GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

COIMBATORE-641 018

Learning outcomes-based Curriculum Framework (LOCF) for

B.Sc. CHEMISTRY

(Effective from the Academic year 2021-2022)

POSTGRADUATE AND RESEARCH

DEPARTMENT OF CHEMISTRY

MAY-2021

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Preamble

Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. Such changes have gained momentum with the introduction of Choice Based Credit System (CBCS) which further expects learning outcome-based curriculum in order to maximize the benefits of the newly designed curriculum. The learning outcome-based curriculum will definitely help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. It is pertinent to mention here that the purpose of education is to develop an integrated personality of the individual and the educational system provides all knowledge and skills to the learner for this.

Tamil Nadu State Council for Higher Education (TANSCHE) has formed the State Integrated Boards of Studies, which, with great diligence and expertise has devised the mandatory areas that have to be covered for three-year undergraduation and two-year postgraduation courses to realize the facilitation of the mobility of faculty and students from one university to another and to easily solve the problem of equivalence among courses. Great care has been taken so that these areas would take 75% of the course content and the remaining 25% can be decided by the individual institutions. The areas that must be covered by the student that are mandatory for earning the degree to have due value has been worked out so that the student will gain enough depth of knowledge in the subject concerned. 25% percent of the syllabus should be designed by the institutions, and the areas covered under this also must have a weightage of 25%. This gives the autonomous institution seamless liberty on every Board of Studies (BOS) to innovate and experiment, and more importantly, it is here that the institution devises appropriate strategies by which (i) to make creative and critical applications of what has been learnt in the mandatory components, and (ii) to meaningfully connect the learners to the career demands and expectations. It is essential that the theoretical subject knowledge of the students must be translated into practical hands-on experience.

One of the significant reforms in the undergraduate education is to introduce the Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the country which will help the students to ensure similar quality of education irrespective of the institute and location. With initiatives of University Grants Commission (UGC) for nation-wide adoption and implementation of the LOCF for bachelor's programmes in colleges, universities and HEIs in general. A Core Expert Committee (CEC) was constituted to formulate the modalities for developing the LOCF in various subjects being taught in the undergraduate courses in sciences, humanities, commerce and professional courses. The CEC also

constituted the Subject Expert Committees (SEC) in various subjects to prepare detailed guidelines for the LOCF in subjects concerned.

The key components of the planning and development of LOCF are given in terms of clear and unambiguous description of the Graduate Attributes (GA), Qualification Descriptors (QD), Program Learning Outcomes (PLO) and Course Learning Outcomes (CLO) to be achieved at the end of the successful completion of each undergraduate program to be offered by HEIs. In undergraduate education in Information Technology, the programme of study leading to the degree of B.Sc. in Information Technology is discussed herewith.

The Qualification Descriptors (QD), Program Learning Outcomes (PLO) and the Course Learning Outcomes (CLO) were also finalized keeping the broad requirement of the programme in view. The LOCF also gives general guidelines for the Teaching Learning Process (TLP) corresponding to each component of theory, experiment, tutorials, projects and industrial / field visits to be followed in order to achieve the stated outcomes for each component. Finally, some suggestions for using various methods in the assessment and evaluation of learning levels of students are also made. It is a student centric framework where they are expected to learn fundamentals of Information Technology along with the latest trends and techniques like Artificial Intelligence, Internet of Things, Machine Intelligence along with advanced skillsets that include Mobile Application Development, Object Oriented Programming among many other courses.

The template as developed has the provision of ensuring the integrated personality of the students in terms of providing opportunity for exposure to the students towards core courses, skill-based courses, allied courses, Non-major elective courses with special focus on communication and subject specific skills through practical and other innovative transactional modes to develop their employability skills. The template of learning outcome based curriculum has categorically mentioned defined expected outcomes for the programme like core competency, communication skills, criticalthinking, effective skills, problem-solving, analytical reasoning, research-skills, teamwork, digitalliteracy, moral and ethical awareness, leadership readiness and so on along with very specific learning course outcomes at the starting of each course. Therefore, this template on Learning Outcomes based Curriculum Framework (LOCF) for B.Sc. with Chemistry willdefinitely be a landmark in the field of outcome-based curriculum construction.

1. Introduction

Academics and research in India is a priority which depends upon the quality of education. Quality higher education includes innovations that can be useful for efficient governance of higher education institutions, systems and society at large. Thus, fundamental approach to learning outcome-based curriculum framework emphasizes upon demonstration of understanding, knowledge, skills, attitudes and values in particular programme of study. The LOCF based programme intended to follow flexibility and innovation in design of the programme, its assessment, and expect graduate attributes demonstrating the level of learning outcome. It is further expected to provide effective teaching – learning strategies including periodic review of the programme and its academic standard. The learning outcome-based curriculum framework for B.Sc. degree in Chemistry is intended to provide a broad framework and hence designed to addressthe needs of the students with chemistry as the core subject of study. The framework is expected to assist in the maintenance of the standard of chemistry degrees/programmes across the country and periodic programme review within a broad framework of agreed/expected graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes. The framework is intended to allow flexibility and innovation in programme design, syllabi development, teaching-learning process and quality assessment of students learning levels.

This curriculum framework for the bachelor-level program in Chemistry is developed keeping in view of the student centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. To avoid wrote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works. The platform aims at equipping the graduates with necessary skills for Chemistry-related careers, careers with general graduate-level aptitude and for higher education in Chemistry and allied subjects. Augmented in this framework are graduate attributes including critical thinking, scientific reasoning, moral, ethical reasoning and so on, qualification descriptors that are specific outcomes pertinent to the discipline of chemistry, learning outcomes for the programmes these frameworks have been developed, learning outcomes for individual courses, pedagogical methods and assessment methods.

While designing these frameworks, emphasis is given on the objectively measurable teaching-learning outcomes to ensure employability of the graduates. In line with recent trends in education section, these frameworks foster implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms. In addition, the framework pragmatic to

the core; it is designed such a way to enable the learners implementing the concepts to address the real world problems. A major emphasis of these frameworks is that the curriculum focuses on issues pertinent to India and also of the west; for example, green chemistry and biomaterials etc. Above all, these frameworks are holistic and aim to mould responsible Indian citizen to have reflective thinking, scientific temper, and digital literacy in order to acquire requisite skill to be self employed entrepreneurial.

Aims:

1. To transform curriculum into outcome-oriented scenario
2. To develop the curriculum for fostering discovery-learning
3. To equip the students in solving the practical problems pertinent to India
4. To adopt recent pedagogical trends in education including e-learning, flipped class, hybrid learning and MOOCs
5. To mould responsible citizen for nation-building and transforming the country towards the future

1.1 Course Structure – Types of Courses.

The following types of courses are offered under CBCS-LOCF:

a. Core Courses (CC). A core course is a compulsory discipline specific course. A student of B.Sc. Chemistry has to take 10 such Theory and 5 Practical Papers over six semesters.

b. Elective Courses (EC). An elective course is a course that is to be chosen from a specified set of courses. These courses are of two types. Which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

i. **Discipline Specific Electives (DSE).** These are elective courses that provide advanced undergraduate training in specialized areas of Chemistry. A set of six semester-specific, courses of this kind are offered in the First through fourth semester of the Undergraduate programme, Chemistry.

ii. **Project.** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. Such a course is compulsory in the sixth semester.

iii. **Generic Electives (GE).** These courses, in disciplines other than Chemistry, are intended to broaden the training of a student in the Chemistry Undergraduate programme. A student of

B.Sc. Chemistry will take one such course, offered by another department, in each of Semester V and VI.

c. Ability Enhancement Compulsory Course (AECC). Two such courses are to be taken, one in Semester I (Environmental Studies) and one in Semester II (Value Education– Gandhian Thoughts).

d. Skill Enhancement Course (SEC). A student is to take one such course each in Semester III through Semester VI.

2 Learning Outcomes - Based Approach to Curriculum Planning and Development (LOACPD):

Curriculum is the heart of any educational system. It can be focused either to achieve the objectives of each course of the programme or on the expected learning outcomes from each course. The objective based curriculum refers to the overall targets to be achieved through curriculum which may be long term or immediate. On the other hand, the learning outcome based curriculum is very specific in nature in terms of changes in the cognitive, affective and psychomotor behavior of the students as a result of their exposure to the curriculum. The outcome based curriculum provides the teacher very specific targets which he can achieve through the selected instructional process as compared to the objective based curriculum which provides general outcomes.

The learning outcome based curriculum has very close relationship with the learning of the students whereas objective based curriculum focusses on only providing knowledge to the students.In other words, higher cognitive skills are developed through learning outcome based curriculum. Hence, it is preferred to develop learning outcome based curriculum which will provide specific directions to the teacher with respect to the transaction process and expected changes in the behavior of the students as well. Based on higher order cognitive skills, achievable targets are performed through individual development of student's performance. Industry ready students are moulded through use of LOCF methodology to achieve the expected outcome.

2.1 Nature and extent of the B.Sc Chemistry Programme

Chemistry is referred to as the sciences that systematically study the composition, properties, and reactivity of matter at atomic and molecular level. The scope of chemistry is very broad. The keyareas of study of chemistry comprise Organic chemistry, Inorganic Chemistry, Physical Chemistry, Polymer and Pharmaceutical Chemistry. Organic chemistry is a study of substances containing carbon mostly; inorganic chemistry deals with study of all other elements/compounds/substances and their chemical properties. Physical chemistry deals with applications of concepts, laws to chemical phenomena. Development of new interdisciplinary subjects like nano-materials, biomaterials, etc. and their applications from chemistry point of view added new dimension to materials chemistry. Thus, the degree programme in chemistry also intended to cover overlapping areas of chemistry with physics, biology, environmental sciences. Further, a broad range of subjects such as materialschemistry, biomaterials, nano-

materials, environmental chemistry, etc., has also been introduced which can be helpful for students/faculty members to broaden the scope of their studies and hence applications from job prospective point of view. Therefore, as a part of efforts to enhance employability of graduates of chemistry, the curricula also include learning experience with industries and research laboratories as interns. In addition, industrial visits/industrial projects are encouraged and added to the curriculum in order to enhance better exposure to jobs/employment opportunities in industries, scientific projects and allied sectors.

This modified syllabus has been drafted to enable the students to equip for national level competitive exams that they may attempt in future. To ensure implementation of a holistic pedagogical model, several allied disciplines are covered/introduced in this framework, includingPhysics, Mathematics, Biology and a number of generic, and ability enhancement electives. In addition, employability of B.Sc. Chemistry graduate is given due importance such that their core competency in the subject matter, both theoretical and practical, is ensured. To expand the employability of graduates, a couple of advanced elective courses are also introduced in this framework.

2.2 Aims of Bachelor's degree programme in Chemistry

The broad aims of Bachelor's degree programme in Chemistry are:

The aim of Bachelor's degree programme in chemistry is intended to provide:

(i) Broad and balanced knowledge in chemistry in addition to understanding of key chemical concepts, principles and theories.

(ii) To develop students' ability and skill to acquire expertise over solving both theoretical and applied chemistry problems.

(iii) To provide knowledge and skill to the students' thus enabling them to undertake further studies in chemistry in related areas or multidisciplinary areas that can be helpful for self-employment/entrepreneurship.

(iv) To provide an environment that ensures cognitive development of students in a holistic manner. A complete dialogue about chemistry, chemical equations and its significance is fostered in this framework, in addition to real life problems as in industries. Proper exploitation in areas of organic chemistry with regard to Natural Products will kinder enormous skills for assessments.

(v). To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A chemistry graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific

studies, as well as to begin domain-related employment.

(vi) To mould a responsible citizen who is aware of most basic domain-independent knowledge,including critical thinking and communication.

(vii) To enable the graduate prepare for national as well as international competitive examinations,especially UGC-CSIR NET and UPSC Civil Services Examination.

3. Graduate Attributes

Attributes of chemistry graduate under the outcome-based teaching-learningframework may encompass the following:

a. **Core competency:** The chemistry graduates are expected to know the fundamental concepts of chemistry and applied chemistry. These fundamental concepts would reflect the latest understanding of the field, and therefore, are dynamic in nature and require frequent and time-bound revisions.

b. **Communication skills:** Chemistry graduates are expected to possess minimum standards of communication skills expected of a science graduate in the country. They are expected to read and understand documents with in-depth analyses and logical arguments. Graduates are expected to be well-versed in speaking and communicating their idea/finding/concepts to wider audience

c. **Critical thinking:** Chemistry graduates are expected to know basics of cognitive biases, mental models, logical fallacies, scientific methodology and constructing cogent scientific arguments.

d. **Psychological skills:** Graduates are expected to possess basic psychological skillsrequired to face the world at large, as well as the skills to deal with individuals and students of various sociocultural, economic and educational levels. Psychological skills may include feedback loops, self-compassion, self-reflection, goal-setting, interpersonal relationships, and emotional management.

e. **Problem-solving:** Graduates are expected to be equipped with problem-solving philosophical approaches that are pertinent across the disciplines;

f. **Analytical reasoning:** Graduates are expected to acquire formulate cogent arguments and spot logical flaws, inconsistencies, circular reasoning etc.

g. **Research-skills:** Graduates are expected to be keenly observant about what is going on in the natural surroundings to awake their curiosity. Graduates are expected to design a scientific experiment through statistical hypothesis testing and other *a priori* reasoning including logical deduction.

h. **Teamwork:** Graduates are expected to be team players, with productive co- operations involving members from diverse socio-cultural backgrounds.

i. **Digital Literacy:** Graduates are expected to be digitally literate for them to enroll and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning. Graduates should be able to spot data fabrication and fake news by applying rational skepticism and analytical reasoning.

j. **Moral and ethical awareness:** Graduates are expected to be responsible citizen of India and be aware of moral and ethical baseline of the country and the world. They are expected to define their core ethical virtues good enough to distinguish what construes as illegal and crime in Indian constitution. Emphasis be given on academic and research ethics, including fair Benefit Sharing, Plagiarism, Scientific Misconduct and so on.

k. **Leadership readiness:** Graduates are expected to be familiar with decision- making process and basic managerial skills to become a better leader. Skills may include defining objective vision and mission, how to become charismatic inspiring leader and so on.

4. Qualification Descriptors

The qualification descriptors for a Bachelor's degree in Chemistry may include following:

(i). Systematic and fundamental understanding of chemistry as a discipline.

(ii). Skill and related developments for acquiring specialization in the subject.

(iii). Identifying chemistry related problems, analysis and application of data using appropriatemethodologies.

(iv). Applying subject knowledge and skill to solve complex problems with defined solutions.

(v). Finding opportunity to apply subject-related skill for acquiring jobs and self-employment.

(vi). Understanding new frontiers of knowledge in chemistry for professional development.

(vii). Applying subject knowledge for solving societal problems related to application of chemistry in day to day life.

(viii). Applying subject knowledge for sustainable environment friendly green initiatives.

(ix). Applying subject knowledge for new research and technology.

The qualification descriptors for a Bachelor's degree in Chemistry may also include following:

(i) To demonstrate a systematic, extensive and coherent knowledge and understanding of academic

fields of study as a whole and its applications and links to disciplinary areas of the study; including critical understanding of the established theories, principles and concepts of a number of advanced and emerging issues in the field of chemistry;

(ii) To demonstrate procedural knowledge that creates different types of professionals in the field of chemistry. Further application of knowledge can enhance productivity of several economically important product. Knowledge of Chemistry is also necessary for the development and management of industry, manufacturing of fine chemicals, etc.

(iii) Developing skills and ability to use knowledge efficiently in areas related to specializations and current updates in the subject

(iv) .Demonstrate comprehensive knowledge about chemistry, current research, scholarly and professional literature of advanced learning areas of Chemistry

(v) Use knowledge understanding and skills for critical assessment of wide range of ideas and problems in the field of Chemistry.

(vi) Communicate the results of studies in the academic field of Chemistry using main concepts, constructs and techniques

(vii) Apply one's knowledge and understanding of Chemistry to new/unfamiliar contexts and to identify problems and solutions in daily life.

(viii) To think any apply understanding of the subject of Chemistry, Chemical Sciences in identifying the problems which can be solved through the use of chemistry knowledge.

(ix) To think of the adopting expertise in chemical sciences and solve the problems of environment, green chemistry, ecology, sustainable development, hunger, etc.

5. Program Learning Outcome in B.Sc. Chemistry

The student graduating with the Degree B.Sc. Chemistry should be able to

Core competency: Students will acquire core competency in the subjectChemistry,

(i). Systematic and coherent understanding of the fundamental concepts in Physical chemistry, Organic Chemistry, Inorganic Chemistry, Polymer, Pharmaceutical Chemistry and all other related allied chemistry subjects.

(ii). Students will be able to use the evidence based comparative chemistry approach to explain thechemical synthesis and analysis.

(iii). The students will be able to understand the characterization of materials.

