



**ST. ALBERT'S COLLEGE (AUTONOMOUS)
ERNAKULAM**

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

SYLLABUS FOR UNDERGRADUATE PROGRAMMES

BACHELOR OF SCIENCE (HONOURS) IN

CHEMISTRY

**SACA – UGP
(WITH EFFECT FROM 2024 ADMISSION)**

Syllabus of BSc Chemistry

Prepared by the Board of Studies on 11th March 2024

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Preface

In view of the National Educational Policy, the Higher Education Council has taken initiative to revamp, reconstruct, and release a new curriculum opening the doors of multidisciplinary education, imparting the opportunity for the student community to choose the subject for their undergraduate programme with their own free will.

This curriculum is prepared to promulgate a multifaceted and profound syllabus including a wide range of knowledge and technological advancement. This syllabus also gives emphasis to skill development, research and innovation and value added components to make the degree aspirant to inculcate professional and contemporary ways of modern education.

The reconstruction of the syllabus is an effort of consciousness and consensus of the faculty members from an enthusiastically committed team of subject experts constituted by the University. We deeply acknowledge the contributions of the Board of Studies of Chemistry MG University for framing a new curriculum of Four Year Degree Honours Programme.

At this juncture, we are adopting the major components of MG University Syllabus and integrating the Signature Courses developed by Chemistry Board of Studies of St. Albert's College (Autonomous). We express our sense of gratitude towards the University Nominee, Industrial Experts, Alumni, and other Stakeholders.

Dr. Vijay John Gerson

Chairman, BoS Chemistry

THE ST. ALBERT'S COLLEGE (AUTONOMOUS) UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024

SACA-UGP (Honours)

PREAMBLE

The University Grants Commission (UGC) has issued the Curriculum and Credit Framework for Undergraduate Programmes 2023 (CCFUP) which would provide a flexible choice-based credit system, multidisciplinary approach, multiple entry and exit options, and establish three Broad Pathways, (a) 3-year UG Degree, (b) 4-year UG Degree (Honours), and 4-year UG Degree (Honours with Research).

The Kerala Higher Education Reforms Commission has recommended a comprehensive reform in the undergraduate curriculum for the 2023-24 academic year, adopting 4-year undergraduate programmes to bring Kerala's undergraduate education at par with well acclaimed universities across the globe.

The Kerala State Curriculum Committee for Higher Education has been constituted and have proposed a model Kerala State Higher Education Curriculum Framework (KSHECF) for Undergraduate Education. Further, an Executive Committee and various sub committees were constituted for the implementation of the Regulations. Further, MGU has framed the Rules and Regulations based on this namely: THE MAHATMA GANDHI UNIVERSITY UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024 {MGU-UGP (Honours)} under the New Curriculum and Credit Framework, 2024. Being an Autonomous college affiliated to MG University, St. Albert's College is adopting all the major components of MGU UGP (Honours) 2024 in the title SACA-UGP (Honours) to our UG curriculum from the academic year (2024-25) onwards.

1. Short Title and Commencement

- i. The Regulations will be called as “**THE ST. ALBERT'S COLLEGE (AUTONOMOUS) UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024 {SACA-UGP (Honours)}**” under the New Curriculum and Credit Framework 2024.
- ii. These Regulations will come into effect from the academic year 2024-2025 and will have prospective effect.

2. Scope, Application

- i. These Regulations shall apply to all undergraduate programmes (except B. Voc.) of ST. ALBERT'S COLLEGE (AUTONOMOUS) for the Admissions commencing in the academic year 2024-2025.
- ii. Every programme conducted under the SACA-UGP shall be monitored by the SACA-UGP Academic Committee (Academic Council).

3. Definitions

Unless context otherwise required,

- i. FYUGP means Four Year Undergraduate Programme.
- ii. Academic Year: Two consecutive (one odd and one even) semester followed by a vacation in one academic year.
- iii. Academic Coordinator/Nodal Officer: Academic Coordinator/Nodal Officer is a faculty nominated by the College Council to co-ordinate the effective conduct of the FYUGP including Continuous Comprehensive Assessment (CCA) undertaken by various departments within the College. She/ he/ they shall be the convenor for the College level Academic Committee.
- iv. Academic Week: A unit of five working days in which the distribution of work is organized, with five contact hours of one-hour duration on each day.
- v. Academic Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week in a semester. It is defined both in terms of student efforts and teacher's efforts. A course which includes one hour of lecture or tutorial or minimum 2 hours of lab work/ practical work/ field work per week is given one credit hour. Accordingly, one credit is equivalent to one hour of lecture or tutorial or two hours of lab work/ practical work/ field work/ practicum and learner engagement in terms of course related activities (such as seminar preparation, submitting assignments, group discussion, recognized club-related activities etc.) per week. Generally, a one credit course in a semester should be designed for 15 hours lecture/ tutorials or 30 hours of practical/ fieldwork/ practicum and 30 hours learner engagement.
- vi. Academic Bank of Credits (ABC): An academic service mechanism as a digital/ virtual entity established and managed by Government of India to facilitate the

learner to become its academic account holders and facilitating seamless learner mobility, between or within degree-granting Higher Education Institutions (HEIs) through a formal system of credit recognition, credit accumulation, credit transfers and credit redemption to promote distributed and flexible process of teaching and learning. This will facilitate the learner to choose their own learning path to attain a Degree/ Diploma/ Certificate, working on the principle of multiple entry and exit, keeping to the doctrine of anytime, anywhere, and any level of learning.

- vii. **Credit Accumulation:** The facility created by ABC in the Academic Credit Bank Account (ABA) opened by the learner across the country in order to transfer and consolidate the credits earned by them by undergoing courses in any of the eligible HEIs.
- viii. **Credit Recognition:** The credits earned through eligible/ partnering HEIs and transferred directly to the ABC by the HEIs concerned.
- ix. **Credit Redemption:** The process of commuting the accrued credits in the ABC of the learner for the purpose of fulfilling the credits requirements for the award of various degrees. Total credits necessary to fulfil the criteria to get a degree shall be debited and deleted from the account concerned upon collecting a degree by the learner.
- x. **Credit Transfer:** The mechanism by which the eligible HEIs registered with ABC are able to receive or provide prescribed credits to individuals registered with ABA in adherence to the UGC credit norms for the course(s) registered by the learner in any HEIs within India.
- xi. **Credit Cap:** Maximum number of credits that a student can take per semester, which is restricted to 30.
- xii. **Continuous Comprehensive Assessment (CCA):** The mechanism of evaluating the learner by the course faculty at the institutional level.
- xiii. **End Semester Evaluation (ESE):** The mechanism of evaluating the learner at the end of each semester.
- xiv. **Audit Course:** A course that the learner can register without earning credits and is not mandatory for completing the SACA-UGP. The student has the option not to take part in the CCA and ESE of the Audit Course. If the student has 75% attendance in an Audit Course, he/ she/ they are eligible for a pass in that course, without any credit (zero-credit).
- xv. **Courses:** Refer to the papers which are taught and evaluated within a programme, which include lectures, tutorials, laboratory work, studio activity, fieldwork, project work, vocational training, viva, seminars, term papers, presentations, assignments,

- self-study, group discussion, internship, etc., or a combination of some of these elements.
- xvi. Choice Based Credit System (CBCS) means the system wherein students have the option to select courses from the prescribed list of courses.
 - xvii. College-level Academic Committee: Is a committee constituted for the FYUGP at the College level comprising the Principal as the Chairperson, the Academic Co-ordinator/ Nodal Officer as its convenor.
 - xviii. Academic Co-ordinator/ Nodal Officer: A senior faculty member nominated by the College Council.
 - xix. Course Faculty: A faculty member nominated by the Head of the Department shall be in charge of offering a particular course in a particular semester of FYUGP.
 - xx. Department means any teaching department in a college offering a course of study approved by the Governing body and statutory bodies of the College.
 - xxi. Senior Faculty Advisor (SFA) is a faculty nominated by a Department Council to coordinate all the necessary work related to FYUGP undertaken in that department, including the Continuous Comprehensive Assessment.
 - xxii. Department Council means the body of all teachers of a department in a college.
 - xxiii. Faculty Advisor (FA) means a teacher from the parent department nominated by the Department Council to advise students in academic matters.
 - xxiv. Graduate Attributes means the qualities and characteristics to be obtained by the graduates of a programme of study at the College, which include the learning outcomes related to the disciplinary areas in the chosen field of learning and generic learning outcomes. The graduate attributes for its programmes will be specified.
 - xxv. Programme means the entire duration of the educational process including the evaluation leading to the award of a degree.
 - xxvi. Programme Pathway: Combination of courses that can be chosen by a student that give options to pursue interesting and unconventional combinations of courses drawn from different disciplinary areas, like the sciences and the social sciences/ humanities. The pathways could be in terms of major- minor options with different complementary/allied disciplines.
 - xxvii. Regulatory Body means University Grants Commission (UGC), All India Council for Technical Education (AICTE), National Council for Teacher Education (NCTE), Medical Council of India (MCI), Pharmacy Council of India (PCI), Indian Council for Agricultural Research (ICAR), Bar Council of India, Council of Architecture,

National Assessment and Accreditation Council (NAAC) and National Board of Accreditation (NBA) etc.

- xxviii. Signature Courses: Signature courses are the specialized Discipline Specific Elective courses or skill enhancement/value addition courses offered by the regular/ ad hoc/visiting/ emeritus/ adjunct faculty member of a particular Department with the prior recommendation of the BoS and the approval of Academic Council of the College.
- xxix. Letter Grade or simply 'Grade' in a course is a letter symbol (O, A+, A, B+, B, C, P, F, and Ab). Grade shall mean the prescribed alphabetical grade awarded to a student based on their performance in various examinations. The Letter grade that corresponds to a range of CGPA.
- xxx. Grade Point: Each letter grade is assigned a 'Grade point' (G) which is an integer indicating the numerical equivalent of the broad level of performance of a student in each course. Grade Point means point given to a letter grade on 10-pointscale.
- xxxi. Semester Grade Point Average (SGPA) is the value obtained by dividing the sum of credit points obtained by a student in the various courses taken in a semester by the total number of credits in that semester. SGPA shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.
- xxxii. Credit Point (P) of a course is the value obtained by multiplying the grade point (G) by the credit (C) of the course: $P = G \times C$
- xxxiii. Cumulative Grade Point Average (CGPA) is the value obtained by dividing the sum of credit points in all the semesters earned by the student for the entire programme by the total number of credits in the entire programme and shall be rounded off to two decimal places
- xxxiv. Grade Card means the printed record of students' performance, awarded to them.
- xxxv. Words and expressions used and not defined in this regulation but defined in the M. G. University Act and Statutes, and College handbook shall have the meaning assigned to them in the Act and Statutes and handbook

4. Features and Objectives of SACA-UGP 2024

The features and objectives of the SACA-UGP 2024 shall be:

- i. The features, meaning, and purpose of FYUGP shall be as stipulated by the UGC and as adapted by the Kerala State Higher Education Curriculum Framework (KSHECF) and MGU-UGP (Honours) for undergraduate education.

- ii. The practice of lateral entry of students to various semesters exists, but an exit with a Degree shall be awarded only upon successful completion of 133 credits as per the conditions stipulated in this regulation.
- iii. FYUGP shall have three Broad Pathways, (a) 3-year UG Degree, (b) 4-year UG Degree (Honours), and (c) 4-year UG Degree (Honours with Research).
- iv. Students who choose to exit after 3 years shall be awarded UG Degree in their respective Discipline/ Disciplines after the successful completion of the required minimum Courses with 133 credits.
- v. A 4-year UG Degree (Honours) in the Discipline/ Disciplines shall be awarded to those who complete the SACA-UGP with a specific number of Courses with 177 credits including 12 credits from a capstone level graduate project/dissertation. Those students who are not doing capstone project shall do three courses at the level 400 or above or three vocational training courses or internships for 12 credits.
- vi. Students who acquire minimum 75% in their graduation (upto 6th semester) are eligible for Honours with Research Programme. However, if necessary, College may conduct screening test for the honours with research programme in accordance with University and College Regulations time to time.
- vii. 4-year UG Degree (Honours with Research): Students who aspire to pursue research as a career may opt for 4-year UG Degree Honours with Research stream under FYUGP with a specific number of Courses with 177 credits including 12 credits from a research project in their major discipline.
- viii. The recognized research departments or departments with at least two faculty members having PhD shall offer the Honours with Research programme. Minimum 2 students (mentees) should be allotted to a faculty member (Mentor).
- ix. Students who have chosen the honours with research stream shall do their entire fourth year under the mentorship of a mentor.
- x. The mentor shall prescribe suitable advanced level/capstone level courses for a minimum of 20 credits to be taken within the institutions along with the courses on research methodology, research ethics, and research topic-specific courses for a minimum of 12 credits which may be obtained either within the institution or from other recognized institutions, including online and blended modes. Students shall also be allowed to pursue these three courses of 12 credits from suitable interdisciplinary/ transdisciplinary/ multidisciplinary/ vocational areas of their choice.
- xi. Students who have opted for the honours with research should successfully complete a research project under the guidance of the mentor and should submit a research

- report for evaluation. They need to successfully defend the research project to obtain 12 credits under a faculty member of the University/ College/Recognized Research Institute. The research shall be in the Major/ allied discipline.
- xii. The research outcomes of their project work may be published in peer-reviewed journals or presented at conferences or seminars or patented.
 - xiii. The proposed FYUGP curriculum comprises three broad parts: a) Foundation Components, b) Discipline Specific Pathway components (Major/ Minor), and c) Discipline Specific Capstone Components.
 - xiv. The Foundation component of the FYUGP shall consist of a Set of General Foundation Courses and a Set of Discipline Specific Foundation Courses.
 - xv. General Foundation Courses shall be grouped into 4 major baskets as Ability Enhancement Courses (AEC), Skill Enhancement Courses (SEC), Value Addition Courses (VAC), and Multi-Disciplinary Courses (MDC).
 - xvi. Ability Enhancement Courses shall be designed specifically to achieve competency in English, other languages as per the student's choice with special emphasis on language and communication skills.
 - xvii. English or other language courses shall be designed to enable the students to acquire and demonstrate the core linguistic skills, including critical reading, academic and expository writing skills as well as the cultural and intellectual heritage of the language chosen. Separate courses will be designed for Science, Humanities and Commerce streams.
 - xviii. Multi-Disciplinary Courses (MDC) shall be so designed as to enable the students to broaden their intellectual experience by understanding the conceptual foundations of Science, Social Sciences, Humanities, and Liberal Arts. Students shall not be eligible to take the MDC in the same discipline that they have studied during their Plus Two. Third semester MDC can be Kerala specific content. Each BoS can prepare basket of courses under MDC.
 - xix. Skill Enhancement Courses (SEC) shall be designed to enhance 21st century workplace skills such as creativity, critical thinking, communication, and collaboration.
 - xx. Discipline Specific Courses shall include Discipline Specific Pathway Courses, both Major and Minor streams, enabling students to gain basic knowledge in the chosen discipline.
 - xxi. Discipline Specific Foundation Courses shall focus on foundational theories, concepts, perspectives, principles, methods, and critical thinking essential for taking

up advanced/ Capstone Courses. Practical courses shall be included in discipline specific foundation courses.

- xxii. The curriculum of the SEC should be designed in a manner that at the end of year-1, year-2, year-3, and year-4 students are able to meet the level descriptors for levels 5, 6, 7, and 8 of the UGC Guidelines on National Skills Qualifications Framework (NSQF).
- xxiii. Value Addition Courses (VAC) shall be so designed as to empower the students with personality development, perspective building, and self-awareness.
- xxiv. Discipline Specific Pathway Components (Major/Minor) shall provide the students with an opportunity to pursue in-depth study of a particular subject or discipline and develop competency in that chosen area, which includes Discipline Specific Core (DSC) courses and Discipline Specific Elective (DSE) courses as Major and Minor courses.
- xxv. Major components consist of three types: Discipline Specific Core or the Discipline Specific Elective Courses, and the research/laboratory/fieldwork.
- xxvi. Minor Courses can be selected from any discipline. A student who completes 12 credits in a particular stream will be eligible for a minor.
- xxvii. Students who complete a sufficient number of Courses in a discipline or an interdisciplinary area of study other than their chosen Major shall qualify for a Minor in that discipline or in a chosen interdisciplinary area of study.
- xxviii. Major Components shall be the main focus of study. By selecting a Major, the student shall be provided with an opportunity to pursue an in-depth study of a particular discipline.
- xxix. Each Board of Studies (BoS) shall identify specific Courses or baskets of Courses towards Minor Course credits. Students shall have the option to choose Courses from disciplinary/ interdisciplinary minors and skill-based courses related to a chosen programme.
- xxx. Students can opt for a change of Major at the end of the second semester to any Minor discipline studied among the foundation level courses. Students can also opt for a change of Major at the end of the second semester to any MDC.
- xxxi. Students should opt their 5th and 6th semester VAC and SEC from their Major disciplines only.
- xxxii. Course cum Credits Certificate: After the successful completion of a semester, this certificate is essential as proof for re-entry to another institution. This will help the learner for preserving the credits in the Academic Bank of Credits.

- xxxiii. The Advanced Level/ Capstone Level Courses shall be designed in such a manner as to enable students to demonstrate their cumulative knowledge in their main field of study, which shall include advanced thematic specialization or internships or community engagement or services, vocational or professional training, or other kinds of work experience.
- xxxiv. Advanced/ Capstone level Major Specialization shall include Courses focused on a specific area of study attached to a specific Major, which could be an Elective Course. They shall include research methodology as well.
- xxxv. The student has the option to register for and attend a course without taking part in the CCA and ESE of that course. Such a course is called the Audit Course. If the student has 75% attendance in an Audit Course, he/she/they is eligible for a pass in that course, without any credit (zero-credit). The Audit Course will be recorded in the final grade card of the student.
- xxxvi. All students shall undergo Summer Internship or Apprenticeship in a Firm, Industry or Organization; or Training in labs with faculty and researchers or other Higher Education Institutions (HEIs) or Research Institutions. A separate guideline for Internship Programmes will be published.
- xxxvii. Students will be provided the opportunities for internships with local industries, business organizations, agriculture, health and allied sectors, Local Government institutions (such as panchayats, municipalities), State Planning Board, State Councils/Boards, Research Institutions, Research Labs, Library, elected representatives to the parliament/state assembly/panchayath, media organizations, artists, crafts persons etc. These opportunities will enable the students to actively engage with the practical aspects of their learning and improve their employability.
- xxxviii. The College will assist in providing opportunities for field-based learning/minor Projects enabling them to understand the different socio-economic and development-related issues in rural and urban settings. The College will assist in providing the students with opportunities for Community engagement and services, exposing them to socio-economic issues to facilitate theoretical learning in real-life contexts.
- xxxix. Additional Credits will be awarded for those who actively participate in Social Activities, which may include participation in National Service Scheme (NSS), Sports and Games, Arts, participation in University/ college union related activities (for respective elected/nominated members), National Cadet Corps (NCC), adult education/literacy initiatives, mentoring school students, and engaging in similar social service organizations that deemed appropriate to the College.
- xl. Grace marks shall be awarded to a student for meritorious achievements in co-curricular activities (in Sports/ Arts/ NSS/ NCC etc.). Such a benefit is applicable in

the same academic year spreading over two semesters, in which the said meritorious achievements are earned. The Academic Council will decide from time to time the eligibility and other rules of awarding the grace marks.

- xli. Options will be made available for students to earn credit by completing quality-assured remote learning modes, including Online programmes offered on the Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM) or other Online Educational Platforms approved by the competent body from time to time.
- xlii. Students shall be entitled to gain credits from courses offered by other recognized institutions directly as well as through distance learning.
- xliii. For the effective operation of the FYUGP, a system of flexible academic transaction timings shall be implemented for the students and teachers.
- xliv. Specialization: Student will have the option to achieve specialization within their Major by securing 12 credits from a disciplinary/interdisciplinary area. By choosing atleast 3 courses from discipline specific elective basket under a chosen field (preferably one from 200 level course and two 300 level courses) student will be awarded specialization in that particular area of study. Each student will have the option to achieve two specializations at a time from the institution.

5. Eligibility for Admission and Reservation of Seats

- i. The eligibility for admissions and reservation of seats for various FYUG Degree Programmes shall be in accordance with the norms/ rules made by the Government/University/College from time to time.
- ii. No student shall be eligible for admission to FYUG Degree Programmes in any of the disciplines unless he/she/they have successfully completed the examination conducted by a Board/University at the Plus Two level of schooling or its equivalent.
- iii. Students shall be admitted and enrolled in the respective programmes solely based on the availability of the academic and physical facilities within the institution. The College shall provide all students with a brochure detailing the Courses offered by the various departments under the various Programmes and the number of seats sanctioned for each Programme.
- iv. During the time of admission each student may be provided with a unique higher education student ID which may be linked with the Aadhar number of the students so that his ID can be transferred if required to other higher education institutions as well.
- v. The students at the end of second semester may be permitted to change their major programme of study to any course/ institution/ university across the state. Based on

the availability of seats and other facilities, the students may be permitted to opt any discipline which he/she/they had studied during the first two semesters as Discipline Specific Foundation courses/ Multidisciplinary Foundation courses. If ranking is required, it will be in the order of the highest-grade points secured in the discipline to which the switching of Major is sought.

- vi. Students shall be allowed to change their major programmes, if required, to a maximum of 10% of the sanctioned strength of that particular programmes depending upon the academic and infrastructural facilities available in the Institution.
- vii. Depending upon the availability of academic and infrastructural facilities, the Institution may also admit a certain number of students who are registered for particular programmes in each semester by transfer method, if required, from other Institutions subject to conditions as may be issued by the University.
- viii. A student who has already successfully completed a First-Degree Programme and is desirous of and academically capable of pursuing another First-Degree Programme may also be admitted with the prior approval of the University as per the conditions regarding programme requirements specified by the University.
- ix. A Student can also be admitted for an additional major/ second major/ additional minor and on completion of the required credits he/she/they can be awarded a second major/ additional major/ minor. He/she/they may be exempted from minor pathway and general foundation course requirement.
- x. The HEIs can also enrol students in certain courses as per their choice depending upon the availability of infrastructure and other academic facilities from other recognized HEIs who are already registered for a particular programme there either through regular/online/distance mode irrespective of the nature of programme (Govt/ Aided/ Self- finance/ Autonomous). On successful completion of the course the credits may be transferred through the Academic Bank of Credit (ABC), against the unique higher education ID provided by the College at the time of admission.

6. Academic Monitoring and student Support

The academic monitoring and student support shall be in the following manner, namely

- i. College should appoint a Senior Faculty member as Academic Co-ordinator/Nodal officer for the smooth conduct of FYUGP.
- ii. Advisory System: There shall be one Senior Faculty Advisor (SFA) for each department and one Faculty Advisor (FA) for 20 to 30 students of the class to provide advice in all relevant matters. The Head of the Department, in consultation with the SFA, shall assign FA for each student.

- iii. The documents regarding all academic activities of students in a class shall be kept under the custody of the FA/SFA.
- iv. All requests/ applications from a student or parent to higher offices are to be forwarded/recommended by FA/SFA.
- v. Students shall first approach their FA/ SFA for all kinds of advice, clarifications, and permissions on academic matters.
- vi. It is the official responsibility of the institution to provide the required guidance, clarifications, and advice to the students and parents strictly based on the prevailing academic regulations.
- vii. The SFA shall arrange separate or combined meetings with FA, faculty members, parents, and students as and when required and discuss the academic progress of students.
- viii. The FA/SFA shall also offer guidance and help to solve the issues on academic and non-academic matters, including personal issues of the students.
- ix. Regular advisory meetings shall be convened immediately after the commencement of the semester and immediately after announcing the marks of the Continuous Comprehensive Assessment (CCA).
- x. The CCA related results shall be uploaded on the College portal only after displaying the same on the department notice board/other official digital platforms of the college at least for two working days.
 - i. Any concern raised by the students regarding CCA shall be looked into in the combined meetings of advisors, HoD, course faculty, and the students concerned.
 - ii. If the concerns are not resolved at the advisor's level, the same can be referred to the properly constituted department-level grievance redressal committees
 - iii. The HOD shall ensure the proper redressal of the concerns raised by the students regarding CCA.
 - iv. If the students raise further concerns about the issue, the Principal shall refer the issue to the College-level grievance committee with proper documents and minutes of all the committees.
- xi. The FA/SFA shall be the custodian of the minutes and action taken reports of the advisory meetings. The SFA shall get the minutes and action taken reports of advisory meetings approved by the Head of Department and the Principal. It shall

- be the duty of the HoD and the Principal to produce them before the Governing body of the College as and when required.
- xii. The Principal shall inform/forward all regulations, guidelines, communications, announcements, etc. issued by the University regarding student academic and other matters to the HODs/ SFA for information and timely action.
 - xiii. It shall be the official responsibility of the Principal to extend the required administrative and financial support to the HODs, SFAs and FAs to arrange necessary orientation programmes for students regarding student counselling, the prevailing College norms, regulations, guidelines and procedures on all academic and other College related matters.
 - xiv. An integrated educational planning and administration software will be made available by the College to manage the academic information of all students. Which include student admissions and registration, managing student personal and academic information, course registrations, attendance management, all process related to assessments including regular & online examinations, grading, publishing of results, supplementary examinations, LMS, stakeholders' feedback, etc.
 - xv. Faculty, staff, students, and parents shall be allowed to access this software system over a highly secure authenticated mechanism from within the campus and outside the campus.

7. Course Registration

- i. Each department shall publish well in advance the relevant details of courses offered, such as the name, academic level, expected outcomes, time slot, and course faculty members.
- ii. Students shall be allowed to visit and interact with respective faculty members during the first week of each semester, to gather more information about the courses and the availability of seats.
- iii. Based on consultations and advice from the faculty adviser, each student shall complete course registration within one week from the commencement of each semester.
- iv. The number of credits that a student can take in a semester is governed by the provisions in these Regulations, subject to a minimum of 16 and a maximum of 30 Credits.
- v. A student can opt out of a Course or Courses registered, subject to the minimum Credit/ Course requirement, if he/she/they feel that he/she/they has registered for more Courses than he/she/they can handle, within 30 days from the commencement

of the semester. An option can be given to the student to convert this course as audit course if he/she/they wishes to do so.

- vi. The college shall publish a list of the students registered for each course including audit course, if any, along with the chosen Programmes, repeat/reappearance courses, if any, and shall forward the same to the university.
- vii. The higher education institutions shall admit candidates not only for programmes, but also for courses.

8. Re-admission and Scheme Migration

- i. Students who opt out before the completion of the third year shall be provided with a 'Course cum Credits Certificate' after the successful completion of a semester as proof for re-entry to another institution.
- ii. Students who have successfully completed a particular programme pathway maybe permitted to take an additional minor or second major.
- iii. Those students who are opting for a second major are eligible for getting certain credit transfer/ credit exemption from their previous minor programs of study, subject to the prior recommendation of the BoS that, those credits are relevant for the present major programme of study.

9. Duration of Programmes, Credits Requirements and Options

- i. Students will be offered the opportunity to take breaks during the programme and resume after the break, but the total duration for completing the FYUG programme shall not exceed 7 years.
- ii. Students who wish to complete the undergraduate programmes faster may do so by completing different courses equivalent to the required number of credits and fulfilling all other requirements in N-1 semesters, where N is the number of semesters in the FYUGP.
- iii. Provided further that the students may complete the undergraduate programme in slower pace, they may pursue the three years or six semester programme in 4 to 5 years (8 to 10 semesters), and four years, or eight semester programme in 5 to 6 years (10 to 12 semesters) without obtaining readmission.
- iv. For students who crossed 6 semesters at a slower space, the requirement of 16 credits per semester from the institutions where they enrolled may be relaxed.

