropic: pinacol rearrangement. (iii)Free radical: Wittig rearrangement. (iv)Special rearrangements: Fries rearrangement, Stevens rearrangement.	**12**
IV.	**Pericyclic Reactions and Organic Photochemistry** Definition and examples of 2+2 and 2+4 cycloadditions. The conservation of orbital symmetry. Woodward Hoffman rules. Diels Alder reaction, 1, 3 Dipolar Cycloaddition. Sigmatopic rearrangements-Cope and Claisen rearrangements. Electrocyclic reactions - HOMO-LUMO approach. Typical photochemical reactions: Photo-reduction of benzophenone, photolysis of ketones, Norrish type-I and Norrish type-II reactions, dimerization and cycloaddition of ethene.	**12**
Total		**48**

Text Books:

1. *Organic Chemistry*, Morrison R. T. and Boyd R.N., Bhattacharjee S.K.B., 7th edition, 2011, published by Prentice Hall.
2. *Organic Chemistry*,FinarI. L. 6th edition, (Low price), 2017, Pearson Education.
3. *Organic Chemistry*, Stanley H. Pine, 5th edition, 2010, McGraw-Hill Bool.
4. "Principles of biochemistry" A. L. Lehninger; 7th edition; 2017, W. H. Freeman and company.

Reference Books:

1. Kalsi P.S.,"*Organic Reactions and their Mechanisms*", 4th edition, 2017, New Age International.
2. Solomons T. J., "*Organic Chemistry* " , 11th Revised edition, 2013, John Wiley Sons Inc.

SYLLABUS (6thSEMESTER)

Paper DSE VI/Subject Name:Nanochemistry **Subject Code:CHY012D606**

L-T-P-C –3-1-0-4 **Credit Units: 4 Scheme of Evaluation: T**

Objective: The objective of **Nanochemistry** is to understand the fundamental concepts of nanomaterials and their application to solve various real-life problems.

Course Outcomes:

After successful completion of the course, student will be able to		
Sl. No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Recall** the basic concept, size and synthesis of nanomaterials, and their practical importance.	BT1
CO2	**Illustrate** the structure, morphology and synthetic method of nanomaterials.	BT2
CO3	**Apply** the principle and synthetic methods for application of nanomaterials in various fields.	BT3
CO4	**Analyze** the concepts of nanomaterials and their applications to resolve scientific problems.	BT4

Detailed Syllabus:

Modules	**Topics & Course Content**	**Periods**

I	**Introduction to Nanomaterials** Introduction to nanoscience and nanotechnology, nanotechnology from the perspective of Medieval period, nanomaterials in nature, influence of nano over micro-material and macro-material. 1D, 2D and 3D nanostructured materials, quantum dots shell structures.	**12**
II	**Structure and Morphology of Nanoparticles** Crystal structure of materials, packing fraction, basics of solid-state chemistry, specific surface energy and surface stress and effect on the lattice parameter, nanoparticle morphology and morphology of supported particles.	**12**
III	**Synthesis and Stabilization of Nanomaterials** Top Down and Bottom Up approaches of fabricating nanomaterials, challenges in nano fabrication, different physical and chemical methods of synthesizing nanoparticles, Ostwald ripening, electrostatic and steric stabilization, synthesis of metal, semiconducting and oxide nanoparticles, Techniques of synthesis: electroplating and electrophoretic deposition, conversion through chemical reactions and lithography, thin films: chemical vapor deposition and atomic layer deposition techniques.	**12**
IV	**Recent Advances and application of Nanotechnology** Designing molecules for nan-electronics advances of nanotechnology in materials science, biology and medicine, surface science, energy and environment, applications of nanostructured thin films, applications of quantum dots, applications of magnetic nanoparticles.	**12**
TOTAL		**48**

Text Books:

1. M.S. RamachandraRao, S. Singh, Nanoscience and Nanotechnology: Fundamentals of Frontiers, Wiley India. 2016.
2. G. Cao, Y. Wang, Nanostructures and Nanomaterials Synthesis, Properties, and Applications 2nd Ed., World Scientific. 2004.