(iv). Students will be able to understand the basic principle of equipment's, instruments used in the chemistry laboratory.

(v). Students will be able to demonstrate the experimental techniques and methods of their area ofspecialization in Chemistry.

(vi). ***Disciplinary knowledge and skill***: A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding of both theoretical and experimental/applied chemistry knowledge in various fields of interest like Analytical Chemistry, Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Material Chemistry, etc. Further, the student will be capable of using of advanced instruments and related soft-wares for in-depth characterization of materials/chemical analysis and separation technology.

(vii). ***Skilled communicator***: The course curriculum incorporates basics and advanced training inorder to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

(viii). ***Critical thinker and problem solver***: The course curriculum also includes components that can be helpful to graduate students to develop critical thinking ability by way of solving problems/numerical using basic chemistry knowledge and concepts.

(ix). ***Sense of inquiry***: It is expected that the course curriculum will develop an inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation.

(x). ***Team player***: The course curriculum has been designed to provide opportunity to act as teamplayer by contributing in laboratory, field based situation and industry.

(xi). ***Digitally literate***: The course curriculum has been so designed to impart a good working

knowledge in understanding and carrying out data analysis, use of library search tools, and use of chemical simulation software and related computational work.

(xii). ***Ethical awareness/reasoning***: A graduate student requires to understand and develop ethicalawareness/reasoning which the course curriculum adequately provide.

(xiii). ***Lifelong learner***: The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity.

6. Structure of B.Sc., Course objectives, learning Outcomes, Contents, Teaching Learning Programmes, Assessment References

PROGRAM LEVEL OUTCOMES FOR BSc CHEMISTRY

PLO-1: Demonstrate coherent knowledge and skills gained during the course of the program in formulating solution to real problems with constant upgradation. Preserve and attain strong foundation in chemical principles with higher level of understanding in chemistry.

PLO-2: Effectively communicate and exchange ideas with regard to principles, phenomena, processes and mechanisms involved both theoretical and experimental aspects.

PLO-3: Apply basic laws with a systematic approach to synthesize chemical / materials without any environmental compromise, evaluate, classify, compare and interpret effectively.

PLO-4: Develop and practice professional knowledge coupled with laboratory techniques and be able to apply skills to design and conduct independent research work.

PLO-5: Demonstrate analytical reasoning skill sets towards social, cultural, ethical and environmental responsibility as an individual/teams/leader on impacts of chemistry in societal domain.

PLO-6: Embrace and apply leadership in problem solving assistance on attitudinal and ethical behavior when required to work in a team/individual.

PLO-7: Apply knowledge of chemistry and interact among team members and to function effectively in multidisciplinary environment for job trade, employability and higher education.

PLO-8: Educate and communicate complex terminologies / concepts utilizing proper open education resources and modern tools.

PLO-9: Master technical skills including the use of educational technology and ICT in teaching and managing information and lifelong learning of chemistry.

GOVERNMENT ARTS COLLEGE (Autonomous)
(Accredited by NAAC with 'A' Grade)
POSTGRADUATE AND RESEARCH DEPARTMENT OF CHEMISTRY
COIMBATORE – 641 018, INDIA
B.Sc. Degree Program in Chemistry (Effect from 2021 – 22 onwards) Annexture-7

UG – SCHEME OF EXAMINATION: CBCS PATTERN

							Marks					
Semester	S.No	Subject Code	Part	Subject	Hrs/week	Exam (Hrs)	External mark	Internal mark	Total	External Passing Minimum.	Total passing minimum	No. of Credits
I	1	21TAM11L	I	Language I-Tamil – I	6	3	50	50	100	20	40	3
	2	21ENG12L	II	Language II-English – I	6	3	50	50	100	20	40	3
	3	21BCH13C	III	Core-I:General Chemistry– I: Inorganic, Organic & Physical Chemistry	5	3	50	50	100	20	40	4
	4	21BCH14A	III	Allied 1- Mathematics – I	8	3	50	50	100	20	40	5
	5	-	III	Core Practical-I Inorganic Qualitative Analysis	3	-	-	-	-	-	-	-
	6	21ENV1GE	IV	Environmental Studies	2	3	50	50	100	20	40	2
II	1	21TAM21L	I	Language I - Tamil – II	6	3	50	50	100	20	40	3
	2	21ENG22L	II	Language II - English – II	6	3	50	50	100	20	40	3
	3	21BCH23C	III	Core-II: General Chemistry– II: Inorganic, Organic & Physical Chemistry	5	3	50	50	100	20	40	4
	4	21BCH24A	III	Allied 2- Mathematics – II	8	3	50	50	100	20	40	5
	5	21BCH25P	III	Core Practical I - Inorganic Qualitative Analysis	3	3	50	50	100	20	40	5
	6	21VAL2GE	IV	Value Education Gandhian Thoughts	2	3	50	50	100	20	40	2
Total					**60**				**1100**			**39**
III	1	21TAM31L	I	Language I - Tamil – III	6	3	50	50	100	20	40	3

	2	21ENG32L	II	Language II - English – III	6	3	50	50	100	20	40	3
	3	21BCH33C	III	Core-III:General Chemistry – III: Inorganic, Organic & Physical Chemistry	4	3	50	50	100	20	40	4
	4	21BCH34A	III	Allied 3 - Physics – I	5	3	45	30	75	18	30	3
	5	-	III	Allied Physics Practical	3	--	--	--	--	--	--	--
	6	-	III	Core Practical-II: Volumetric and Organic Qualitative Analysis	3	--						
	7	21BCH35S	IV	Skill Based Elective- I: Polymer Chemistry	3	3	50	50	100	20	40	3
IV	I	21TAM41L	I	Language I - Tamil – IV	6	3	50	50	100	20	40	3
	2	21ENG42L	II	Language II - English – IV	6	3	50	50	100	20	40	3
	3	21BCH43C	III	Core-IV: General Chemistry – IV: Inorganic, Organic & Physical Chemistry	4	3	50	50	100	20	40	4
	4	21BCH44A	III	Allied 4 -Physics – II	5	3	45	30	75	18	30	3
	5	21BCH45P	III	Allied Physics Practical	3	3	25	25	50	10	20	4
	6	21BCH46P	III	Core Practical- II: Volumetric and Organic Qualitative Analysis	3	6	50	50	100	20	40	5
	7	21BCH47S	IV	Skill Based Elective – II: Pharmaceutical Chemistry	3	3	50	50	100	20	40	3
	8	21EXA4GE	V	Extension activities NCC/NSS/YRC/PEd								1
Total					**60**				**1100**			**42**
V	1	21BCH51C	III	Core V-Theoretical Chemistry	5	3	50	50	100	20	40	4
	2	21BCH52C	III	Core VI - Organic Chemistry	5	3	50	50	100	20	40	4
	3	21BCH53C	III	Core VII - Electrochemistry	5	3	50	50	100	20	40	4
	4	21BCH54S	IV	Skill Based Elective-III: Textile Chemistry	4	3	50	50	100	20	40	3
	5	21BCH5EL	IV	Non major Elective- I:Chemistry in Changing Life Style – I	3	3	50	50	100	20	40	2
	6	-	III	Core Practical III: Gravimetric Estimation and Preparation	3	--						
	7	-	III	Core Practical IV: Physical	3	--						

				Chemistry Practical								
	8	-	III	Core Practical V: Application Oriented Practical	2							
	9	-	III	Project	-							
VI	1	21BCH61C	III	Core VIII - Inorganic Chemistry	5	3	50	50	100	20	40	4
	2	21BCH62C	III	Core IX – Chemistry of Natural Products	5	3	50	50	100	20	40	4
	3	21BCH63C	III	Core X- Physical Chemistry	5	3	50	50	100	20	40	4
	4	21BCH67S	IV	Skil Based Elective-IV Industrial Chemistry	4	3	50	50	100	20	40	3
	5	21BCH6EL	IV	Non major ElectiveII:Chemistry in Changing Life Style –II	3	3	50	50	100	20	40	2
	6	21BCH64P	III	Core Practical III: Gravimetric Estimation and Preparation	3	3	50	50	100	20	40	3
	7	21BCH65P	III	Core Practical IV: Physical Chemistry Practical	3	3	50	50	100	20	40	3
	8	21BCH66P	III	Core Practical V: Application Oriented Practical	2	3	50	50	100	20	40	4
	9	21BCH68V	III	Project with Viva Voce.	-	50		50	100	20	40	15
Total					**60**				**1400**			**59**

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GOVERNMENT ARTS COLLEGE (Autonomous), COIMBATORE – 641 018 **Annexture-10**

Credit and Marks Details for UG Chemistry with effect from 2021-22 onwards

Subject	Part	No. of Papers	Total Credits	Total Marks
Language I: Tamil	I	04	12	400
Language II: English	II	04	12	400
Core	III	10	40	1000
Allied Maths Allied Physics	III III	02 2+1(practical)	10 10	200 200
Core Practical	III	05	20	500
Project	III	01	15	100
Skill Based Elective	IV	04	12	400
Non-Major Elective	IV	02	4	200
Environmental Studies Value Education	IV	01 01	2 2	200
Extension Activities	V	01	1	---
Total		**38**	**140**	**3600**

I

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	I	21BCH13C	**PAPER – I: GENERAL CHEMISTRY – I:** Inorganic, Organic & Physical Chemistry	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Discuss the underlying principles of macro, semi-micro methods and lab safety measures for experimenting and precaution in handling chemicals.
CLO- 2 Infer procedure of waste disposal, environmental associated problems, reuse of recycled products
CLO- 3 Interpret structure, properties and uses of rare gas compounds to be known on a larger scale application
CLO- 4 Apply the concept on theoretical principles of bonding and the knowledge associated with reactions.
CLO- 5 Summarize various types of conjugation, polar effects, reactivity of simple organic reactions
CLO- 6 Infer the hybridization types involved in simple molecules, isomerism and its classification in organic compounds and it use in industrial applications.
CLO- 7 Classify information in the basics of conformational analysis on simple molecules.
CLO- 8 Extrapolate the fundamental aspects of Thermodynamics with respect to heat, work and free energy.

Unit – I **15 hours**

Semi micro Qualitative Analysis

Macro, micro, semi-micro and ultra micro methods - semimicro qualitative analysis for inorganic anions and cations (pertaining to B.Sc. practical syllabus only). Dry and wet tests, sodium carbonate extract tests, identification of interfering radicals and their elimination- confirmation test for anions – general group separation and individual group analysis.

Lab safety measures:

Chemical safety and ethical handling of chemicals: Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric level. Safe storage and disposal of waste chemicals. Recovery, recycling and reuse of laboratory chemicals. Procedure for laboratory disposal of explosives. Identification, verification and segregation of laboratory waste. Disposal of chemicals in the sanitary sewer system. Incineration and transportation of hazardous chemicals.

Unit – II **15 hours**

Inert Gases and their Compounds

Compounds of rare gases – preparation properties structure and uses of XeF_2, XeF_4, XeF_6. H_4XeO_6, XeO_4, XeO_3, XeOF4 and XeO F_2.

Inter halogen compounds: ICl, BrF_3, IF_5, and IF_7 - preparation, properties, structure and uses. Ozone and hydrogen peroxide – Preparation, properties, structure and uses. Comparison between ozone and hydrogen peroxide. Oxyacids of sulphur – Caro's acid and Marshall's acid.

Unit – III **15 hours**

Basic Principles of Organic Chemistry

The breaking & forming of bonds – homolytic & heterolytic fission – generation, structure and stability of carbocations, carbanions and free radicals. Classification of reagents - electrophiles, nucleophiles and free radicals.

Types of organic reactions – displacement or substitution, addition, elimination and rearrangement. Polar effects – inductive effects and field effects (of acids & bases) mesomeric (conjugation) effects, hyperconjugation, steric effects (ortho effect, steric hindrance and steric inhibition of resonance) and their effects on reactivity of simple organic compounds.

Hybridization – sp, sp^2 and sp^3 with examples.

Unit – IV **15 hours**

Introduction to Organic Compounds

Hydrocarbons – classification and nomenclature – open chain, cyclic, aliphatic, aromatic, saturated, unsaturated and polycyclic hydrocarbons.

Isomerism in Organic compounds: Aliphatic hydro carbons-General classification – structural isomerism – types – explanation with examples.

Bayer's strain theory. Conformational analysis of ethane, 1,2-dichloroethane, n-butane and cyclohexane.

Unit – V **15 hours**

Thermodynamics I

Terminologies to Thermodynamics

Introduction to system and surrounding. Types of system.

Laws of Thermodynamics

Zeroth law of Thermodynamics – Absolute Temperature scale – Extensive and Intensive properties. Internal energy (E), Enthalpy (H), Derivation of C_p & C_v and their relationship. First law of Thermodynamics – internal energy, enthalpy, heat and work done - calculations work done in isothermal and adiabatic reversible and irreversible processes for ideal gases. Joule – Thomson effect – Joule Thomson Coefficient for ideal and real gases – Inversion Temperature.

Class Practicals:

Demo for Inorganic mixture analysis

Pedagogy Strategies:

Chalk and talk, Charts, Demonstration, Molecular models, Periodic tables, Power point presentation with animation, Quiz, Test yourself and Virtual class room.

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1. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., New Delhi, 28th Edn., (2004).
2. Chemical safety matters IUPAC – IPCS, Cambridge University Press (1992).
3. Gurdeep Raj, Advanced Physical Chemistry, Krishna Prakash, 3rd Edn., (2006).
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3. O.D. Tyagi, M. Yadav, A Text Book of Reaction Mechanism, Anmol Publication Ltd., New Delhi, 1st Edn., (2002).
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9. V.K.Ahluwalia and Rakesh Kumar Parashar ,Organic Reaction Mechanisms –,IV Edn.,,Narosa Publishing House, New Delhi.
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11. Dr.R.L.Madan, Chemistry for Degree Students (as per UGC), 2011, S.Chand & Company, New Delhi.
12. James E. House, Inorganic Chemistry - 2008-Academic Press
13. G.W. Castellan, Physical Chemistry, Addison – Wesley Publication Co., London, II Printing, (1973).. Samuel Glasstone, Thermodynamics for Chemists, East West press, (2008).

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1. https://www.youtube.com/watch?v=bpgF4xBGF_Y
2. https://www.youtube.com/watch?v=RDVsgjVItw4&list=PLOzRYVm0a65f298xo_WnFOmXm5t-piWHk
3. https://ndl.iitkgp.ac.in

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑	☑			☑			☑
	2	Communication skills		☑			☑			☑
	3	Critical thinking	☑	☑						☑
	4	Research-related skills		☑		☑	☑			
	5	Analytical reasoning	☑		☑					
	6	Problem solving			☑			☑	☑	☑
	7	Team work	☑						☑	☑
	8	Moral and ethical awareness	☑							☑

AECC-1 @ SEMESTER I

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	I	21ENV1GE	ENVIRONMENTAL STUDIES (For all UG courses)	2

COURSE LEARNING OUTCOMES:

On the successful completion of the course, students will be able to:

1. Recognize the role of the environment and the need to conserve it for sustaining life.
2. Enumerate the natural resources
3. Explores the adverse effects of deforestation and over exploitation of natural resources
4. Associate the components of the ecosystem and need for biodiversity conservation.
5. Evaluate the environmental pollution hazards and their effects on the living system.
6. Interpret the different disaster management procedures.
7. Analyse the climatic change and global effects
8. Infer the need for environmental laws in the constitution of India.
9. Relate the growth of the human population and its impact on the environment.

UNIT I: **6 hours**

Environment – Introduction – Nature - Scope – Content – Need for study. Natural resources- Forest and energy resources- Use and overexploitation - deforestation. Energy resources- renewable and non-renewable energy resources.

UNIT II: **6 hours**

Ecosystem – concept – types- Forest, Grassland, Desert and Aquatic (Pond)- Structure and function of an ecosystem – Producers- consumers and decomposers – Food chain – food web- ecological pyramids- energy flow. Biodiversity and its conservation- *in situ* and *ex situ* conservation- Mega biodiversity centres and hotspots.

UNIT III: **6 hours**

Environmental pollution- definition- causes-effects and control measures of air, water, soil, thermal and nuclear pollution. Waste management- Industrial and solid waste. Disaster management – earthquake, cyclone, flood and landslides.

UNIT IV: **6 hours**

Social Issues and the environment-Urbanization-Urban problems related to energy and watershed management. Environmental Ethics- Issues and possible solutions- Wasteland reclamation- Climate change - causes and effects. Global warming- Acid rain- Ozone layer depletion- Public awareness. Environmental laws- Environment Protection Act, Wildlife Protection Act, Forest Conservation Act.