10. Credit Structure

The proposed number of credits per course and the credit distribution of them for the

FYUG Programmes are given below-

- i. An academic year shall consist of 200 working days; one semester consists of 90 working days; and an academic year consists of two semesters.
- ii. Ten working days in a semester shall be used for extracurricular activities. One semester consists of 18 weeks with 5 working days per week. In each semester, 15 days (3 weeks) should be kept aside for End Semester Evaluation (ESE) and CCA.
- iii. The maximum number of available weeks for curriculum transactions should be fixed at 15 in each semester. A minimum of 5 teaching or tutorial hours could be made available for a day in a 5-day week.
- iv. A course that includes one hour of lecture/ tutorial or two hours of lab work/practical work/fieldwork/practicum per week is given one credit hour.
- v. One credit in a semester should be designed for 15 hours of lectures/ tutorials or 30 hours of lab work/ practical work/ field work/ practicum and 30 hours of learner engagement in terms of course-related activities such as seminar preparation, assignment submission, etc.
- vi. A one-credit seminar or internship or studio activities or field work/ projects or community engagement and service will have two-hour engagements per week (30 hours of engagement per semester).
- vii. A course can have a combination of Lecture (L)/ Tutorial (T)/ Practicum or Practical (P)/ & Others (O) credits.
- viii. Minimum credit for one Course should be 2 (Two), and the maximum credit should be 4 (Four).
- ix. All Discipline Specific Major/Minor Courses shall be of 4 (Four) credits.
- x. For all Discipline Specific Major/Minor Courses, there may be practical/ practicum.
- xi. All Courses under the Multi-Disciplinary, Ability Enhancement, Value Addition and Skill Enhancement categories are of 3 credits. Practical/Practicum credits can also be included in this category.
- xii. Summer Internship, Apprenticeship, Community Outreach activities, etc. may require sixty hours (or as appropriate) of engagement for acquiring one credit.
- xiii. A student shall be able to opt for a certain number of extra credits over and above the requirements for the award of a degree.
- xiv. Maximum number of credits that a student can earn per semester shall be restricted

to 30. Hence, a student shall have the option of acquiring credits to a maximum of 180 credits for a 3-year (6-semester) UG programmes and 240 credits for a 4-year (8-semester) programmes.

- xv. Each faculty member shall offer a maximum of 16 credits per semester. However, those who are offering both practical and theory courses shall offer a maximum of 12-16 credits per semester.
- xvi. For a four-credit theory course, 60 hours of lecture/ tutorial class shall be assured as a mandatory requirement for the completion of that course.

11. Course Structure of the SACA-UGP Programmes

The SACA-UGP consists of the following categories of courses and the minimum credit requirements for pathway option-one shall be as follows:

Sl. No.	Categorization of Courses for all Programmes	Minimum Number of Credit Required	
		3-yearUG	4-yearUG
1	Major	68	88
2	Minor	24	24+12*
3	Multi-Disciplinary Courses (MDC)	9	9
4	Skill Enhancement Courses (SEC)	9	9
5	Ability Enhancement Courses (AEC)	12	12
6	Value Addition Courses (VAC)	9	9
7	Summer Internship, field-based learning etc.	2	2
8	Research Project/Dissertation		12**
	Total Credits	133	177

*The students can acquire advanced/capstone level courses with 12 credits from their DSC/ DSE/ Minor courses depending upon their pathway choice. The Minor courses can be of level 300 or above.

** The students pursuing the 4-year honours with research have to complete a capstone project with 12 credits and for the 4-year honours degree students have to complete a project with 12 credits. Those honours students who are not doing capstone project shall do three courses at the level 400 or above or three vocational training courses or internships for 12 credits.

- i. 20% syllabus of each course will be prepared by the teacher as 'Teacher Specific Content' and will be evaluated under CCA.
- ii. In case of MDC, SEC, VAC courses coming under 3rd & 4th semester, college should make necessary arrangements to give adequate preference to courses designed by language departments. MDC in the 3rd semester can be Kerala Specific Content.

12. Academic Levels of Pathway Courses

Semester	Difficulty level	Nature of Course
1&2	100-199	Foundation level or introductory courses
3&4	200-299	Intermediate level courses
5&6	300-399	Higher level courses
7&8	400-499	Advanced/Capstone level courses

13. Signature Courses

- i. With a prior recommendation of BoS and the approval of academic council, each faculty member can design and offer at least one signature course in every semester, which may be offered as DSE/SEC/VAC.
- ii. College may publish a list of their signature courses in DSE/ SEC/ VAC offered by their faculty members with a prior recommendation of BoS and the approval of Academic Council.
- iii. College may empanel distinguished individuals who have excelled in their field of specialization like science and technology, industry, commerce, social research, media, literature, fine arts, civil services etc. as adjunct faculty as per the UGC guidelines with the approval of the University/College. With a prior recommendation of BoS and the approval of academic council, the adjunct faculty can offer SEC/VAC as signature course.
- iv. Adhoc/ Guest faculty/ Visiting faculty/ Visiting Scholars can also offer DSE/SEC/ VAC as signature courses with a prior recommendation of BoS and the approval of academic council.
- v. The faculty concerned may design the particular course and it should be forwarded to the BoS after the approval of department council.

- vi. The examinations and evaluation of the signature courses designed by the faculty shall be conducted by the faculty themselves and an external expert faculty chosen by the college from a panel of experts submitted by the faculty and recommend by the BoS concerned.

14. Programme Pathways and Curriculum Structure

Students who have joined for any programme under these regulations shall have the option to choose the following pathways for their UG degree and Honours programme.

- i. **Degree with single Major:** A student pursuing the FYUG programme in a specific discipline shall be awarded a Major degree if he secures at least 50% of the total credits in the specific discipline required for the award of the Degree in that Discipline.
Example: Physics Major/Economics Major/Commerce Major
- ii. **Degree Major with Minor:** If a student pursuing the FYUG Programme is awarded a Major Degree in a particular discipline, he/she/they are eligible to be awarded a Minor in another discipline of his choice, if he earns a minimum of 32 credits (approximately 25% of credit required for the three-year programme) from 8 pathway courses in that discipline.
Example: Physics Major with Chemistry Minor/ Chemistry Major with English Minor/ Commerce Major with Economics Minor/ English Major with Functional English Minor/Hindi Major with Malayalam Minor etc.
- iii. **Major with Multiple Disciplines of Study:** This pathway is recommended for students who wish to develop core competencies in multiple disciplines of study. In this case, the credits for the minor pathway shall be distributed among the constituent disciplines/ subjects. If a student pursuing FYUG Degree Programme is awarded a major Degree in a particular discipline, he/she/they are eligible to get mentioned his core competencies in other disciplines of his choice if he has earned 12 credits from the pathway courses of that discipline.
Example: Physics Major with Minors in Chemistry and Mathematics, Economics Major with Minors in History and English, Commerce Major with Minors in Economics and Statistics.
- iv. **Interdisciplinary Major:** For these programme pathways, the credits for the major and minor pathways shall be distributed among the constituent disciplines/subjects to attain core competence in the inter disciplinary programme.
Example: Econometrics Major, Global Studies Major, Biostatistics Major.
- v. **Multi-Disciplinary Major:** For multidisciplinary major pathways, the credits for

the major and minor pathways will be distributed among the broad disciplines such as Life Sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc.

Example: Life Science, Data Science, Nano Science.

- vi. **Degree with Double Major:** A student who secures a minimum of 50% credits from the first major will be awarded a second major in another discipline if he could secure 40% of credit from that discipline for the 3-year/ 4-year UG degree to be awarded a double major degree.

Example: Physics and Chemistry Major, Economics and History Major,
Economics and History Major, Commerce and Management Major



Pathway Option1-Degree Major or Major with Multiple Disciplines of Study

Course Components	No. of Courses												
	Semester 1	Semester 2	Semester 3	Semester 4	Internship of 2 Credits	Semester 5#	Semester 6#	Total	Remarks	Semester 7	Semester 8	Total	
DSCA (4 Credit/ Course)	1(P)	1(P)	3 (2P)	3 (2P)			5	4	17	7 Out of 17 can be opted as DSE	3	2	22
DSCB&C (4 Credit Course)	2(P)	2(P)	1(P) (BorC)	1(P) (CorB)					6		3		9
Multidisciplinary Courses (MDC) (3 Credit/ Course)	1(P)	1(P)	1*						3	*Cannot opt from DSC			3
Ability Enhancement Courses (AEC) (3 Credit/ Course)	1 (English) 1 (OL)	1 (English) 1 (OL)							4				4
Skill Enhancement Courses (SEC) (3 Credit/ Course)				1*			1**	1**	3	*Cannot opt from DSCA **From DSCA only			3
Value Addition Courses (VAC) (3 Credit/ Course)			1*	1*				1**	3	*Cannot opt from DSCA **From DSCA only			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours												12 (1 DSC /DSE for Honours)	
Total Courses	6	6	6	6			6	6	36		6	2+1	
Total Credits	21	21	22	22		2	23	22		Total Credits 133	24	20	Total Credits 177
Total Hours per Week	25	25	25	25			25	25		Exit option available	25	25	

Pathway Option 2 – Major with Minor

Course Components	No. of Courses											
	Semester 1	Semester 2	Semester 3	Semester 4	Internship of 2 Credits	Semester 5#	Semester 6#	Total	Remarks	Semester 7	Semester 8	Total
DSCA (4Credit/ Course)	1(P)	1(P)	3 (2P)	3 (2P)			4	3	15	7 Out of 15 can be opted as DSE	3	2
DSCB (4Credit/ Course)	2(P)	2(P)	1(P)	1(P)		1	1	8	1 Out of 8 can be opted as DSE	3		11
Multidisciplinary Courses (MDC) (3Credit/ Course)	1(P)	1(P)	1*					3	*Cannot opt from DSC			3
Ability Enhancement Courses (AEC) (3Credit/ Course)	1 (English) 1 (OL)	1 (English) 1 (OL)						4				4
Skill Enhancement Courses (SEC) (3Credit/ Course)				1*		1**	1**	3	*Cannot opt from DSCA **From DSCA only			3
Value Addition Courses (VAC) (3 Credit/ Course)			1*	1*			1**	3	*Cannot opt from DSCA **From DSCA only			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours											12 (1DSC/ DSE for Honours)	
Total Courses	6	6	6	6		6	6	36		6	2+1	
Total Credits	21	21	22	22	2	23	22		Total Credits 133	24	20	Total Credits 177
Total Hours per Week	25	25	25	25		25	25		Exit option available	25	25	

Pathway Option 3 – Double Major

Course Components	No. of Courses				Internship of 2 Credits	No. of Courses			Remarks	No. of Courses		Total
	Semester 1	Semester 2	Semester 3	Semester 4		Semester 5#	Semester 6#	Total		Semester 7	Semester 8	
DSC A (4 Credit/ Course)	1(P)	1(P)	2(2P)	2(1P)		4	3	13	7 Out of 13 can be opted as DSE	3	2	18
DSC B (4 Credit/ Course)	2(P)	2(P)	2(1P)	2(2P)		1	1	10	2 Out of 10 can be opted as DSE	3		13
Multidisciplinary Courses (MDC) (3 Credit/ Course)	1(P)	1(P)	1*					3	*Cannot opt from DSC			3
Ability Enhancement Courses (AEC) (3 Credit/ Course)	1 (English) 1 (OL)	1 (English) 1 (OL)						4				4
Skill Enhancement Courses (SEC) (3 Credit/ Course)				1		1	1	3				3
Value addition Courses (VAC) (3 Credit/ Course)			1	1			1	3				3
Project/Dissertation 12 credits for Honours with Research & 8 for Honours											12 (1 DSC/DSE for Honours)	
Total Courses	6	6	6	6		6	6	36		6	2+1	
Total Credits	21	21	22	22	2	23	22		Total Credits 133	24	20	Total Credits 177
Total Hours per Week	25	25	25	25		25	25		Exit option available	25	25	

15. Guidelines for Acquiring Credit from Other Institutions/Online/Distance Mode

- i. A student shall register to a minimum of 16 credit per semester from the college/ department where he/ she/ they is officially admitted for a particular programme. However, students enrolled for a particular programme in one institution can simultaneously enrol for additional credits from other HEIs within the University or outside the University subject to a maximum of 30 credits per semester including the 16 institutional credits.
- ii. The College shall publish a list of courses that are open for admission for students from other institutions well in advance before the commencement of each semester.
- iii. Each BoS shall prepare and publish a list of online courses at different levels before the commencement of each semester offered in various online educational platforms recognized by the academic council of the College, which can be opted by the students for acquiring additional credits.
- iv. Each BoS shall prepare and publish a list of allied/relevant pathway courses before the commencement of each semester offered by other Board of Studies that can be considered as pathway courses for major/minor for their disciplines at different levels.
- v. At the end of each, the semester College will include the credit acquired by the student through online courses in their semester grade cards subject to a maximum of 30 credits.

16 Attendance

- i. A student shall be permitted to register for the end-semester evaluation of a specific course to acquire the credits only if he/ she has completed 75% of the prescribed classroom activities in physical, online, or blended modes, including any other activities as specified by the faculty coordinator of that particular course.
- ii. A student is eligible for attendance as per the existing university and government orders which includes participation in a meeting, or events organized by the college or the university, a regularly scheduled curricular or extracurricular activity prescribed by the college or the university. Due to unavoidable or other legitimate circumstances such as illness, injury, family emergency, care-related responsibilities, bad or severe weather conditions, academic or career-related interviews, students are eligible for authorized absence. Apart from this, all other eligible leave such as maternity leave, and menstrual leave shall also be treated as authorized absences.
- iii. The condonation facility can be availed as per the College norms.

17. Workload

- i. The workload of a faculty who offers only lecture courses during an academic year shall be 32 credits.
- ii. The workload of a faculty offering both practical courses and theory courses may be between 24-32 credits per academic year.
- iii. An academic year shall consist of two semesters.
- iv. To protect the existing language workload, college should make necessary arrangements to give adequate preference to those courses designed by language departments coming under MDC, SEC and VAC of 3rd & 4th semester.
- v. Programme wise workload calculation will be as per the FYUGP workload ordinance 2024.
- vi. The teachers given the administrative responsibilities in the department and college level may give a relaxation in their workload as specified in the UGC regulations 2018.

18. Credit Transfer and Credit Accumulation

- i. College will establish a digital storage (DIGILOCKER) of academic credits for the credit accumulation and transfer in line with ABC.
- ii. The validity of credits earned shall be for a maximum period of seven (7) years or as specified in the university/UGC regulations.
- iii. The students shall be required to earn at least 50% of the credits from the College.
- iv. Students shall be required to earn the required number of credits as per any of the pathway structure specified in this regulation for the award of the degree

19. Outcome Based Approach

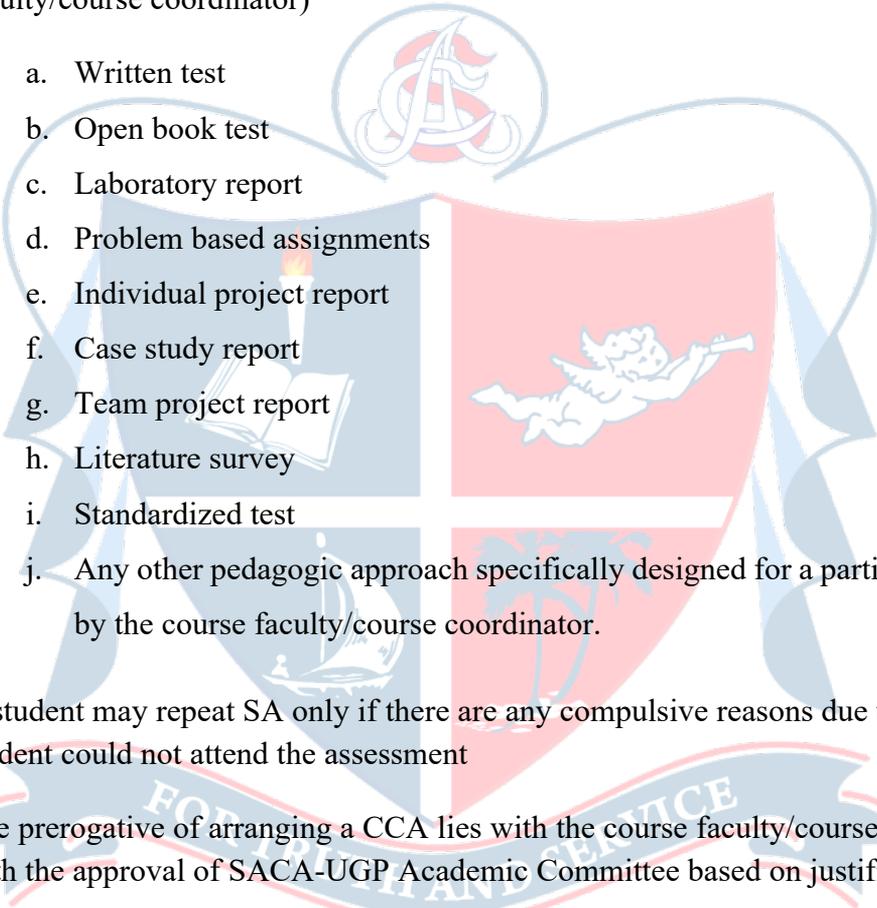
The curriculum will be designed based on Outcome Based Education (OBE) practices. The Graduate Attributes (GA) and Programme Outcomes (PO) are provided in appendix-1. The OBE based syllabus template is provided in appendix-2.

20. Assessment and Evaluation

- i. The assessment shall be a combination of Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE).
- ii. 30% weightage shall be given for CCA. The remaining 70% weight shall be for the ESE.
- iii. Teacher Specific Content will be evaluated under CCA.
- iv. CCA will have two subcomponents: Formative Assessment (FA) and Summative Assessment (SA). Each of these components will have equal weightage and must be conducted by the course faculty/course coordinator offering the course.
- v. FA refers to a wide variety of methods that teachers use to conduct in-process evaluations of student comprehension, learning needs, and academic progress during a lesson, unit, module or course. FA is to encourage students to build on their strengths rather than fixate or dwell on their deficits. FA can help to clarify and calibrate learning expectations of students. FA will help students become more aware of their learning needs, strengths, and interests so they can take greater responsibility for their educational growth. FA will be the prerogative of the course faculty/course coordinator based on specific requirement of the student.
- vi. Suggested methods of FA are as follows: (any one or in combination could be followed as decided by the course faculty/course coordinator)
 - a. Practical assignment
 - b. Observation of practical skills
 - c. Viva voce
 - d. Quiz
 - e. Interview
 - f. Oral presentations
 - g. Computerized adaptive testing
 - h. In-class discussions
 - i. Group tutorial work
 - j. Reflection writing assignments
 - k. Home assignments
 - l. Self and peer Assessments
 - m. Any other method as may be required for specific course/student by the Course faculty/course coordinator
- vii. Summative Assessments (SA) are used to evaluate student learning, skill

acquisition, and academic achievement at the conclusion of a defined instructional period- typically at the end of a project, unit, module, course or semester. SA may be class tests, assignments, or project, used to determine whether students have learned what they were expected to learn. It will be based on evidence, collected using single or multiple ways of assessment. The systematically collected evidence should be kept in record by course faculty/course coordinator and the marks should be displayed on the college notice board/ other official digital platforms of the college before the end semester examinations

viii. The method of SA will be as follows: (any one as decided by the course faculty/course coordinator)

- 
- a. Written test
 - b. Open book test
 - c. Laboratory report
 - d. Problem based assignments
 - e. Individual project report
 - f. Case study report
 - g. Team project report
 - h. Literature survey
 - i. Standardized test
 - j. Any other pedagogic approach specifically designed for a particular course by the course faculty/course coordinator.
- ix. A student may repeat SA only if there are any compulsive reasons due to which the student could not attend the assessment
- x. The prerogative of arranging a CCA lies with the course faculty/course coordinator with the approval of SACA-UGP Academic Committee based on justified reasons
- xi. The course faculty/ course coordinator shall be responsible for evaluating all the components of CCA. However, the university may involve any other person (External or Internal) for evaluation of any or all the components as decided by the Vice-Chancellor/Pro-Vice Chancellor from time to time in case any grievances are raised.
- xii. Written tests shall be precisely designed using a variety of tools and processes (e.g., constructed responses, open-ended items, multiple-choice), and the students should be informed about the evaluation modalities before the commencement of the course.

- xiii. The course faculty may provide options for students to improve their performance through continuous assessment mechanism.
- xiv. There shall be theory and practical examinations at the end of each semester.
- xv. Regarding evaluation, one credit may be evaluated for 25 marks in a semester; thus, a 4-credit course will be evaluated for 100 marks; and 2-credit courses for 50 marks. However, for tabulation purpose course with 1-credit will be evaluated for 50 marks and will be converted to 25 marks
- xvi. Odd semester examinations will be conducted by the institution and will be evaluated at the institution level. However, even semester examinations will be conducted and evaluated by internal and external faculty.
- xvii. Individual Learning Plans (ILPs) and/ or specific assessment arrangements may be put in place for differently abled students. Suitable evaluation strategies including technology assisted examinations/alternate examination strategies will be designed and implemented for differently abled students.
- xviii. Distribution of CCA & ESE will be as given below

Credit	CCA	ESE
4	30	70
3	25	50
2	15	35

21. Practical Examination

- i. The end semester practical examination will be conducted and evaluated by the institution.
- ii. There shall be a CCA of practical courses conducted by the course faculty course coordinator.
- iii. The scheme of evaluation of practical courses will be as given below:

Components for the Evaluation of Practical Courses	Weightage
CCA of practical/practicum.	30%
ESE conducted under the supervision of internal examiner	70%

- iv. Those who have completed the CCA alone will be permitted to appear for the ESE.
- v. For grievance redressal purposes, the university shall have the right to call for all the records of CCA.
- vi. Duration of Examination
 Questions shall be set as per the defined Outcome. The question setter shall ensure that there will be Time and Mode (T & M) flexibility for all External Examinations. BoS can recommend the T&M from the following list.

Mode	Time (in Hours)	
	Minimum	Maximum
Written Examination	1	2
Multiple Choice	1	1.5
Open Book	1	2
Any Other Mode	1	2

22. Evaluation of Project/Dissertation

The evaluation of project work shall be CCA with 30% and ESE 70%. The scheme of evaluation of the Project is given below

Components of Evaluation of Internship	Weightage	Marks for Internship 2 Credits / 50Marks
CCA	30%	15
ESE	70%	35

The department council may decide any mode for the completion of the Internship. If in case evaluation is not specified in any of the selected internship programme, institution can adopt a proper evaluation method as per the weightage specified in the table above.

23. Letter Grades and Grade Points

A Mark system is followed for evaluating each question. For each course in the semester, letter grades and grade points are introduced in a 10-point indirect grading system as per the guidelines given below,

- i. The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative Grade Point Average (CGPA)

is based on the grades in all courses taken after joining the programme of study.

- ii. Based on the marks obtained, the weighted grade point will be mentioned in the student's grade cards.

Letter Grade	Grade Point	Percentage of Marks (Both Internal & External Marks put together)	Class
O (Outstanding)	10	95% and above	First Class with Distinction
A+ (Excellent)	9	Above 85% and below 95%	
A (Very good)	8	Above 75% and below 85%	
B+ (Good)	7	Above 65% and below 75%	First Class
B (Above average)	6	Above 55% and below 65%	
C (Average)	5	Above 45% and below 55%	Second Class
P(Pass)	4	Above 35% and below 45% Aggregate (external and internal put together) with a minimum of 30% in external	Third Class
F(Fail)	0	Below an aggregate of 35% or Below 30% in external evaluation	Fail
Ab (Absent)	0		Fail

- iii. When students take audit courses, they may be given pass (P) or fail (F) grade without any credits

24. Computation of SGPA and CGPA

The following method is recommended to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

- i. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undertaken by a student in the semester, i.e.

$$SGPA(S_i) = \frac{\sum_{i=1}^n (C_i \times G_i)}{\sum_{i=1}^n C_i}$$

Where S_i is the SGPA in the i^{th} semester, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

$$SGPA = \frac{\text{Sum of the credit points of all the courses in a semesters}}{\text{Total Credits in that semester}}$$

Illustration–Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	Credit Point (Credit Grade)
I	DSC A	4	A	8	4x8=32
I	DSC B	4	B+	7	4x7=28
I	DSC C	4	B	6	4x6=24
I	MDC	3	B	6	3x6=18
I	AEC 1	3	O	10	3x10=30
I	AEC 2	3	C	5	3x5=15
	Total	21			147
	SGPA				147/21=7

- ii. The CGPA is also calculated in the same manner considering all the courses undertaken by a student over all the semesters of a programme i.e.

$$CGPA = \frac{\sum_{i=1}^n (C_i \times S_i)}{\sum_{i=1}^n C_i}$$

Where S_i is the SGPA in the i^{th} semester, C_i is the total number of credits in the i^{th} semester.

$$CGPA = \frac{\text{Sum of the credits of all the courses in six/eight semesters}}{\text{Total Credits in Six(133)/Eight(177) semesters}}$$

- iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

25. Committees to be Constituted for the Implementation and Monitoring of SACA-UGP

- i. There shall be a college level SACA-UGP Academic Co-ordinator/Nodal Officer, academic committee and SACA-UGP department committee in each department.
- ii. The tenure of the college level committees will be 4 years.

SACA-UGP Academic Committee

- i. The Principal (Chairman)
- ii. Academic Co-ordinator/Nodal Officer (Convenor)
- iii. All the Heads of Departments in the college
- iv. Four teachers of the college representing different discipline nominated by the college council by rotation
- v. Not less than four experts/academicians from outside the college representing areas such as Industry, Commerce, Education, Sciences etc., to be nominated by the college council preferably from the alumni of the college
- vi. Three nominees of the affiliating University (not less than the designation of associate professor in a college/university department)

Functions of SACA-UGP Academic Committee

- i. Scrutinize, approve, and recommend to the University all the proposals submitted by the department committee with regard to the SACA-UGP such as, academic pathway, allowed syllabi enrichment/update, details of elective courses, Online courses, blended teaching, courses offering to the students of other HEIs, panel of examiners, summative and formative evaluation tools proposed by the concerned course faculty, new courses and syllabus proposed by the faculty members as signature courses etc. The Academic Committee can differ on any proposal, and it shall have the right to return the matter for reconsideration to the concerned Department committee or reject it, after giving sufficient reasons to do so.
- ii. Scrutiny of all documents related to Teacher Specific Content.
- iii. Recommend to the College Governing Body for starting innovative programmes using the flexibility and holistic nature of the SACA-UGP curriculum framework

SACA-UGP Department Committee

- i. Head of the Department concerned (Chairman)
- ii. The entire faculties of the Department
- iii. Two subject experts from outside the college to be nominated by the MGU-UGP Academic Committee
- iv. One representative from industry/ corporate sector/ allied area relating to placement
- v. One meritorious alumnus of the department to be nominated by the department council
- vi. The department council of the SACA-UGP, may with the approval of the principal of the college, co-opt:
 - (a) Experts from outside the college whenever special courses of studies are to be formulated.
 - (b) Other faculty members of the same Faculty within the college

Functions of SACA-UGP Department Committee

- i. Prepare teacher specific content of syllabi for various courses keeping in view the objectives of the SACA-UGP and submit the same for the approval of the academic committee.
- ii. Scrutinize the signature course content and its evaluation techniques.
- iii. Suggest methodologies for innovative teaching and evaluation techniques.
- iv. Suggest panel of examiners to the academic committee.
- v. Coordinate research, teaching, extension and other academic activities in the department/college.

26. Proposed Options for Higher Studies for the Students of SACA-UGP

The following higher studies options at the level of post-graduation/research was described by UGC in the national higher education qualification framework;

- i. The two-year master programme will continue (with an option of having the second year devoted entirely to research) for those who have completed a 3-year UG programme under the SACA-UGP regulations.
- ii. For students who have completed a 4-year honours degree could complete their master programme within one year by acquiring the required credits as per the Post

Graduate curriculum framework requirement.