Recommended Books:

1. H.S. Nalwa, Encyclopedia of Nanoscience and Nanotechnology, 2004
2. G.B. Sergeev Nanochemistry, Elsevier, B.V. 2010
3. C.N.R. Rao, A. Müller, A.K. Cheentham, Chemistry of Nanomaterials, Wiley. 2005

SYLLABUS (6th SEMESTER) (SEC)

Subject Name: Chemistry of Biomolecules		**Subject Code: CHY012S611**
L-T-P-C: 0-0-4-2	**Credit Units: 2**	**Scheme of Evaluation: P**

Objective: The objective of **Chemistry of Biomolecules** is to provide the knowledge for qualitative and quantitative estimation and investigation of individual components

Course Outcomes:

After successful completion of the course, student will be able to		
Sl No	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	**Show** the importance of qualitative and quantitative analysis in modern chemistry	BT1
CO2	**Demonstrate** the chemistry of separation using chromatography and centrifugation.	BT2
CO3	**Apply**separation techniques to isolate organic biomolecules.	BT3
CO4	**Inspect**the individual components via various spectroscopic techniques.	BT4

Detailed Syllabus:

1. Qualitative analysis of Biomolecules: Carbohydrates, protein,lipids, etc.
   (a) Benedict's test for reducing sugars.
   (b) Iodine test for starch.
   (c) Emulsion test for Lipids.
   (d) Biuret test for proteins.
2. Estimations
   c) To estimate glucose content in a given solution
   d) To estimate amino acids by using Ninhydrin.
3. Separation techniques
   (a) Lycopene extraction from tomato using thin layer Chromatography
   (b) Starch from potato
   (c) Peptide (dipeptide, tripeptide, etc) by centrifugation process
   (d) Extraction of chlorophyll from plants leaves using Chromatographic technique

Text Books:

1. An Introduction to Practical biochemistry by David T. Plummer.
2. Experimental Biochemistry, A student Companion by BeeduSashidharRao and Vijay Deshpande

Reference Books:

1. IUPAC, *Compendium of Chemical Terminology*, 2nd ed. (the "Gold Book") (1997). Online corrected version: (2006-) "Haworth representation.
2. H. Fehling (1849). "Die quantitative Bestimmung von Zucker und StärkmehlmittelstKupfervitriol". *Annalen der Chemie und Pharmacie* **72** (1): 106–113.

SYLLABUS (6thSEMESTER)(VAC)

Subject Name: Medicinal & Pharmaceutical Chemistry **Subject Code: CHY012V601**
L-T-P-C: 2-0-0-2 **Credit Units: 2** **Scheme of Evaluation: T**

Objective: The objective of **Medicinal & Pharmaceutical Chemistry** is to provide students with a thorough understanding of the action of commonly used drugs, structure-activity relationships, different steps of pharmacokinetics and therapeutic application of various classes of drugs.

Course Outcomes:

After successful completion of the course, student will be able to

Sl No	Course Outcome	Bloom's Taxonomy Level
CO1	**Define** and gain the knowledge from various steps Pharmacokinetics	BT1
CO2	**Explain** the concept of the general aspects of design of drugs	BT2
CO3	**Apply** the knowledge of various common routes of drug administration in day-to-day life.	BT3
CO4	**Analyze** the adverse effects, therapeutic uses of some of the commonly used drugs.	BT4

Modules	Topics & Course Content	Periods

I	**Introduction:** Definition of drugs and phermaceuticals, general classification of drugs, general idea of structure activity relationship of drugs.	**12**
II	**Pharmacokinetics:** Common routes of drug administration; general introductions of phases of pharmacokinetics: absorption, distribution, metabolism and excretion of drugs; drug dosing; bioavailability and drug half-life.	**12**
III	**Study of anaesthetic, antifungal and anti-inflammatory agents:** General anaesthetic agents: Introduction, medicinal aspects of anaesthetics, gases and volatile liquid anaesthetics, Antifungal agents: Introductions, medicinal aspects of antifungal agents, examples. Anti-inflammatory agents: Introduction, examples of common anti-inflammatory agents	
IV	**Study of antiviral, anticancer and central nervous system agents:** Antiviral agents: General introduction, classification of antiviral agents. Anticancer agents: An introduction, common examples of anticancer drugs. Central Nervous System agents: General introduction, Phenobarbital, Diazepam.	**12**
TOTAL		**48**

Detailed Syllabus:

Text Books:

1. An Introduction to Medicinal Chemistry; Patric G. L.; 6th edition; 2017; Oxford UniversityPress.
2. Fundamental of Medicinal Chemistry; Thomas G.; 2nd edition, 2007;Wiley.

Reference Books:

1. King F. D.; *Medicinal Chemistry: Principles and Practice*; 2nd edition; Royal Society of Chemistry