UNIT V: **6 hours**

Human population and its impact on environment- Population growth- Resettlement and Rehabilitation of project affected persons- Case studies – Sardar Sarovar Project, Maharashtra and Bandipur National Park- Project Tiger, Karnataka, NTPC, India. Role of Indian and Global religions and Cultures in environmental conservation- Case study: sacred groves in Western Ghats (kavu) & Chinese culture. Human and Wildlife Conflict.

Pedagogy Strategies

- Board and Chalk lectures
- PowerPoint slide presentations

- Assignments

Textbooks:

1. Sharma, P. D. 2000. Ecology & Environment. Rastogi Publications, Meerut, India.
2. Bharucha, E. 2003. Text book of Environmental Studies. UGC, New Delhi & Bharati Vidyapeeth Institute of Environmental Education and Research, Pune.
3. Arumugam, M. and Kumaresan, V. 2016. Environmental Studies (Tamil version). Saras Publications, Nagerkoil.

Online/E-Resources:

1. https://www.edx.org/course/subject/environmental-studies
2. https://www.coursera.org/courses?_facet_changed_=true&domains=life-sciences%2Cphysical-science-and-engineering%2Csocial-
3. https://www.coursea.org/coures?_facet_changed_=true&domainms=life _sciences&query=environmental%20science%20and%20sustainability&userQuery=environmental% 20science%20and%20sustainability
4. https://www.open.edu/openlearn/nature-environment/free-courses

COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOME:

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Disciplinary Knowledge		√	√		√	√			
Communication Skills		√		√				√	√
Critical Thinking	√		√		√		√		
Research related skills	√		√			√		√	
Analytical reasoning	√			√		√		√	
Problem Solving		√	√			√			√
Team Work				√	√		√		√
Moral and ethical awareness		√		√		√		√	√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	II	21BCH23C	**PAPER –II: GENERAL CHEMISTRY – II:** Inorganic, Organic & Physical Chemistry	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Discuss the events in extraction of metals as well in refinement process. Assess and apply the purification techniques in any extraction methodology.

CLO- 2 Illustrate the position of alkali and alkaline earth metals. A comparative account on the various reactions of alkali metals.

CLO- 3 Infer on the basis of *cis* and *trans* eliminations with name reactions to understand basics of alkenes.

CLO- 4 Extrapolate the study of alkenes to conjugated dienes, and fundamentals of alkynes.

CLO- 5 Acquire basic knowledge on aromatic compounds and aromaticity.

CLO- 6 Perform variety of reactions with benzene towards its reactivity, orientation and further extension towards anti-aromaticity.

CLO- 7 Infer techniques on the need for enthalpy, bond energy and second law of Thermodynamics with preference to application to combustion reactions.

CLO- 8 Extend the application of Entropy to ideal gas and real gases for an expected outcome.

Unit – I **15 hours**

Metallurgy

General methods of extraction of metals: Ore dressing – froth floatation, gravity, magnetic & chemical separation. Extraction of metals – Electrolytic reduction, Chemical reduction, Metal displacement & Complex formation. Refining of metal – Electrolysis, Van–Arkel process, Zone refining.

Purification Techniques: Distillation – Vacuum, Fractional, Steam & Azeotropic.

Crystallization & Sublimation: Principles & Techniques with suitable examples.

Unit – II **15 hours**

Alkali and Alkaline earth metals

Position of Alkali and Alkaline earth metals- Physical properties of alkali metals, Electronic structure, Density, Atomic volume, Atomic & Ionic radii, Ionization energy & Electro negativity.

A comparative study of reactions of Alkali metals with Oxygen, Hydrogen, Halogen & Water. Difference between Lithium & other Alkali metals. Diagonal relationship between Lithium and Magnesium. Extraction of Lithium & Sodium.

Alkaline Earth Metals: Beryllium, Barium & Radium: Extraction, Properties & Uses.

Unit – III **15 hours**

Aliphatic Hydrocarbon - Alkenes

Elimination Reactions: *cis* and *trans* - Eliminations – Mechanisms of Eliminations: E1 and E2 – Hofmann's & Saytzeff's Rule.

Alkenes: General Methods of Preparation, Properties & Reactions: Preparation involving (i) Dehydration, Dehalogenation and dehydrohalogenation (ii) Reduction involving alkynes, Wittig reaction.

Reaction of alkenes: General Addition and Substitution Reactions - Markovnikov's addition – peroxide effect- Hydration, Hydro halogenation, Hydroboration, Ozonolysis and Allylic substitution.

Dienes – Types with suitable examples-Stabilities of isolated & conjugated dienes 1,2 and 1,4 additions – Addition of HBr to butadiene – Diel's Alder Reaction.

Unit – IV **15 hours**

Alkynes and Aromatic Hydrocarbons

Alkynes: General Methods of preparation, properties and reactions. Metal acetylides, acidity of alkynes.

Benzene and aromaticity: Resonance energy of benzene, Huckel's rule – Aromaticity in cyclopropenyl cation, cyclopentadienyl anion and tropylium cation. Aromatic eletrophilic substitution Reactions: Arenium ion mechanism and typical reactions of benzene: Nitration, Sulphonation, Halogenation, Friedel Craft's alkylation, acylation and their mechanism. Orientation and reactivity in mono substituted benzene. Anti-aromaticity - Cyclobutadiene.

Unit – V **15 hours**

Thermodynamics II

Hess' Law of constant heat summation and its applications in the calculation of enthalpy of reactions, formation and combustions. Bomb Calorimeter – Bond Energies, and their applications in the determination of enthalpy of reactions, formation and resonance energies of an ideal gas. Introduction to Second Law of Thermodynamics – Need for Second Law – Various statements of Second Law – Carnot cycle. Concept of Entropy (S) – units – Entropy change of an ideal gas in reversible and irreversible processes. Entropy changes accompanying change of phase – Trouton's Rule. Calculation of Entropy changes (ΔS) of an ideal gas with changes in P. V, and T. Entropy changes of an ideal gas in different processes. Physical significance of entropy.

Class Practicalss:

Demo on recrystallization, sublimation, boiling point, melting point determination and distillation.

Pedagogy Strategies:

Chalk and talk, Charts, Demonstration, Molecular models, Periodic tables, Power point presentation with animation, Quiz, Test yourself and Virtual class room.

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1. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishingh Co., New Delhi, 28th Edn., (2004).
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2. https://www.youtube.com/watch?v=870y6GUKbwc
3. https://www.youtube.com/watch?v=6IRXVZKH6WQ
4. https://ndl.iitkgp.ac.in

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑	☑	☑		☑	☑		
	2	Communication skills			☑		☑			
	3	Critical thinking		☑				☑	☑	
	4	Research-related skills				☑				
	5	Analytical reasoning	☑			☑			☑	
	6	Problem solving		☑		☑	☑			☑
	7	Team work			☑					☑
	8	Moral and ethical awareness		☑				☑		☑

B. Sc., Chemistry

AECC-2 @ SEMESTER II

Year	Subject Title	Semester	Sub Code
2021 -22 Onwards	**VALUE EDUCATION – GANDHIAN THOUGHTS (For all UG courses)**	**II**	**21VAL2GE**

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to:

1. Interpret Gandhiji's experiments to his spiritual pursuits and search for purity, political activities through fasting protests, and even his role as an educator using diet and meals as teaching exercises.
2. Lead a life marked with humility and truthfulness and subsequent realization of the Truth as the purpose of human life.
3. Infer lessons that are fundamental to living in harmony and social progress such as respect, empathy, equality, solidarity and critical thinking.
4. Promote tolerance and understanding above and beyond our political, cultural and religious differences.
5. Create special emphasis on the defense of human rights, the protection of ethnic minorities
6. Emerge as responsible citizens with clear conviction to practice values and ethics in life.
7. Transform themselves to become good leaders.
8. Realize their role and contribution to the nation building.

UNIT I: **6 hours**

Birth and Parentage - Childhood - At the High school - Stealing and Atonement - Glimpses of Religion - Gandhi's choice - Experiments in Dietetics - Acquaintance with Religions - The Great Exhibition.

UNIT II: **6 hours**

The first case - Preparing for South Africa - same experiences - on the way to Pretoria – Coolie - Natal Indian Congress - Education of Children - Brahmacharya.

UNIT III: **6 hours**

Simple life - The Boer war - Sanitary Reform and Famine Relief - Lord Curzon's Darbar - A month with Gokhale - Experiments in Earth and water treatment - Indian opinion - Coolie Locations or Ghettoes - The Black plague.

UNIT IV: **6 hours**

The Magic spell of a Book - The Zulu Rebellion - The Birth of Satyagraha - More experiments in Dietetics - Kasturbai's Courage - Domestic Satyagraha- Fasting - Shanti Niketan - Woes of Third-Class passengers.

UNIT V: **6 hours**

Kumbha mela - Lakshman Jhula - Founding of the Ashram - Abolition of Indentured Emigration - The Kheda Satyagraha - The Rowlatt Bills - Navajivan and young India - Congress Initiation - The Birth of Khadi.

TEXT BOOKS

1. M.K. GANDHI, "The Story of My Experiments with Truth", An Autobiography

Apple publishing International(P) Ltd, Chennai.

2.

. மகாத்மா காந்தியின் சுயசரிதை - சத்தியசோதனை தமிழாக்கம் -
-ரா.வேங்கடராஜுலு, நவஜீவன் பரசுராலயம், அகமதாபாத

Pedagogy Strategies

- Board and Chalk lecture
- Powerpoint slide presentations
- Seminar
- Assignments
- Quizes
- Group discussion

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Reflective thinking	✓	✓			✓		✓	✓
	2	Communication skills		✓		✓	✓	✓	✓	✓
	3	Critical thinking	✓			✓		✓	✓	✓
	4	Multicultural competence				✓	✓	✓	✓	✓
	5	Analytical reasoning		✓	✓	✓		✓		
	6	Problem solving		✓	✓	✓		✓	✓	✓
	7	Team work	✓		✓		✓	✓	✓	
	8	Leadership readiness/qualities			✓		✓	✓		✓
	9	Moral and ethical awareness	✓		✓		✓	✓		✓

B. Sc., Chemistry

Year	Sem	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	**III**	**21BCH33C**	**PAPER – III: GENERAL CHEMISTRY – III:** Inorganic, Organic & Physical Chemistry	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Illustrate the separation and solvent extraction in analyzing components in a mixture.
CLO- 2 Summarize the techniques in understanding the principles of volumetric and gravimetric analysis.
CLO- 3 Expedite preparation and properties of aldehydes and name reactions with mechanisms.
CLO- 4 Embrace the knowledge on Boron and silicate chemistry on structural aspects.
CLO- 5 Enlighten the use of naming reactions and adapt to typical reactions of carbonyl compounds.
CLO- 6 Apply the selectivity of specific reducing reagents in conversion processes.
CLO- 7 Discuss the basic relations in respect of free energy, entropy, Helmholtz-Gibbs etc.
CLO- 8 Interpret the concepts of Partial Molar functions and interpret Le Chatelier–Braun Principle.

Unit – I **12 hours**

Analytical techniques

Separation techniques: General principles of separation by precipitation, solvent extraction, chromatography – Basic principles and applications of Paper, Thin layer and Column Chromatography.

Principles of Volumetric Analysis: Concentration terms - molarity, molality, normality, mole fraction, percentage and related problems - Acid – base, Redox, and Complexometric Titrations – Theory and Principles. Role of indicators.

Principles of Gravimetric Analysis: conditions, choice and selectivity of precipitants – sequestering agents – solubility product principle and Applications; co- and post Precipitations.

Unit – II **12 hours**

Chemistry of Boron and Silicates

Boron and its Compounds: Group discussion – Electron acceptor behavior and Electron deficiency of Boron hydrides, Bonding in diboranes - Boron nitride (diamond and graphite forms) – Borozoles-Sodium per borate-preparation and uses. Diagonal relationship between Boron and Silicon.

Silicates: Classifications and Structure of Silicates – Simple, chain and sheet and 3D silicates (structure only). – Silicones–preparation, uses and structure.

Unit – III **12 hours**

Chemistry of Carbonyl Compounds

Preparation and Properties of Aldehydes and Ketones: Formaldehyde, Acetaldehyde, Benzaldehyde (from Toluene), Acetone and Acetophenone. Nucleophilic addition reactions of Carbonyl compounds: Addition of HCN, $NaHSO_3$, and RMgX. – Reactions with NH_3, NH_2OH, N_2H_4 and Semicarbazide.

Condensation Reactions: Aldol, Perkin, Knoevenagal, Claisen, Dieckmann and Benzoin Condensations. Cannizarro, Reformatsky and Haloform reactions.

Reduction Reactions: Reaction and mechanism of Wolff-Kishner, Meerwin Pondroff Verley - Applications of reducing reagents like $LiAlH_4$ & $NaBH_4$.

Unit-IV **12hours**

Thermodynamics III

Definition of Helmholtz Free Energy (A) Gibb's Free Energy (G): Variation of Free Energy with Temperature and Pressure – Thermodynamic Equation of States – The general condition of equilibrium

and spontaneity - Criteria for reversible and irreversible processes- Gibbs – Helmholtz Equation. Maxwell's relations for Internal energy (E), Enthalpy (H), Helmholtz Free energy (A) and Gibb's Free energy (G).

Unit-V **12 hours**

Chemical Potential and Chemical Equilibria

Partial Molar Functions – Concepts of Chemical Potential (Δμ): Gibb's Duhem Equation and its Application - Chemical Potential for Ideal gases. Variation of Δμ with T and P. Clapeyron Equation, Clausius – Clapeyron Equation: Derivations and their applications. Activity, Fugacity and Activity coefficient (definition only).

Law of Mass Action: Derivation of Kp and Kc and their relationship – Le Chatelier–Braun Principle – Thermodynamic Interpretation – Application to homogeneous and Heterogeneous Equilibria. van't Hoff isotherm and isochore.

Class Practicals:

Demo on Thin Layer, Paper and Column Chromatography; Gravimetric precipitation methods and Volumetric titrations

Pedagogy Strategies:

Chalk and talk, Charts, Demonstration, Molecular models, Periodic tables, Power point presentation with animation, Quiz, Test yourself and Virtual class room.

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2. Arun Bahl, B.S.Bahl, G.D.Tuli. Essentials of Physical Chemistry, S.Chand Publications, (2000).
3. Anthony R. West , Solid State Chemistry and its Applications Second Edition Student Edition Wiley Publications (2014).
4. Peter Atkins and Julio de Paula-Elements of Physical Chemistry- Fifth Edition - W. H. Freeman and Company , (2009)
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			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑	☑	☑	☑	☑	☑		☑
	2	Communication skills		☑					☑	
	3	Critical thinking	☑				☑	☑		
	4	Research-related skills		☑		☑				☑
	5	Analytical reasoning			☑				☑	
	6	Problem solving			☑					☑
	7	Team work						☑	☑	
	8	Moral and ethical awareness		☑		☑	☑			☑

B. Sc., Chemistry

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	III	21BCH35S	SKILL BASED ELECTIVE-I: POLYMER CHEMISTRY	3

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Assess various types of polymerization, its classification, structural modifications, etc.
CLO- 2 Illustrate coordination polymerization, functional catalysts and comparison between various types of polymerization.
CLO- 3 Summarize the properties of polymers with respect to physical, chemical with utility
CLO- 4 Identify the copolymers for industrial applications.
CLO- 5 Apply the concept of polymerization techniques on industrial scale preparation and utility.
CLO- 6 Analyze and test prepared polymers with respect to stability, transition temperature.
CLO- 7 Explain the processing of polymers for application as sheets, films etc.

Unit I **9 hours**

Introduction to Polymers

Basic Concepts: monomer, polymer, degree of polymerization - Classification of polymers natural and synthetic polymers with examples.

Tacticity of Polymers:Atactic, syndiotactic and isotactic.

Addition Polymerization: Free-radical polymerization: Initiation, propagation and termination reactions involving vinyl monomers – propylene and styrene with any two free-radical catalysts. Cationic polymerization: Initiation, propagation and termination reactions involving $BF_3.H_2O$ catalyst with isobutylene monomer. Anionic polymerization: Initiation, propagation and termination reactions involving KNH_2 with styrene monomer.

Unit II **9 hours**

Condensation Polymerization: Basic principles of condensation polymerization. General reactions with examples for the formation of polyamides, polyesters and polycarbonates.

Coordination polymerization – Ziegler-Natta catalysts – monometallic and bimetallic mechanism.

Molecular weight – weight average, number average, viscosity average. Methods of determination – end group analysis, osmometry and viscometry.

Unit III **9 hours**

Copolymerization: Importance and types. Monomer reactivity ratios and their importance. Types of copolymers: alternate copolymers, random copolymers, block copolymers and graft copolymers (two examples each with copolymer structures). Typical polymers: preparation and uses of Teflon, polyethylene and Bakelite.

Unit IV **9 hours**

Methods of Polymerization: Basic principles and comparisons of polymerization techniques
Bulk polymerization, solution polymerization, suspension polymerization and emulsion polymerization-melt, solution and interfacial polymerization.