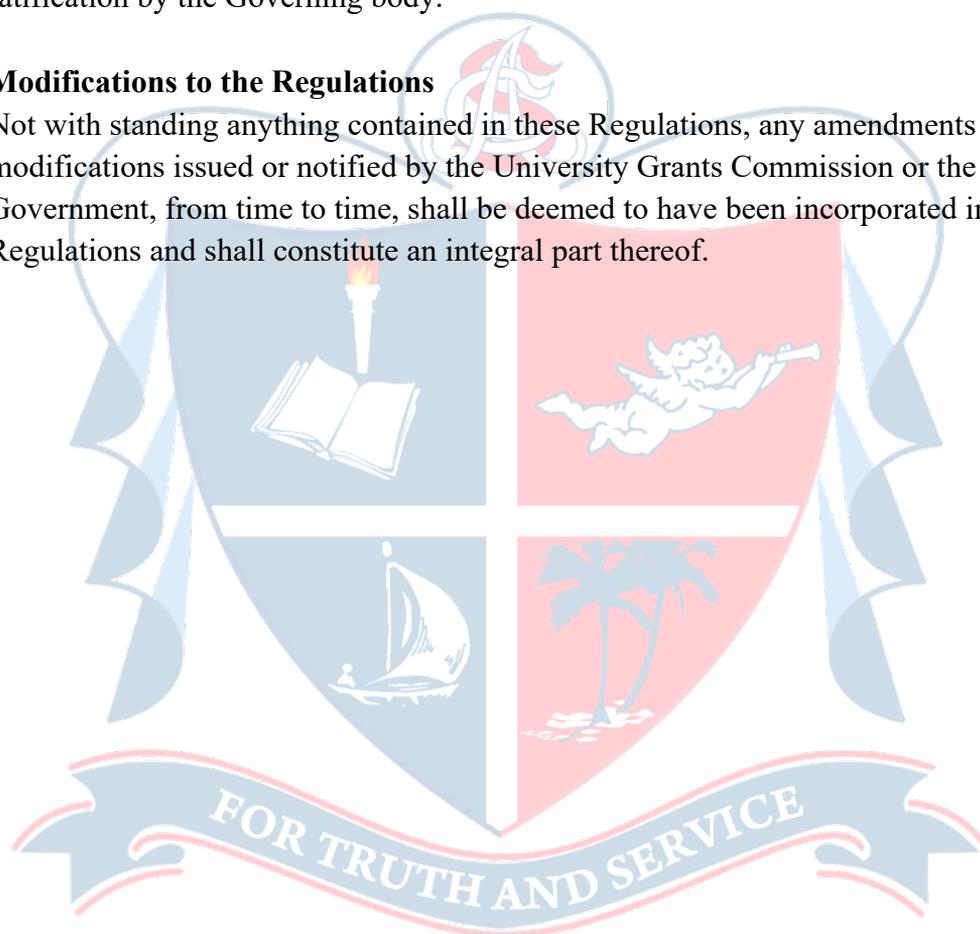
- iii. For enrolling in a PhD programme the candidate should have acquired a master degree or a 4-year honours degree with research.

28. Power to Remove Difficulties

If any difficulty arises in giving effect to the provisions of these Regulations, the Principal may by order make such provisions not inconsistent with the Act, Statutes, Ordinances or other Regulations, which appears to him to be necessary or expedient for removing the difficulty. Every order made under this rule shall be subject to ratification by the Governing body.

29. Modifications to the Regulations

Not with standing anything contained in these Regulations, any amendments or modifications issued or notified by the University Grants Commission or the State Government, from time to time, shall be deemed to have been incorporated into these Regulations and shall constitute an integral part thereof.



Appendix-1

Graduate Attributes (GA) of St. Albert's College (Autonomous)

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that, higher education qualifications are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected. The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme outcomes and course outcomes which in turn will help in curriculum planning and development, and in the design, delivery and review of academic programmes. The graduate attributes of St. Albert's College (Autonomous) are:

GA1: Critical thinking and Analytical reasoning

Capability to analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.

GA2: Scientific reasoning and Problem solving

Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

GA3: Multidisciplinary / interdisciplinary / trans disciplinary Approach

Acquire interdisciplinary / multidisciplinary / transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative – multidisciplinary / interdisciplinary / transdisciplinary-approach to formulate constructive arguments and rational analysis for achieving common goals and objectives.

GA4: Intra and Interpersonal skills

Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team; lead the team to guide people to the right destination, in a smooth and efficient way.

GA5: Digital literacy

Capability to use ICT in a variety of learning situations, demonstrate ability to access,

evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

GA6: Global citizenship

Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

GA7: Social Competency

Ability to contemplate on the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs, and reaching the targets for attaining inclusive and sustainable development.

GA8: Equity, Inclusiveness and Sustainability

Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity (caste, ethnicity, gender and marginalization), managing diversity and use of an inclusive approach to the extent possible.

GA9: Lifelong Learning

Ability to acquire knowledge and skills, including learning how to gain knowledge, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of workplace through knowledge / skill development/ reskilling.

Programme Outcomes (PO)**PO1: Critical thinking and Analytical reasoning**

Capability to analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; critical sensibility to lived experiences, with self-awareness and reflexivity of both the self and the society.

PO2: Scientific reasoning and Problem solving

Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

PO3: Multi-disciplinary/interdisciplinary/transdisciplinary Approach

Acquire interdisciplinary/multidisciplinary/transdisciplinary knowledge base, as a result of the learning they engage within their programme of study; develop a collaborative-multidisciplinary/interdisciplinary/transdisciplinary-approach to formulate constructive arguments and rational analysis for achieving common goals and objectives.

PO4: Communication Skills

Ability to express thoughts and ideas effectively in writing and in speech; communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

PO5: Leadership Skills

Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating an inspiring vision, building a team that can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO6: Social Consciousness and Responsibility

Ability to contemplate on the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

PO7: Equity, Inclusiveness and Sustainability

Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity (caste, ethnicity, gender and marginalization), managing diversity and use of an inclusive approach to the extent possible.

PO8: Moral and Ethical Reasoning

Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour.

PO9: Networking and Collaboration

Acquire skills to be able to collaborate and network with educational institutions, research organisations and industrial units in India and abroad.

PO10: Lifelong Learning

Ability to acquire knowledge and skills, including “learning how to learn”, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of workplace through knowledge/skill development/reskilling.



Syllabus Index

Name of Major: **Chemistry**

Semester: 1

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
24SACCHE1DA101 (MAJOR) 24SACCHE1DB101 (MINOR)	Fundamentals of Chemistry 1	DSC A	4	5	3		2	
24SACCHE1MD101	Food Chemistry and Nutrition	MDC	3	4	2		2	

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester: 2

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
24SACCHE2DA101(MAJOR) 24SACCHE2DB101(MINOR)	Fundamentals of Chemistry 2	DSC A	4	5	3		2	
24SACCHE2MD101	Chemistry of Water	MDC	3	4	2		2	

Semester: 3

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
24SACCHE3DA101	Inorganic Chemistry-1	DSC A	4	5	3		2	

24SACCHE3DA102	Organic Chemistry-1		DSC A	4	5	3		2	
24SACCHE3DE201	Basic Analytical Chemistry	Any one	DSE	4	4	4		0	
24SACCHE3DE202	Introduction to Nanoscience			4	4	4		0	
24SACCHE3DE203	Safe Laboratory Practices in Chemistry			4	4	4		0	
24SACCHE3DE204	Geochemistry			4	4	4		0	
24SACCHE3MD201	Chemistry in Everyday Life		MDC	3	3	3		0	
24SACCHE3VA201	Forensic Chemistry		VAC	3	3	3		0	
24SACCHE3DB201	Inorganic and Organic Chemistry (Minor for Others)		DSC B	4	5	3		2	

Semester: 4

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
24SACCHE4DA201	Organic Chemistry-2	DSC A	4	5	3		2	
24SACCHE4DA202	Physical Chemistry- 1	DSC A	4	5	3		2	
24SACCHE4DE201	Polymer Chemistry	Any one	DSE	4	4	4		0
24SACCHE4DE202	Food Chemistry			4	4	4		0
24SACCHE4DE203	Material Chemistry			4	4	4		0
24SACCHE4DE204	Industrial Chemistry I			4	4	4	0	0
24SACCHE4SE201	Rubber Chemistry		SEC	3	3	3		0
24SACCHE4VA201	Basic Environmental Chemistry		VAC	3	3	3		0

24SACCHE4DC201	Fundamentals of Physical Chemistry (Minor for Others)	DSC C	4	5	3		2	
24SACCHE4IN201	Internship	INT	2					

Semester: 5

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
24SACCHE5DA301	Organic Chemistry - 3	DSC A	4	5	3		2	
24SACCHE5DA302	Physical Chemistry- 2	DSC A	4	5	3		2	
24SACCHE5DE301	Quantum Mechanics, Spectroscopy & Group Theory	Any three	4	4	4		0	
24SACCHE5DE302	Green Chemistry for Sustainable Development		4	4	4		0	
24SACCHE5DE303	Environmental Chemistry		4	4	4		0	
24SACCHE5DE304	Nanotechnology for Energy Applications		4	4	4		0	
24SACCHE5DE305	Medicinal Chemistry		4	4	4		0	
24SACCHE5DE306	Main Group Elements		4	4	4		0	
24SACCHE5DE307	Drug Chemistry		4	4	4		0	
24SACCHE5DE308	Biochemistry		4	4	4		0	

24SACCHE5DE309	Industrial Chemistry II			4	4	4		0	
24SACCHE5SE301	Analytical Chemistry and Professional skills		SEC	3	3	3		0	

Semester: 6

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
24SACCHE6DA301	Inorganic Chemistry-2		DSC A	4	5	3		2	
24SACCHE6DA302	Physical Chemistry- 3		DSC A	4	5	3		2	
24SACCHE6DE301	Organic Chemistry 4	Any one	DSE	4	5	3		2	
24SACCHE6DE302	Rubber Technology			4	5	3		2	
24SACCHE6DE303	Industrial Inorganic Chemistry and Nuclear Chemistry	Any one	DSE	4	4	4		0	
24SACCHE6DE304	Spectroscopic Methods of Chemical Analysis			4	4	4		0	
24SACCHE6DE305	Forensic Chemistry			4	4	4		0	
24SACCHE6DE306	Industrial Chemistry III			4	4	4		0	
24SACCHE6SE301	Data Analysis using Python and Soft skills		SEC	3	3	3		0	
24SACCHE6VA301	Intellectual Property Rights	Any one	VAC	3	3	3		0	
24SACCHE6VA302	Research			3	3	3		0	

	Methodology for Chemistry								
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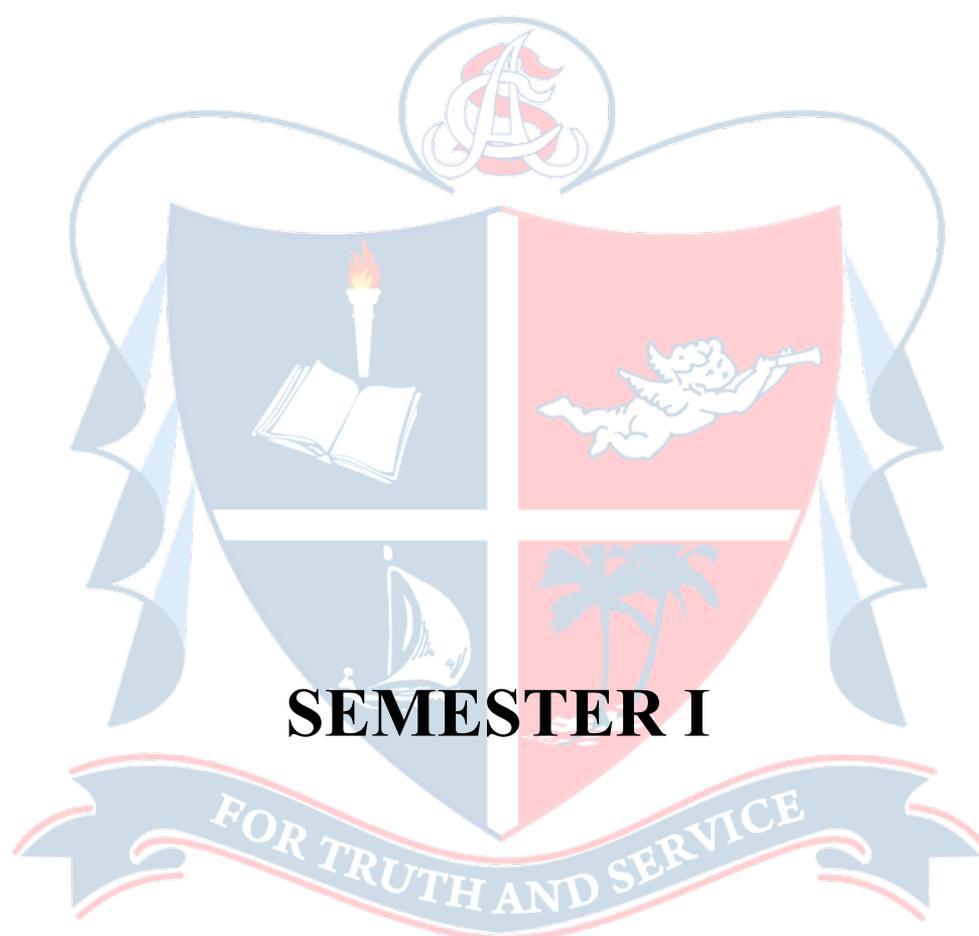
Semester: 7

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
24SACCHE7CC401	Coordination and Organometallic Chemistry		DCC	4	4	4		0	
24SACCHE7CC402	Organic Chemistry-5		DCC	4	5	3		2	
24SACCHE7CE401	Molecular Spectroscopy		DCC	4	4	4		0	
24SACCHE7CE402	Drug Therapy and Drug Design	Any three		4	4	4		0	
24SACCHE7CE403	Industrial Chemistry			4	4	4		0	
24SACCHE7CE404	Advanced Chemistry of Main Group Elements			4	4	4		0	
24SACCHE7CE405	Statistical Thermodynamics and Bioenergetics			4	4	4		0	
24SACCHE7CE406	Novel Inorganic Solids			4	4	4		0	
24SACCHE7DE403	Analytical Chemistry			DSE*	4	4	4		0
24SACCHE7DE404	Biophysical Chemistry		4		4	4		0	
24SACCHE7DE405	Nanochemistry and Technology		4		4	4		0	

***Minor**

Semester: 8

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
24SACCHE8CC401	Advanced Coordination and Organometallic Chemistry		DCC	4	6	2		4	
24SACCHE8CC402	Physical Chemistry- 4		DCC	4	6	2		4	
24SACCHE8CE401	Organic Chemistry-6		DCE	4	5	3		2	
24SACCHE8CE402	Group Theory and Quantum Chemistry	Any two	DCE	4	4	4		0	
24SACCHE8CE403	Instrumental Methods of Chemical Analysis			4	4	4		0	
24SACCHE8CE404	Molecular Modelling			4	4	4		0	
24SACCHE8CE405	Crystallography and Electrochemistry			4	4	4		0	
24SACCHE8PR401	Project				PRJ	2			





Department of Chemistry

St. Albert's College (Autonomous)

Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Fundamentals of Chemistry-1					
Type of Course	DSC A					
Course Code	24SACCHE1DA101					
Course Level	100-199					
Course Summary	This course covers the basic principles and concepts of atoms, elements, compounds, and fundamentals of organic chemistry. Students explore atomic structure, electron displacements in organic chemistry, reactive intermediates, and the periodic table to understand the foundation of chemical interactions.					
Semester	I	Credits			4	Total Hours
Course Details	Learning approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Apply atomic models to forecast and explain electronic configurations, atomic behaviour, and characteristics.	A	1,2
2	Describe the relevance of organic chemistry, catenation and hybridisation.	U	1,2,10
3	Evaluate electron displacement patterns in organic molecules using arrow notation.	E	1,2

4	Utilize arrow-pushing mechanisms to illustrate and solve simple chemical reactions involving reactive intermediates.	A	1,2
5	Analyse periodic trends, the relationship between electronic configuration and the chemical reactivity of elements, including the formation of chemical bonds.	An	1,2
6	Identify metals through flame and spot tests, chloride in water, and lead in food samples, and acquire skill in organic preparation.	S	1,2,10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT**Content for Classroom Transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Atomic Structure			
	1.1	Atomic spectrum of hydrogen atom, explanation using Bohr atom model, limitations of Bohr atom model.	4	1
	1.2	Dual nature of matter, de Broglie equation, Heisenberg's uncertainty principle and its significance.	2	1
	1.3	Concept of orbit and orbital. Types of orbitals, shapes of s, p and d orbitals.	2	1
	1.4	Quantum numbers and their significance.	2	1
	1.5	Pauli's Exclusion Principle, Hund's rule of maximum multiplicity and Aufbau principle.	2	1
	1.6	Electronic configuration of atoms (upto atomic number 30). Stability of half-filled and completely filled electronic configurations.	3	1

Fundamentals of Organic Chemistry				
2	2.1	Relevance of organic chemistry in day-to-day life (with 2-3 examples). Carbon: catenation and hybridisations (with examples ethane, ethene and ethyne).	3	2
	2.2	Arrow notations, bond fissions: curved arrow notation, drawing electron displacements with curved arrows, curved and fishhook arrows in organic reaction mechanisms. Polarity of bonds (basic concepts only).	2	3,4
	2.3	Homolysis and heterolysis with examples. Reactive intermediates: formation, structure and stability of carbocations, carbanions, and free radicals.	4	3,4
	2.4	Electron displacement effects: inductive effect influence of inductive effect in the acidity of carboxylic acids. Resonance effect (delocalization, contributing structures, and stability) - hyperconjugation	6	3,4
3	Chemistry of Elements and Molecules			
	3.1	Modern periodic law – long form periodic table. Classification of elements- s, p, d and f block, metal, non-metals and metalloids.	4	5
	3.2	Diagonal relationship and anomalous behavior.	1	5
	3.3	Periodicity in properties: Atomic and ionic radii - ionization enthalpy - electron affinity (electron gain enthalpy) – electronegativity. Electronegativity scales: Pauling Scale	5	5
	3.4	Effective nuclear charge – Slater rule and its applications	2	5
	3.5	Valency and oxidation state with examples	1	5
	3.6	Introduction to molecules- types of bonds, ionic bond, covalent bond, coordinate bond	2	5

Foundation Course 1 Practical				
4	4.1	1. Demonstration of atomic models using software (non-evaluative) 2. Detection of sodium, potassium, calcium, barium and strontium ions through flame test. 3. Spot test of nickel, zinc and copper. 4. Chloride ion detection in well water and tap water. 5. Detection of lead in food samples. 6. Draw structures of simple organic molecules and resonance structures using chem-sketch / chemdraw. 7. Preparation of 5-nitrosalicylic acid from salicylic acid. 8. Preparation of <i>p</i> -nitroacetanilide from acetanilide. 9. Separation of the Components of a mixture by decantation, extraction, filtration and sublimation techniques.	30	6
5	Teacher-Specific content			
Teaching and Learning Approach	Lecture sessions, interactive sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding. Encourage students to ask questions during or after the lectures. Begin with safety instructions and guidelines for lab work. Allow students to conduct experiments under supervision (for lab work).			
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory(25 marks) Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities Practical (5 marks) Lab skill / involvement			

B. End Semester Evaluation (ESE)**Theory- 50 marks – 1.5 hrs**

- i) MCQ 20 questions: $20 \times 1 = 20$
- ii) Short essay 4 questions (out of 6): $4 \times 5 = 20$
- iii) Essay 1 question (out of 2): $1 \times 10 = 10$

Practical -20 marks - 1 hrs

- i) Lab skill and Lab involvement - 5
- ii) Lab report: 3
- iii) Viva : 5
- iv) Writing procedure: 2
- v) Lab test -5

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2. J. D. Lee, *Concise Inorganic Chemistry*, 5th Edn. Chapman & Hall, 2009.
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4. R.T Morrison, R.N. Boyd and S.K. Bhattacharjee *Organic Chemistry*, 7th Edn. Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
5. T.W. Graham Solomon, C.B. Fryhle, S.A. Snyder, *Organic Chemistry*, John Wiley & Sons, 2014.
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11. S M. Basavarajaiah, G. Y. Nagesh, K. R. Reddy, *Compendious Practical Organic Chemistry: Preparations, Isolation, and Chromatography*, Notion Press, 2021.
12. T. Brown, C. Murphy, H. LeMay, *Laboratory Experiments for Chemistry*, Pearson, 2018.

SUGGESTED READINGS

1. J.E. Huheey, E.A. Keitler and R.L. Keitler, *Inorganic Chemistry–Principles of Structure and Reactivity*, 4th Edn, Pearson Education, New Delhi, 2013.
2. J.Clayden, N.Greeves, S. Warren and P.Wothers, *Organic Chemistry*, 2nd Edn. Oxford University Press, 2012.



Department of Chemistry

St. Albert's College (Autonomous)

Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Food Chemistry and Nutrition					
Type of Course	MDC					
Course Code	24\$ACCHE1MD101					
Course Level	100-199					
Course Summary	This course provides a comprehensive understanding of the composition and health implications of various food items.					
Semester	I	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2		1		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the concept of nutrition	U	1,2,3
2	Identify the use of various food additives	A	1,3,10
3	Describe the health effects of food adulterants	U	1,2,3,6 ,8,10
4	Evaluate different adulterants in food	E	1,2,3,6, 10
5	Apply the concept of food chemistry to conduct simple laboratory experiments.	A	1,2,3,4 ,10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Introduction to Nutrition & Food Additives			
	1.1	Functions of food, nutrients in food- energy yielding nutrients (carbohydrates, proteins and lipids) and protective nutrients (vitamins and minerals)	3	1
	1.2	Food additives- definition, importance of food additives, types of additives -natural, synthetic and artificial- with one example. E- number	5	2
	1.3	Preservatives, food colours, flavour enhancers, sweeteners, emulsifiers, stabilizer, glazing agents, thickeners, gelling agents. (definition and applications with examples)	7	2
2	Food Adulteration and Safety			
	2.1	Food adulterants- definition, types (intentional and incidental contamination) and health effects.	3	3
	2.2	Common adulterants in different foods, their health effects and detection: milk, ghee, butter, honey, sweets, chilli powder, turmeric, tea, sugar and salt, black pepper, wheat and rice.	7	3
	2.3	Food adulteration act- objectives	1	4
	2.4	Modern food habits- introduction, health effects of fast food, junk food and instant food. Composition and health effects of soft drinks. a comparative study of traditional and modern food habits.	4	4
3	Food Chemistry and Nutrition Practical			
	3.1	1. Detection of adulterants in food items-milk, turmeric powder and chili powder. 2. Demonstration of preparation of value added food products- jam, squash. 3. To find out the moisture content of a given food sample by Lab oven method. 4. Test the solubility of vegetable oils in different solvents.	30	5

4	Teacher Specific content
Teaching and Learning Approach	<p style="text-align: center;">Classroom Procedure (mode of transaction)</p> <p>Lecture Sessions, interactive sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding. Encourage students to ask questions during or after the lectures. Begin with safety instructions and guidelines for lab work.</p> <p>Allow students to conduct experiments under supervision (for lab work).</p>
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p>Theory (15 marks) Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>Practical (10 marks) Lab involvement/ lab skill</p>
	<p>B. Semester end examination</p> <p>Theory (35 marks)- 45 minutes MCQ 35 questions : 35 X 1 = 35</p> <p>Practical (20 marks) -1 hr.</p> <p>i) Lab skill/Lab test - 5 ii) Lab report: 3 iii) Writing procedure: 2 v) Viva : 5</p>

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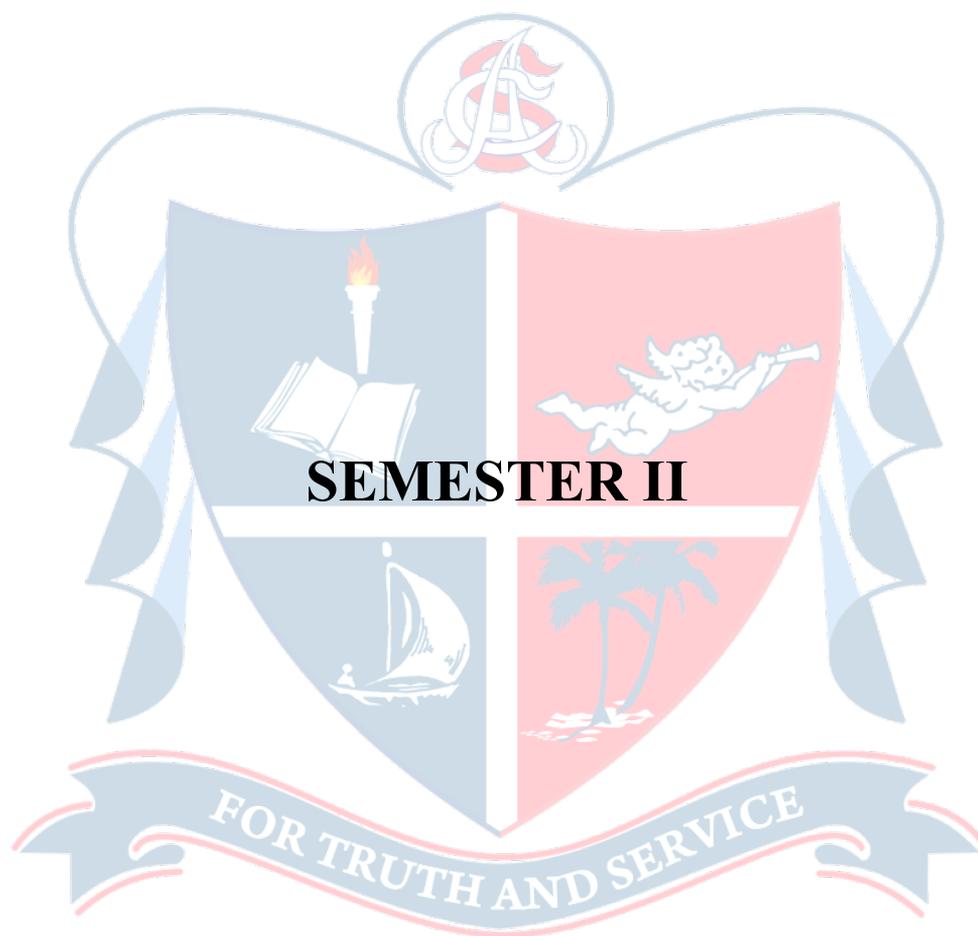
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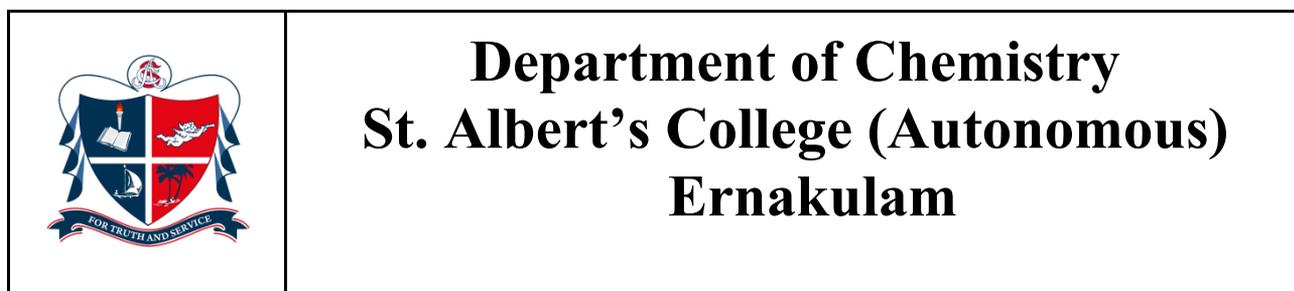
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7. I. Bevier, *Food and Nutrition Laboratory Manual*, Forgotten Books, 2018.