Testing of polymers - melting point (T_m), glass transition temperature (T_g), critical temperature (T_c), Viscosity, Viscosity index and Fire-retardant properties. Melt Flow index (basic idea).

Unit V **9 hours**

Processing of Polymers: Additives for polymers: Fillers, colourants, plasticisers, antioxidants and flame retarders. Moulding techniques - blow moulding, compression moulding, transfer moulding, extrusion moulding and injection moulding.- Film and sheet formation. Polymer Nanocomposites – definition - Photoresist etching applications of nanocomposites.

Class Practicals:

Determination of viscosity of a polymer using viscometer.

Pedagogy Strategies:

Chalk and talk, Charts, Demonstration, Molecular models, Periodic tables, Power point presentation with animation, Quiz, Test yourself and Virtual class room.

Industrial visit: Polymer and Rubber Industries.

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2. J. R. Friel, Polymer Science and Technology, Pearson, 2nd Edn., (2005).
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Skill based Course Level Outcomes (CLOs)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Disciplinary Knowledge**	☑	☑		☑	☑	☑	
	2	**Analytical reasoning**				☑			☑
	3	**Research- related skills**			☑	☑		☑	☑
	4	**Scientific reasoning**	☑	☑			☑		
	5	**Information/digital literacy**				☑			☑
	6	**Problem solving**			☑		☑		☑
	7	**Cooperation/Team work**		☑		☑		☑	
	8	**Moral and ethical awareness**	☑		☑		☑		☑
	9	**Self-directed learning**		☑			☑		☑

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	IV	21BCH43C	PAPER – IV: GENERAL CHEMISTRY – IV: Inorganic, Organic & Physical Chemistry	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Conceptualize amorphous and crystalline solids, structural differences, imperfections based on defects and classifications etc.
CLO- 2 Apply in-depth knowledge on extraction on zinc, copper, cobalt, nickel and alloys (coinage metals).
CLO- 3 Discuss on platinum and gold extraction from its ores/compounds.
CLO- 4 Explain aromatic acids and its homologues and extrapolate to aliphatic and aromatic dicarboxylic acids
CLO- 5 Deduce the third law of thermodynamics and apply to real and ideal gases.
CLO- 6 Application of third law in solving colligative properties of dilute solutions.
CLO- 7 Evaluate the impact of non-electrolyte in real systems.
CLO- 8 Interpret phase equilibria in solving simple eutectic system (Single and Two component systems).

Unit – I **12 hours**

Solid State Chemistry and Liquid Crystals

Amorphous and Crystalline Solids – Differences – Isotropy – Anisotropy. The Symmetry in Crystals- Bravais lattices. – Laws of Rational indices – Miller indices, X-ray studies of crystal -Bragg's equation. Imperfections in Crystals – Point defects – Stoichiometric-Schotky and Frenkel defects and Non-stoichiometric defects-metal excess defects (colour centre) and metal deficiency defects.

The nature of Cohesive forces in liquids and solids.

Liquid crystals: The concept of mesomorphic state – typical liquid crystalline substances. Classifications –Smectic, Nematic, Cholesteric Properties– molecular arrangements and applications.

Unit – II **12 hours**

Chemistry of Coinage metals

Zinc and Copper – Extraction, Properties and uses.

Compounds of Zn (II) – ZnO, $ZnCl_2$ - Preparation, Properties and Uses. Alloys of Cu- Brass, bronze, Monel metal.

Elements of Group VIII: Co and Ni - Extraction, Properties and Uses. Alloys of Co and Ni

Gold – Extraction - Amalgamation and Mac Arthur Forest Cyanide Process. Properties and Uses- Compounds of Au- Auric Chloride ($AuCl_3$), Choroauric acid ($HAuCl_4$) and Colloidal gold

Platinum – Extraction and Uses. Compounds of Pt – $PtCl_4$, H_2PtCl_6.

Unit – III **12 hours**

Carboxylic acids and esters

Aromatic acids - preparation, properties of benzoic acid, benzenesulphonic acid and p-toluene sulphonic acid.

Aliphatic dicarboxylic acids - preparation and properties of oxalic acid, malonic acid and succinic acid and adipic acid.

Aromatic dicarboxylic acid - Preparation and properties of phthalic acid and isophthalic acid.

Active methylene compounds - malonic ester, acetoacetic ester - their synthetic applications. Tautomerism in acetoacetic ester.

Unit – IV **12 hours**

Applications of Thermodynamics and Colligative Properties I

Third law of Thermodynamics – Need for Third Law – Nernst Heat Theorem – Limitations of Nernst Heat Theorem – Contribution of Richards and Planck – Determination of Absolute Entropies of Solids, Liquids and Gases. Exceptions to Third Law.

Distribution Law: Thermodynamic Derivation. Nernst Distribution Law and its applications.

Colligative properties of Dilute Solutions: Osmosis and Osmotic Pressure. Theories of semi-permeability – Reverse Osmosis – Determination of Elevation of Boiling Point and Depression in Freezing Point – van't Hoff Factor – Degree of association and Degree of dissociation.

Unit – V **12 hours**

Colligative Properties II and Phase Rule

Solutions of Non-electrolyte – Solution of Liquid and its Applications – Raoult's Law and Henry's law – Deviations from Raoult's Law – Gibbs – Duhem Margules Equation. Vapor Pressure of Non-ideal Gases. Fractional Distillation - Distillation of immiscible liquids – Steam distillation, Partially Miscible Liquids.

Phase Equlibria – Terminologies - Phase, Component, Degrees of Freedom, Eutectic. Derivation of Phase rule – phase equilibria in one component system – the phase diagram of water and sulphur systems – Two component system – reduced phase rule- simple eutectic system formed by Pb-Ag and Mg-Zn. Thermal cooling analysis and Congruent melting point.

Class Practicals:

Phase diagram, Melting point determination

Pedagogy Strategies:

Chalk and talk, Charts, Demonstration, Crystal models, Periodic tables, Power point presentation with animation, Quiz, Test yourself and Virtual class room.

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4. https://www.youtube.com/watch?v=Adr9_2LnQdw
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑	☑	☑	☑	☑	☑		
	2	Communication skills	☑	☑						☑
	3	Critical thinking		☑			☑		☑	
	4	Research-related skills			☑				☑	☑
	5	Analytical reasoning		☑			☑		☑	
	6	Problem solving	☑				☑	☑		
	7	Team work	☑						☑	
	8	Moral and ethical awareness		☑	☑			☑		

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	IV	21BCH47S	SKILL BASED ELECTIVE-II: PHARMACEUTICAL CHEMISTRY	3

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Discuss the basics of drugs and therapeutic index as well the action of drugs its LD value etc.

CLO- 2 Explain in a broader perspective, the mechanism and action of sulpha drugs. Structures of Antibiotics and classification can be inferred.

CLO- 3 Design the preparative mode of certain Analgesic, antipyretic with uses in daily life.

CLO- 4 Discuss the preparation of morphine, paracetamol, asprin etc.

CLO- 5 Summarize the use of antiseptic, anesthetic and antianeamic: mode of action.

CLO- 6 Revise the need for life saving drugs, in terms of action in the CNS.

CLO- 7 Evaluate the traditional medicinal plants in curing diseases.

UNIT –I **9 hours**

Definition of the terms -drugs, pharmacophore, pharmacodynamics, pharmacopoea, pharmacology, bacteria, virus, fungus, actinomycetes, metabolites, LD50, ED50.

Therapeutic index – its use in selection of drugs.-Mode of action of drugs- Assay of drugs – Biological and chemical methods.

UNIT – II **9 hours**

Sulphonamides : mechanism and action of sulpha drugs, preparation and uses of sulphathiazole and sulphapyridine.

Antibiotics: Definition, classification as broad and narrow spectrum antibiotics – penicillin, chloramphenicol, ampicillin – structure only.

UNIT-III **9 hours**

Analgesics: Definition and actions-narcotic and non narcotic-morphine and pethidine – pharmacological action- uses.

Antipyretic analgesics: salicylic acid derivatives- methyl salicylate, aspirin, p-amino phenol, paracetamol and ibuprofen-preparation and uses.

UNIT-IV **9 hours**

Antiseptics and disinfectants: Definition and distinction, phenol co-efficeient, properties and uses of phenols and phenolic compounds - Dyes - crystal violet - acridine - cationic surfactants- Benzalkonium chloride and formaldehyde

Anaesthetics: Definition and classification- local and general anaesthetics. Volatile - nitrous oxide, ether, chloroform, cyclopropane - uses and disadvantages. Non volatile – intravenous - thiopental sodium and methanexitone.

Antianeamic drugs: Iron Supplement - Livogen, Dexorange syrup,Vitamin B12 and Folic acid –Mode of action.

UNIT-V **9 hours**

Life saving medicines and Indian Medicinal Plants

Drugs affecting CNS –definition, examples for tranquilizers, sedatives, hypnotics, psychedelic drugs- chlorpromazine. Hypoglycemic agents - sulphonyl urea, biguanides (only structure).

Chemotherapy - definition - cyclophosphopramide, use of phytochemicals in cancer therapy - Taxol

Medicinal plants and Herbs**:** Medicinal properties and uses of Hibiscus rosasinesis, Ocimum sanchum, Mangifera indica, Azadirachtra indica, Andrographis paniculata, Solatum trolbafum and Tinospora cordifolia.

Class Practicals:

Formulation and Evaluation of Tablets; Analysis of Active Pharmaceutical Ingredient (API).

Pedagogy Strategies:

Chalk and talk, Charts, Demonstration, Crystal models, Periodic tables, Power point presentation with animation, Quiz, Test yourself and Virtual class room.

Industrial Visit:

Visiting medicinal plant gardens and Ayurvedic centres.

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1. Thiagarajan, Pharmaceutical Chemistry, Educational Publishers
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Skill based Course Level Outcomes (CLOs)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Disciplinary Knowledge**	☑	☑	☑	☑		☑	
	2	**Analytical reasoning**	☑	☑			☑		
	3	**Research- related skills**			☑	☑		☑	☑
	4	**Scientific reasoning**		☑					
	5	**Information/digital literacy**	☑		☑		☑		☑
	6	**Problem solving**	☑	☑					☑
	7	**Cooperation/Team work**		☑				☑	
	8	**Moral and ethical awareness**			☑		☑		☑
	9	**Self-directed learning**	☑	☑		☑			

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	V	21BCH51C	PAPER –V:THEORETICAL CHEMISTRY	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Discuss the fundamentals of Quantum chemistry, Principles of HUP, atomic orbitals.
CLO- 2 Differentiate between ionic and covalent bonding, emphasize on the nature of ionic crystals, its formation, Born-Haber cycle
CLO- 3 Interpret Molecular Orbital Theory in terms of sigma- and pi- bond formation.
CLO- 4 Demonstrate all types of spectroscopy (theoretical principles) including basics of NMR with solving spectra for a few compounds.
CLO- 5 Operate Microwave or Rotational spectroscopy and vibrational spectroscopy (IR)
CLO- 6 Apply the knowledge to solve structure and bonding with help of group theory
CLO- 7 Evaluate the Electrical and Magnetic Properties of molecules for polar and non-polar materials
CLO- 8 Analyze ferro and ferrimagnetism as well as antiferromagnetism.

Unit – I **15 hours**

Fundamentals of Quantum Chemistry: Failure of classical theory in explaining black body radiation – Planck's radiation formula – Quantization of Energy – Einstein's Theory of Photoelectric effect – de Broglie's Theory of wave – particle dualism – Heisenberg's Uncertainty Principle (problems) – Importance of wave mechanics – Application of Schrodinger wave equation to particle in one dimensional box–Significance of ψ and ψ^2. Quantum numbers – Concept of atomic orbitals.

Unit – II **15 hours**

The Chemical Bonding: Ionic bonding –general properties of Ionic crystals - high melting, hardness, conductivity in molten state or in solution, solubility in polar solvent – Rock salt, CsCl – Crystal lattice energy and its determination by Born Haber cycle – factors affecting crystal lattice energy — ion polarization and Fajans rules.

Covalent bonding: Valence bond theory – directional character of hybrid orbitals – hybridization involving d- orbitals – complex ions – valance shell electron pair repulsion theory (VSEPR) and shapes of simple covalent molecules – resonance in molecules – molecular orbital theory as applied to σ and π bonds – partial ionic character of covalent bonds from electro negativity and dipole moment data –Hydrogen bonding – nature, energy and effects on structure and properties.

UNIT- III **15 hours**

Fundamentals of Molecular Spectroscopy: Definition, quantization of energy, interaction of electromagnetic radiation with matter and changes induced, Absorption and emission spectroscopy.

Microwave Spectroscopy: Theory of rotational spectroscopy (rigid diatomic molecule), determination of bond length and the effect of isotopic substitution (Stark effect) examples.

Electronic Spectroscopy: Principle of electronic – spectroscopy, Types of electronic transitions, Born - Oppenheimer approximation, Franck-Condon principle, pre-dissociation.

NMR – spectra - Basic Principles - chemical shift-NMR spectra of simple molecules only (Ethanol, Acetaldehyde, Xylene)

UNIT- IV **15 hours**

IR Spectroscopy: Principle of IR spectroscopy- molecular vibrations , vibrational frequency, fundamental vibrations for linear and non-linear molecules, selection rules. Combination bands,

overtone and Fermi resonance. Factors affecting vibrational frequencies- inductive and mesomeric effects (with simple examples). Differentiating inter & intra molecular hydrogen bonding using IR spectra.

Group Theory: Symmetry elements and symmetry operations, simple point groups –C_{2v} (H_2O) and C_{3v} (NH_3).

Unit – V **15 hours**

Electrical and Magnetic Properties of Molecules: Electrical properties – polar and non polar molecules – meaning of the terms – total molar polarization, orientation polarization and distortion polarization – determination of dipole moments of polar gases, liquids and solids – applications of dipole moments in the study of simple molecules.

Magnetic Properties of Molecules: Magnetic Susceptibility, Magnetic moment–Dia-magnetism,Para-magnetism,Ferromagnetism,Ferrimagnetism and Anti-Ferrimagnetism – Determination of the Magnetic Susceptibility of paramagnetic substances using Guoy Balance – Applications of Magnetic properties in solving structural problems involving Simple and Complex ions.

Class Practicals:

Demo on recording UV, IR, NMR spectra

Pedagogy Strategies:

Chalk and talk, Charts, Demonstration, Molecular models, Periodic tables, Power point presentation with animation, Quiz, Test yourself and Virtual class room. Visit to Central Instrumentation Centers and hands on training

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8. https://serc.carleton.edu/NAGTWorkshops/mineralogy/xtlsymmetry/elements.html
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑	☑	☑	☑	☑	☑		
	2	Communication skills	☑				☑			
	3	Critical thinking		☑	☑				☑	
	4	Research-related skills			☑		☑			☑
	5	Analytical reasoning				☑	☑			
	6	Problem solving	☑	☑		☑				☑
	7	Team work				☑		☑	☑	
	8	Moral and ethical awareness	☑		☑		☑			

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	V	21BCH52C	PAPER – VI: ORGANIC CHEMISTRY	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Identify, create and illustrate between various aromatic hydroxy compounds and its homologue.

CLO- 2 Prepare aliphatic halo acids and its homologue series

CLO- 3 Outline the importance of hetero atoms in Acid Amides, Imides and Nitro Compounds in synthesizing chemical products

CLO- 4 Discuss the details of aliphatic and aromatic amines in lab and on industrial scale.

CLO- 5 Evaluate molecular rearrangement, its mechanism and need to replicate on a larger scale

CLO- 6 Conceptualize both stereo and geometrical isomerism as well specific notations from structural aspects.

CLO- 7 Assess the heterocyclic chemistry with lower analogs to higher series

CLO- 8 Illustrate the mechanism of nucleophilic substitution for both SN_1 and SN_2 orders, NGP etc.

Unit – I **15 hours**

Phenols, Hydroxy and Halo acids

Phenols: Preparation, properties and uses of the following Phenols:Monohydric Phenols: Phenols, Cresols, Xylenols and NaphtholsDihydric Phenols: Catechol, Resorcinol and Quinol.Trihydric Phenols: Phloroglucinol, Pyrogallol and Hydroxyquinol.

Hydroxy Acids: – Preparation and uses of Lactic acid, Tartaric acid and Citric acid –ortho-, meta- and para- Hydroxy benzoic acids - their Preparation, Properties and Uses.

Halo acids: Preparation, properties and uses of α-halo acids (mono-, di- and trichloroacetic acid only).

Unit – II **15 hours**

Acid Amides and Imides: Preparation properties and uses of Acetamide, Urea, N-bromo succinimide, Benzamide, Phthalimide, Sulphanilamide and Saccharin.

Nitro Compounds: Preparation, Properties and Synthetic uses of Nitro methane, Nitro ethane, Nitrobenzene and *meta* Dinitrobenzene, Reduction of Nitrobenzene in neutral, acidic alkaline media and electrolytic reduction.

Unit – III **15 hours**

Amines: Classification and Separation of Primary, Secondary and Tertiary amines – Quaternary ammonium salts.

Preparation, Properties and Synthetic uses of Aliphatic amines, aniline, *N*-methylaniline, *N*,*N*-dimethylaniline – Phenylenediamines and Naphthyl amines – Basicity of amines. Diazotisation and coupling.

Unit – IV **15 hours**

Molecular Rearrangements: Pinacol – Pinacolone, Beckmann, Claisen Cope, Hoffmann, Curtius, Lossen, Schmidt and Benzil – Benzilic acid Rearrangements.

Isomerism: Stereo isomerism – Geometrical isomerism (C=C), (C=O) and (C=N) compounds. E–Z – Nomenclature**.** Optical isomerism–sequence rules and R,S notations. Chirality, Asymmetric synthesis, Racemic mixture and Resolution of Racemic mixture.Optical Activity in Biphenyls, Allenes and Spiranes.

Unit – V **15 hours**

Heterocyclic Compounds: Preparation, Properties, Structure and Uses of Pyrrole, Furan, Thiophene, Pyridine, Quinoline, Isoquinoline, Indole, Indigo and Isatin.

Nucleophilic Substitution Reactions: Mechanisms of Substitution Nucleophilic Unimolecular (SN_1) Substitution Nucleophilic Bimolecular (SN_2), Substitution Nucleophilic internal (SN_i) and Neighboring Group participation (NGP) reactions – Effects of substrate, solvent, nucleophile and leaving group.

Class Practicals:

Test for Phenols, Acids, Amines, Amides, Imides and Nitro Compounds. Optical activity measurements using Polarimeter.

Pedagogy Strategies:

Chalk and talk, Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room

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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑	☑	☑		☑	☑	☑	
	2	Communication skills		☑		☑	☑			☑
	3	Critical thinking	☑				☑			
	4	Research-related skills		☑		☑			☑	
	5	Analytical reasoning			☑			☑		
	6	Problem solving			☑	☑				☑
	7	Team work	☑				☑		☑	
	8	Moral and ethical awareness	☑		☑		☑			

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	V	21BCH 53C	PAPER – VII: ELECTROCHEMISTRY	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Analyze the electrical properties of electrolytes, conductance in solution and application to electrolytic dissociation.

CLO- 2 Utilize the principles of transference numbers in assessment of movement of individual ionic charges.

CLO- 3 Extrapolate the conductivity measurements to different electrolytes. Accumulate the knowledge of electrodes

CLO- 4 Outline need for voltage generation from chemical energy. Compute the calculation of electomotive forces. Adapt the technical knowledge of reference electrodes.

CLO- 5 Evaluate potentiometric titrations, cell voltages, hydrogen over voltage, redox reactions, buffer action etc.

CLO- 6 Experimentally understand polarography, analyse reduction potential of cationic species through DME polarogram and demonstrate technical know-how of amperometric titrations

CLO- 7 Illustrate Electrochemical storage cells, battery as storage devices and as accumulators.

CLO- 8 Interpret the fuel cells with specific reference to hydrogen-oxygen fuel cell and summarize the fundamentals of corrosion and its prevention.

Unit – I **15 hours**

Electrical Transport and Ohm's Law: Conduction in metals and in electrolytic solutions – measurement of conductivity in electrolytic solution – Equivalent and specific conductance of strong & weak electrolytes- migration of ions and Kohlrausch's law of independent migration of ions – Arrhenius theory of electrolytic dissociation and Ostwald's dilution law – the idea of strong and weak electrolytes – An elementary treatment of the Debye – Huckel – Onsager equation for strong electrolytes. Wein effect and Debye-Falkenhagen effect.

Transference number – principle – determination of transference number by Hittorff's method and moving boundary method.

Unit – II **15 hours**

Application of Conductivity Measurements: Determination of equivalent conductance of a weak organic acid – determination of solubility product of a sparingly soluble salt – ionic product of water, conductometric titrations.

Electrodes – the standard hydrogen electrode (SHE) – kinds of electrodes: gas / ion, metal / metal ion, metal / insoluble salt, redox electrodes – derivation of Nernst equation.

Unit – III **15 hours**

Electrochemical Cell – Daniel cell – Electromotive forces (EMF) – computation of the cell EMF – Weston-cadmium cell, determination of E^0 of half cell – Temperature dependence of the cell EMF – thermodynamic quantities of cell reactions.

Reference electrodes – electrodes for the measurement of pH – Hydrogen, quinhydrone, glass electrode – concentration cells with and without transference – liquid junction potential – determination and elimination.

Unit – IV **15 hours**

Potentiometric Titrations: Acid / base, precipitation, redox titrations – buffer solutions – pH of a

buffer. Henderson – Hasselbach equation – Evaluation of the dissociation constant of weak – decomposition potential – hydrogen over voltage – application.

Polarography: Representation of a Polarogram, Half–wave potential, Dropping Mercury Electrode (DME) cell assembly, Applications of polarography, Amperometric titrations.

Unit V **15 hours**

Electrochemical cells: Classifications - Storage batteries –Lead storage battery, Nickel-Cadmium cell and lithium ion cell.

Fuel cells: Hydrogen-oxygen and Hydrocarbon- oxygen cells.

Corrosion: Definition, Mechanism of dry and wet Corrosion. Prevention of corrosion - Sacrificial anodic method and Impressed current cathodic protection.

Class Practicals:

Construction of Cells, Conductometric and Potentiometric Titrations, Weight Loss method, pH determination, Preparation of Buffers.

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room

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2. Arun Bahl, B.S.Bahl, G.D.Tuli. Essentials of Physical Chemistry, S.Chand Publications,(2000).
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑					☑	☑	☑
	2	Communication skills	☑	☑	☑					☑
	3	Critical thinking	☑			☑			☑	
	4	Research-related skills		☑			☑			
	5	Analytical reasoning					☑	☑		
	6	Problem solving			☑	☑			☑	
	7	Team work					☑		☑	
	8	Moral and ethical awareness	☑			☑	☑			☑

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	**V**	**21BCH54S**	**SKILL BASED ELECTIVE-III: TEXTILE CHEMISTRY**	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Discuss the fundamentals of fibre, filament, yarn-in natural and synthetics with properties.
CLO- 2 Apply techniques adapted operational procedures.
CLO- 3 Interpret theoretical aspects of color, assessment of modern machinery, dyes and its sources,
CLO- 4 Illustrate the process of printing technology with special reference to pigment printing as well use of natural dyes in printing.
CLO- 5 Evaluate compilation on types of finishes in textile industry, use of flame retardants in textiles.
CLO- 6 Rate the quality of water used in textile treatment processing, water softening by chemical additions, types of boiler requirement.
CLO- 7 Interpret specification issued by government bodies, and pollution norms followed.

Unit – I **12 hours**

Fundamentals of Textile Chemistry: General definition of a textile fibre and a textile filament – yarn count – classification of fibres – natural regenerated and synthetic – basic structural formula of cotton, silk, wool, rayon, acetates, nylon, polyester, PAN, PET non-acrylic fibres.

Fibre properties: crystallinity, tensile strength, tear strength, abrasion resistance, lusture and thermal properties.

Unit – II **12 hours**

Textile Processing: General sequence of processing by melt, dry and wet spinning of Textile Fibers. Textile chemical processing; (i) Sizing-desizing (ii) Singeing (iii) Scouring (iv) Bleaching (v) Mercerization (Principles, acid and alkali treatment and Conditions of operations)

Unit-III **12 hours**

Color and Constitution: Dye molecule – Chromophores – Auxochromes – Classification of Dyes – Principles of Textile Materials dyeing; Operation conditions, machinery and modern developments of acidic basic dyes, azoic dyes disperse dyes, direct dyes, sulfur dyes, mordant and vat dyes.

Fastness properties to washing, rubbing, light, perspiration and sublimation.

Unit-IV **12 hours**

Principles of Textile Printing: Conditions, machinery and modern developments involved in styles of printing, pigment printing, block printing, screen printing, roller printing and rotary printing methods. Natural dyes in Printing.

Textile Finishes: mechanical and functional finishes and their importance –resin, soft, stiff finishes, water repellent, soil repellent and flame retardants.

Unit-V **12 hours**

Textile Treatment Processing: Physical and Chemical properties of water for textile processing, Requirement and estimation of the quality of water for textile processing-water softening – by chemical additions, demineralization and Zeolite process. Importance of steam in textile dyeing processes – various types of boilers used in textile industries-nature of textile dye house effluents and their treatments.

Government policy: Government Specifications and Pollution Control on Textile Industries, polluter-pays principle.

Class Practicals:

Preparation of dyes and recording UV-Vis spectra.

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz,Test yourself and Virtual class room.

Industrial Visit :

Textile and Dyeing Industries.

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1. Gohl, Textile Science an Explanation of Fibre Properties, CBS, 3rd Edn., (2009).
2. S.P. Mishra, Text Book of Fibre Science and Technology, New Age, 4th Edn., (2010).
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Skill based Course Level Outcomes (CLOs)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Disciplinary Knowledge**	☑	☑	☑	☑		☑	
	2	**Analytical reasoning**		☑					
	3	**Research- related skills**			☑	☑		☑	
	4	**Scientific reasoning**		☑			☑		
	5	**Information/digital literacy**		☑		☑			☑
	6	**Problem solving**			☑				☑
	7	**Cooperation/Team work**		☑				☑	
	8	**Moral and ethical awareness**			☑		☑		☑
	9	**Self-directed learning**	☑			☑			

B. Sc., Chemistry

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	VI	21BCH61C	PAPER – VIII: INORGANIC CHEMISTRY	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Demonstrate isomerism in complexes. Assumptions of metal ligand bond formation. Assessment on Werners' theory.

CLO- 2 Explain theoretical compilation of VBT and CFT. Splitting in complexes, compare VBT and CFT in its application and limitations.

CLO- 3 Discuss the Electronic Structural aspects of Lanthanides and Actinides, a property with respect to oxidation, magnetic, contraction sequences is dealt.

CLO- 4 Illustrate the use of Non aqueous solvents in conduction reactions and extraction. Study of Carbides and nitrides as well a special emphasis on metal carbonyls

CLO- 5 Recreate the structures of large biomolecules. Summarize theories of metallic state and solid solutions (alloys)

CLO- 6 Evaluate semiconductors and super conductors on the basis of applications.

CLO- 7 Discuss nuclear chemistry- isotopes, mass defect, Radioactivity etc.

CLO- 8 Evaluate the working of nuclear reactors and applications of radioactivity in agriculture, medicine, carbon dating.

Unit – I **15 hours**

Coordination Chemistry: Nomenclature – Isomerism in complexes – different types of structural isomerism –stereo isomerism-geometrical isomerism-optical isomerism – Theories of metal ligand bond: Werner's theory, EAN rule, Valence bond theory - postulates and applications, Crystal field theory– Postulates – Explanation with examples – Crystal Field Stabilization Energy – Crystal Field Splitting in Tetrahedral and Octahedral Complexes – Limitations – Comparison of the two theories (VB & CFT).

Unit – II **15 hours**

Biomolecules: Introduction, structure and functions of Hemoglobin, Myoglobin, Cytochrome & Chlorophyll.

Inner Transition Elements

Lanthanides and Actinides: Lanthanide Series and Actinide series- Electronic Structure and Position in the Periodic Table - Isolation of Lanthanides –- Oxidation states and Oxidation Potential, Magnetic Properties- Lanthanide Contraction and its Consequences – Comparison of Lanthanides and Actinides. – Chemistry of Thorium and Uranium, occurrence, extraction, properties and uses. Trans Uranium elements.

Unit – III **15 hours**

Non – aqueous Solvents: Classification of solvents – protic and aprotic solvents – acid, basic and amphoteric solvents, ionizing and non-ionizing solvents-general properties of ionizing solvents -Chemical reactions in liq NH_3 and liq SO_2.Auto ionization. Alkali metals in liquid ammonia-advantages and disadvantages of liq NH_3 and liq SO_2 as a solvent.

Binary metallic compounds: Carbides and Nitrides - Classification, Preparation, Properties, Structure and Uses. Metallic carbonyls – mono and binuclear carbonyls of Ni, Fe, Cr, and Co and Mn-Synthesis, reaction and structure

Unit – IV **15 hours**

Metallic State: Close packing of atoms in metals (HCP and CCP) metallic bonding - Free electron theory - Valence bond approach - Band theory.

Structure of alloys: – Intermetallic compounds - Substitutional – Interstitial solid solution. Hume Rothary ratios.

Semi-conductors: Types of semi conductors – Intrinsic semi conductors - extrinsic semi conductors – 'n' type and 'p' type semi conductors, theory properties and uses - Super conductors – basic concepts and applications.

Unit – V **15 hours**

Nuclear Chemistry: Isotopes, isobars and isotones – Aston's mass Spectrograph - nuclear stability – n/p ratio – Magic number - packing fraction- pi meson theory – mass defect and nuclear binding energies – Radio activity- half-life period- Group Displacement law- Radioactive series. Artificial radio activity – Synthesis of Artificial radio isotopes.

Nuclear Reactions: Nuclear Fission and Fusion Reactions – Fast and Breeder Type Reactors Atomic Power Project in India – Application of Radio Isotopes – Determination of Age of earth - Carbon Dating (^{14}C Dating), Biomedical, Agricultural and Industrial Applications. Spallation, Q-value.

Class Practicals:

Preparation of Inorganic complexes, Estimation of hardness of water by EDTA method.

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room

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1 Satyaprakash, G.D. Tuli, S.K. Basu, R.D. Madan, Advanced Inorganic Chemistry, S. Chand & Co., Ltd., New Delhi, 16th revised Edn., (1985).

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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑	☑	☑	☑	☑		☑	
	2	Communication skills	☑	☑				☑		☑
	3	Critical thinking		☑					☑	
	4	Research-related skills		☑			☑			☑
	5	Analytical reasoning			☑			☑		
	6	Problem solving		☑		☑			☑	
	7	Team work			☑		☑		☑	
	8	Moral and ethical awareness	☑			☑				☑

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	VI	21BCH62C	PAPER –IX: CHEMISTRY OF NATURAL PRODUCTS	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Discuss the classification and isolation of Alkaloids and methods for the Systematic elucidation of certain alkaloids.

CLO- 2 Explain Terpenoids with structural elucidation strategies and the synthetic route on chemical formation of certain important Terpenoids.

CLO- 3 Demonstrate recreation of synthetic route for the formation of Dipentene, α-Pinene.

CLO- 4 Classify water soluble and fat soluble vitamins and elucidate the structure of Vitamin A (Retinol) and Vitamin C.

CLO- 5 Overview hormones in the context of biological importance.

CLO- 6 Infer carbohydrates with structural elucidation of mono-, di-, polysaccharides..

CLO- 7 Compile chemical Properties of amino acids and propos the preparation of α-amino acids, Assessment of Strecker synthesis

CLO- 8 Evaluate protein and peptide synthesis with test reactions and identifications.

Unit – I **15 hours**

Alkaloids: Introduction, Classification and Isolation of Alkaloids – General methods of elucidation of Structure – Structural elucidation and synthesis of Conine, Piperine, Nicotine, Atropine and Papaverine.

Unit – II **15 hours**

Terpenoids: Introduction – Isoprene and Special Isoprene rule – Isolation and General properties – Classification – Structural elucidation of Geraniol, Menthol, ,α-Terpeniol, Limonene (Dipentene) and α-Pinene.

Unit – III **15 hours**

Vitamins: Introduction- Fat soluble and water soluble vitamins- Sources, biological importance and Deficiency diseases of vitamins.

Structural elucidation of Vitamin A (Retinol) and Vitamin C.

Hormones: Biological importance of hormones - Structural elucidation of Thyroxin and Adrenaline.

Unit – IV **15 hours**

Carbohydrates: Classification, Mono-saccharides and Elementary account of Aldoses, Ketoses, D and L forms, Pentoses and Hexoses. Reducing and non-reducing sugars. Structural features and properties.

Hexoses: Structure of D (+) Glucose and D (-) Fructose – Open and Closed chain structures, muta rotation, Epimerization, Killiani-Fisher synthesis, Ruff's degradation. Conversion of Glucose to fructose and vice versa.

Disaccharides: Structural elucidation and Ring structure of Sucrose.

Polysaccharides: Elementary account of Starch and Cellulose, Important derivatives of Cellulose.

Unit – V **15 hours**

Amino Acids: Classification, Properties of amino acids - Zwitter ion, Iso-electric point, General Chemical Properties of amino acids.

Preparation of α-amino acids: Amination of α-halogenated acids - Gabriel phthalimide synthesis, Strecker synthesis, Erlenmeyer Aza lactone synthesis.