8. S. Sehgal, *A Laboratory Manual of Food Analysis*, International Publishing, 2016.







Programme	BSc (Hons) CHEMISTRY				
Course Name	Fundamentals of Chemistry-2				
Type of Course	DSC A				
Course Code	24SACCHE2DA101				
Course Level	100-199				
Course Summary	This course provides a basic understanding of the physical nature of matter, reactions in organic chemistry and the analytical tools for chemical investigations and identifications.				
Semester	II	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	
		3		1	
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Make use of fundamental principles of analytical chemistry to solve quantitative titrimetric problems.	A	1,2
2	Classify various types of organic reactions based on their mechanisms.	U	1,2
3	Describe the fundamental principles governing the behaviour of different states of matter.	U	1,2
4	Compare and contrast the properties of solids, liquids, and gases.	An	1,2

5	Apply the basic principles of analytical chemistry in preparation of standard solutions, acid-base titrations and in the determination of viscosity and surface tension.	S	1,2,10
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****Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)***

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Basic Concepts in Analytical Chemistry			
	1.1	Molecular mass - mole concept. Oxidation and reduction (electron concept only)	2	1
	1.2	Titrimetric analysis - fundamental concepts- analyte, end point, indicators etc. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm and ppb. Primary and secondary standards, quantitative dilution – problems	6	1
	1.3	Acid base concepts Arrhenius definition, Bronsted Lowry definition and conjugate acid-base pairs, Lewis concept, ionization of acids and bases.	2	1
	1.4	Acid base titrations- strong acid -strong base, strong acid – weak base, weak acid – strong base weak acid – weak base - pH indicators (phenolphthalein and methyl orange), redox titrations	5	1
2	Introduction to Organic Reactions			
	2.1	Representation of organic molecules: Projection formulae (Fischer, Sawhorse, Flying wedge and Newman)	3	2
	2.2	Types of reagents: electrophiles and nucleophiles	1	2
	2.3	Addition reactions: Markovnikov's addition, peroxide effect. Elimination	8	2

		reactions: E ₁ and E ₂ mechanism. Substitution reactions (SN ₁ , SN ₂ reactions of alkyl halides only).		
	2.4	Polymers- Basic concepts. Addition polymerisation (polyethylene, PVC) and condensation polymerization (Nylon 6,6, Polyester)	3	2
3	States of matter			

	3.1	Matter and its different states (elementary idea only), intermolecular forces: dipole- dipole interaction, dipole-induced dipole interaction and induced dipole-induced dipole interaction, ion-dipole interaction, hydrogen bonding: intra and intermolecular hydrogen bonds- effect on physical properties.	4	3,4
	3.2	Gaseous state: - postulates of kinetic theory, ideal and real gas behaviour, compressibility factor deviation from ideal behaviour, van der Waals equation (no derivation)	4	3,4
	3.3	Liquid state: properties of liquids: vapour pressure, boiling point, surface tension, viscosity.	3	3, 4
	3.4	Solid state: types of solids: crystalline and amorphous solids: ionic solids: unit cell, crystal systems, Bravais lattices.	4	3,4
4	Fundamentals of Chemistry-2 Practical			
	1. Calibration of apparatus -Standard flask and preparation of standard molar solutions of any two primary standards-Oxalic acid, Mohr's Salt, Na ₂ CO ₃ . 2. Determination of pH of different water sources, common acids and bases using pH meter/pH strips 3. Acid base titration- acidimetry and alkalimetry: titration of strong acid vs. strong base, strong acid vs. weak base and weak acid vs. strong base. 4. Estimation of citric acid in citrus fruits. 5. Determination of viscosity of liquids using Ostwald viscometer.		30	5

	6. Determination of surface tension of liquids using a stalagmometer. 7. Identification of substances by physical properties such as colour, melting point, boiling point, solubility, density etc.		
5	Teacher Specific content		

Teaching and Learning Approach	<p>Classroom procedure (mode of transaction)</p> <p>Lecture sessions, interactive sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding, encourage students to ask questions during or after the lectures, begin with safety instructions and guidelines for lab work. Allow students to conduct experiments under supervision (for lab work).</p>
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Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p>Theory (25 marks) Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>Practical (5 marks) Lab involvement/lab skill</p>
	<p>B. Semester end examination</p> <p>Theory (50 marks)- 1.5 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p>Practical (20 marks)-1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

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1. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, *Fundamentals of Analytical Chemistry*, 8th Edn., Brooks/Cole, Thomson Learning, Inc., USA, 2004.
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Department of Chemistry

St. Albert's College (Autonomous)

Ernakulam

Programme	B.Sc. Chemistry (Honours)				
Course Name	Chemistry of water				
Type of Course	MDC				
Course Code	24SACCHE2MD101				
Course Level	100-199				
Course Summary	This course discusses about unique properties of water and examples of these properties impacting daily life. It also provides insight into physical characteristics of water and potential contaminants. This course enables the students to conduct a detailed examination of the quality parameters, emphasizing their importance in assessing water quality and identifying potential issues.				
Semester	II	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		2		1	
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the sources of water and their significance in daily life and ecosystems	U	1,2
2	Identify the physical and chemical properties of water, and relate these properties to their various applications and implications in everyday situations.	U, A	1,2
3	Explain the water cycle and its role in maintaining Earth's ecosystems and supporting life	U	1,2
4	Recognize the causes and consequences of water pollution, and explore strategies for water conservation and sustainable water management.	A	1,2
5	Demonstrate proficiency in analyzing water quality parameters through laboratory techniques, including measurement methods and data interpretation.	A, An	1,2,10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT**Content for Classroom transaction (Units)**

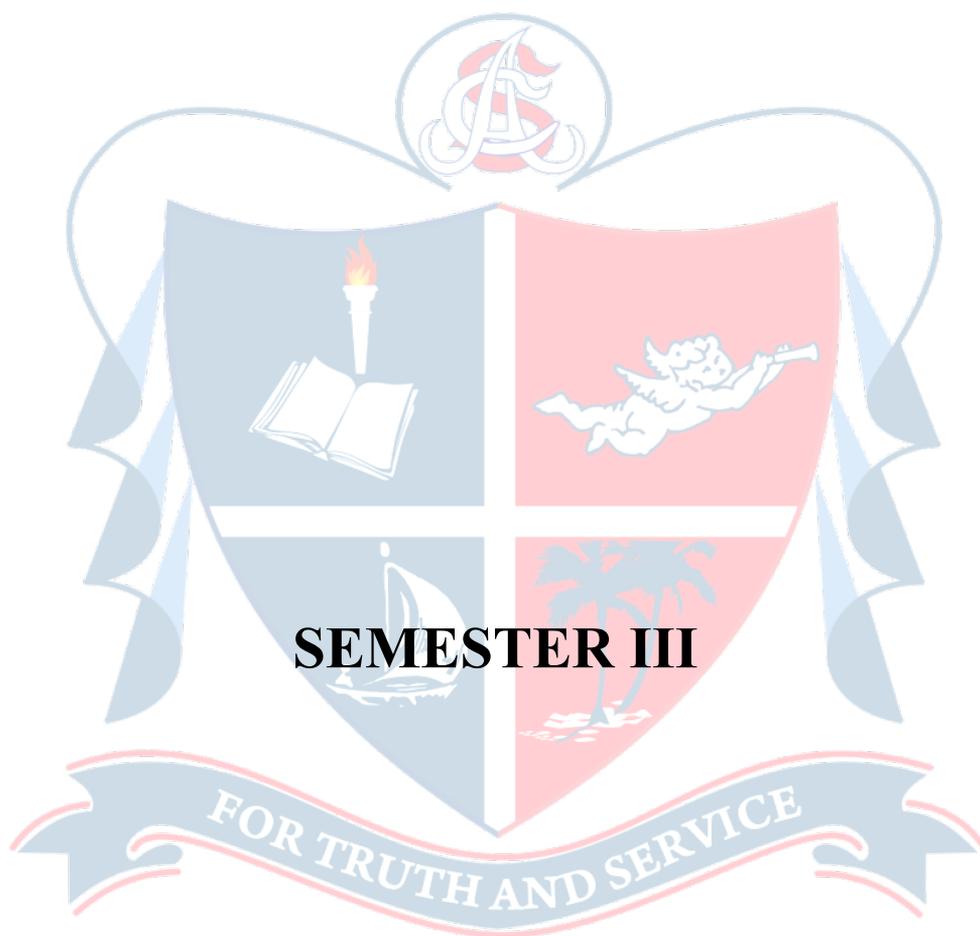
Module	Units	Course description	Hrs	CO No.
1	Water – The Universal Solvent			
	1.1	Sources of water- Surface water, ground water. Potable and non-potable water	2	1
	1.2	Physical and Chemical Properties of water connecting to amazing facts in day to day life.	5	2
	1.3	Water cycle- Definition, steps, diagrams and facts.	3	3
	1.4	Water Pollution- Treatment methods. Water conservation. Rainwater harvesting.	5	4
2	Water Quality Parameters			
	2.1	Sampling and Storage, Methods of determination of water quality parameters –physical parameters - electrical conductivity, salinity, total dissolved solids.	5	5
	2.2	Physical parameters - turbidity, temperature, color, and taste and odour.	4	5
	2.3	Chemical water parameters - pH, acidity, alkalinity, hardness, chloride	4	5
		Dissolved oxygen, BOD, COD.	2	
Unit 3:	Analysis of water quality (Practical)			
	3.1	pH, electrical conductivity, salinity, total dissolved solids	4	5
	3.2	Turbidity, temperature, color, taste and odour	4	5
	3.3	Acidity, alkalinity, hardness, chloride	4	5
	3.4	Dissolved oxygen, BOD, COD	3	5

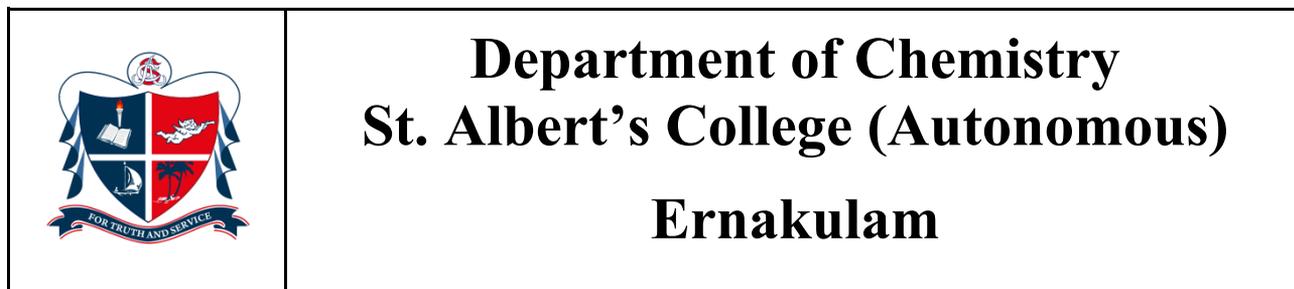
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture Sessions, Interactive Sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding. Encourage students to ask questions during or after the lectures. Begin with safety instructions and guidelines for lab work. Allow students to conduct experiments under supervision.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA)

	<p>Theory :15 Marks</p> <p>Assignments : 5 mark MCQ : 5 marks Involvement in classroom & other activities : 5 marks</p> <p>Practical : 10 Marks</p> <p>Lab involvement / skill : 10 marks</p>
	<p>B. Semester End examination</p> <p>Theory : 35 Marks</p> <p>MCQ 35questions : 35 X 1 = 35</p> <p>Practical : 15 Marks</p> <p>Lab Skill/ Lab Test: 10 marks Viva voce: 3 marks Writing procedure: 2 marks</p>

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2. "Principles of Environmental Chemistry" by James E. Girard. American University, Johns and Bartlett Publishers.
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Inorganic Chemistry-1					
Type of Course	DSC A					
Course Code	24SACCHE3DA201					
Course Level	200-299					
Course Summary	This course addresses bonding concepts in molecules, chemistry of p, f and d block elements and discusses the fundamentals of coordination chemistry. The practical component includes preparation of complexes and complexometric titrations.					
Semester	III	Credits			4	Total Hours
Course Details	Learning approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Apply the bonding concepts to molecules.	A	1,2,10
2	Compare the physical and chemical properties of lanthanides and actinides.	An	1, 2
3	Explain different nuclear reactions.	U	1,2
4	Differentiate the theories of coordination complexes of d block elements.	An	1,2

5	Apply the knowledge for estimation of Zn, Ca and Mg using complexometric titrations and complex preparations.	A, S	1,2,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Chemical Bonding			
	1.1	Properties of ionic compounds, lattice energy of ionic compounds - Born- Lande equation with derivation - solvation enthalpy and solubility of ionic compounds – Born-Haber cycle and its applications.	3	1
	1.2	Polarisation of ions – Fajan's rule and its applications.	2	1
	1.3	Covalent Bond: VSEPR theory- Postulates and applications .Valence Bond Theory and its limitations. Hybridization: definition, characteristics, and shape of molecules (BeCl ₂ , BF ₃ , NH ₄ ⁺ , H ₃ O ⁺ , PCl ₅ , SF ₆ , XeF ₂ , XeF ₄ , XeOF ₂ , XeOF ₄ , and XeF ₆).	5	1
	1.4	Properties of covalent compounds - polarity of bonds – percentage of ionic character – dipole moment and molecular structure.	2	1
	1.5	Molecular Orbital Theory: LCAO - bonding and antibonding molecular orbitals – bond order and its significance. MO diagrams of homonuclear and heteronuclear diatomic molecules: N ₂ , O ₂ , F ₂ , CO and NO – comparison of bond length, magnetic behaviour and bond energy of O ₂ , O ₂ ⁺ , O ₂ ²⁺ , O ₂ ⁻ and O ₂ ²⁻ .	3	1
	Chemistry of f-block elements and radioactivity			
	2.1	Lanthanides: lanthanide series, abundance and natural isotopes, separation of lanthanides, lanthanide contraction, similarity in properties, occurrence, oxidation states, chemical properties of Ln(III) cations, magnetic properties, colour and electronic spectra of lanthanide compounds.	6	2

	2.2	Chemistry of actinides – actinide series, abundance and natural isotopes, occurrence, preparation of actinides, oxidation states, general properties.	2	2
	2.3	Radioactivity – natural and artificial radioactivity; types of radioactive decay, Group displacement law, rate of disintegration - half life, nuclear fission and nuclear fusion reaction, chain reactions.	4	3
	2.4	Applications of radioactive decay: carbon dating, and nuclear medicine. Nuclear pollution and hazards.	3	3

d-block elements and coordination compounds				
3	3.1	Transition Metals: General characteristics.	2	4
	3.2	Werner's theory, types of ligands, coordination number, oxidation state. Geometry of complexes with coordination numbers 4 and 6.	2	4
	3.3	Stability of complexes: factors affecting the stability of metal complexes. Chelates, chelate effect. Theory of complexometric titrations.	2	4
	3.4	Isomerism in coordination compounds – structural isomerism and stereoisomerism (complexes with 4 and 6 coordination numbers).	2	4
	3.5	Valence bond theory, geometries of tetrahedral, square planar and octahedral (inner and outer orbital) complexes. Limitations of VB theory.	3	4
	3.6	Crystal field theory, splitting of d-orbitals in octahedral, tetrahedral, and square-planar complexes-introduction to Mulliken symbol, low spin and high spin complexes. Spectrochemical series-strong and weak field ligands, CFSE, pairing energy.	4	4
Inorganic Chemistry-1 Practical				
4	4.1	Identify salts visually – Cobalt chloride, copper chloride, copper sulphate, ferrous sulphate, ferric chloride, potassium dichromate and nickel chloride.	2	5
	4.2	Preparation of simple coordination complexes such as hexaaquacobalt(II), hexaaquacopper(II), hexaaquanickel(II) ions and prussian blue.	8	5

	4.3	Complexometric titration using EDTA Estimation of Ca, Mg and Zn Determination of hardness of water	10	5
	4.4	Permanganometry 1. Estimation of Fe ²⁺ 2. Estimation of oxalic acid 3. Estimation of calcium	10	5
5	Teacher Specific content			

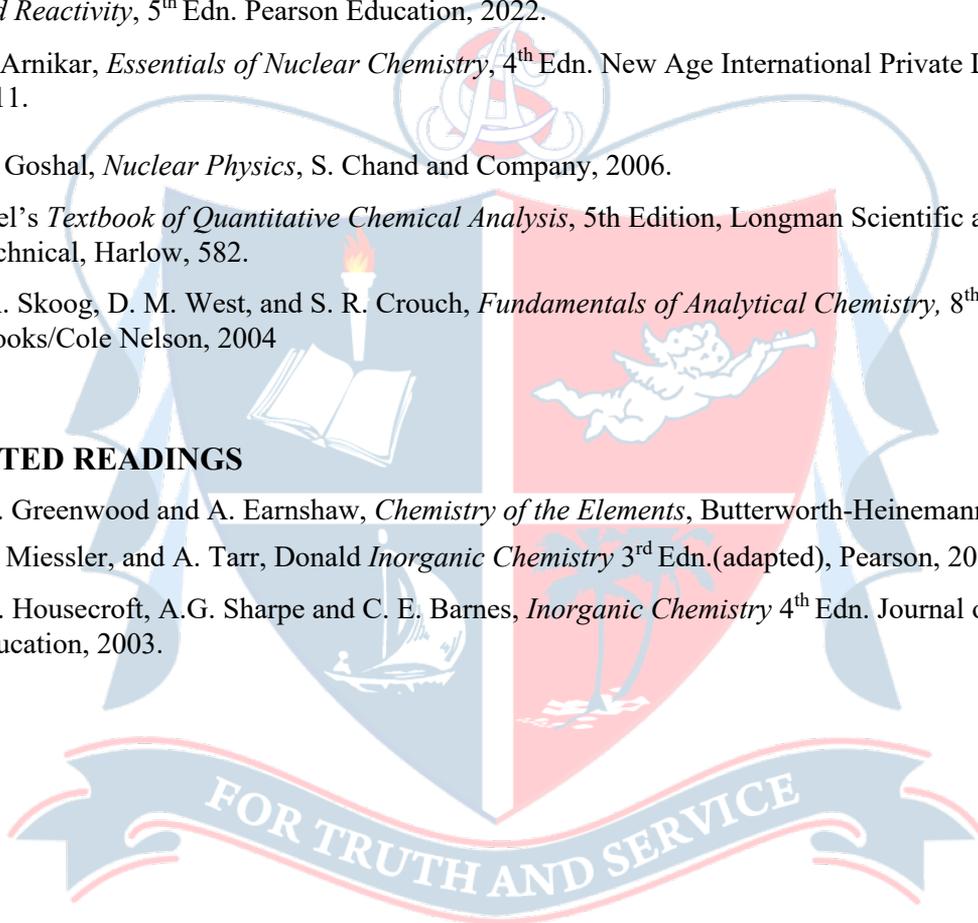
Teaching and Learning Approach	<p>Classroom procedure (mode of transaction)</p> <ul style="list-style-type: none"> ● Lecture ● Group discussion ● Peer teaching ● Demonstration of experiments ● Hands-on training
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment</p> <p>Theory(25 marks) Assignments/ Class tests / MCQ / Viva / Participation in classroom activities</p> <p>Practical (5 marks) Lab involvement /lab skill</p>
	<p>B. Semester end examination</p> <p>Theory: Written examination (50 Marks)-1.5 hrs.</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p>Practical: (20 marks)- 1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

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Department of Chemistry

St. Albert's College (Autonomous)

Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Organic Chemistry-1					
Type of Course	DSC A					
Course Code	24SACCHE3DA202					
Course Level	200-299					
Course Summary	This course explores the chemical principles underlying alkanes, alkenes, alkynes, and aromatic compounds. Additionally, it covers fundamental stereochemistry concepts. The practical segment of the course focuses on some methods used in organic qualitative analysis.					
Semester	III	Credits			4	Total Hours
Course Details	Learning approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Distinguish between aliphatic, aromatic, and non aromatic compounds.	An	1,2
2	Deduce the logical mechanism of reactions of aliphatic and aromatic compounds.	E	1,2,10
3	Outline industrial uses of aliphatic compounds.	U	1,2
4	Assign R, S, E and Z notation to compounds.	A	1,2,10

5	Compare stabilities of conformations of organic molecules.	An	1,2
6	Determine aromatic/aliphatic, saturated/unsaturated character and physical constants of organic compounds by microscale analysis and systematically record the observations.	An, S	1,2,4,6,1 0

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
	Alkane, Alkenes and Alkynes			
1	1.1	Alkanes: physical properties, industrial use - LPG and petrol, preparation-Wurtz reaction. Reactions- Free radical substitutions (chlorination) with mechanism and cracking.	3	1, 2
	1.2	Alkenes: physical properties, industrial uses of ethylene, preparation- Saytzeff and Hofmann eliminations, reactions-hydrogenation, hydration, hydrohalogenation, Markovnikov's rule, Kharasch effect, = ozonolysis, dihydroxylation using KMnO ₄ and bromination (with mechanisms).	7	1
	1.3	Alkynes: physical properties, industrial uses of acetylene, preparation of acetylenes dehydrohalogenation of vicinal dihalides, reactions- acidity of alkynes, formation of metal acetylides, alkylation of terminal alkynes and conversion into higher alkynes, addition of water, bromine and alkaline KMnO ₄ , reduction using Lindlar's catalyst.	5	1
	Aromatic compounds			
2	2.1	Aromaticity: Definition, Huckel's rule, benzenoid aromatic compounds-benzene,	6	3

		naphthalene, anthracene; non-benzenoid aromatic compounds cyclopropenyl cation, cyclopentadienyl anion, tropylium cation, heterocyclic aromatic compounds (pyridine, pyrrole and furan). Non aromatic and antiaromatic compounds.		
	2.2	Benzene: molecular orbital picture, resonance energy, reactions - electrophilic aromatic substitution - nitration, halogenation, Friedel Craft's reactions with their mechanisms.	4	1,6
	2.3	Ring activating and deactivating groups with examples. Orientation of aromatic substitution ortho, para and meta directing effects of groups.	3	1
	2.4	Aromatic nucleophilic substitutions of halobenzenes – bimolecular displacement mechanism, elimination-addition (benzyne intermediate) mechanism.	2	1
	Basic Stereochemistry			
	3.1	Stereoisomerism: definition, classification, configuration and conformation, interconversion of wedge formula, Newman, Sawhorse and Fischer projection formulae	1	4
	3.2	Geometrical isomerism: Cis-trans and E/Z nomenclature (upto two C=C systems) with Cahn Ingold Prelog (CIP) rules. Methods of distinguishing geometrical isomers.	4	4
3	3.3	Optical isomerism: optical activity, specific rotation, concept of chirality, stereogenic centres, enantiomerism, diastereomerism and meso compounds, optical isomers of lactic acid and tartaric acid, racemic mixture and resolution.	5	4
	3.4	Relative and absolute configuration: D and L, threo and erythro; d and l designations; CIP rules: R/ S notation (up to 2 chiral carbon atoms).	3	4

	3.5	Conformations: conformational analysis with respect to ethane, butane, cyclohexane. Relative stability and energy diagrams.	2	5
		Organic Chemistry-1 Practical		
4	4.1	Microscale organic analysis- test for aromatic character- ignition test, nitration test, picrate test and tests for unsaturation.	15	6
	4.2	Determination of physical constants-melting point, boiling point, specific rotation (Polarimetry).	15	6
5		Teacher Specific content		

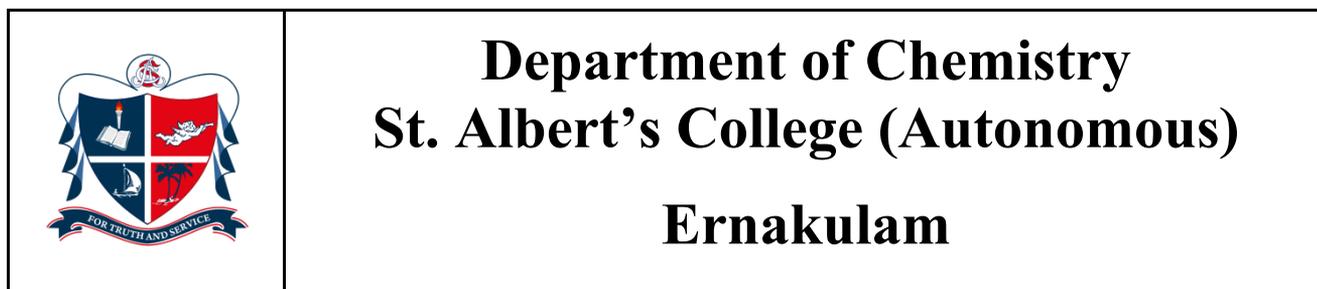
Teaching and Learning Approach	Classroom procedure (mode of transaction) Classroom lecture Hands on training using models Demonstration and practical training in laboratory Use of molecular visualisation software Industrial Visit
	MODE OF ASSESSMENT
Assessment Types	A. Continuous Comprehensive Assessment (CCA) Theory (25 marks) Pop quiz/ Assigning R and S using molecular models/open book / Written tests Practical (5 marks) Quiz /Lab involvement
	B. End Semester examination Written examination - 50 Marks- 1.5 hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10 Practical (20 Marks)- 1 hr. i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Basic Analytical Chemistry					
Type of Course	DSE					
Course Code	24SACCHE3DE201					
Course Level	200-299					
Course Summary	This course covers the fundamentals of analytical chemistry, and discusses topics such as SI Units, significant digits, precision, accuracy, errors, statistical treatment, calibration graphs, and Origin for data analysis. Additionally, it encompasses qualitative analysis techniques, safety protocols, titrimetric analysis, and the principles and applications of chromatography.					
Semester	III	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain fundamental measurement concepts, and statistical analysis in analytical chemistry .	U	1, 2,3,10

2	Make use of graphical representation techniques, fostering essential skills for success in analytical chemistry	An	1, 2,3
3	Apply methods for the qualitative determination of ions	A	1, 2,3
4	Develop a comprehensive knowledge of titrimetric analysis including redox titrations, complexometric titrations, conductometric titrations and potentiometric titrations	A	1, 2,3
5	Apply the principles of gravimetric analysis	A	1, 2,3
6	Analyse various separation and purification techniques of compounds	An	1, 2,3
7	Distinguish between different chromatographic methods based on their principle and mechanism	An	1, 2,3,10
<i>*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO
1	Evaluation of Analytical Data and Qualitative Analysis			
	1.1	SI Units, significant digits, rounding. Elementary idea of population and sample. Precision and accuracy. Types of errors – determinate and indeterminate errors. Ways to reduce determinate errors. Statistical treatment of analytical data (with Simple problems)-mean, variance and standard deviation. Limit of detection and limit of quantification.	6	1
	1.2	Graphical representation of data: calibration graphs. Introduction to software in data analysis – MS Excel, and Origin. Regression analysis-importance of coefficient of determination.	3	2
	1.3	Qualitative analysis: separation of cations into groups and group reagents. Principle of intergroup separation–solubility, ionic product, solubility product and common ion effect in the precipitation of cations. Identification test of anions-carbonate, chloride, acetate, nitrate, oxalate, fluoride, borate and phosphate ions. Elimination of interfering anions - oxalate, fluoride, borate and phosphate ions.	6	3

Chemicals apparatus and unit operations of analytical chemistry				
2	2.1	Selecting and handling reagents and other chemicals	2	5
	2.2	Cleaning and marking of laboratory ware	2	5
	2.3	Evaporating liquids, measuring mass, equipment and manipulations associated with weighing, measuring volume, calibrating volumetric glassware	5	5
	2.4	The laboratory notebook	1	5
	2.5	Safety in the laboratory- the four principles of safety, personal protective equipment: eye protection, lab coat, shoes and long pants, gloves, respiratory protection and masks, hair, lead apron and shields.	5	5

Titrimetric and Gravimetric Analysis				
3	3.1	Titrimetric analysis – basic concepts of redox reactions, redox titrations involving KMnO_4 , and $\text{K}_2\text{Cr}_2\text{O}_7$, titration curves, redox indicators.	4	4
	3.2	Complexometric titrations – direct, indirect, back and replacement titrations, EDTA titrations. Precipitation titration - methods of argentometric titration-indicators (action not required).	6	4
	3.3	Conductometric and potentiometric titrations – principle, examples and graphical representation.	2	4
	3.4	Gravimetric analysis: unit operations in gravimetric analysis - illustrations using iron and barium estimation.	3	5
4	Separation and Purification of compounds			
	4.1	Separation and purification techniques: filtration, recrystallization, precipitation, distillation, fractional distillation, solvent extraction and sublimation.	4	6
	4.2	Chromatography- principle and classification. Chromatographic techniques: paper chromatography, thin layer chromatography, R_f -values.	3	7