Peptides: General method of synthesis of peptide –solid phase peptide synthesis.

Proteins: Classification, properties, structure (Primary, Secondary and tertiary) and identification tests.

Class Practicals:

Demonstration on isolation of natural products, Analysis of Carbohydrates.

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room.

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1. I.L. Finar, Organic Chemistry, Volume 2, Longman Scientific & Technical (2000).
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Course Level Outcomes (CLO)							
			1	2	3	4	5	6	7	8
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	☑	☑	☑		☑	☑	☑	☑
	2	Communication skills	☑			☑				
	3	Critical thinking		☑			☑			☑
	4	Research-related skills	☑				☑			
	5	Analytical reasoning	☑		☑					
	6	Problem solving				☑			☑	
	7	Team work			☑				☑	
	8	Moral and ethical awareness	☑			☑				

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	VI	21BCH63C	PAPER – X: PHYSICAL CHEMISTRY	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Develop and articulate chemoinformatics. Significance, nomenclature, modeling etc.

CLO- 2 Discuss IPR and its evolution, need for protection of inventions, discoveries etc through IPR and development of cyber security for information protection.

CLO- 3 Overview reaction rates, classification of order of reactions, calculated kinetic laws, experimental determination of reaction rate etc.

CLO- 4 Demonstrate theoretical aspects of reaction rate: collision theory. ARRT etc., Energy of activation

CLO- 5 Create complex reactions and chain reactions with kinetic solutions

CLO- 6 Analyze fast reactions studied with help of flash photolysis and certain flow methods in time domain.

CLO- 7 Interpret the fundamentals of photochemistry: Laws and significance.

CLO- 8 Examine photochemical chain reactions and its comparison with thermal methods and summarize the need for calculation of quantum yields

Unit – I **15 hours**

Chemoinformatics, IPR and Cyber security:

Chemoinformatics: Introduction to Chemoinformatics: History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular modeling and structure elucidation. Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sd files, Libraries and tool kits, Different electronic effects, Reaction classification.

Intellectual Property Rights: Introduction: Basic concept of Intellectual Property, Rationale behind Intellectual Property, Justifications for protection of IP, IPR and Economic Development, Major International Instruments relating to the protection of IP. The World Intellectual Property Organization (WIPO), WTO and TRIPS Agreement.

Cyber Security: History, What is Information Security?. Components of information security, The security system development life cycle- Information security, an art of Science.
Need for security- Threats and attacks.

Unit – II Chemical Kinetics: **1** **15 hours**

Order and molecularity: Rate law expression, zero order and fractional order reactions. Derivation of integrated rate expression for first, second and zero order reactions. Factors influencing rate of the reaction. Characteristics of first ,second and zero order reactions.

Expressions for the half-life periods of zero, first, second, third and fractional order reactions. Determination of order of reaction – Half life period method, differential method, isolation method & graphical method. Experimental methods of measuring reaction rate- Polarimetry, Dilatometry, Colorimetric , Monometry and Volumetry.

Unit – III **15 hours**

Chemical Kinetics: Effect of Temperature on the Rate Constant - The Activation Energy - The Collision Theory of Reaction rates and its limitation - ARRT – thermodynamic formulation,

Comparison of Collision Theory with ARRT. Significance of Free Energy of Activation ($\Delta G^{\#}$) and Entropy of Activation – Lindeman's theory of Unimolecular reaction.

Unit – IV **15 hours**

Complex reaction: Consecutive, Parallel, Reversible Reactions and Chain Reactions, $H_2 – Cl_2$, and $H_2 – Br_2$ Reactions and their Kinetics – Fast reactions: – Flash photolysis – Flow Techniques – Relaxation Methods.

Unit – V **15 hours**

Photochemistry: Absorption of Light and Photophysical and Photochemical processess – Jablonski diagram – Fluorescence and Phosphorescence. The Stark – Einstein Law of Photochemical Equivalence, Laws of Light Absorption – Lambert's Law and Beer's law – Photochemical chain reaction – Hydrogen – Chlorine reaction, Hydrogen – Bromine reaction, Hydrogen – Iodine reaction
Quantum yield (φ) – Determination of quantum yield by Actinometry. Reasons for high and low Quantum yield. Comparison of Thermal and Photochemical Reactions of $H_2 – Cl_2$ and $H_2 – Br_2$. Photolysis of Acetaldehyde and Acetone. Photosensitized Reactions. Chemiluminescence.

Class Practicals:

Kinetics of selected reactions

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room

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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Program Level Outcomes (PLO)	**1**	**Disciplinary Knowledge**	☑	☑		☑	☑		☑	☑
	2	**Communication skills**	☑	☑			☑	☑		☑
	3	**Critical thinking**	☑			☑				
	4	**Research-related skills**		☑			☑	☑		
	5	**Analytical reasoning**			☑	☑				
	6	**Problem solving**		☑	☑			☑		☑
	7	**Team work**	☑					☑	☑	
	8	**Moral and ethical awareness**	☑				☑			☑

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	VI	21BCH67S	SKILL BASED ELECTIVE-IV: INDUSTRIAL CHEMISTRY	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Infer processing or conversion of sugar from cane. Multistage treatment process of crystallization.

CLO- 2 Interpret experimental testing of sugar, technical know-how of cost effective value addition through byproducts can be understood.

CLO- 3 Observe the inter-twined pigment manufacture process for industrial applications.

CLO- 4 Interpret the use of paint in domestic and industrial sectors. Also assess the manufacturing process of varnish, special paints etc.

CLO- 5 Evaluate the industrial utility of petroleum and petroleum products.

CLO- 6 Infer the process of cement manufacture in industrial scale and type of kilns.

CLO- 7 Revisit to iron and steel industry for application oriented need and Safer alloys manufacture.

Unit – I **12 hours**

Sugar Industry: Manufacture of Crystalline sugar: Extraction of the Juice, Clarification of the Juice – Two step and One step process – Classification of Juice by Double carbonation process - Evaporation of Clarified juice to make syrup - Crystallization of Syrup – Use of Seed Crystals for Crystallization – Curing of Sugar – Double Centrifuging – Treatment of Molasses – Composition of Back strap – Refining of Raw sugar – Recovery of Bone char – Utilization of Bagasse – filter cakes used as manure – Testing and Estimation of Sugar – Industrial Spirit – Absolute Alcohol – Cane sugar industries in Tamilnadu and in India.

Unit – II **12 hours**

Pigments: Manufacture, Physical properties and Uses- White lead – French and Rowley process. ZnO – Electrolytic process. Blue Pigments: Cobalt blue and Ultra marine blue. Red pigment: Red Lead and Iron oxide.

Paints: Classification – Requirements of a Good Paint and Importance of pigment volume concentration (PVC) – Paints Failure. Emulsion Paints and Varnishes – constituents and Manufacture. Special paints.

Unit – III **12 hours**

Petroleum and Petroleum Products: Origin – Composition – Classification – Distillation – Natural Gasoline – Aviation Gasoline – Cracked Gasoline – Cracking Process – Thermal and Catalytic Process. Octane number – Flash point – Percentage and Principal products of Crude Petroleum – Antiknock Compounds . Petroleum Refineries in India.

Industrial ethics: Ethical and moral values in Industrial Organization.

Unit – IV **12 hours**

Cement Industry: Raw materials for Cement Manufacturing – Proportioning – Blending and Preparation of the raw mixture – The burning – Rotary kilns – Refractory material – Dry process – Wet process – Physical requirements of Cement – Varieties of cement – Tests and Specification (ISI Specification for Cement) – Setting of Cement – Cement Factories in Tamil Nadu and in India .

Unit – V **12 hours**

Iron and Steel Industry: – Iron- Carbon Alloy System – Phase Diagram of Fe-C and Its study – Function of Carbon in Steels and Its Classification – Heat Treatment of Steel – Annealing, Tempering,

Normalizing, Hardening, Cold rolling of steel– Alloy Steels – Need for Alloying of Steels. Special Alloying Metals like Cr, Ni, Mn, V, and Co – Special Steels such as Magnetic Steels – Stainless steels, Tool steels and High speed steel.

Class Practicals:

Testing of Sugar and Cement.

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room.

Industrial Visit :

Sugar, Cement Industries.

REFERENCE BOOKS

1. B.K. Sharma, Industrial Chemistry, Krishna Prakasam Medai (P) Ltd., Meerut, 4th revised Edn., (2001).
2. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai & Sons, Delhi

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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Skill based Course Level Outcomes (CLOs)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Disciplinary Knowledge**	☑		☑			☑	
	2	**Analytical reasoning**		☑			☑		
	3	**Research- related skills**			☑	☑			
	4	**Scientific reasoning**		☑		☑			
	5	**Information/digital literacy**	☑		☑				☑
	6	**Problem solving**		☑			☑		☑
	7	**Cooperation/Team work**		☑				☑	
	8	**Moral and ethical awareness**			☑				☑
	9	**Self-directed learning**		☑		☑			

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	**V**	**21BCH5EL**	**NON-MAJOR ELECTIVE-I: CHEMISTRY IN CHANGING LIFE STYLE – I**	**3**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Identify water resources for domestic and industrial use. Water softening process with chemicals. Treatment of wastewater

CLO- 2 Demonstrate the know-how of reverse osmosis and ISO standards

CLO- 3 Interpret technical know-how of fermentation process, process details in the manufacture of alcoholic beverages

CLO- 4 Analyze the basics of Oils, Fats, soap etc., their major differences and use in detergent manufacture.

CLO- 5 Identify the chemicals often used as food adulterants, toxicity, its adverse effect on the humans

CLO- 6 Explain the use of paint and its manufacturing process, uses of additives to adhere permanently

CLO- 7 Distinguish paint failure-causes and rectification, properties of enamels. lacquers

Unit – I **9 hours**

Water Treatment: Introduction – Sources and Uses of Water – Water for Industrial Purposes – Quality of Normal water – water in human body – Hardness of water – Types - Softening of Water – Zeolite and Ion-exchange Processes (principles only). Demineralization of water – Treatment of Water for Municipal purposes – Desalination of Brackish Water – Reverse Osmosis Method (principles only). ISO standards.

Unit – II **9 hours**

Fermentation: Introduction – Conditions for Fermentation – Characteristics of Enzymes – Fermentation Processes – Alcohol Beverages – Wine, Beer- Manufacture of Spirits .Vinegar – Power Alcohol – Alcohol from Molasses, Starch, Hydrocarbon gases – Uses.

Unit – III **9 hours**

Oils, Fats, Waxes and Soap: Waxes – Classification – Solubility – Saponification value – Manufacture of Candles – Hydrocarbon of Candles – Hydrogenation – of Oils – Soaps – Manufacture – detergents – Cleansing Action of Soaps.

Unit – IV **9 hours**

Food Adulteration and Hygiene: Definition of Adulteration Food – Common Adulterants in Different Foods – Toxic Effects of Some Metals and Chemicals – Contamination of Foods with Harmful Microorganisms – Detection of Adulteration in Some Common Food items – Food Additives and Preservatives – Food standards.

Unit – V **9 hours**

Paints: Classification – Requirements of a Good Paint and Importance of pigment volume concentration (PVC) – Paints Failure. Emulsion Paints , Enamels , Lacquers and Varnishes – constituents and Manufacture.

Class Practicals: Determination of hardness of water by EDTA method

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself

and Virtual class room

REFERENCE BOOKS

1. B.K. Sharma, Environmental Chemistry, Krishna Prakasam Medai (P) Ltd., Meerut, 6th Revised Edn (2001).
2. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai & Sons, Delhi
3. M. Swaminathan, Food & Nutrition, Bappco, 2nd Edn., (2011).
4. B. Sri Lakshmi, Food Science, New Age, 5th Edn.,(2011).
5. Jayashree, Applied Chemistry, S. Chand, 3rd Edn., (2013

FURTHER READING

1. N.Shakuntala Manay & M. Shadaksharaswamy, Foods, Facts and Principles,Wiley Eastern Ltd., New Delhi, (1987).

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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			General Elective Course Level Outcomes (CLOs)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Additional academic Knowledge**	☑	☑		☑			
	2	**Psychological skills**	☑				☑	☑	
	3	**Problem solving**	☑		☑				☑
	4	**Additional Knowledge enhancement**	☑	☑		☑	☑		
	5	**Exposure beyond discipline**	☑	☑		☑	☑	☑	☑
	6	**Analytical reasoning**	☑	☑			☑	☑	
	7	**Digital literacy**		☑				☑	
	8	**Moral and ethical awareness**	☑			☑	☑		

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	VI	21BCH6EL	NON-MAJOR ELECTIVE-II: CHEMISTRY IN CHANGING LIFE STYLE – II	3

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Apply the knowledge of VOC's in creating awareness among public and hazards of detergent pollution.

CLO- 2 Evaluate Lubricants its utility in regular activity

CLO- 3 Discuss value addition in milk products, purity check in milk and preservation of milk and its products.

CLO- 4 Analyse composition of blood, grouping, general properties of blood etc.

CLO- 5 Summarize the need for dosage of drugs in particular cardiovascular drugs for treating cardiac diseases. Antihypertension drugs utility

CLO- 6 Identify special foods/diets for specific diseases.

CLO- 7 Discuss the rejuvenation of the human body with extracts of Indian medicinal plants to revive strength.

Unit – I **9 hours**

Chemistry in day-to-day life: Dry Cleaning of Clothes, Versatile Bleaching Agents. Environmental Pollution by Volatile Organic Solvents / Compounds (VOCs).

Lubricants; Definition, function of lubricants and properties. Examples, classification of lubrication, additives for lubricating oils, synthetic lubricants, greases and solid lubricants (Graphite and MoS_2).

Unit – II **9 hours**

Milk and Milk Products: Milk, Changes at Room Temperature, Methods of Routine Examination of Milk. Classification of bacteria, acid products, peptonizing organisms, fat splitters, pathogens. Milk Products – Butter, Cheese, Fermented Milk, Curd, Yoghurt, Abnormal Changes in Milk and Milk Spoilage, Preservation of Milk and Milk Products.

Unit – III **9 hours**

Blood and Hametalogical agents: Composition of blood, blood grouping and matching, role of blood as oxygen carrier, blood pressure, coagulation of blood. Determination of blood urea (using urease method only).

Drugs: Cardiovascular drugs, action, dosage and examples of cardiac glycosides, antiarrhythemic drugs, antihypertension drugs and vascodialator.

Unit – IV **9 hours**

Special diets for specific diseases: Peptic ulcer, diabetes, mellines, infective hepatitis, heart disease and hypertension.

Unit – V **9 hours**

Indian medicinal plants: Medicinal properties and uses of Hibiscus Rosasinesis, adathoda vasica, Ocimum sanchum, Mangifera Indica, Azadirachtra Indica, Phyllantum Niruri, Solatum Trolbafum.

Class Practicals:

Analysis of milk.

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room

REFERENCES

1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
2. V. Thiagarajan, Pharmaceutical Chemistry, Educational Publishers.
3. A.K. De. Environmental Chemistry.
4. B. Sri Lakshmi, Food Science, New Age, 5th Edn., (2011).

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1. B.K.Sharma, Industrial Chemistry (including Chemical Engineering), Goel Publishing House, Meerut, Krishnaprakasan Media Pvt Ltd., (2016).

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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			General Elective Course Level Outcomes (CLOs)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Additional academic Knowledge**	☑	☑		☑			
	2	**Psychological skills**	☑			☑			
	3	**Problem solving**			☑		☑	☑	☑
	4	**Additional Knowledge enhancement**	☑	☑		☑			
	5	**Exposure beyond discipline**			☑		☑		☑
	6	**Analytical reasoning**		☑			☑		
	7	**Digital literacy**	☑			☑		☑	
	8	**Moral and ethical awareness**	☑		☑		☑		☑

B. Sc., Chemistry

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	III I	21BPH/BBO/ BZO34A & 21BGI15A	PAPER –I : ALLIED CHEMISTRY –I	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Conceptualize the art of bonding in molecules through respective through ionic and co-valency.

CLO- 2 Put forth the preparation of interhalogen compounds.

CLO- 3 Discuss VBT, Band theory with respect to imperfection in solids - semiconductors

CLO- 4 Explain organic reagents and reactions, geometrical and optical isomerism, hybridization etc.

CLO- 5 Infer utilization of chloro containing compounds as solvents its benefits and hazards.

CLO- 6 Analyze certain reactions involving benzene as substrate and recreate the mechanism of various reactions.

CLO- 7 Recall thermodynamics Carnot cycle and significance of entropy.

Unit – I **15 hours**

Theories of Chemical Bonding: Ionic, and Covalent, Bonds, □ and □ Bonding – H_2 Molecule, F_2 Molecule – Partial Ionic Character – Hydrogen Bonding – Types and Applications van Der Waals Forces.