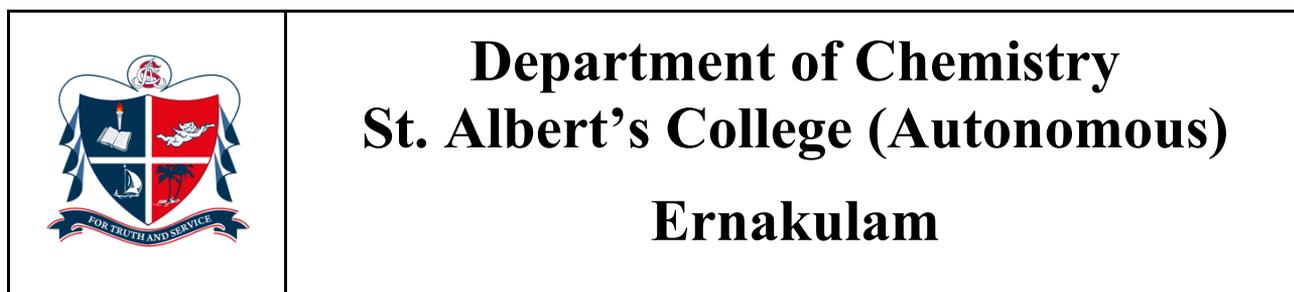
	4.3	Principle and applications of column chromatography, high performance liquid chromatography (HPLC), gas chromatography, gel permeation chromatography (GPC), ion exchange chromatography, and reverse phase chromatography.	8	7
5	Teacher Specific content			

Teaching and Learning Approach	Classroom procedure (mode of transaction) <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Peer teaching ● Demonstration of experiments ● Hands-on training
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Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: (30 marks) Assignments/ Class tests / MCQ / Viva / Participation in classroom activities
	B. End Semester examination (70 marks)- 2 hrs. Theory- 70 marks – 2 hrs <ul style="list-style-type: none"> i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Introduction to Nanoscience					
Type of Course	DSE					
Course Code	24SACCHE3DE202					
Course Level	200-299					
Course Summary	This course explores basic concepts, synthesis, properties and applications of nanomaterials					
Semester	III	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the fundamental concepts of nanomaterials.	U	1,2,3
2	Compare bottom-up and top-down approaches in nanomaterial synthesis	An	1,2,3
3	Describe various characterisation techniques of nanomaterials.	U	1,2,3
4	Explain the synthesis, properties and applications of different types of nanomaterials.	U	1,2,3

5	Analyse the applications of nanomaterials in various fields.	An	1,2,3,10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Classification and Synthesis of Nanomaterials			
	1.1	Feynman's hypothesis- scales of nanosystems- Moore's law .	1	1
	1.2	Different types of nanomaterials. Classification of nanomaterials based on dimensions, and based on origin.	3	1
	1.3	Nano in nature: lotus-leaf effect, gecko's feet, butterfly wings, and magneto-tactic bacteria.	3	1
	1.4	Bottom-up approach: chemical precipitation, reduction technique, and sol-gel method.	4	2
	1.5	Top-down approach: mechano-chemical method, laser ablation, and arc-discharge method.	4	2
2	Characterisation of Nanomaterials			
	2.1	Imaging through electron microscopy: Interaction of electron beam with sample. Scanning electron microscope and transmission electron microscope-comparison, advantages, applications and basic instrumental features.	5	3
	2.2	Scanning probe microscopy: scanning tunneling microscope and atomic force microscope-comparison, applications and basic instrumental features.	5	3
	2.3	Characterisation through spectroscopy (elementary idea only): UV-visible, IR, X-ray photoelectron and Auger electron spectroscopy. Secondary ion mass spectrometry.	5	3

Properties of Nanomaterials				
3	3.1	Metal Nanoparticles (Au, Ag) – synthesis (any one method), properties and applications .	3	4
	3.2	Carbon nanotubes– classification, synthesis (any one method), properties and applications .	3	4
	3.3	Quantum dots – semiconductor QDs and carbon dots – synthesis (any one method), properties and applications	3	4
	3.4	Magnetic nanoparticles – synthesis (any one method), properties and applications .	3	4
	3.5	Metal oxide nanoparticles – synthesis (any one method), properties and applications .	3	4

Applications of Nanoparticles				
4	4.1	Medicine and Healthcare: applications of nanomaterials in medical diagnosis, advanced drug delivery systems, targeted drug delivery and therapy.	5	5
	4.2	Applications of nanotechnology in integrated circuits, data storage and displays .	3	5
	4.3	Applications of nanotechnology in water purification and air pollution control .	2	5
	4.4	Piezoelectric nanomaterials, hydrogen generation and storage, batteries and solar energy harvesting.	3	5
	4.5	Chemical and biosensors using nanomaterials and defence applications of nanotechnology .	2	5
5	Teacher Specific content			

Teaching and Learning Approach	Classroom procedure (mode of transaction) <ul style="list-style-type: none"> ● Interactive instruction (chalk & board method, multimedia presentation) ● Group discussion ● Peer teaching ● Experimental demonstrations ● Practical training
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: (30 marks) Assignments/ Class tests / MCQ / Viva / Participation in classroom activities

	B. End Semester examination (70 marks)- 2 hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20
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REFERENCES

1. N. Kumar, K. Sunita, *Essentials in Nanoscience and Nanotechnology*, Wiley, 2016.
2. Pradeep, T. *NANO: The Essentials: Understanding Nanoscience and Nanotechnology*; 1st Edition ed.; McGraw-Hill Education: New York, 2007.
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	<h2 style="margin: 0;">Department of Chemistry</h2> <h1 style="margin: 0;">St. Albert's College (Autonomous)</h1> <h2 style="margin: 0;">Ernakulam</h2>
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Safe Laboratory Practices in Chemistry					
Type of Course	DSE					
Course Code	24SACCHE3DE203					
Course Level	200-299					
Course Summary	This course deals with proper procedures for handling, storing, and transporting chemicals safely, including the use of appropriate containers and labelling.					
Semester	III	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify potential hazards in a laboratory setting .	U	1,2,10
2	Exhibit proper handling and usage of laboratory equipment, including safety gear like goggles, gloves, and lab coats.	A	1,2,10
3	Analyse and interpret Material Safety Data Sheets (MSDS) to understand chemical properties, hazards, and proper handling techniques.	An	1,2,10
4	Assess and evaluate potential risks associated with various chemicals and experimental procedures.	U	1,2,10

5	Apply the knowledge of chemical safety in the storage, transportation and disposal of chemicals.	A	1,2,10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Introduction to Laboratory Safety			
	1.1	The four principles of safety: recognising hazards, assessing the risks of hazards, minimising the risks of hazards and preparing for emergencies.	3	1
	1.2	Safety ethic. Food, beverages, and smelling in the lab. Basic safety rules for handling laboratory chemicals.	3	1
	1.3	Going green in the lab: examples for using safer solvents, reducing volumes and quantity, minimising wastes and hazardous by products, using less toxic reagents.	3	1,2
	1.4	Personal protective equipment: eye protection, lab coat, shoes and long pants, gloves, respiratory protection and masks, hair, lead apron and shields.	3	1,2
	1.5	The laboratory: hazards, safety features, biological storage, chemical storage, gas storage and use, glassware, electrical safety.	3	1,2
2	Chemicals			
	2.1	Safety data sheets, chemical labels, toxic compounds, corrosives -acids and bases, gases, explosives, flammable compounds and oxidizers, cryogenics	4	1,2,3,4
	2.2	Working with extremely hazardous chemicals, permanent and temporary storage containers.	2	1,2,4
	2.3	Transporting Chemicals, ethers and other peroxide-forming chemicals, picric acid and nitro compounds, hazard and precautionary statements (H- and P-codes).	4	1,5
	2.4	Chemical Waste Management: waste disposal rules and regulations, labelling of hazardous waste, waste	5	1,5

		containers, sorting of hazardous chemicals, disposal of biological samples and biohazards.		
3	Hazard Control Measures			
	3.1	Hazard control measures: fume hoods, other laboratory ventilation, safe work procedures, emergency showers and eyewash stations.	4	1,4
	3.2	Fire and explosion safety: types of fire, fire safety and precautions, preventive measures, fire extinguishers, explosion safety, explosive mixtures.	3	1,4
	3.3	Laboratory equipment safety: vacuum pumps and systems safety, heat sources safety, heating mantles, oil and sand baths, ovens and furnaces safety, refrigerators and freezers safety, decontamination of laboratory equipment.	5	1,4
	3.4	Emergency procedures: chemical spills, fire and explosion, compressed gas leaks. Case study: Bhopal tragedy	3	1,4
	Demonstration experiments			
4	<ol style="list-style-type: none"> 1. Use of Electronic Balance for weighing chemicals 2. Measurement of volume and determination of density of liquids. 3. Safe use of burners and glassware in the laboratory 4. Use of safety glasses or goggles, apron, and gloves. 5. Use of eyewash station 6. Fire extinguishers 7. Safety Evaluation of common chemicals in the laboratory 8. Fume Hood 9. Interpretation of MSDS datasheets of flammable liquids, toxic, carcinogenic, corrosive and flammable chemicals in the laboratory. 10. Reports on the safe use of acids, bases, oxidising agents and reducing agents. 11. Reports on first aid in the laboratory. 12. Analysis of labels of common chemicals in the laboratory. 	15	1,4	
5	Teacher Specific content			

Teaching and Learning Approach	Classroom procedure (mode of transaction) Lecture-based approach, interactive discussions, laboratory sessions, flipped classroom, peer teaching and collaborative learning.
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: (30 marks) Assignments/ Class tests / MCQ / Viva / Participation in classroom activities
	B. End Semester examination (70 marks)- 2 hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 = 30 iii) Essay 2 question (out of 4): 2 X 10 = 20

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1. H H Robert Jr, C F, David, *Laboratory Safety for Chemistry Students*, 2nd Edn. Wiley, 2016.
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Department of Chemistry

St. Albert's College (Autonomous)

Ernakulam

Programme	B.Sc (Honours) Chemistry				
Course Name	Geochemistry				
Type of Course	DSE				
Course Code	24SACCHE3DE204				
Course Level	200-299				
Course Summary	<p>The goal of this course is to provide students an understanding of the fundamentals, applications, as well as the physicochemical characteristics of minerals, the dynamics of the earth's numerous spheres, and the chemistry of the planet.</p> <p>Students can learn about the atomic and chemical characteristics of mineral stuff as well as an integrated study of the earth systems. The curriculum also covers chemical makeup of the earth's spheres and their contamination, chemical reactions, the genesis of several economically valuable minerals, and the processes that occur in the earth's surface.</p> <p>The theoretical approach and course objectives lay the foundation for the creation of the practical course.</p>				
Semester	III	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4			
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	To understand, analyse and evaluate the geochemical classification of elements	K,U, An	1,2,3
2	To Compare and analyse the composition of the Earth's main geochemical reservoirs.	K,U, An	1,2,3
3	To identify and explain geochemical processes using the behaviour of chemical elements and their isotopes.	K,U, A	1,2,3
4	Analyse the details of aqueous geochemistry, marine chemistry and geochemical systems.	K, U, An, E	1, 2,3

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

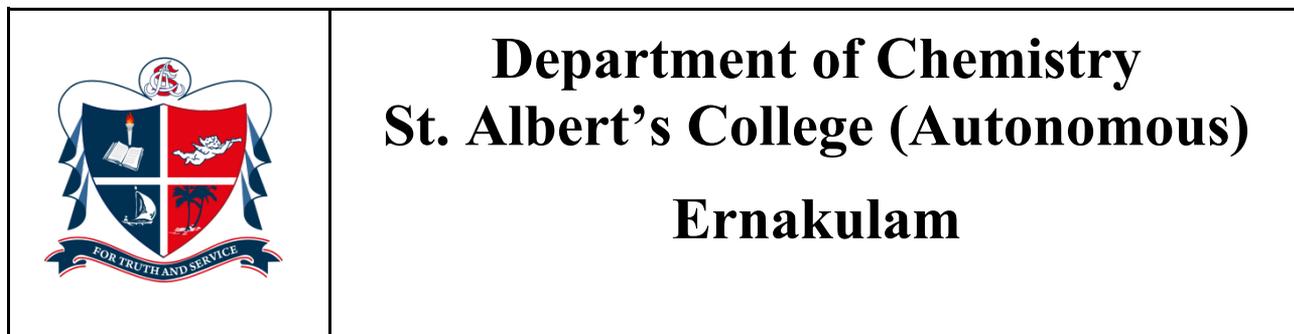
COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Concepts of geochemistry			
	1.1	Introduction to properties of elements: The periodic table	3	1,2,3
	1.2	Chemical bonding, states of matter and atomic environment of elements.	7	
	1.3	Geochemical classification of elements	5	
Layered structure of Earth and geochemistry				
2	2.1	Composition of different Earth reservoirs and the nuclides and radioactivity	3	1,2,3
	2.2	Conservation of mass, isotopic and elemental fractionation	5	
	2.3	Concept of radiogenic isotopes in geochronology and isotopic tracers	7	
Element transport				
3	3.1	Advection and diffusion	3	1,2,3
	3.2	Chromatography Aqueous geochemistry- basic concepts and speciation in solutions, Eh, pH relations Elements of marine chemistry	7	
	3.3	Mineral reactions- diagenesis and hydrothermal reactions	5	
Geochemistry of solid Earth				
4	4.1	The solid Earth – geochemical variability of magma and its products.	4	1,2,3
	4.2	The Earth in the solar system, the formation of solar system	2	
	4.3	Composition of the bulk silicate Earth Meteorites	2	
	4.4	Geochemical behavior of selected elements like Si, Al, K, Na etc.	7	

Teaching and Learning Approach	Classroom procedure (mode of transaction) Lecture-based approach, interactive discussions, laboratory sessions, flipped classroom, peer teaching and collaborative learning
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory- 30 marks Assignments/ Class tests / MCQ / Viva / Participation in classroom activities
	B. Semester End examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: $20 \times 1 = 20$ ii) Short essay 6 questions (out of 8): $6 \times 5 = 30$ iii) Essay 2 question (out of 4): $2 \times 10 = 20$

REFERENCES

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2. Rollinson, H. (2007) Using geochemical data – evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical.
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4. Albarède, F. (2003). Geochemistry: an introduction. Cambridge University Press



Programme	B.Sc (Honours) Chemistry					
Course Name	Chemistry in Everyday Life					
Type of Course	MDC					
Course Code	24SACCHE3MD201					
Course Level	200-299					
Course Summary	This course provides a comprehensive understanding of how chemistry permeates various aspects in our daily life.					
Semester	III	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		0		45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the uses of fertilizers and pesticides and their impact on the environment.	U	1,2,3,6,7,10
2	Compare various types of drugs	An	3,6,7,10
3	Classify soaps and understand its cleansing action	U	1,2,3,6,7, 10
4	Investigate the chemical components in personal care products.	An	1,2,3,6,7, 10

5	Make use of theories to prepare cosmetics	A,S	1,2,3,6.7.10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
Chemistry in Agriculture and Medicine				
1	1.1	Fertilizers – introduction. Types of fertilizers - natural, synthetic, NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Bio-fertilizers and organic manures.	4	1
	1.2	Pesticides - Introduction. Classification (brief idea only) - insecticides, fungicides, herbicides (structures not required). Excessive use of pesticides - environmental hazards. Biopesticides.	4	1
	1.3	Classification of drugs - analgesics, antipyretics, antihistamines, antacids, antibiotics and antifertility drugs with examples (structures not required). Psychotropic drugs - tranquilizers, antidepressants and stimulants with examples (structures not required). Drug addiction and abuse. Prevention and treatment.	7	2
Chemistry in personal care products				
2	2.1	Soaps – introduction, types of soaps - toilet soaps, washing soaps, liquid soap, TFM and grades of soaps, cleansing action, environmental aspects.	5	3
	2.2	Composition of different types of cosmetics - toothpaste, hair dye, face and skin powders, lipsticks and perfumes, shaving creams Shampoos- ingredients and functions – different kinds of shampoos (anti-dandruff, anti-lice, herbal and baby shampoos). Herbal cosmetics- definition, natural ingredients used- aloe vera, turmeric, henna, amla, neem, clove	10	4

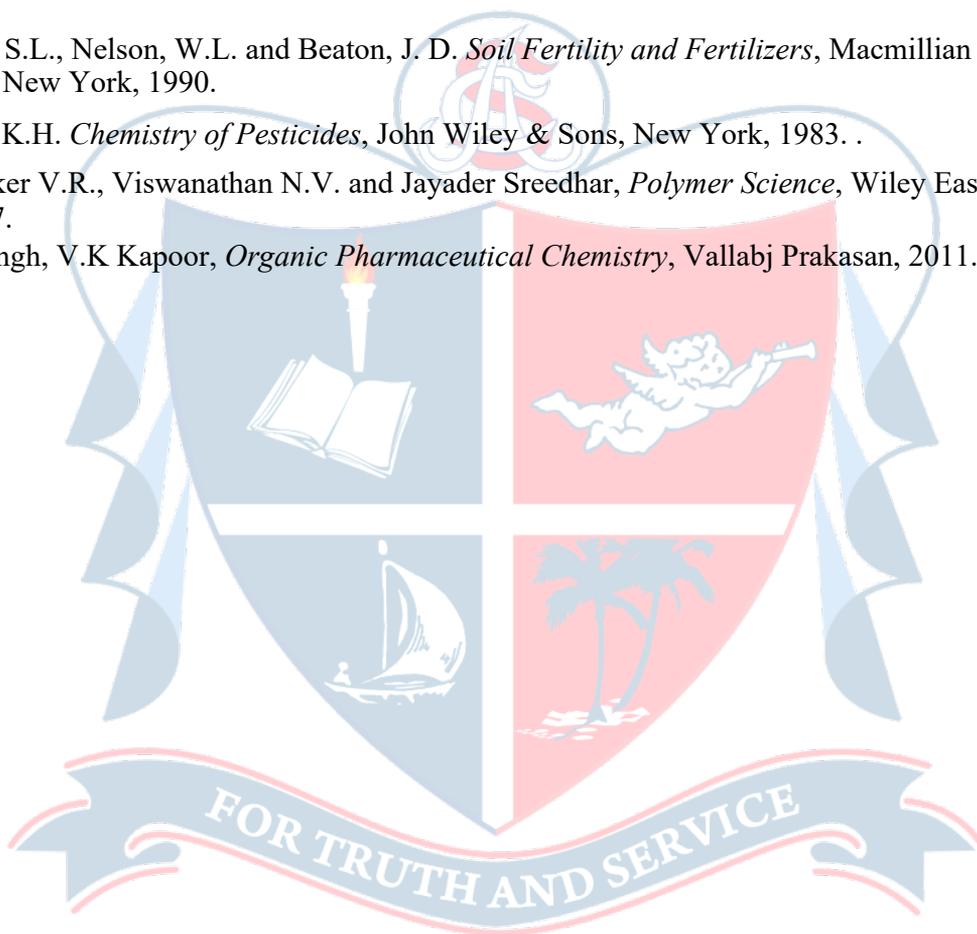
		Harmful effects of cosmetics.		
3	Demonstration Experiments			
	3.1	1. Synthesis of Organic manure 2. Preparation of Toilet soap 3. Evaluate TFM value of soap 4. Preparation of Shampoo 5. Preparation of Perfume 6. Preparation of Sanitizers	15	5

4		Teacher Specific Content		
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Teaching and Learning Approach	<p style="text-align: center;">Classroom procedure (mode of transaction)</p> <p>Lecture sessions, interactive sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding. Encourage students to ask questions during or after the lectures. Begin with safety instructions and guidelines for lab work. Allow students to conduct experiments under supervision (for lab work).</p>
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA) Theory: (15 marks) Assignments/ Class tests / MCQ / Viva / Participation in classroom activities Practical: (10 marks) Lab skill / laboratory involvement</p> <p>B. End Semester examination Theory: (35 marks)- 45 minutes MCQ 35 questions : 35 X 1 = 35</p> <p>Practical: (15 marks)- 1 hr Lab Skill/ Lab Test: 10 marks Viva voce: 3 marks Writing procedure: 2 marks</p>

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Department of Chemistry St. Albert's College (Autonomous) Ernakulam

Programme	B.Sc (Honours) Chemistry					
Course Name	Forensic Chemistry					
Type of Course	VAC					
Course Code	24SACCHE3VA201					
Course Level	200-299					
Course Summary	This course provides a comprehensive understanding of the basic principles of chemistry as they apply to forensic science. It focuses on enabling non-chemists to comprehend and utilize chemical concepts in forensic analysis.					
Semester	III	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Recognize various types of chemical substances, their properties, and their relevance in forensic contexts.	U	1,2
2	Utilize fundamental chemical principles to understand forensic analysis techniques.	A	1,2,10
3	Evaluate and interpret chemical evidence commonly encountered in forensic investigations.	An	1,2

4	Explain the role of chemistry in forensic science, including its impact on legal proceedings and criminal investigations.	U	1,2,6,8,10
5	Extract meaningful conclusions from chemical data obtained during forensic analysis.	U	1,2,6,8
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
Poisons				
1	1.1	Poisons-types and classification-diagnosis of poisons in the living and the dead – clinical symptoms - post-mortem appearances.	4	1,2,3,4,5
	1.2	Heavy metal contamination (Hg, Pb, Cd) of sea foods.	3	1,2,3,4,5
	1.3	use of neutron activation analysis in detecting Arsenic in human hair	2	1,2,3,4,5
	1.4	Treatment in cases of poisoning - use of antidotes for common poisons.	3	1,2,3,4,5
Crime Detection				
2	2.1	Accidental explosion during manufacture of matches and fireworks.	2	1,2,3,4,5
	2.2	Human bombs- possible explosives (gelatine sticks and RDX)	3	1,2,3,4,5
	2.3	metal detector devices and other security measures for VVIP	2	1,2,3,4,5
	2.4	Composition of bullets and detecting powder burn	2	1,2,3,4,5
	2.5	Analysis of incendiary and timed bombs - spill of toxic and corrosive chemicals from tankers.	3	1,2,3,4,5

3 (a)	Forgery and Counterfeiting			
	3.1	Documents - different types of forged signatures simulated and traced forgeries – inherent signs of forgery methods - writing deliberately modified - uses of ultraviolet rays - comparison of typewritten letters	5	1,2,3,4,5
	3.2	Checking silver line watermark in currency notes, alloy analysis using AAS to detect counterfeit coins	4	1,2,3,4,5
3.3	Detection of gold purity in 22 carat ornaments - detecting gold plated jewels - authenticity of diamond.	3	1,2,3,4,5	

3 (b)	Tracks and Traces			
	3.4	Tracks and traces - small tracks and police dogs footprints- walking pattern or tyre marks	3	1,2,3,4,5
	3.5	Glass fracture – tool mark paints – fibres.	2	1,2,3,4,5
	3.6	Analysis of biological substances - blood, saliva, urine and hair	2	1,2,3,4,5
3.7	DNA Finger printing for tissue identification in dismembered bodies -detecting steroid consumption in athletes and race horses	2	1,2,3,4,5	
4	Teacher Specific Content			

Teaching and Learning Approach	<p>Classroom procedure (mode of transaction) Lecture sessions, interactive sessions including discussions and demonstrations to engage students actively and visual aids like presentations and videos to enhance understanding. Utilize case studies to illustrate how forensic analysis is applied.</p>
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p style="text-align: center;">A. Continuous Comprehensive Assessment (CCA) Theory :25 marks Assignments /Viva /Class Tests/ MCQ/Classroom participation (participation in class activities)</p>

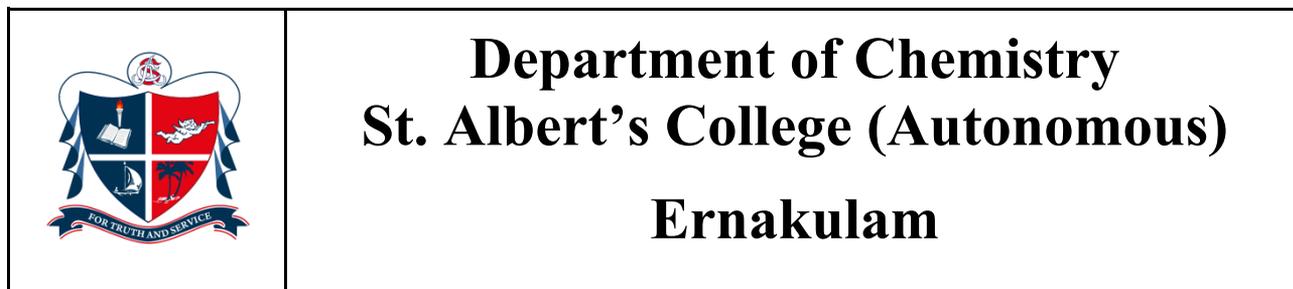
B. End Semester examination**Theory :50 marks- 1.5 hrs.**

- i) MCQ 20 questions: $20 \times 1 = 20$
- ii) Short essay 4 questions (out of 6): $4 \times 5 = 20$
- iii) Essay 1 question (out of 2): $1 \times 10 = 10$

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Programme	B.Sc (Honours) Chemistry					
Course Name	Inorganic and Organic Chemistry					
Type of Course	DSC B					
Course Code	24SACCHE3DB201					
Course Level	200-299					
Course Summary	This course provides a comprehensive understanding of the various aspects of inorganic and organic chemistry.					
Semester	III	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe radioactivity, its applications and nuclear reactors in India	U	1,2
2	Describe the basic principles of bioinorganic chemistry and the importance of metals in biological systems	U	1,2
3	Discuss the importance of functional groups, aromatic stability and aromatic electrophilic substitution.	U	1,2
4	Investigate the adulterants present in food	An	1,2

5	Describe the basic principles behind geometrical and optical isomerism and conformations	U	1,2
6	Apply basic principles of chemistry in volumetric analysis and organic preparations.	A	1,2,10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
		Nuclear Chemistry and Bioinorganic Chemistry		
1	1.1	Natural and induced radioactivity, radioactivity – detection, units of radioactivity. Modes of decay – group displacement laws. Isotopes, isobars and isotones with examples. Nuclear fission - atom bomb, nuclear fusion – hydrogen bomb.	6	1
	1.2	Nuclear reactors - nuclear reactors in India. application of radioactive isotopes, ¹⁴ C dating, rock dating, isotopes as tracers, radiodiagnosis and radiotherapy	4	1
	1.3	Haemoglobin and myoglobin, pH of blood, cytochromes, ferredoxin, mechanism of O ₂ and CO ₂ transportation and chlorophyll and photosynthesis (mechanism not expected) elementary idea of photophosphorylation.	4	2
	1.4	Photosynthesis and respiration – comparison. – Elementary idea of structure and mechanism of action of sodium potassium pump. Biochemistry of zinc and cobalt.	3	2
2	Food Additives & Adulterants			
	2.1	Food Additives: Food preservatives, artificial sweeteners, flavours, emulsifying agents, antioxidants, leavening agents and flavour enhancers (definition and examples, structures not required) – Natural pigments in fruits and vegetables	5	4

		(carotenoids, chlorophylls and flavonoids). Artificial ripening of fruits. Common food adulterants in various food materials and their identification: Milk, vegetable oils, tea, coffee powder and chilli powder.		
	2.2	Commonly used permitted and non-permitted food colours BHT, BHA and MSG - (structures not required) Fast foods and junk foods & their health effects – Soft drinks and their health effects	4	4

	Aromatic Hydrocarbons and Stereochemistry			
3	3.1	Nomenclature and isomerism in substituted benzene. Benzene-Structure and stability: Kekule, resonance and molecular orbital description. Mechanism of aromatic electrophilic substitution: Halogenation, nitration, sulphonation and Friedel-Crafts reactions, orientation effect of substituents.	5	3
	3.2	Aromaticity and Huckel's rule: Application to benzenoid (benzene, naphthalene and anthracene) and non-benzenoid (pyrrole, pyridine and indole) aromatic compounds.	4	3
	3.3	Conformations: Conformations of ethane, butane and cyclohexane– explanation of stability.	3	5
	3.4	Geometrical isomerism: definition – condition – geometrical isomerism in but-2-ene and but-2-ene-1,4- dioic acid – methods of distinguishing geometrical isomers using melting point and dipole moment.	4	5
	3.5	Optical Isomerism: optical activity, chirality, – enantiomers, meso compounds, diastereoisomers, optical isomerism in lactic acid and tartaric acid.	3	5
4	Inorganic and Organic Chemistry Practicals			
		1. <u>Permanganometry</u> i Standardization of KMnO_4 using (i) oxalic acid (ii) Mohr's salt ii Estimation of Fe^{2+} in Mohr's salt and crystalline Ferrous Sulphate using standard KMnO_4 .	30	6

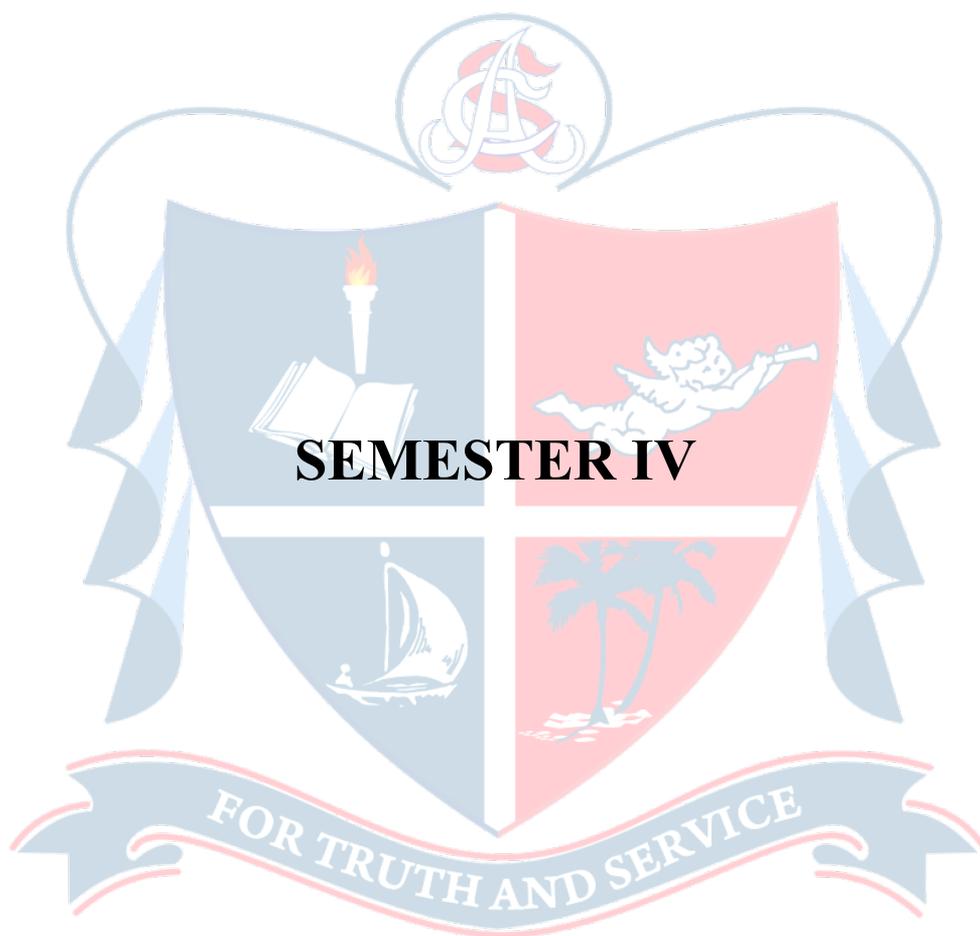
	2. <u>Dichrometry</u> i. Estimation of Ferrous ions (external indicator) ii. Estimation of Ferrous ions (internal indicator) 3. Determination of physical constants: melting point, boiling point and density. 4. Preparation of m-dinitrobenzene from nitrobenzene 5. Benzoylation of phenol		
5	Teacher Specific content		

Teaching and Learning Approach	Classroom procedure (mode of transaction) <ul style="list-style-type: none"> ● Lecture (chalk& board, power point presentation) ● Group discussion ● Peer teaching ● Demonstration of experiments ● Hands-on training
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p>Theory (25 marks)</p> <p>Pop quiz/Problem based assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>Practical (5 marks)</p> <p>Quiz/Lab involvement</p> <p>B. Semester end examination</p> <p>Theory: Written examination (50 Marks)-1.5 hrs.</p> <p>i) MCQ 20 questions: $20 \times 1 = 20$ ii) Short essay 4 questions (out of 6): $4 \times 5 = 20$ iii) Essay 1 question (out of 2): $1 \times 10 = 10$</p> <p>Practical: 20 marks-1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

REFERENCES

- 1 H.J. Arnikaar, *Essentials of Nuclear Chemistry* (Revised IV edn.), New Age, 1995
2. T.P. Coultate, *Food- The Chemistry of its components*. Royal Society of Chemistry, London.
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8. R. T. Morrison, R. N. Boyd, *Organic Chemistry*, 7th Edn., Pearson Education, New Delhi, 2013.
9. I. L. Finar, *Organic Chemistry*, Vol. I, 5th Edn. Pearson Education, New Delhi, 2013. 3.
10. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, 3rd Edn., Vishal Publishing Company Co., 2010.
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14. R. Gopalan, *Analytical Chemistry*, S. Chand and Co., New Delhi, 2003. 15. O. P. Pandey, *Practical Chemistry*, S. Chand, 2010.







Department of Chemistry

St. Albert's College (Autonomous)

Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Organic Chemistry-2					
Type of Course	DSC A					
Course Code	24SACCHE4DA201					
Course Level	200-299					
Course Summary	A study of the reactions of alcohols, aldehydes, ketones, carboxylic acids, and its derivatives. Practical part includes Qualitative Microscale analysis of organic compounds.					
Semester	IV	Credits		4	Total Hours	
Course Details	Learning Approach	Lecture	Tutorial	Practical		Others
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Summarize the structure and uses of alcohols, aldehydes, ketones, acids, and acid derivatives.	U	1,2
2	Predict the product and reasonable mechanism for reactions of alcohols, aldehydes, ketones, carboxylic acids, and its derivatives	E	1, 2
3	Apply the functional group chemistry to interconvert alcohol, aldehyde, ketone and acid.	A	1, 2
4	Design synthetic pathways to higher and lower homologous series in acids and alcohols.	A	1, 2

5	Analyse the functional groups and systematically record the observations. (Practical)	An, S	1, 2, 4, ,10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Alcohols			
	1.1	Alcohols-classification (monohydric, dihydric, polyhydric, primary, secondary and tertiary), Luca's test, preparation of alcohols using Grignard reagents.	2	1, 2, 3
	1.2	Chemical Properties: esterification, reactions with sodium and KMnO_4 , pinacol-pinacolone rearrangement (with mechanism), ascend and descend in homologous series, alcohol metabolism in human body.	4	1, 3, 4, 5
	1.3	Phenol- acidity of phenol, effect of substituent on acidity, comparison of acidity of phenols with alcohols. Hydrogen bonding (inter and intramolecular) in phenols, effect of H-bonding on boiling point and solubility in water.	4	1, 3
	1.4	Chemical reactions of phenol: electrophilic substitution reactions-nitration, halogenation, Reimer-Tiemann reaction (with mechanisms) Structure and uses of catechol, resorcinol, quinol and picric acid.	5	3, 4, 5
2	Aldehydes and Ketones			
	2.1	Structure and industrial uses of representative aldehydes and ketones-formaldehyde, acetaldehyde, benzaldehyde and acetone.	2	1

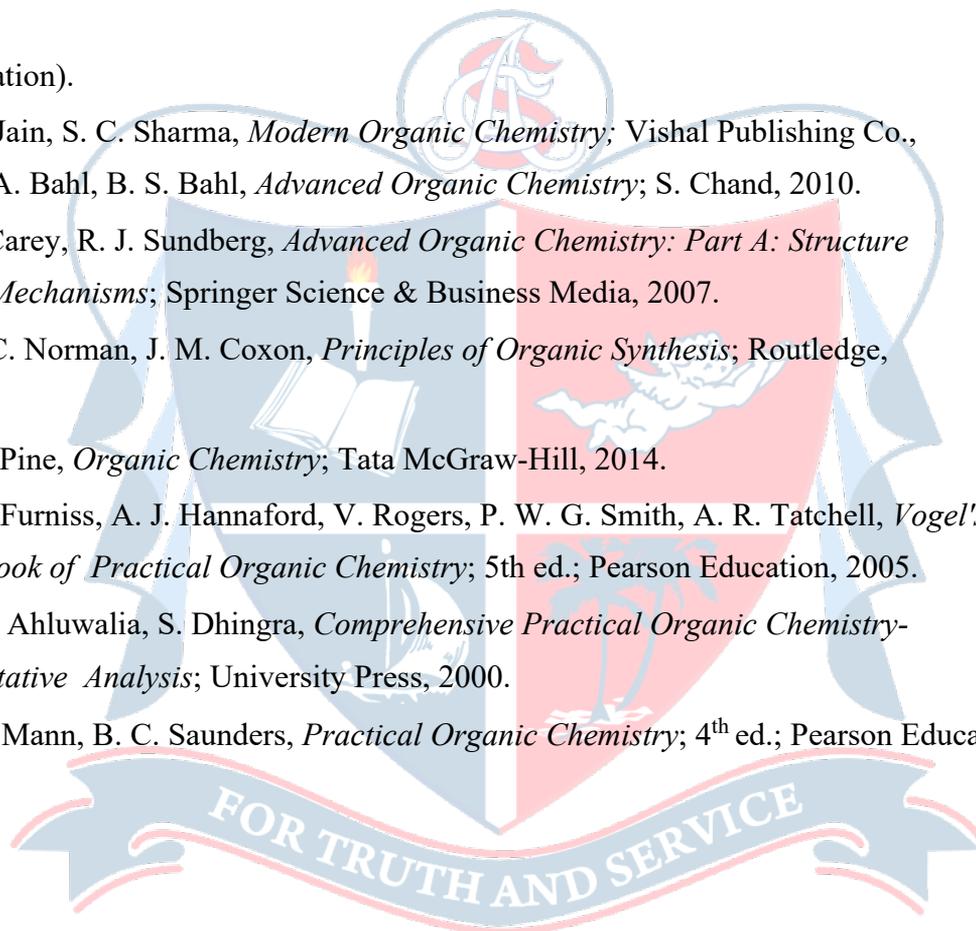
	2.2	Nucleophilicity of carbonyl compounds- comparison between aldehydes and ketones Nucleophilic addition reactions-reaction with HCN, ammonia derivatives (reaction with primary amine, hydroxylamine, phenylhydrazine).	4	1, 3, 4, 5
	2.3	Acidity of alpha-hydrogen in aldehydes and ketones, aldol condensation, Claisen condensation, Knoevenagel reaction, Claisen-Schmidt reaction, Perkin condensation, benzoin condensation, Cannizzaro reaction (with mechanisms)	6	1, 3, 4, 5
	2.4	Clemmensen reduction, Wolff-Kishner reduction, iodoform reaction, Beckmann rearrangement (with mechanisms) Tollen's and Fehling's reaction	3	2, 3, 4, 5
	Carboxylic acids and acid derivatives			
	3.1	Structure and uses of formic acid, acetic acid, benzoic acid, oxalic acid, phthalic acid, and salicylic acid.	1	1
	3.2	Acidity of carboxylic acid- effect of substituents on acid strength for aromatic carboxylic acids.	1	1, 2
3	3.3	Reactions of carboxylic acids: - reduction, decarboxylation and Hell – Volhard - Zelinsky reaction. Ascend and descend in carboxylic acid homologous series.	4	1, 2
	3.4	Acid derivatives-Conversion of acid to acid chlorides, amides, esters and anhydrides Comparative study of nucleophilicity of acyl derivatives.	3	1, 2
	3.5	Reactions of acid derivatives with mechanisms: conversion of acid chloride to acid anhydride, ester, amide, aldehyde, and alcohol; conversion of acid	6	1, 2

		anhydride to acid, ester, and amide; conversion of ester to acid, amide, primary and secondary alcohols; conversion of amide to acid, nitrile and primary amine. Reformatsky reaction.		
4	Organic Chemistry-2 Practicals			
	4.1	Qualitative microscale analysis of organic compounds identification and preparation of derivatives of alcohols, phenols, aldehydes, ketones, carboxylic acid, and carboxylic acid derivatives.	30	1, 2, 4
5		Teacher Specific Content		

Teaching and Learning Approach	<p>Classroom Procedure (mode of transaction)</p> <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Peer teaching ● Demonstration of experiments ● Hands-on training
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p>Theory (25 marks) Pop quiz / Problem based assignments / Assignments / Class tests / MCQ / Viva / Involvement in classroom activities</p> <p>Practical (5 marks) Lab involvement</p>
	<p>B. Semester end examination</p> <p>Theory: Written examination (50 Marks)-1.5 hrs.</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 = 20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p>Practical: 20 marks-1 hrs.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

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1. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, *Organic Chemistry*; 7th Edn. Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Physical Chemistry- 1					
Type of Course	DSC A					
Course Code	24SACCHE4DA202					
Course Level	200-299					
Course Summary	This course deals with the fundamental concepts of gaseous state, ionic and phase equilibria, and solutions.					
Semester	IV	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Interpret the properties of real and ideal gases and calculate the critical constants theoretically.	E	1,2
2	Distinguish the different types of molecular velocities and define various terms involved in molecular motion.	An	1,2
3	Utilize the concepts of acids, bases and buffer solutions to calculate ionic product, pH and ionic strength.	A	1,2
4	Interpret different phases coexist in a phase diagram.	E	1,2

5	Identify different types of solutions and its properties.	A	1,2
6	Distinguish the colligative properties of solutions and calculate the molar mass.	U	1,2
7	Make use of theoretical knowledge and execute experiments in phase equilibria, critical solution temperature and colligative properties.	A,S	1,2, 10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT**Content for Classroom transactions (Units)**

Module	Units	Course description	Hrs	CO No.
1	GASEOUS STATE			
	1.1	Deviation of real gases from ideal behaviour: causes of deviation, van der Waals equation of state for real gases. Boyle temperature. Critical phenomena and Andrew's isotherms of CO ₂ , continuity of states, critical constants and their calculation from van der Waals equation. Virial equation of state, van der Waals equation expressed in Virial form.	5	1
	1.2	Maxwell Boltzmann distribution laws of molecular velocities (graphical representation – derivation not required) and their importance. Temperature dependence of these distributions.	5	1, 2
	1.3	Collision properties: Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules (No derivation). Relation between mean free path and coefficient of viscosity.	5	2
2	IONIC EQUILIBRIA			
	2.1	Introduction – Concepts (Lowry-Bronsted and Lewis concept) of acids and bases, relative strength of acid-base pairs, influence of solvents, Dissociation constants – acids, bases, and polyprotic acids. Ostwald's dilution law.	4	3
	2.2	Degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water- pH. Effects of solvents on ionic strength.	3	3

	2.3	Buffer solutions – Mechanism of buffer action, Henderson equation. Hydrolysis of salts (concepts only).	3	3
PHASE EQUILIBRIA				
3(a)	3.1	The phase rule (no-derivation). One component system – water and sulphur systems.	2	4
	3.2	Two component systems- simple eutectic; lead silver system. Application to metallurgy-Pattinson's process.	3	4
SOLUTIONS				
3(b)	3.3	Introduction , binary liquid solutions, Raoult's law, ideal and non-ideal solutions, Vapour pressure– composition and temperature – composition curves of ideal and non-ideal binary liquid solutions.	5	5
	3.4	Critical solution temperature (CST). Solubility of gases in liquids – Henry's law and applications. Distribution of a solute between two solvents– Nernst distribution law.	5	6
	3.5	Colligative properties of dilute solutions – vapour pressure lowering, boiling point elevation and freezing point depression. Molar mass determination (no derivation) -related problems – osmotic pressure – laws of osmotic pressure – reverse osmosis – purification of seawater. Abnormal molecular masses – van't Hoff factor – degree of association and degree of dissociation.	5	6
Physical chemistry 1 - Practicals				
4	4.1	Determination of CST of Phenol-water system Effect of KCl/Succinic acid on Critical Solution Temperature of phenol-water system Determination of unknown concentration of KCl/Succinic acid using CST method Transition temperature of salt hydrates. (Sodium thiosulphate, sodium acetate)	30	7

	4.2	Determination of mass of solvent/molecular mass of solute using transition temperature. Construction of phase diagram of simple eutectics (Naphthalene-Biphenyl System) Molecular weight determination by Rast's method. (Using naphthalene, camphor or biphenyl as solvent and acetanilide, p-dichlorobenzene etc. as solute.)		
5		Teacher Specific Content		

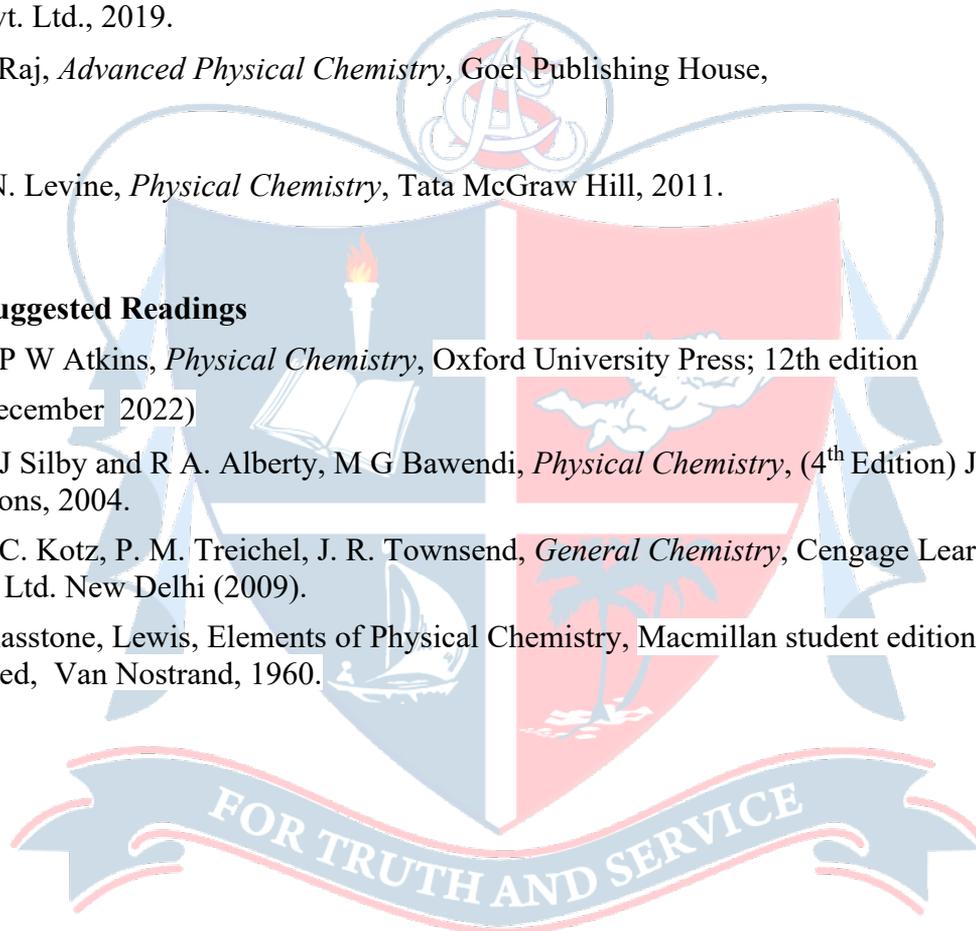
Teaching and Learning Approach	<p>Classroom Procedure (mode of transaction)</p> <ul style="list-style-type: none"> • Lecture (chalk & board and powerpoint presentations) • Interactive sessions and simulations, • Visual aids like videos and models to enhance understanding. • Peer discussions. • Laboratory experiments and hands-on training
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p>Theory (25 marks)</p> <p>Pop quiz /Problem based assignments /Class tests/ MCQ /Viva/ Involvement in classroom activities</p> <p>Practical (5 marks) Lab involvement</p> <p>B. Semester end examination</p> <p>Theory: Written examination (50 Marks)-1.5 hrs.</p> <p>i) MCQ 20 questions: $20 \times 1 = 20$ ii) Short essay 4 questions (out of 6): $4 \times 5 = 20$ iii) Essay 1 question (out of 2): $1 \times 10 = 10$</p> <p>Practical: 20 marks-1 hrs.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

REFERENCES

1. Puri, Sharma, Pathania, *Principles of Physical Chemistry*, 48th Edn. Vishal Publishing Company, 2012
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Suggested Readings

1. R P W Atkins, *Physical Chemistry*, Oxford University Press; 12th edition (5 December 2022)
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Polymer Chemistry					
Type of Course	DSE					
Course Code	24SACCHE4DE201					
Course Level	200-299					
Course Summary	This course explores synthesis, structure, properties and applications of important polymers.					
Semester	IV	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the fundamental concepts of polymers, polymerisation reactions and techniques	U	1,2,3
2	Analyse basic determinants of polymer properties	An	1,2,3
3	Develop a comprehensive idea of tacticity in polypropylene and Ziegler-Natta polymerisation of alkenes.	A	1,2,3
4	Examine the structures, properties, and applications of addition polymers, condensation polymers and polymer resins	U	1,2,3

5	Identify the importance of the vulcanization process and the practical aspects of formulating rubber compounds.	A	1,2,3
6	Analyse the applications of advanced polymers	An	1, 2
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

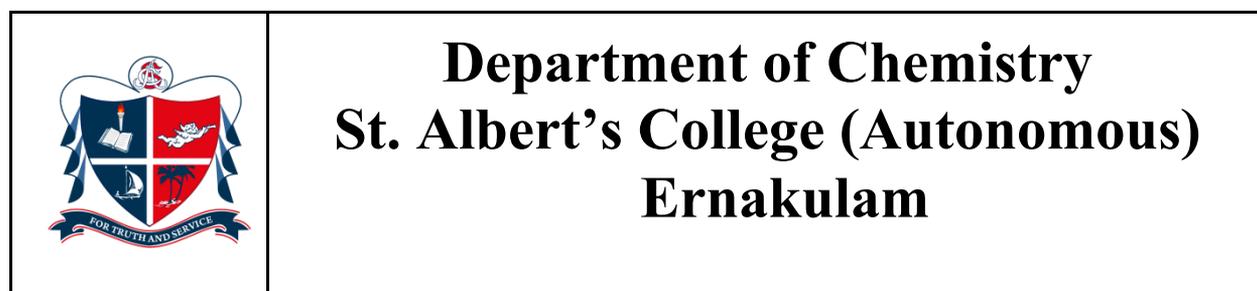
Module	Units	Course description	Hrs	CO No.
1.	Introduction to polymers and polymerisation reactions			
	1.1	Monomers, oligomers, and polymers. Classification of polymers-based on origin, structure and intermolecular forces Importance of polymers in life- proteins and DNA. (Elementary idea only).	5	1,2
	1.2	Addition polymerisation of olefins - classification (cationic, anionic and free radical), mechanism.	4	1
	1.3	Mechanism of condensation polymerisation (polyamides and polyesters) and ring opening polymerisation (Nylon 6). Living polymerisation -definition and applications only	5	1,2
	1.4	Self-healing polymers and shape-memory polymers- definition and applications only	1	1,2
2.	Polymerisation Techniques			
	2.1	Definition, advantages, disadvantages and examples of bulk polymerisation, suspension polymerisation, solution polymerisation and emulsion polymerisation.	5	1
	2.2	Structure-property relationships of polymers: tacticity in polypropylene –isotactic, syndiotactic and atactic. Ziegler-Natta polymerisation of alkenes. Crystalline and amorphous polymers. Basic determinants of polymer properties: Polymer chain flexibility, Factors affecting chain flexibility.	5	1,4

	2.3	Molecular weight of polymers: Number average (M_n), weight average (M_w), Polydispersity index. Glass transition temperature (T_g): Definition. Factors influencing glass transition temperature (T_g). Importance of T_g .	5	3
3.	Chemistry of Commercial Polymers			
	3.1	Brief introduction to the structure, properties and applications of the following addition polymers: polyolefins (LDPE, HDPE and PP), poly (vinyl chloride), polystyrene, poly (vinyl acetate), acrylic polymers (PAN and PMMA), fluoropolymers (PTFE).	5	5
	3.2	Brief introduction to the structure, properties and applications of the following polymers: aliphatic polyamides (Nylon 6,6 and Nylon 6), aromatic polyamides (Kevlar), polyesters (PET).	4	5
	3.3	Brief introduction to structure, properties and applications of the following resins: Formaldehyde resins (PF, UF and MF), polyurethanes, polycarbonates and epoxy resins.	3	5
	3.4	Introduction to vulcanisation of natural rubber-types of vulcanisation (EV, semi-EV and CV), activator system, accelerator system. Formulation of a rubber compound – rubber mat.	3	6
4	Polymeric Materials for Special Applications			
	4.1	Support materials: materials based on polystyrene-cross linking with divinylbenzene-applications.	3	6
	4.2	Drug release agents: biodegradable polyurethane Temperature sensitive polymers as drug delivery agents: LCST polymers-examples and applications.	5	6
	4.3	Conducting polymers: polyacetylene- doping, synthesis and applications	3	6
	4.4	Photo-conducting polymers: applications of poly(vinyl carbazole)	2	6
	4.5	Heat and flame retardant polymers: nomex-applications	2	6
5	Teacher Specific Content			

Teaching and Learning Approach	<p>Classroom Procedure (mode of transaction)</p> <p>Lecture-based approach, interactive discussions, laboratory sessions, flipped classroom, peer teaching and collaborative learning.</p>
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA) Theory : 30 marks</p> <p>Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>B. End Semester examination Theory:70 marks- 2 hrs.</p> <p>i) MCQ 20 questions: $20 \times 1 = 20$ ii) Short essay 6 questions (out of 8): $6 \times 5 = 30$ iii) Essay 2 question (out of 4): $2 \times 10 = 20$</p>

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11. A. Ravve, *Principles of Polymer Chemistry*, Springer, 2012.