Inter Halogen Compounds: ICl, BrF_3, IF_5 – Preparation, Properties, Hybridization, and Structure.

Unit – II **15 hours**

Metallic Bonding: Free Electron Theory – Valance Bond Theory Band or Zone Theory – Semiconductors. Imperfections in crystal – Schottky defects, Frenkel defects and F-centeres.

Unit – III **15 hours**

Types of Organic Reactions and Reagents: Common Electrophiles, Nucleophiles and Free Radicals. Isomerism: Geometrical and Optical Isomerisms – Optical Isomerism in Lactic and Tartaric acids – Resolution. Geometrical Isomerism in Dichloroethyelene, Maleic and Fumaric acid. Keto – Enol Tautomerism – Orbital overlap – Types of Hybridization and Geometry of Methane, Ethylene and Acetylene.

Unit – IV **15 hours**

Halogen Containing Compounds: Important Chloro hydrocarbons used as Solvents and Pesticides (Dichloro methane, Choloroform, CCl_4, DDT, BHC) Chloro Fluro Carbons (CFCs) – Freons – Properties and Uses.

Aromatic Compounds: Aromatic electrophilic substitution in benzene – arenium ion mechanism - typical Substitution Reactions with mechanism – Nitration, Sulfonation, Halogenation, Friedel-Crafts Alkylation and Acylation, orientation in mono substituted benzenes. Synthesis and reactions of naphthalene.

Unit – V **15 hours**

Thermodynamics: Definition of Zeroth and First Law of Thermodynamics – Types of Systems – Reversible, Isothermal, Adiabatic, and Spontaneous Processes. Need for the Second Law-Carnot Cycle –Entropy and Its Significance.

Class Practicals:

Analysis of an Organic compound

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room

REFERENCES

1 V. Veeraiyan, Allied Chemistry – I, High Mount Publishing House (Educational Publishers), Chennai 14.

2 B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishingh Co., New Delhi, 28th Edn., (2004).

3 Arun Bahl and B. S. Bahl, Advanced Organic Chemistry, S. Chand, New Delhi, (2008).

4 R.T. Morrison, R.N. Boyd, Organic Chemistry Prentice Hall of India (P) Ltd., New Delhi, 2nd Edn.,(1974).

5 B.R. Puri, L.R. Sharma, Inorganic Chemistry, Miestone revised Edn., (2011).

6 J. D. Lee, Concise Inorganic Chemistry, Wiley, 5th Edn., (2010).

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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Specific Elective Course Level Outcomes (CLOs)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Additional academic Knowledge**	☑	☑		☑	☑		
	2	**Psychological skills**			☑		☑		
	3	**Problem solving**						☑	☑
	4	**Additional Knowledge enhancement**	☑	☑		☑			
	5	**Exposure beyond discipline**			☑	☑	☑		☑
	6	**Analytical reasoning**	☑	☑		☑			
	7	**Digital literacy**		☑				☑	
	8	**Moral and ethical awareness**	☑		☑		☑		☑

B. Sc., Chemistry

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	IV II	21BPH/BBO/ BZO44A & 21BGI25A	PAPER –II : ALLIED CHEMISTRY –II	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

CLO- 1 Prepare solutions of definite strength, to practice at laboratory level
CLO- 2 Apply coordination theory, hardness of water.
CLO- 3 Interpret chromatography principles, assessment of fuel gases with composition.
CLO- 4 Discuss the use of heterocyclic chemistry, classification of proteins. Properties and uses of prepared polymer
CLO- 5 Overview of kinetics, order of reaction, experimental determination of activation energy.
CLO- 6 Explore the need for photochemistry, its primary laws, quantum efficiency etc.
CLO- 7 Interpret electrochemistry, the power of conductance, applications etc.

Unit – I **15 hours**

Preparation of standard solutions: Definition for normality, molarity, equivalent weight with examples.

Co-ordination Chemistry: Introduction, Nomenclature, Werner, Sidgwik and Pauling's Theories– Chelation, its Importance and application - EDTA method of estimation of hardness of water. Hemoglobin and Chlorophyll.

Unit – II **15 hours**

Chromatography: Principles of Column, Paper and Thin Layer Chromatography.

Fuel gases: Composition and uses of natural gas, water gas, semi water gas, producer gas and oil gas.

Unit – III **15 hours**

Heterocyclic Compounds: Preparation, Properties and Uses of Pyrrole, Furan, Thiophone, Pyridine.

Proteins: Classification, properties and biological functions -Primary and Secondary Structures of proteins.

Synthetic Polymers: Teflon, Alkyl Resins, Polyesters and Epoxy Resins – General Treatment.

Unit – IV **15 hours**

Chemical Kinetics: Order and Molecularity – Determination of Order, Activation Energy, Effect of Temperature on Reaction Rate – Catalysis – Types, Mechanisms and Industrial Applications.

Photochemistry: Laws of Photochemistry -Lambert's law, Beer-Lambert's law, Grotthus- Draper law, Stark-Einstein's law. Quantum Yield. Fluorescence and Phosphorescence (Definition only).

Unit – V **15 hours**

Electrochemistry: Specific Conductance, Equivalent Conductance, Effect of Dilution on Conductance, Ostwalts Dilution Law, Kohlrausch's Law – Applications.

Importance of pH and Buffer Solution in Living Systems.

Corrosion: Definition – Mechanism of electro chemical corrosion. Prevention methods: Sacrificial anodic method and Impressed Current Cathodic Protection.

Class Practicals:

Preparation of standard solutions**,** Determination of hardness of water by EDTA method

Pedagogy Strategies:

Chalk and talk Charts, Demonstration, Power point presentation with animation, Quiz, Test yourself and Virtual class room

REFERENCES.

1. V. Veeraiyan Allied Chemistry – II, High Mount Publishing House (Educational Publishers), Chennai 14.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishingh Co.,New Delhi, 28th Edn., (2004).
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5. B.R. Puri, L.R. Sharma, Inorganic Chemistry, Miestone revised Edn., (2011).
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Specific Elective Course Level Outcomes (CLOs)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Additional academic Knowledge**		☑	☑	☑		☑	
	2	**Psychological skills**			☑	☑			
	3	**Problem solving**	☑		☑			☑	☑
	4	**Additional Knowledge enhancement**	☑			☑			
	5	**Exposure beyond discipline**				☑	☑	☑	
	6	**Analytical reasoning**		☑			☑		
	7	**Digital literacy**		☑		☑			
	8	**Moral and ethical awareness**			☑		☑		☑

B. Sc., Chemistry

PRACTICAL Distribution of marks

For B. Sc., Major Practicals

For each of the papers:

Total Marks =50 (Internal = 50 & External = 50)

Distribution of internal Marks:

Continuous assessment (for minimum of ten experiments) = 30 Model examination = 05

Record = 15

Distribution of External Marks:

Total = 50 (Record:05 & Experiment(s): 45)

For Allied Chemistry practical:

Total Marks =50 (Internal = 25 & External = 25)

Distribution of internal Marks:

Continuous assessment (for minimum of ten experiments) = 15 Model examination = 05

Record = 05

Distribution of External Marks:

Total = 25 (Record:05 & Experiment(s): 20)

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	**I & II**	**21BCH25P**	**CORE PRACTICAL – I: INORGANIC QUALITATIVE ANALYSIS**	**3**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

Technical know-how on the analysis of Inorganic mixture is gained in due course.

Analysis of Inorganic Mixture Containing Two Acid and Two Basic Radicals. One of the acid radicals must be an interfering radical.

The Following may be Avoided:

a. Two Interfering radicals;
b. Combination of an Oxidizing and a Reducing agent;
c. Mixtures that Require Fusion.

The Following **anions and cations** may be given.

Carbonate	Phosphate	Iron	Strontium
Chloride	Oxalate	Chromium	Barium
Fluoride	Chromate	Cobalt	Magnesium
Bromide	Lead	Nickel	Ammonium
Sulfate	Copper	Manganese	
Nitrate	Bismuth	Zinc	
Borate	Cadmium	Calcium	

Distribution of Marks: Total = 50 (Record:06 & Experiment(s): 44)

Four radicals 4 x 11 = 44 marks
(For basic radicals, fixing the group alone = 3 marks, only spot tests = 3 marks)

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	III &IV	21BCH46P	CORE PRACTICAL – II: VOLUMETRIC AND ORGANIC QUALITATIVE ANALYSIS	3

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

- ❖ Express and instill basic foundation and skill sets in volumetric techniques.
- ❖ Systematic Analyze and identify any type of organic compound.

1. Volumetric Analysis

Acidimetry and Alkalimetry: Estimation of (1) Sodium carbonate, (2) Oxalic acid, (3) Carbonate – Bicarbonate Mixture.

Permanganometry: (4) Sodium oxalate, (5) Calcium, (6) Lead, (7) Ferrous ion, (8) Ferric ion Using Internal Indicator, (9) Percentage Purity of Pyrolucite.

Dichrometry : (10) Potassium dichromate, (11) Potassium permanganate

Iodometry – demonstration only.

2. Organic Qualitative Analysis

Organic substances with two functional groups may be given for analysis. The students have to report on the following;

a) The Special Elements (N, S and Cl, Br, and I) Present or Absent.
b) Whether Aliphatic or Aromatic.
c) Whether Saturated or Unsaturated.
d) The nature of the Functional Group Present (to be confirmed by a suitable reaction or by preparing a solid derivative).

Distribution of Marks: Total = 50
(Record: 05 & Experiment(s): 45)
Volumetric estimation = 20

Procedure = 5 marks; Experiment = 15 marks
Error <2% = 15 marks;
2-3%= 12.5 marks (less 0.5 mark for each 0.2 % error)
3-4%= 7.5 marks (less 1 mark for each 0.2% error);
>4% 5 marks

Organic analysis = 25 marks

Special elements= 3x 2 = 6 marks
Aromatic/aliphatic = 4 marks (two tests)
Saturated or unsaturated = 4 marks (two tests)
Preliminary tests = 3 marks
Functional group = 6 marks
Solid derivative = 2 marks

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	V & VI	21BCH64P	CORE PRACTICAL – III: GRAVIMETRIC ESTIMATION AND PREPARATION	3

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

- A sound knowledge on gravimetric estimations is expected with many trials of analysis.
- Knowledge on the methods of preparation of Inorganic complexes.

I. Gravimetric Estimations:

i. Estimation of the percentages of water of hydration in crystalline barium chloride.
ii. Estimation of barium as barium sulphate.
iii. Estimation of barium as barium chromate.
iv. Estimation of lead as lead chromate.
v. Estimation of calcium as calcium oxalate monohydrate.
vi. Estimation of nickel as Ni-DMG.

II. Inorganic complex preparation (minimum four preparations)

Distribution of Marks: Total = 50
(Record:05 & Experiment(s): 45)
Gravimetric estimation = 35

Procedure = 05 marks; Experiment = 30 marks
Error <2% = 30 marks;
2-3%= 25 marks (less 1 mark for each 0.2 % error)
3-4%= 15 marks (less 1 mark for each 0.1% error);
>4% 10 marks

In-organic Preparation = 10 marks

B. Sc., Chemistry

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	V & VI	21BCH65P	CORE PRACTICAL – IV: PHYSICAL CHEMISTRY PRACTICAL	3

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

Skill on Physical Chemistry and electrochemistry based experiments is the outcome.

Physical Chemistry Experiments

1. Distribution Coefficient

1. Determination of distribution coefficient of iodine between water and carbon tetra chloride.
2. Determination of the equilibrium constant for the reaction. $KI + I_2 \quad <==> \quad KI_3$

2. Chemical Kinetics

3. Determination of the hydrolysis constant of ethyl acetate with the given mineral acid.

4. Determination of the rate constant of the reaction between I^- and $S\,O^{2-}$

3. Phase Rule

5. Determination of the critical solution temperature of phenol - water system.

6. Determination of the strength of sodium chloride solution.

7. Phase diagrams of the following simple eutectic systems.

a) Naphthalene-diphenyl.
b) Naphthalene – p-nitrotoluene or p-nitrophenol.
c) Naphthalene – p-toluidine.

4. Determination of Molecular Weight (By Rast Method)

8. Determination of the depression constant of the given solvent (naphthalene or diphenyl).

9. Determination of molecular weight of the given substance.

5. Transition Temperature

10 . Determination of the transition temperature of the given salt hydrates.

a. $CH_3COONa{\cdot}3H_2O$.
b. $SrCl_2 \cdot 2H_2O$.
c. $Na_2S_2O_3{\cdot}5H_2O$.
d. NaBr

6. Electrochemistry

11. Determination of the cell constant of the given conductivity cell.

12. Determination of the equivalent conductance of the given solution of a strong electrolyte.

13. Determination of the degree of dissociation of acetic acid.

14. Conductometric titration of a strong acid versus a strong base.

15. Potentiometric Redox Titration ($K_2Cr_2O_7$ vs. Fe^{2+}).

7. Polarimetry: demonstration

16 Determination of the strength of the given cane sugar solution. Inversion of cane sugar in the presence of an acid.

Distribution of Marks: Total = 50 (Record:05 & Experiment(s): 45)

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	V & VI	21BCH66P	CORE PRACTICAL – V: APPLICATION ORIENTED PRACTICAL	2

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

- Possess knowledge on determination of physical constants, preparation of organic dyes, preparation of organic compounds and homecare products.
- Adapt to any laboratory condition in sharing knowledge on estimation of hardness of water, dissolved oxygen, alkalinity, calcium in limestone, total fatty mater, acid value of an oil and available chlorine in bleaching powder.

Determination of Physical Constants.

1. Determination of Melting point
2. Determination of Boiling point.

II. Preparation of Organic dyes

1. Preparation of dyes like Methyl Orange, Methyl Red, Azo Amino benzene

III. Preparation of Organic Compounds

One stage preparations involving bromination, acetylation, benzoylation, nitration, oxidation, and hydrolysis of organic compounds may be given. At least five preparations are to be given .

Examples:

i) Preparation of Acetanilide from Aniline.
ii) Preparation of p-Bromo acetanilide from Acetanilide.
iii) Preparation of Phenyl benzoate from Phenol.
iv) Preparation of Benzoic acid from Ethylbenzoate.
v) Preparation of Salycylic acid from Methylsalicylate.
vi) Preparation of Benzoic acid from Benzaldehyde.
vii) Preparation of Benzoic acid from Benzamide.
viii) Preparation of Glucosazone from Glucose.

IV. Preparation of Home care products

1. Preparation of white phenyl
2. Preparation of soap oil
3. Preparation of detergent powder
4. Preparation of transparent soap
5. Preparation of moisturizing cream

V Estimations

1. Estimation of Hardness of water using EDTA
2. Estimation of dissolved oxygen in water
3. Estimation of alkalinity in water
4. Estimation of calcium in limestone by EDTA method
5. Estimation of Total Fatty Matter (TFM) of a soap
6. Estimation of acid value of an oil
7. Estimation of available chlorine in bleaching powder

Distribution of Marks: Total = 50 (Record:05 & Experiment(s): 45)

Estimation = 30 marks

Error <10% = 30 marks;
10-15%= 25 marks (less 1 mark for each 1 % error)
15-20%= 20 marks (less 1 mark for each 1% error);
>20% = 10 marks

Organic Preparation = 15 marks

Crude = 12 marks; Recrystallised sample = 03 marks

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2. Mendham. J., Denney. R.C., Bames. J.D. and Thomas, M. **Vogel's Text Book of Quantitative Analysis**, 6th Edition, Pearson Education.
3. Sharma, K.K. and Sharma, D.S. **Introduction to Practical Chemistry**, Vikas Publishing House, New Delhi, 2005.
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5. https://www.youtube.com/watch?v=kc0Nc77t5Ig
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B. Sc., Chemistry

Year	Sem.	Subject Code	Title of the paper
2021 -2022 onwards	**V & VI**	**21BCH68V**	**PROJECT with Viva – Voce**

COURSE LEVEL OUTCOMES:
On the successful completion of the course, students will be able to:

Knowledge and Practical experience on the relevant discipline of chemistry.

The Project Work may comprise of the following components:

1 Analysis of Waste Water, Industrial Effluent, and Sludge and other Solid, Liquid and / (or) Air Samples for Pollution Parameters as per TNPCB, CPCB, USEPA, and WHO Standards from various Industries such as Chemicals and Pharmaceutical, Cement, Sugar, Polymer, Dyeing and Textile, Food Industries, etc (the work which involves the application of .Chemistry).

2. Latest / Current State of the Art Methodologies / Technologies.

3 Frequent Industrial Visit or On – Site Experimental Studies supported by proper Authorization Letter from the Concerned Industry.