Programme	BSc (Hons) CHEMISTRY					
Course Name	Food Chemistry					
Type of Course	DSE					
Course Code	24SACCHE4DE202					
Course Level	200-299					
Course Summary	This course covers the scientific principles behind the composition, structure, properties, and reactions of food components. It also deals with topics related to the various substances added to food to enhance flavour and taste, improve texture and prolong shelf life.					
Semester	IV	Credits				4
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		4				
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyse the chemical composition of various food components such as proteins, carbohydrates, lipids, vitamins, and minerals.	An	1,2,3
2	Apply principles of food chemistry to understand and predict the behaviour of food during processing, storage and cooking.	A	1,2,3
3	Explain the significance of food additives.	U	1,2,3
4	Analyse the impact of food practices in the society	An	1,2,4,5, 6, 8

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Food Additives			
	1.1	Food additives – definition. Preservatives- natural food preservatives, traditional food preservation methods, artificial preservative agents, modern food preservation techniques, safety concerns of food preservatives.	3	2,3
	1.2	Food Colours- classification, chemistry of food colourants, non-permitted food colours, quality assurance of food colourants.	2	2,3
	1.3	Fragrances, flavouring agents and enhancers- classification, chemistry, quality control of flavour compounds.	2	2,3
	1.4	Emulsifiers- mechanism, role, types with examples.	1	2,3
	1.5	Stabilisers, gums, thickeners and gelling agents	1	2,3
	1.6	Antioxidants- types, chemistry, safety concerns of antioxidants.	2	2,3
	1.7	Food acids and acidity regulators, flour treatment/ improving agents, leavening agents, anticaking agents, minerals and mineral salts, dietary supplements- vitamins	3	2,3
	1.8	FSSAI, Food safety and standards act	1	2,3
2	Role of Water, Carbohydrates, Lipids and Proteins in Food			
	2.1	Structure and chemical properties of water, solute effects on water: state of water in foods, water activity: principles, measurement, control, effects and related concepts.	4	1
	2.2	Carbohydrates- basic chemistry, reactivity and sweetness of simple sugars and oligosaccharides, sugar derivatives: sugar alcohols, glycosides. Browning and related reactions. Polysaccharides- starch, cellulose, gums.	4	1,2
	2.3	Lipids- content and role in food, chemical, nutritional and physical properties, processing of fats and oils, degradation reactions.	3	1,2

	2.4	Proteins- amino acids and proteins, physical properties of proteins,,: hydration, ionization, colloidal behaviour, functional properties, effects of food processing: changes occurring in chemical, functional & nutritional properties of proteins	4	1,2
3	Enzymes, Vitamins and Minerals			
	3.1	Food enzymes: enzymes acting on carbohydrates, proteins and lipids.	3	1,2
	3.2	Vitamins- fat-soluble vitamins, water-soluble vitamins, sources of vitamins, general causes of variation/losses of vitamins in food, biological function of vitamins, toxicity of vitamins.	5	1,2
	3.3	Essential mineral elements, nutritional aspects of minerals, bioavailability, effect of processing on mineral bioavailability, chemical and functional properties of minerals in foods.	5	1,2
	3.4	Societal role of food chemists	2	4
4	Herbs and Spices			
	4.1	Black Pepper: black pepper and white pepper, blackening of pepper, piperine- properties. Health benefits.	3	4
	4.2	Ginger: components, medicinal uses.	2	4
	4.3	Turmeric: uses, components and medicinal applications.	2	4
	4.4	Cinnamon: components and uses.	2	4
	4.5	Cardamom: Components and uses.	2	4
	4.6	Adulteration of herbs and spices.	2	4
	4.7	Wine: production of wine grapes and wine.	2	4
5	Teacher Specific Content			
Teaching and Learning Approach	Classroom Procedure (mode of transaction) Lecture-based approach, interactive discussions, laboratory sessions, flipped classroom, peer teaching and collaborative learning.			
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) 30 marks Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities			

	<p style="text-align: center;">B. End Semester examination (70 marks)- 2hrs.</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>
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1. S. Damodaran, K. L. Parkin, Fennema's *Food Chemistry*, 5th Edn. CRC Press 2017.
2. H. D. Belitz, W. Grosch and P. Schieberle, *Food Chemistry*, 4th Edn. Springer, 2009.
3. T. Coultate, *Food: The Chemistry of Its Components*, 6th Edn. RSC. 2015.
4. T. A. M. Msagati, *Chemistry of Food Additives and Preservatives*, John Wiley & Sons, 2013.
5. V. Kontogiorgos, *Introduction to Food Chemistry*, Springer, 2021.
6. N. Agarwal and A. Srivastava, *Food Chemistry*, Anu Books, 2023.
7. C. M. Weaver and J. R. Daniel, *The Food chemistry Laboratory*, CRC Press, 2005.
8. S. S. Nielsen, *Food Analysis Laboratory Manual*, 3rd Edn. Springer, 2019.
9. D. D. Miller and C. K. Yeung, *Food Chemistry A Laboratory Manual*, Wiley, 2022.
10. A. V. Ramani, *Food Chemistry*, Mjp Publishers. 2011.
11. J. M. deMAN, *Principles of Food Chemistry*, Springer, 2018.
12. V. Kontogiorgos, *Introduction to Food Chemistry*, Springer, 2021.



		Department of Chemistry St. Albert's College (Autonomous) Ernakulam			
Programme	B.Sc (Honours) Chemistry				
Course Name	Material Chemistry				
Type of Course	DSE				
Course Code	24SACCHE4DE203				
Course Level	200-299				
Course Summary	This course covers the synthesis, characterization, and application of materials, focusing on nanomaterials, ceramics, polymers, and composites. Through theoretical knowledge and practical applications, students will gain a comprehensive understanding of how materials are developed and utilized in various technological and industrial sectors.				
Semester	IV	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3		1	
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyse the concept of polymers its property and applications	K,U, A	1,2,3
2	Explain the categories of nanomaterials, various techniques used for the preparation and its applications.	U	1,2,3
3	Analyse the new developments in ceramic materias and its applications	K,U, A, E	1,2,3
4	Describe different types of advanced materials and composites.	K, U, An, E	1,2,3

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT**Content for Classroom transaction (Units)**

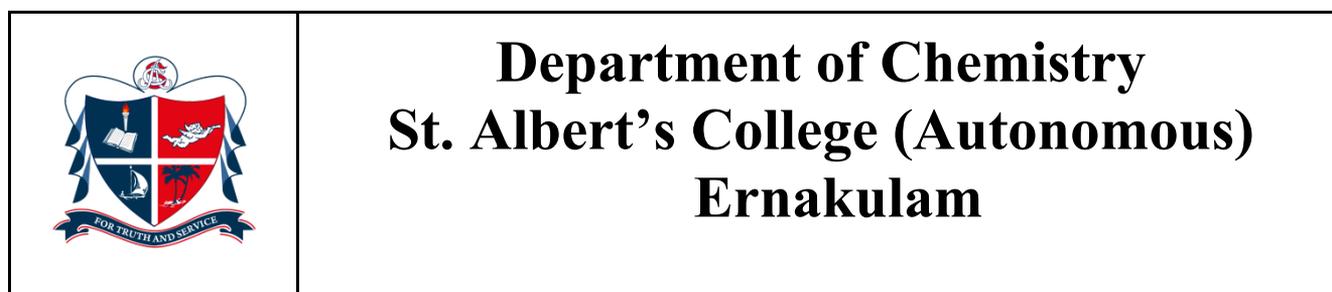
Module	Units	Course description	Hrs	CO No.
1	Polymers			
	1.1	History, Classification, Polymerization Mechanism, Bulk polymerization, solution polymerization, suspension polymerization, Emulsion polymerization	4	1, 2,3
	1.2	Physio-chemical properties of polymers, Polymerization techniques, Molecular Weight, Crystallinity and Tg	5	
	1.3	Industrially important Polymers- Polymeric materials for special applications	4	
	1.4	Biodegradable polymers, Environmental impact of plastics	2	
2	Nanomaterials			
	2.1	Basic definition, Feynman's hypothesis, Moore's Law, Nano scale, Preparation,	2	1,2
	2.2	Characterization through UV visible spectroscopy, XRD, SEM analysis, Different types of nano materials.	5	
	2.3	Medical and health care applications, Electrical and optical applications of nano materials. .	5	2,3
	2.4	Nanomaterials in Energy and Environmental applications, Nano materials for defense applications	3	2,3
3	Advanced materials (15 Hours)			
	3.1	Ceramics, classification, Importance of Modern ceramic materials, their structure, properties, applications, potential uses and limitations.	3	1, 2,4
	3.2	Composites: Different types based on matrix. Advantages and limitations of composites. Properties of composites	7	
	3.3	Advanced composite materials, Function of matrix and reinforcements. Multifunctional composites,	5	

Practical			
4	4.1	Polymerization of Styrene, PMMA by free radical polymerization Emulsion and suspension polymerization of various polymers. Analysis of LDPE and HDPE Estimation of Molecular weight of polymers Preparation and characterization of different nano metal oxides. Preparation of some ceramic Formulations	30 2,3,4

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Peer teaching ● Demonstration of experiments ● Hands-on training
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) 30 marks Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	B. Semester End examination (70 marks)- 2hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

REFERENCES

1. Polymer Science and Technology, Joel R Fried
2. Fundamentals of Ceramics (Series in Materials Science and Engineering) Hardcover – 27 November 2002. by Michel Barsoum (Author), M.W Barsoum (Author)
3. Engineering Materials and Metallurgy K Sreenivasan
4. Nano the Essentials: understanding nanoscience and technology. T Pratheep Kumar



Department of Chemistry St. Albert's College (Autonomous) Ernakulam

Programme	B.Sc. Chemistry (Honours) with specialization in Industrial Chemistry				
Course Name	INDUSTRIAL CHEMISTRY I				
Type of Course	DSE				
Course Code	24SACCHE4DE204				
Course Level	200-299				
Course Summary	This course provides students with a comprehensive understanding of basics of industrial chemistry including catalysis and its diverse applications in industrial processes. Students acquire an in-depth overview of the petroleum industry. This course also provides a comprehensive overview of coal as an energy resource, its origin, properties, classification, utilization, and major industries associated with coal mining and processing in India. The course offers students the theoretical knowledge and practical skills related to various chemical industries, including lubricants, cement production, and batteries.				
Semester	IV	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3		1	4
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the fundamentals of industrial chemistry and industrial catalysis.	U	1,2
2	Understand the basic properties of fuels and analyze the characteristics of a good fuel.	A, An	1,2
3	Describe the origin, composition, and classification of coal, and evaluate different coal conversion processes, for the production of liquid fuels and by-products.	U, E	1,2

4	Understand the chemistry and production processes chemical industries and analyse the characteristics of industrial products.	U, An	1,2
5	Apply theoretical knowledge to practical scenarios in industrial inorganic chemistry.	Ap	1,2
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1 Basics of Industrial Chemistry (15 Hours)	1.1	Introduction to industrial chemistry – classification of industries, basic requirements and production of chemicals and raw materials. Introduction to unit processes and unit operations.	4	1
	1.2	Key concepts in industry management - quality control, quality assurance, process control, research and development, pollution control and safety measures, human resource, selection of parameters for chemical industry, classification of industrial chemical reactions - batch and continuous operations.	4	1
	1.3	Industrial Catalysis: Introduction, types of catalysis-homogeneous and heterogeneous, Characteristics of catalysts. Catalytic promoters, catalytic poisons, acid-base catalysis, auto catalysis, Introduction to phase transfer catalysis. Enzyme Catalysed reactions, characteristics of enzymes. Applications of catalysts in industries.	7	1
2 Fuel Industry (15 Hours)	2.1	Fuels: Introduction –Solid, liquid and gaseous fuels, Characteristics of a good fuel, Calorific value –GCV & NCV, Calorific values of different fuels.	2	2
	2.2	Petroleum: Introduction, origin, Composition of crude oils. Natural gas - LNG, CNG. Petroleum refining- Fractional Distillation of petroleum. Cracking: thermal and catalytic cracking, Reforming-Isomerisation, Octane and cetane rating. Petroleum products: LPG, Naphtha, Kerosene, MS, asphalt, HSD, ATF, Furnace oil and Bitumen. Petroleum Refineries in India.	1 2 2	2

	2.3	Coal: Origin, classification of coal, analysis of coal-proximate and ultimate analysis Coal Carbonization, Coal liquefaction - Fischer-tropsch method and Bergius process, Coal gasification, Products from coal – Coal tar, Coal tar chemicals, Coal gas. Major coal related industries in India.	1 3 1	3
	2.4	Alternate fuels: Biogas, Biodiesel, Ethanol mixed petrol, Hydrogen. Other gaseous fuels: Producer gas, Water gas, oil gas.	3	3
3 Other Chemical Industries (15 Hours)	3.1	Lubricants : Types of lubricants-solid, liquid (lubricating oils), semi-solid (grease-types), synthetic lubricants, Properties of lubricants (viscosity, viscosity index, pour point, flash point)	3	4
	3.2	Cement Industry: Raw materials used for cement manufacturing and its proportionating, dry process, wet process, semi wet process, Setting of cement, factors affecting setting time. Types of cement - Portland cement, blended cement, special cement - chemical composition and physical properties, ISI Specifications of Cement, Cement corrosion.	3 3	4
	3.3	Batteries: Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Lead acid battery, Lithium-ion battery, Solid state electrolyte battery. Fuel Cells, Solar cell and polymer cell.	2 4	4
4 Industrial Chemistry Practical (30 hours)	4.1	Cement analysis: 1. Determination of setting time of cement with different water to cement ratio. 2. Determination of percentage of silica in the given cement sample. 3. Determination of fineness of cement by sieve analysis. 4. Determination of heat of hydration of cement using calorimeter. 5.	10	5
	4.2	Fuels and lubricants: 1. Determination of density of different fuels. 2. Determination of viscosity of different liquid lubricant samples using viscometer. 3. Preparation of biodiesel from vegetable oil. 4. Preparation of grease.	10	5

	4.3	Catalysis: 1. Comparison of acid and base catalysis for sucrose inversion reaction. 2. Synthesis of aspirin using acid-catalysed esterification reaction.	5	5
	4.4	Separation techniques: 1. Purification of crude aniline by simple distillation. 2. Purification of liquids from a mixture using separating funnel. 3. Purification of solids using recrystallization. 4. Separation of solids using centrifugation.	5	5

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> • Lecture • Interactive Discussions • Power point presentations • Laboratory Sessions • Peer Teaching • Industrial visit
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment Theory (30 marks) Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	B. Semester End examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

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1. B. K. Sharma, Industrial Chemistry, Krishan Prakashan, 2014.
2. B. Delmon, G.Janner, Catalysis-Heterogeneous and homogeneous.
3. J. Anderson, Catalysis science and technology
4. J. Fendler , E. Fendler, Catalysis in micellar and macromolecular systems
5. K. Rideal, H. S. Taylor, Catalysis in theory and practice
6. Starles, Phase transfer catalysis, Principles and techniques
7. Delmon, Catalysis: Heterogeneous and homogeneous, Elsevier science publisher
8. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi
9. T. Sathesh Babu, A textbook for Engineering Chemistry Aspirants, Saradhi Publishers, Kerala.
10. B.K.Sharma: Engineering Chemistry, Goel Publishing House, Meerut

	Department of Chemistry St. Albert's College (Autonomous) Ernakulam				
Programme	B.Sc. (Honors) Chemistry				
Course Name	Rubber Chemistry				
Type of Course	24SACCHE4SE201				
Course Code	To be prepared by the College				
Course Level	200-299				
Course Summary	This course explores the basic aspects of rubber production and processing and modifications of natural rubber and its applications.				
Semester	IV	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		2		1	
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the characteristics and production of Natural Rubber	K, U	1,2,3
2	Demonstrate the rubber compounding techniques.	U, A	1,2,3
3	Differentiate between various grades of natural rubber	An	1,2,3
4	Understand and evaluate the Vulcanization Process	K, U, An, E	1,2,3
5	Apply theoretical knowledge to real-world production scenarios and enhancing hands-on skills in rubber processing	A, An	1,2,3

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Introduction, Production and Processing of Natural Rubber			
	1.1	Sources and History of natural and Synthetic Rubber.	2	1,3,
	1.2	Advantages and Disadvantages of Natural Rubber	1	
	1.3	Difference between Heavea and Gutta Percha Rubber, synthetic rubber.	2	
	1.4	Significance of structure of natural rubber in contrast to the Synthetic Rubber, Aging of rubber.	2	3
	1.5	Different grades of natural rubber from latex - pale crepe and smoke sheet rubber	1	1,2,3
	1.6	Latex NR latex types and grades;	3	
	1.7	Preservation, concentration, stability, gelatin, coacervation Gradation system, processing characteristics & curing systems.	4	
2	Compounding and Applications of Rubber			
	2.1	Mastication, Compounding of natural and synthetic rubber	2	3,4
	2.2	Compounding ingredients and methods of compounding.	2	
	2.3	Vulcanization, Sulphur Vulcanization and Non sulphur Vulcanization,	3	
	2.4	Some Major rubber products i.e. synthetic rubber, Polyurethane etc.	2	5
	2.5	Silicones, and their application	3	
	2.6	Industrial fabrication of few rubber articles such as conveyer belt, House pipes Rubber (TPR) and gloves	3	
3	Practicals and Workshop			
	3.1	<ul style="list-style-type: none"> • Determination of Dry Rubber Content • Alkalinity of Latex • Solid content • Latex formulation • Latex Treatment 	15	1,2,3,4
	3.2	<ul style="list-style-type: none"> • Workshop on Dipped Products 	15	

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> • Lecture • Group discussion • Peer teaching • Demonstration of experiments • Hands-on training
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<p>Assessment Types</p>	<p>MODE OF ASSESSMENT</p> <p>Continuous Comprehensive Assessment (CCA)</p> <p>Theory : 15 marks</p> <p>Quiz/ Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>Practical : 10 marks</p> <p>Lab involvement/ skill /Report of lab works done</p> <p>Semester End examination</p> <p>Theory: Written examination (35 Marks)- 30 mins</p> <p>MCQ 35 questions : 35 X 1 = 10</p> <p>Practical: (15 Marks)-1 hr.</p> <p>Lab Skill/ Lab Test: 10 marks Viva voce: 3 marks Writing procedure: 2 marks</p>
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REFERENCES

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2. Ghosh, Premamoy. *Polymer Science and Technology: Plastics, Rubber, Blends and Composites*. 3rd ed., McGraw Hill Education, 2010.
3. Bahadur, P., and N. V. Sastry. *Principles of Polymer Science*. Narosa Publishing House, 2002.
4. Billmeyer, Fred W. *Textbook of Polymer Science*. 3rd ed., Wiley-Interscience, 1984.

SUGGESTED READINGS

1. Practical Guide to Latex Technology Rani Joseph
2. Chemistry, Manufacture and Applications of Natural Rubber 1st Edn - February 6, 2014 Editors: Shinzo Kohjiya, Yuko Ikeda
3. Rubber Chemistry J. A. Brydson Applied Science Publishers



Department of Chemistry St. Albert's College (Autonomous) Ernakulam

Programme	B.Sc (Honours) Chemistry					
Course Name	Basic Environmental Chemistry					
Type of Course	VAC					
Course Code	24SACCHE4VA201					
Course Level	200-299					
Course Summary	This course explores various aspects of environmental chemistry such as greenhouse effect, air and water pollution and renewable energy sources.					
Semester	IV			Credits		3
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3				
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe basic concepts of environmental chemistry.	U	1,2, 3, 4, 5, 6, 8
2	Describe strategies for the remediation and purification of contaminated soil, air and water.	U	1,2,10
3	Apply principles of green chemistry to propose sustainable solutions for minimizing environmental contamination.	A	1,2,6,8,10
4	Discuss the basic chemical processes involved in air and water pollution and global warming identifying key sources.	U	1,2,8

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

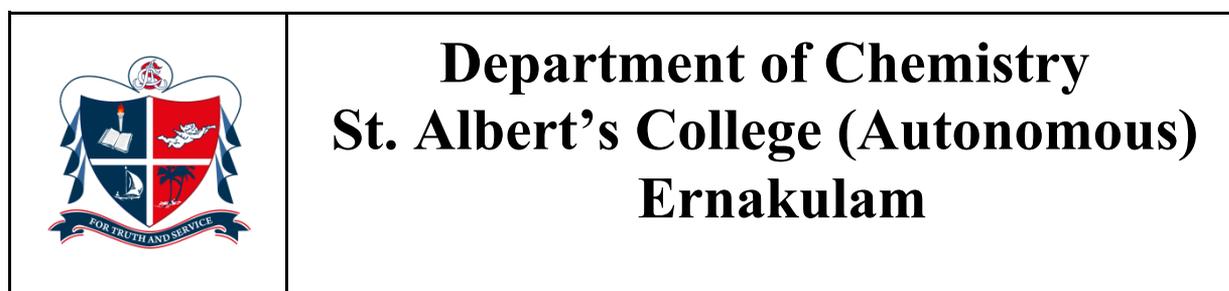
COURSE OUTCOME**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Introduction to the Environment			
	1.1	Classification of the environment-troposphere, stratosphere, mesosphere, thermosphere, exosphere, hydrosphere, lithosphere and biosphere	5	1
	1.2	Greenhouse gases and global warming: natural occurring greenhouse gases, anthropogenic greenhouse gases, other greenhouse gases, ozone, global warming potential (GWP), emission metrics, influence of technology on global warming.	8	4
	1.3	Schemes to reduce greenhouse gases: capture and storage of carbon dioxide, sequestration of CO ₂ . other schemes to reduce greenhouse gases, removing CO ₂ from the atmosphere: direct air capture, carbon dioxide emissions in the future	7	2,4
2	Air and Water Pollution			
	2.1	Water pollution causes, categories of water pollution, the long-term consequences of water pollution, basic idea of waste water purification and disinfection	5	2,3,4
	2.2	Air pollution: particulates, fog smog, acid rain, ozone umbrella, depletion- causes, basic idea of air quality improvement methods.	5	2,3,4
3	Renewable Energy and Sustainability			
	3.1	Renewable energy: hydroelectric, wind, solar, geothermal, and marine energy and their storage and hydrogen as sustainable energy	6	3
	3.2	Biomass energy: biofuels and their resources, decarbonization with biomass utilization. Conversion of biomass to other fuels- ethanol fuel, biodiesel fuel, fuel from algae. Biogas	6	3
	3.3	Sustainable materials: environmental effects of mining and mineral extraction, sustainable utilization of geospheric mineral resources- metals and nonmetal mineral resources	3	3
4	Teacher Specific content			

Teaching and Learning Approach	Classroom Procedure (mode of transaction) Lecture-based approach, interactive discussions, laboratory sessions, flipped classroom, peer teaching and collaborative learning
Assessment Types	MODE OF ASSESSMENT Assignment Viva Classroom participation (participation in class activities) Examination Continuous Comprehensive Assessment (CCA) Theory : 25 marks Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities Semester End examination Theory- 50 marks – 1.5 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10

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2. C H. Middlecamp, *Chemistry in Context: Applying Chemistry to Society*, A Project of the American Chemical Society, McGraw-Hill, 2012.
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7. V. Subramanian, *A Text Book Of Environmental Chemistry*. Wiley, 2020.



Programme	B.Sc (Honours) Chemistry				
Course Name	Fundamentals of Physical Chemistry				
Type of Course	DSC C				
Course Code	24SACCHE4DC201				
Course Level	200-299				
Course Summary	This course provides the student a thorough knowledge about solids and surface chemistry. It also gives basic information on green chemistry and nano chemistry along with an introduction on spectroscopy.				
Semester	IV	Credits			4
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3		1	
Pre-requisites, if any					
					Total Hours 75

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe types of solids, crystals and properties of solids	U	1,2
2	Discuss the adsorption of gases by solids	U	1,2
3	Analyse the properties and applications of colloids	An	1,2
4	Apply the basic principles of electrochemistry to conductance and emf measurements.	A	1,2
5	Apply the principles of electrochemistry to conduct simple laboratory experiments.	A, S	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
Solid State				
1	1.1	Classification of solids: amorphous and crystalline – differences. Crystal lattice, unit cell, examples of simple cubic, bcc and fcc lattices, calculation of number of atoms in a unit cell, calculation of lattice parameters of cubic unit cell.	6	1
	1.2	Electrical properties: Conductors, semiconductors and insulators, band theory, superconductors. Magnetic Properties: classification-paramagnetic, diamagnetic, ferromagnetic, antiferromagnetic and ferrimagnetic. Permanent and temporary magnets.	6	1
Surface chemistry and colloids				
2	2.1	Adsorption – types of adsorption of gases by solids, factors influencing adsorption, Freundlich and Langmuir adsorption isotherm (derivation not required).	3	2
	2.2	True solution, colloidal solution and suspension. Classification of colloids: lyophilic, lyophobic, macromolecular, multimolecular and associated colloids with examples. Purification of colloids by electrodialysis and ultrafiltration.	4	3
	2.3	Properties of colloids: Brownian movement, Tyndall effect, electrophoresis. Origin of charge and stability of colloids, zeta potential, coagulation, Hardy-Schulze rule, protective colloids, gold number. Emulsions.	3	3
	2.4	Applications of colloids: delta formation, medicines, emulsification, micelle formation, cleaning action of detergents and soaps.	2	3

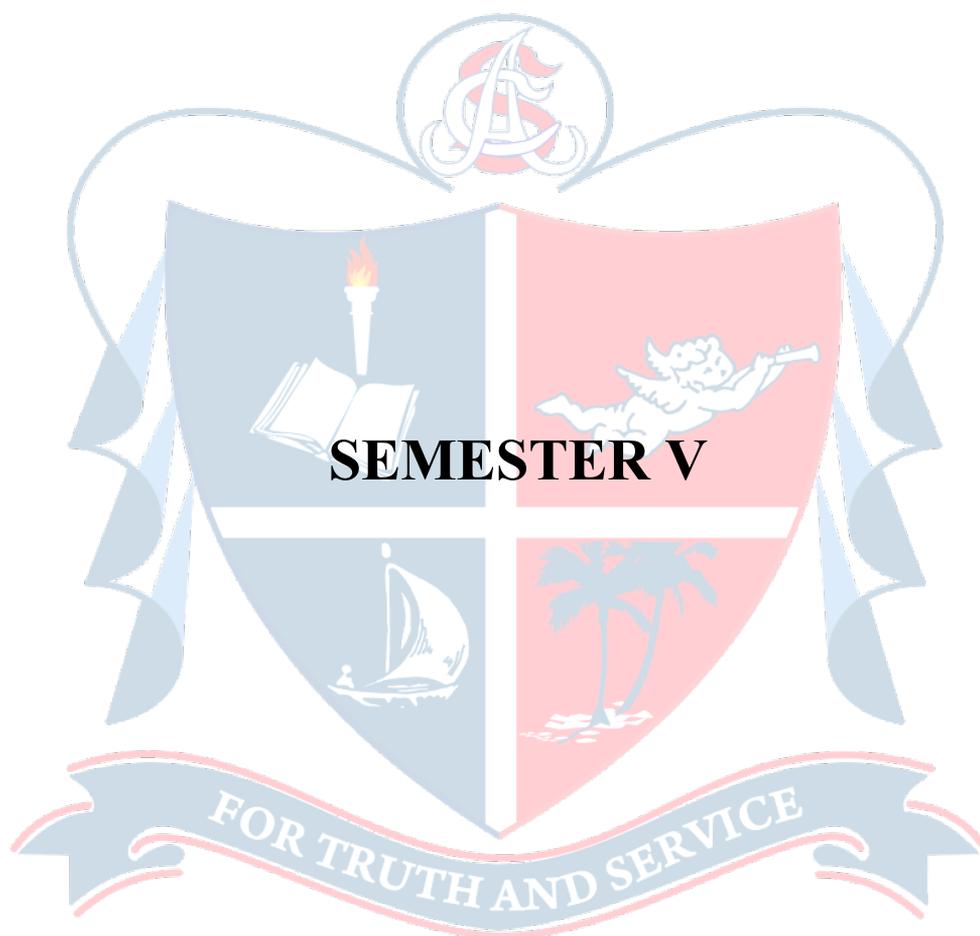
Electrochemistry				
3	3.1	Introduction, Faraday's laws of electrolysis, electrochemical equivalent and chemical equivalent	3	4
	3.2	Specific conductance, equivalent conductance and molar conductance, variation of conductance with dilution - Kohlrausch's law - degree of ionization of weak electrolytes	4	4

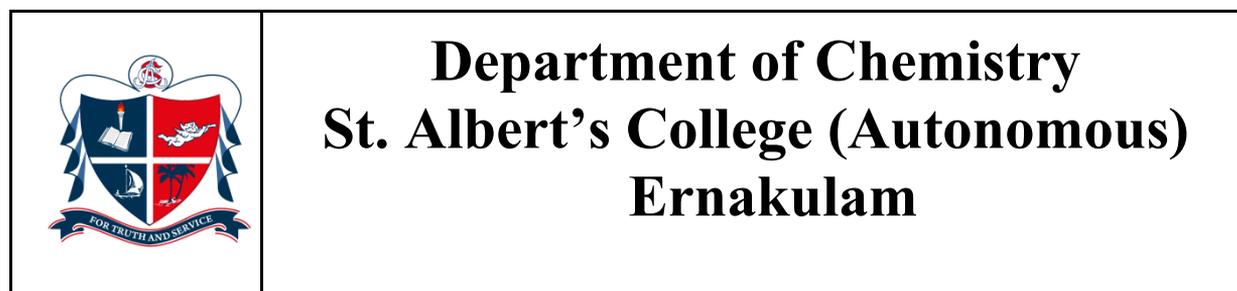
	3.3	Application of conductance measurement: s determination of degree of dissociation of weak electrolytes, conductometric titrations involving strong acid- strong base, strong acid-weak base, weak acid- strong base, and precipitation titrations.	5	4
	3.3	Galvanic cells - Cell and electrode potentials - IUPAC sign convention, Types of electrodes: reference electrodes – standard hydrogen electrode and calomel electrode, indicator electrodes-metal-metal ion electrodes, Quinhydrone electrode and Redox electrodes. Standard electrode potential - Nernst equation, electrochemical series. Gibb's Helmholtz equation and EMF of a cell.	7	4
	3.4	Potentiometric titrations of acid-base, redox and precipitation reactions.	2	4
	Physical Chemistry Practicals			
4	1. Viscosity-percentage composition of sucrose solution. 2. Transition temperature of salt hydrates, e.g. Sodium thiosulphate Sodium acetate etc. 3. Critical solution temperature of phenol water system 4. Conductometric titration of strong acid Vs. strong base 5. Potentiometric titrations : Fe^{2+} Vs. $\text{Cr}_2\text{O}_7^{2-}$ and Fe^{2+} Vs. KMnO_4 6. Determination of molecular weight by Rast's method. 7. Phase diagram of two component systems		30	5
5	Teacher Specific Content			
Teaching and Learning Approach	Classroom Procedure (mode of transaction) <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Peer teaching ● Demonstration of experiments ● Hands-on training 			
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment Theory (25 marks) Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities Practical (5 marks) Lab involvement/Quiz			

	<p style="text-align: center;">B. Semester end examination</p> <p style="text-align: center;">Theory: Written Examination (50 Marks)- 1.5 hrs.</p> <p>i) MCQ 20 questions: $20 \times 1 = 20$ ii) Short essay 4 questions (out of 6): $4 \times 5 = 20$ iii) Essay 1 question (out of 2): $1 \times 10 = 10$</p> <p style="text-align: center;">Practical: (20 marks)- 1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>
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REFERENCES

1. B. R. Puri, L. R. Sharma and M. S. Pathania, *Principles of Physical Chemistry*, 48th Edn., Vishal Publishing Company, New Delhi, 2020.
2. F. Daniels, R. A. Alberty, *Physical Chemistry*, 5th Edn., John Wiley and Sons, Canada, 1980
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4. K.K. Sharma and L.K. Sharma, *A Textbook of Physical Chemistry*, 5th Edition, Vikas Publishing House, New Delhi, 2012.
5. G. M. Barrow, *Physical Chemistry*, 5th Edition, Tata McGraw Hill Education, New Delhi, 2006.
6. S. Glasstone, *An Introduction To Electrochemistry*, Legare Street Press, 2022.
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8. R. C. Das and B. Behra; *Experiments in Physical Chemistry*, Tata McGraw hill, 2010.
9. R. Kumari, A. Anand, *Physical Chemistry Laboratory Manual: An Interdisciplinary Approach*, Dreamtech Press, 2020.