Total Marks = 100 (Internal = 50 & External = 50)

Internal Marks, 50, to be awarded by the concerned Guide

Distribution of External Marks:

Viva-voce Examination = 20 & Project Report = 30

(Jointly by both Internal & External examiners)

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	III & IV*	21BPH/BBO/ BZO45P/ 21BGI26P	ALLIED CHEMISTRY PRACTICAL (forPHYSICS/BOTANY/ZOOLOGY/ GEOLOGY)	3

***For Geology I & II semester**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

Assess on the principles of volumetric analysis and organic qualitative analysis for use in laboratory practices.

1. Volumetric Analysis

Acidimetry – Alkalimetry: Estimation of sodium carbonate, bicarbonate, sodium hydroxide, Oxalic acid, etc.

Permanganimetry: Estimation of Ferrous ions and Oxalic acid.

Iodimetry: Estimation of Copper, Potassium dichromate.

2. Organic Qualitative Analysis

Detection of elements (N, S and Halogens) - To distinguish between aliphatic and aromatic, saturated and unsaturated compounds – functional group test for phenols, aromatic amines, aromatic acids, amides and carbohydrates.

Distribution of Marks: Total = 25 (Record:05 & Experiment(s): 20)

Volumetric estimation = 10

Error <2% = 10 marks;
2-3%= 7.5 marks (less 0.5 mark for each 0.2 %)
3-4%= 5 marks (less 0.5 mark for each 0.2%);
>4% 4 marks

Organic analysis = 10 marks

Special elements= 3x 1 = 3 marks
Aromatic/aliphatic = 1 marks (one test)
Saturated or unsaturated = 1 marks (one test) Preliminary tests = 2 marks
Functional group = 3 marks

7. Teaching Learning Methodologies

The learning outcomes based course curriculum framework of Chemistry is designed to persuade the subject specific knowledge as well as relevant understanding of the course. The academic and professional skills required for Chemistry-based professions and jobs are also offered by same course in an extraordinary way. In addition, the learning experiences gained fromthis course should be designed and implemented for cognitive development in every student. The practical associated with this course helps to develop an important aspect of the teaching-learning process. Various types of teaching and learning processes will need to be adopted to achieve the same. The important relevant teaching and learning processes involved in this course are;

a Class lectures

a. Seminars

b. Tutorials

c. Group discussions and Workshops

d. Peer teaching and learning

e. Question preparation

f. Subjective type

g. Long answer

h. Short answer

i. Objective type

- Multiple choice questions
- One answer/two answer type questions
- Assertion and reasoning

j. Practicum, and project-based learning

k. Field-based learning

l. Substantial laboratory-based practical component and experiments

m. Open-ended project work,

n. Games

o. Technology-enabled learning

p. Internship in industry, and research establishments.

The effective teaching strategies will also need to be adopted to develop problem-solving skills, higher-order skills of reasoning and analysis. The designed course also encourages fostering the social values/responsibility for maintaining and protecting the surrounding environment forimproved living conditions. A learner centric and active participatory pedagogy shall be introducedin this framework.

8. Assessment and Outcome Measurement methods

Academic performance in various courses i.e. core, discipline electives, generic electives and skill enhancement courses are to be considered as parameters for assessing the achievement of students in Chemistry. A number of appropriate assessment methods of Chemistry will be used to determine the extent to which students demonstrate desired learning outcomes. Following assessment methodology should be adopted;

The oral and written examinations (Scheduled and surprise tests),

Closed-book and open-book tests,

Problem-solving exercises,

Practical assignments and laboratory reports,

Observation of practical skills,

Individual and group project reports,

Efficient delivery using seminar presentations,

Viva voce interviews are majorly adopted assessment methods for this curricullum.

The computerized adaptive testing, literature surveys and evaluations, peers and self-assessment, outputs form individual and collaborator.

B. Sc., Chemistry

QP.CODE:21BCH51C **Reg. No.:** | | | | | | | | | |

B.Sc. DEGREE EXAMINATION, - 2021-22
Part III - CHEMISTRY
Fifth Semester
(For the candidates admitted during 2021 Batch)

THEORETICAL CHEMISTRY

Time : Two Hours **Maximum : 50 Marks**

Answer ALL the questions.
All the questions carry equal marks.
PART– A (5 x 1 = 5 Marks)

Choose the Correct Answer

1. The wavelength associated with a particle of mass $1x10^{-4}$ g and velocity 100 ms^{-1} is
$1x10^{-4}$ g எடை மற்றும் 100 ms^{-1} வேகம் கொண்ட ஒரு பொருளின் அலை நீளம்
a) $6.62x10^{-29}$ cm b) $6.62x10^{-34}$ m
c) $6.62x10^{-27}$m d) $6.62x10^{-29}$m

2. The metal that is used in photoelectric cell
ஒளிமின்கலத்தில் பயன்ப்படும் உலோகம்
a) Cs b) Mg
c) Ca d) Li

3. The selection rule for microwave spectroscopy is
மைக்ரோ நிறமாலையின் தேர்வு விதி
a) $\Delta J = \pm 2$ b) $\Delta v = \pm \mathbf{1}$
c) $\Delta J = \pm \mathbf{1}$ d) $\Delta J = 0$

4. The point group of SO_2 is
SO_2 மூலக்கூறுவின்புள்ளித் தொகுதி
a) C_{2v} b) C_{2h}
c) D_{2h} d) C_{3v}

5. The diamagnetic property is exihibited by
டயாகாந்த தண்மையை கொண்ட பொருள்
a) Na^+ b) O_2
c) NO d) Fe

Answer any three of the following questions. (3 x 2 = 6 Marks)

6. What is Black body radiation?
கரும்பொருள் கதிர்வீச்சு என்றால் என்ன?

7. Define Fajan's rule.
பஜான் விதியை கூறு.

8. Highlight various types of electronic transitions.
எலக்ட்ரான் மற்றங்களின் வகைகளை எழுதுக.

9. Explain vertical plane of symmetry.

		செங்குத்து சீர்மை தளத்தினை விவரி
10.		Define the terms orientation polarization and distortion polarization

PART – B (5 x 3 = 15 Marks)

Answer ALL questions

11.	(A)	How will you determine the lattice energy by Born-Haber cycle.
		பார்ன்-ஹேபர் சுழற்சி மூலம் படிக அற்றலை எவ்வாறு அளவிடலாம்.
		(OR)
	(B)	Discuss the application of Schrodinger equation for a particle in one dimensional box.
		ஸ்ராடிடாஞ்சர் அலை சமன்பாட்டை ஒரு பரிமானப் பெட்டிக்கு பயன்படுத்துதல் பற்றி விவரி.
12.	(A)	With a suitable example, discuss the concept of ionic bonding and the general properties of ionic compounds.
		உரிய எடுத்துகாடுக் கொண்ட அயனி பிணைப்பு மற்றும் அயனி சேர்மங்களின் பொது பண்புகளை விவரி.
		(OR)
	(B)	Using PCl_5 , as an example discuss the concept of hybridization.
		PCl_5 எடுத்துகாடுக் கொண்ட இணக்கலபையை விவரி.
13.	(A)	Discuss the isotopic substitution in microwave spectroscopy.The rotational constant for $H^{35}Cl$ is observed at 10.5909 cm^{-1}. What is the value of rotational constant for $H^{37}Cl$ [H=1amu].
		மைக்ரோ அலை நிற்மாலையில் ஒரிடத்தனிம பதிலீட்டின் விளைவு பற்றி விவரி. $H^{35}Cl$ -ன் சுழற்சி மாறிலி 10.5909 cm^{-1}ஆகும், எனில் $H^{37}Cl$-ன் சுழற்சி மாறிலியை கணக்கிடுக. [H=1amu]
		(OR)
	(B)	Using ethanol, explain the principle of NMR spectroscopy.
		NMR நிற்மாலையின் தத்துவம் பற்றி எத்தினால் எடுத்துக்காடு மூலமாக விவரி.
14.	(A)	How does electronic effects, affect the vibrational frequencies? In acetophenone molecule, CO (carbonyl) stretching frequency υ_{CO} =1693 cm^{-1} , while p-nitro acetophenone shows υ_{CO} =1700 cm^{-1} and p-amino acetophenone shows υ_{CO} =1677 cm^{-1}. Explain.
		அதிர்வு அதிர்வெண்ணை பாதிக்கும் எலக்ட்ரானிய விளைவுகளை பற்றி சிறு குறிப்பு எழுதுக. அசிடோஃபீனான், பாரா-நைட்ரா அசிடோஃபீனான் மற்றும் பாரா-அமினோ அசிடோஃபீனான் மூலக்கூறின் CO – தொகுதியின் உறிஞ்சுகை அதிர்வெண்ணை முறையே υ_{CO} =1693 cm^{-1}, 1700 cm^{-1} மற்றும்1677 cm^{-1}. விளக்குக.
		(OR)
	(B)	Using IR spectroscopy how will you distinguish intramolecular and intermolecular hydrogen bonding.
		IR நிரலை பயன்படுத்தி மூலக்கூறுக்கிடைப்பட்ட மற்றும் மூலக்கூறு உட்சார்ந்த ஹைற்றஜன் பிணைப்பை வேறுப்படுத்துக.

15.	(A)	Which of the following compounds are polar, CO_2, NH_3, and H_2O. Discuss the determination of polarity of a gas.
		CO_2, NH_3 மற்றும் H_2O களில் இருமுனைகளையுடைய மூலக்கூகள் யாவை. ஒரு வாயுவின் இருமுனைவாக்கம் எவ்வாறு கண்டறியப்படுகிறது.
	(B)	How is magnetic susceptibility measured using Guoy balance.
		காய் தராசு மூலம் காந்தஏற்பு திறனை எவ்வாறு அளக்க படுகிறது.

PART– C (3 x 8 = 24 Marks)
Answer ANY THREE questions

16.		
17.		Explain in detail about molecular orbital theory and VSEPR Theory.
		மூலக்கூறு ஆர்பிட்டால் விதி மற்றும் VSEPR விதியை விளக்குக.
18.		With a neat diagram , bring out the principle of Franck – Condon principle.
		வரைப்படத்துடன், பிராங்க -கொண்டன் விதியை விளக்குக.
19.		Define absorption and emission spectroscopy. Discuss the changes induced by the EMR on matter.
		உறிஞ்சுதல் மற்றும் உமிழ்தல் நிரலை வரையறு. ஒரு பொருளின் மீது EMR கதிர்வீச்சின் விளைவை பற்றி விளக்குக.
20.		Write a short note on paramagnetism. How will you differentiate $Ni(CO)_4$ and $[NiCl_4]^{-2}$ based on its magnetic properties.
		பாராகாந்த தண்மையை பற்றி சிறு குரிப்பு வறைக. $Ni(CO)_4$ மற்றும் $[NiCl_4]^{-2}$ வின் காந்த தண்மையை வேறுபடுத்துக.

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B. Sc., Chemistry

GOVERNMENT ARTS COLLEGE (AUTONOMOUS) COIMBATORE
DEPARTMENT OF CHEMISTRY
B.Sc., DEGREE EXAMINATIONS NOVEMBER 2021
SEMESTER I ALLIED ZOOLOGY
ALLIED CHEMISTRY-I

21BZO14A REG.NO……
Time: 2 Hrs **Max.Marks: 45**

Part-A (6x1=6 Marks)
CHOOSE THE BEST ANSWER
சிறந்த பதிலைத் தேர்ந்தெடுக்கவும்

1. Pick out an example for ionic bond.
   a) H_2 b) F_2 c) NaCl d) O_2

   அயனி பிணைப்புக்கான உதாரணத்தைத் தேர்ந்தெடுக்கவும்.
   அ) H_2 ஆ) F_2 இ) NaCl ஈ) O_2

2. Choose the existence of hybridization in IF_5
   a) SP^3 b) SP^3d^2 c) SP^4 d) SP^2

   IF5 இல் கலப்பினத்தின் இருப்பைத் தேர்ந்தெடுக்கவும்
   அ) Sp^3 ஆ) Sp^3d^2 இ) Sp^4 ஈ) Sp^2

3. Anionic sites of crystal are occupied by unpaired electrons which are called
   a) B-centres b) F-centres c) C-centres d) A-centres

   ஒரு படிகத்தின் எதிர்மின் அயனி தளங்கள் இணைக்கப்படாத எலக்ட்ரான்களால் ஆக்கிரமிக்கப்படுகின்றன. அவை எவ்வாறு அழைக்கப்படுகின்றன.

   அ) B மையங்கள் ஆ) F- மையங்கள் இ) C- மையங்கள் ஈ) A- மையங்கள்

4. Give an example to optically active acid
   a) Maleic acid b) Tartaric acid c) Acetic acid d) Fumaric acid

   ஒளியியல் செயலில் உள்ள அமிலத்திற்கு ஒரு உதாரணம் கொடு.

   அ) மெலிக் அமிலம் ஆ) டார்டாரிக் அமிலம் இ) அசிட்டிக் அமிலம்
   ஈ) ஃபுமரிக் அமிலம்

5. Naphthalene is purified by
   a) Sublimation b) Distillation c) Steam distillation d) Solvent extraction

   நாப்தலீன் இவ்வாறு சுத்திகரிக்கப்படுகிறது
   அ) பதங்கமாதல் b) வடித்தல் c) நீராவி வடித்தல் ஈ) கரைப்பான் பிரித்தெடுத்தல்

6. Isothermal process is indicated by
   a) $\Delta T = 0$ b) $\Delta V = 0$ c) $\Delta P = 0$ d) $\Delta q = 0$

   சமவெப்ப செயல்முறை இவ்வாறு குறிக்கப்படுகிறது
   அ) $\Delta T = 0$ ஆ) $\Delta V = 0$ இ) $\Delta P = 0$ ஈ) $\Delta q = 0$

Part-B (5x3=15 Marks)

ANSWER ALL QUESTIONS
அனைத்து கேள்விகளுக்கும் பதிலளிக்கவும்

7. Explain σ and π bond with example.
σ மற்றும் π பிணைப்பை உதாரணத்துடன் விளக்கவும்.

(OR)

b. Discuss chemical properties and uses of ICl
ICl இன் இரசாயன பண்புகள் மற்றும் பயன்பாடுகளைப் பற்றி விவாதிக்கவும்.

8. a. Outline free electron theory.
கட்டற்ற எலக்ட்ரான் கோட்பாட்டை கோடிட்டுக் காட்டுக.

(OR)

b. Describe Schottky and Frenkel defects.
ஷாட்கி மற்றும் ஃப்ரெங்கல் குறைபாடுகளை விவரிக்கவும்

9. a. What are Electrophiles ? Give two examples.
எலக்ட்ரான் கவர் பதிலி என்றால் என்ன? இரண்டு எடுத்துக்காட்டுகளைக் கொடுக்கவும்.

(OR)

b.Comment on cis-trans isomerism in maleic and fumaric acid.
மெலிக் மற்றும் ஃபுமரிக் அமிலத்தில் சிஸ்-டிரான்ஸ் ஐசோமெரிசம் பற்றிய கருத்துக் கூறுக.

10. a. Enumerate the preparation and uses of Chloroform.
குளோரோஃபார்மின் தயாரிப்பு மற்றும் பயன்பாடுகளைக் குறிப்பிடவும்

(OR)

b.Write a short note on Friedel crafts alkylation reaction in mono substituted benzene.
ஒற்றை பதிலீட்டு பென்சீனின் ஃப்ரீடெல் கிராப்ட்ஸ் அல்கைல் ஏற்றம் வினை பற்றிய சிறு குறிப்பு எழுதவும்.

11. a. State and explain first law of thermodynamics
வெப்ப இயக்கவியலின் முதல் விதியைக் கூறி விளக்கவும்

(OR)

b. Bring out the differences between isothermal and adiabatic process.
சமவெப்ப மற்றும் வெப்பமாறா செயல்முறைக்கு இடையிலான வேறுபாடுகளைத் தருக.

Part-C (3x8=24 Marks)

Answer any Three Questions
ஏதேனும் மூன்று கேள்விகளுக்கு பதிலளிக்கவும்

12. Discuss preparation, properties and structure of BrF_3.
BrF3 இன் தயாரிப்பு, பண்புகள் மற்றும் கட்டமைப்பைப் பற்றி விவாதிக்கவும்

13. Write an essay about valence bond theory.
இணைதிறன் பிணைப்பு கொள்கையை பற்றி ஒரு கட்டுரை எழுதவும்.

14. Summarize hybridization and geometry of ethylene and acetylene molecules.
எத்திலீன் மற்றும் அசிட்டிலின் மூலக்கூறுகளின் கலப்பினத்தையும் வடிவியலையும் பற்றி சுருக்கமாக எழுதவும்.

15. Explain in detail about synthesis and various chemical reactions of naphthalene.

நாப்தலீனின் தொகுப்பு மற்றும் பல்வேறு இரசாயன வினைகள் பற்றி விரிவாக விளக்கவும்.

16. Examine the working of carnot cycle.
கார்னோட் சுழற்சியின் செயல்பாட்டை ஆராய்ந்து கூறுக.

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