Department of Chemistry St. Albert's College (Autonomous) Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Organic Chemistry - 3					
Type of Course	DSC A					
Course Code	24SACCHE5DA301					
Course Level	300-399					
Course Summary	This course explores nitro compounds, amines, cyanides, isocyanides ethers and epoxides, heterocyclic compounds, active methylene compounds and organic photochemistry. Practical part of the course includes qualitative microscale analysis and reactions of nitrogen containing compounds					
Semester	V	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Predict the product and reasonable mechanism for the reactions of nitro compounds, amines, diazonium salts, cyanides, and isocyanides	A	1,2
2	Explain the reactions of ethers and epoxides	U	1
3	Identify the aromaticity, properties and biological significance of heterocyclic compounds	A	1,2,3
4	Outline synthetic applications of active methylene compounds	U	1,2
5	Apply photochemical methods to organic synthesis	A	1,2
6	Analyze and prepare nitrogen containing compounds and systematically record the observation	An, S	1,2,4,10

COURSE CONTENT**Content for Classroom transaction (Units)**

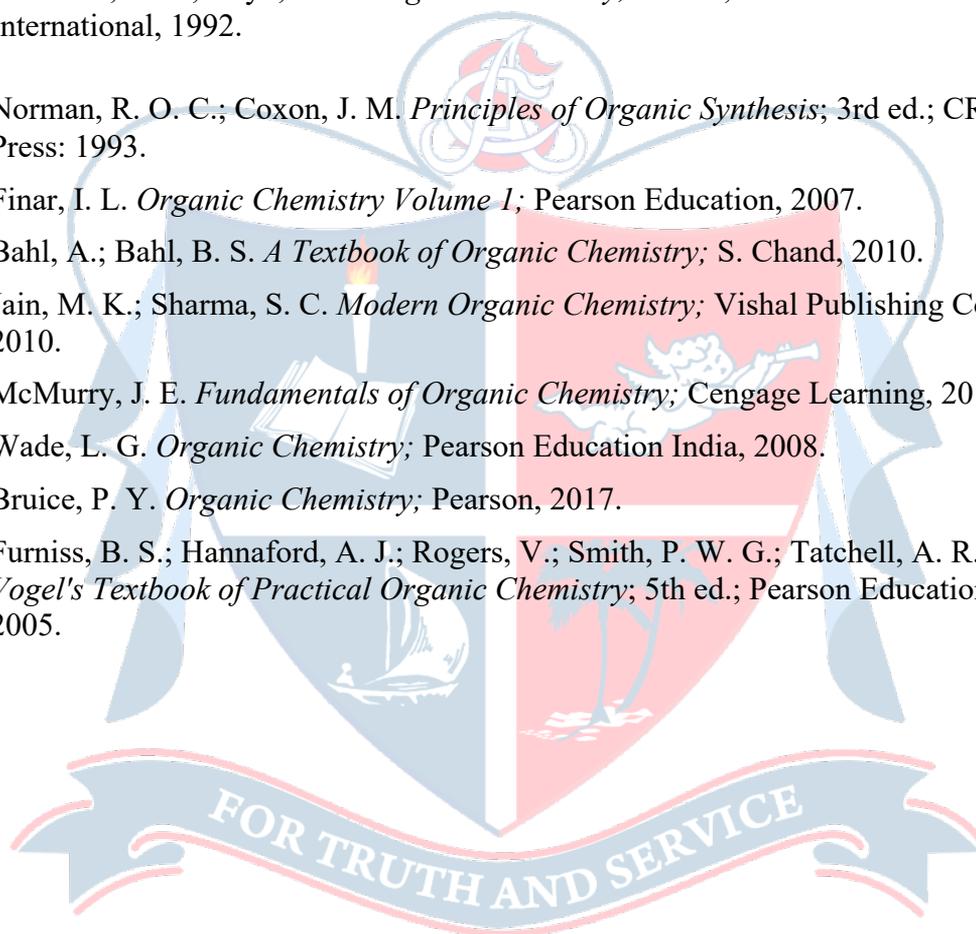
Module	Units	Course description	Hrs	CO No.
1	Nitrogen Containing Compounds			
	1.1	Nitro Compounds: Preparation of aliphatic and aromatic nitro compounds Tautomerism of nitromethane.	1	1
	1.2	Reactions of nitro compounds: Reduction products of nitrobenzene in acidic, neutral and alkaline media. Electrolytic reduction, and selective reduction of polynitro compounds.	3	1
	1.3	Preparation of amines: Gabriel's phthalimide synthesis, Hoffmann bromamide reaction (with mechanisms).	2	1
	1.4	Basicity of aliphatic and aromatic amines – a comparative study, Hinsberg test, Quaternary amine salts as phase-transfer catalysts.	4	1
	1.5	Preparation of diazonium salts from aromatic amines, conversion of diazonium salts to benzene, phenol, chloro, bromo, iodo and fluoro benzenes, nitro benzene and azo dyes with mechanisms.	3	1
	1.6	Cyanides- Preparation from alkyl halides and carboxylic acids. Reactions- hydrolysis, reduction, reaction with Grignard reagent Isocyanides- preparation from alkyl halides and primary amines. Reactions-hydrolysis, reduction.	2	1
2	Ethers, Epoxides and Heterocyclic Compounds			
	2.1	Williamson's ether synthesis. Reactions of ethers - cleavage with HI, Claisen Rearrangement, Zeisel's method of estimation of alkoxy groups.	3	2
	2.2	Structure of epoxides, Reactions of epoxides with alcohols, ammonia derivatives and LAH.	2	2
	2.3	Classification of heterocyclic compounds, structure and aromaticity of furan, thiophene, pyrrole, pyridine and indole	3	3
	2.4	Synthesis and reactions- furan, thiophene, pyrrole (Paal Knorr synthesis and Knorr pyrrole synthesis), Pyridine (Hantzsch synthesis), Indole (Fischer Indole Synthesis),	5	3
	2.5	Importance of purines and pyrimidines in biological systems- adenine, thymine, guanine, cytosine and uracil	2	3

Active Methylene Compounds and Organic Photochemistry				
3	3.1	Structure and synthetic applications of ethyl acetoacetate and diethyl malonate (synthesis of carboxylic acids and ketones)	5	4
	3.2	Photochemistry: introduction. Photochemical versus Thermal reactions. Electronic excitation and fate of excited molecules.	2	5
	3.3	Photochemical reactions: Norrish type I and II reactions of acyclic ketones, Paterno-Buchi reaction and photo-Fries reaction (with mechanisms), Barton reaction (nitrite ester), di- π methane rearrangement Photochemistry of vision	8	5
4	Organic Chemistry – 3 Practicals			
		Qualitative Microscale analysis of organic compounds- Identification and preparation of derivatives of amines, amides and nitro-compounds, amides Preparation of m-dinitro benzene from nitro benzene Synthesis of methyl orange Biginelli Reaction	30	6
5		Teacher-Specific content		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> • Lecture - offline • Practical
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p>Theory (25 marks) Pop quizzes / Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>Practical (5 marks) Quiz/Lab involvement</p> <p>B. End Semester examination</p> <p>Theory: Written examination - 50 Marks-1.5 hrs.</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p>Practical (20 Marks)-1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

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1. Clayden, J.; Greeves, N.; Warren, S. *Organic Chemistry*; Oxford University Press, USA, 2012.
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12. Bruice, P. Y. *Organic Chemistry*; Pearson, 2017.
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Department of Chemistry St. Albert's College (Autonomous) Ernakulam

Programme	BSc (Hons) CHEMISTRY				
Course Name	Physical Chemistry- 2				
Type of Course	DSC A				
Course Code	24SACCHE5DA302				
Course Level	300-399				
Course Summary	This course covers the basic ideas of solid state, photochemistry and thermodynamics.				
Semester	V	Credits			4
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3		1	
Total Hours					75
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Illustrate the basic aspects of ionic solids and identify the crystal structure.	An	1, 2
2	Explain the types of defects in solids and properties of semiconductors and liquid crystals.	U	1, 2
3	Apply the fundamental principles of photochemistry to photochemical reactions.	U	1, 2
4	Explain the fundamental laws of thermodynamics and its application in isothermal, adiabatic and Joule-Thomson expansion processes.	U	1, 2
5	Apply the principles of chemical thermodynamics to thermochemical processes and systems of variable compositions.	A	1, 2
6	Apply principles of physical chemistry to conduct laboratory experiments.	A, S	1,2,4, 10

***Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
SOLID STATE				
1	1.1	Anisotropy in crystals, Laws of Crystallography – Law of constancy of interfacial angles, Law of rational indices. Weiss and Miller indices. X-Ray diffraction by crystals, Bragg's law	4	1
	1.2	Structure of ionic compounds of the type AX (NaCl, CsCl, ZnS) and AX ₂ (CaF ₂ , Na ₂ O) Defects in crystals – stoichiometric and non-stoichiometric defects. Electrical conductivity, semiconductors- n-type, p-type, Superconductivity (Elementary ideas)	6	1,2
	1.3	Liquid crystals - Classification, structure thermographic behavior and applications.	5	2
PHOTOCHEMISTRY				
2	2.1	Laws of photochemistry-Grothus-Draper law, Stark-Einstein law. Jablonski diagram-fluorescence, phosphorescence, non-radiative processes, internal conversion, intersystem crossing.	3	3
	2.2	Quantum yield, examples of low and high quantum yields, photochemical reactions (decomposition of HBr, isomerisation of maleic acid to fumaric acid), photosensitised reactions (photosynthesis, isomerization of 2-butene),chemiluminescence, bioluminescence.	3	3
THERMODYNAMICS				
3	3.1	Internal energy and enthalpy. Heat capacities at constant volume (C _v) and at constant pressure (C _p), relationship between C _p , C _v and R First law of thermodynamics –Mathematical statement of first law. Reversible process and maximum work. Calculation of work, heat, internal energy change and enthalpy change for the expansion of an ideal gas under reversible isothermal and adiabatic condition.	7	4
	3.2	The Joule-Thomson effect – derivation of the expression for Joule-Thomson coefficient. Significance of Joule-Thomson coefficient, inversion temperature.	2	4

	3.3	<p>Limitations of first law. Second law – Different statements of second law, thermodynamic scale of temperature. Carnot cycle and its efficiency, Carnot theorem.</p> <p>Concept of entropy – Definition and physical significance. Entropy as a function of volume and temperature, entropy as a function of pressure and temperature. Criteria of spontaneity and equilibrium.</p> <p>Gibbs and Helmholtz free energies and their significances- criteria of equilibrium and spontaneity. Gibbs-Helmholtz equation</p>	10	5
	3.4	<p>Third law of thermodynamics-statement and determination of absolute entropies of substances. Partial molar quantities – Chemical potential – Gibbs–Duhem equation</p> <p>Zeroth law of thermodynamics</p>	5	5
		Physical chemistry II- Practicals		
4		<ol style="list-style-type: none"> Heat of neutralization Heat of solution – KNO_3, NH_4Cl (Determination of heat of solution from solubility measurements) Surface tension - Determination of the surface tension of a liquid (Drop number method or Drop weight method). Surface tension - Determination of Parachor values Determination of the composition of two liquids by surface tension measurements Determination of CMC of surfactants by surface tension measurements 	30	6
5		Teacher-Specific content		
Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <ul style="list-style-type: none"> Lecture Sessions, (chalk & board, powerpoint presentation) Interactive sessions and simulations, Visual aids like videos and models to enhance understanding. Peer discussions. Laboratory experiments and hands-on training 			
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA) Theory: 25 marks</p> <p>Pop quiz / Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p>			

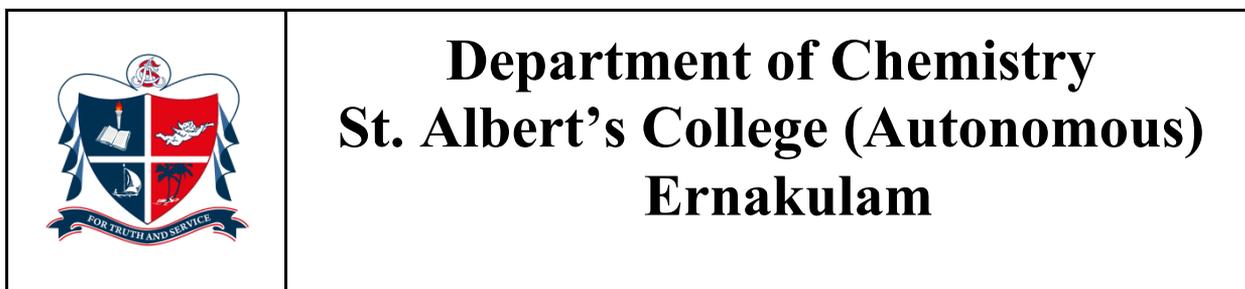
	<p>Practical : 5 marks Quiz /Lab involvement</p>
	<p>B. Semester end examination</p> <p>Theory: Written examination (50 Marks)-1.5 hrs.</p> <p>i) MCQ 20 questions: $20 \times 1 = 20$ ii) Short essay 4 questions (out of 6): $4 \times 5 = 20$ iii) Essay 1 question (out of 2): $1 \times 10 = 10$</p> <p>Practical: (20 Marks)-1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

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1. K. J. Laidler, *Chemical kinetics*, 3rd Edn. Pearson education, 2004.
2. L V Azaroff, "Introduction to Solids", McGraw Hill, 2017.
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8. Puri, Sharma and Pathania, *Principles of Physical Chemistry*, 48th Edn. Vishal Publishing Company, 2020.

Suggested Readings

1. R P W Atkins, "Physical Chemistry", Oxford University Press, 2019.
2. J. Rajaram, J. C. Kuriakose, *Chemical thermodynamics: classical, statistical and irreversible*, Dorling Kindersley (India), New Delhi, 2013
3. Glasstone and Lewis, *Elements of Physical Chemistry*, Macmillan, 1963.
4. I.N. Levine, *Physical Chemistry*, Tata McGraw Hill, 2011.



Programme	BSc (Hons) CHEMISTRY					
Course Name	Quantum Mechanics, Spectroscopy & Group Theory					
Type of Course	DSE					
Course Code	24SACCHE5DE301					
Course Level	300-399					
Course Summary	This course covers fundamental principles and applications in the realm of molecular structure, behaviour, and interactions. This course deals with the basic principles of quantum chemistry, spectroscopic techniques like rotational, vibrational, electronic and NMR and group theory.					
Semester	V	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate the fundamental concepts of quantum mechanics and describe its application to simple systems.	U	1
2	Examine the correlation between angular and radial wave functions in determining orbital shapes	An	2
3	Illustrate the basic concepts of various spectroscopic techniques.	U	2
4	Deduce various symmetry elements and point groups in molecules	E	4,5
5	Develop the group theoretical rules to generate group multiplication tables, matrix representations and classes.	A	2

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest(I) and Appreciation (Ap)*

COURSE CONTENT**Content for Classroom transaction (Units)**

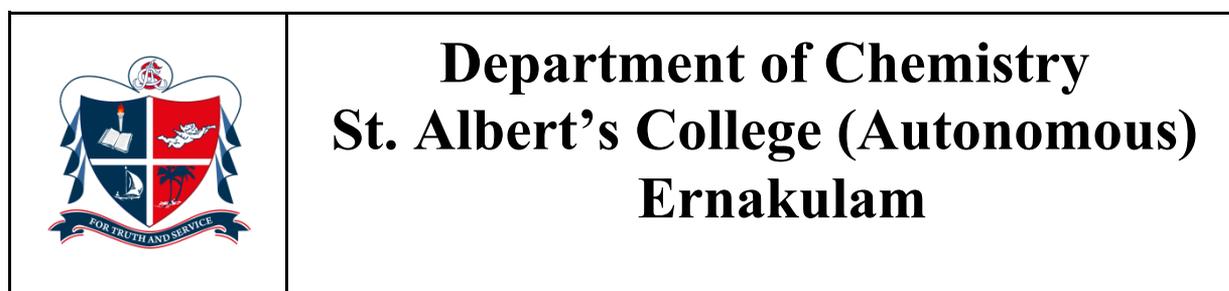
Module	Units	Course description	Hrs	CO No.
		Quantum Mechanics		
1	1.1	Classical mechanics: Concepts – Newtonian equations of motion and Hamiltonian equation of motion.	1	1
	1.2	Failures of Classical mechanics: Blackbody radiation, photoelectric effect, Compton effect and atomic spectra.	3	1
	1.3	Schrodinger wave equation; postulates of quantum mechanics – wave function postulate, operator postulate, Hermitian operator, eigen function postulate, expectation value postulate, time dependent postulate.	3	1
	1.4	Application of quantum mechanics to simple systems – Particle in 1-D box, normalization of wave function, application to 1,3 butadiene.	3	1
	1.5	Schrödinger equation for hydrogen atom – Coordinate system – cartesian and spherical polar coordinates, wave equation in spherical polar coordinates and its components - Radial and angular functions (derivation not required)	3	1
	1.6	Shapes of orbitals (s and p) – sketch of angular and radial wave functions. Radial distribution function	2	2
		Molecular Spectroscopy-I		
2	2.1	Introduction: electromagnetic radiation, regions of the spectrum, interaction of electromagnetic radiation with matter, various types of molecular spectroscopic techniques, Beer-Lambert's law, intensity of absorption, Factors affecting intensity - signal to noise ratio, natural line width. Doppler broadening, Born-Oppenheimer approximation	4	3
	2.2	<i>Rotational spectroscopy:</i> Rigid rotor and derivation of moment of inertia. Rotational energy levels, selection rules, relative population of energy levels, appearance of rotational spectra, calculation of bond length in diatomic molecules	5	3
	2.3	<i>Vibrational spectroscopy:</i> harmonic oscillator (concept only), calculation of force constant and energy levels, selection rules, concept of anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, Fermi resonance. Degrees of freedom for polyatomic molecules, IR spectrum of water & carbon dioxide.	6	3

		Molecular Spectroscopy-II		
3	3.1	<i>Electronic spectroscopy</i> : singlet and triplet states, selection rules (Spin and Laporte selection rule), Franck-Condon principle – transition, dissociation and predissociation, Polyatomic molecules – qualitative description of σ , π and n- molecular orbitals, their energy levels and the respective transitions.	9	3
	3.2	<i>Nuclear Magnetic Resonance (NMR) spectroscopy</i> : Nuclear spin quantum number, energies of nuclei in magnetic field, Larmor precession, chemical shift and δ scale. Factors affecting chemical shift, spin-spin coupling, coupling constant.	6	3
		Group Theory		
	4.1	Symmetry elements and operations, determination of distinct symmetry operations of C_n and S_n .	2	4
	4.2	Mathematical groups: Properties	1	4
	4.3	Point group, classification into MLS, MHS and MSS. Determination of point groups of molecules belonging to C_n , C_s , C_i , C_{nv} , C_{nh} , $C_{\infty v}$, D_{nh} , $D_{\infty h}$, D_{nd} , T_d and O_h point groups.	5	4
	4.4	Abelian groups, cyclic groups, sub groups. Similarity transformation, classes - C_{2v} and C_{3v} . Group multiplication tables (GMTs) - C_{2v} and C_{3v} . Matrix representation of symmetry elements of E, C_n , S_n , i, σ .	7	4,5
5		Teacher-Specific content		

Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <p>Lecture (chalk & board, powerpoint presentation, flipped classroom) Group Discussion – thought problems; mind mapping Peer interaction Demonstration using simulations / models</p>
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA) Theory (30 Marks)</p> <p>Pop quiz/ Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>B. End Semester Examination</p> <p>Theory- 70 marks – 2 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>

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1. P.W. Atkins, R.S. Friedman, *Molecular Quantum Mechanics*, 4th Edn. Oxford University Press, 2005.
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9. F.A. Cotton, *Chemical Applications of Group Theory*, 3rd Edn. Wiley Eastern, 1990.
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Green chemistry for sustainable development					
Type of Course	DSE					
Course Code	24SACCHE5DE301					
Course Level	300-399					
Course Summary	This course explores fundamentals of green chemistry covering aspects from synthesis design to waste management and energy usage.					
Semester	V	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any	Basic concepts on green chemistry					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Familiarize the basic concepts of green chemistry	U	1,2,3,6,7
2	Recognize twelve principles and importance of green chemistry	U	1,2,3,6,7
3	Identify alternative methods and solvents for green synthesis	A	1,2,3,6,7
4	Evaluate the adverse effects of chemicals to environment and select safer green methods for synthesis	E	1,2,3,6,7
5	Deduce the importance of green technologies in sustainable growth of Industry and society	E	1,2,3,6,7
6	Apply suitable energy efficient processes	A	1,2,3,6,7
7	Develop cleaner production and treatment mechanisms for pollution prevention.	A	1,2,3,6,7

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

CORSE CONTENT**Content For Classroom transaction(units)**

Module	Units	Course description	Hrs	CO No.
1	Introduction to green chemistry			
	1.1	Introduction. Goals and challenges of Green Chemistry: Introduction of Green protocol: Rules - Rio declaration- Montreal protocol, Kyoto protocol.	3	1
	1.2	Twelve principles of Green Chemistry with their explanations and special emphasis on the following with examples: Designing a Green Synthesis using these principles; prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products Atom Economy, calculation of atom economy, Atom economic and atom uneconomic reactions: rearrangement (Claisen and fries rearrangements), addition (Michael and Diels Alder reactions), substitution and elimination reactions.	7	2
2	Prevention and minimization of toxic materials (Green alternatives)			
	2.1	Prevention/ minimization of hazardous/ toxic products: reducing toxicity, measuring toxicity- LD ₅₀ & LC ₅₀ , Ames test Sources of waste, cost of waste, problems caused by waste, waste minimization techniques, on site waste treatment, reuse and recycling.	5	4
	2.2	Catalysis and green chemistry-Parameters that affect the inherent greenness of a catalyst, comparison of heterogeneous and homogeneous catalysts, elementary ideas on asymmetric catalysts, photocatalysts, biocatalysts and phase transfer catalysts (definition only)	5	4
	2.3	Prevention of chemical accidents- designing greener processes, inherently safer design (ISD), subdivisions of ISD- Minimization, simplification, substitution, moderation and limitation	5	4
	2.4	Energy requirements for reactions - alternative sources of energy: use of microwaves- microwave heating, microwave assisted reactions (in water and solvent free reactions) and ultrasonic energy.	5	6

		Green synthesis		
3	3.1	Green strategies for organic synthesis, green solvents-water, supercritical fluids (supercritical carbon dioxide, supercritical water), ionic liquids, fluoros biphasic solvent, PEG, immobilized solvents and greenness of solvents, solventless processes.	8	3
	3.2	Organic synthesis using green reagents- oxygen, singlet oxygen, ozone, hydrogen peroxide and peroxy acids. Polymer supported reagents- poly-n-bromosuccinimide, polymeric organotin dihydride reagent, polystyrene carbodiimide, polystyrene sulfide, polymer supported peracid, organic synthesis using biocatalyst- biochemical (microbial) oxidations, biochemical (microbial) reductions.	9	3
Phase Transfer Catalysts and Green Industrial Processes				
4	4.1	Organic synthesis using phase transfer catalysts-mechanism, types of phase transfer catalysts and its advantages. Applications of PTC in organic synthesis: synthesis of nitriles, alcohols, azides and alkyl fluorides from alkyl halides. Green synthesis of following compounds: adipic acid, adiponitrile, ibuprofen, alcohols, aromatic nitriles, cyclohexane oxime, 1-octanol, 3-phenyl catechol.	9	3
	4.2	Green industrial processes: Pollution statistics from various industries, polymer industry, textile industry, greener approach of dyeing, eco-friendly pesticides, pharmaceutical industry, wastewater treatment.	4	7
5	Teacher-Specific content			
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Case studies ● Debates ● Quizzes 			
Assessment Types	MODE OF ASSESSMENT Assignment //Quiz / Class Test – MCQ A. Continuous Comprehensive Assessment (Total 30 marks) Theory Assignments / Class tests/ MCQ / Viva / Involvement in classroom activities			

<p>B. Semester end examination Theory: Written examination (70 Marks)-2 hrs. MCQ – 10 marks (1 mark each – 10 nos) Short answer questions – 24 marks (3 marks each – 8 out of 10 nos) Long answer questions – 21 marks (7 marks each – 3 out of 5 nos) Essay type question – 15 marks (1 out of 2 nos)</p>
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Department of Chemistry

St. Albert's College (Autonomous)

Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Environmental Chemistry					
Type of Course	DSE					
Course Code	24SACCHE5DE303					
Course Level	300-399					
Course Summary	This course provides an overview of environmental planning, energy sources and its conservation, impact assessment, chemical toxicology, water pollution and air pollution. It also addresses soil composition, waste management, effluent treatment methods, emphasizing the use of plants, animals, and microorganisms for pollution control and waste recycling.					
Semester	V		Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any	Basic understanding of energy conservation, toxicity effects of various chemicals, water pollution, air pollution and waste management.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Recognize the importance of environmental management and impact assessment	U	1,2,6,7,8
2	Identify the toxic effects of chemicals	A	1,2,6,7,8
3	Develop a comprehensive knowledge of water pollution, including its various types, effects, and sources.	A	1,2,6,7,8
4	Discuss sampling and measurement of diverse water quality parameters	U	1,2,6,7,8
5	Explain environmental impacts of atmospheric pollution sampling and analysis of key pollutants	U, E	1,2,6,7,8
6	Analyse the soil composition, reactions, soil sampling techniques and management of sustainable agricultural and environmental practices.	An	1,2,6,7,8
7	Build a comprehensive idea about effluent, water and wastewater treatment methods, biological agents in pollution control and waste management principles	A	1,2,6,7,8
8	Analyse sustainable waste management practices	An	1,2,6,7,8, 10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Content for Classroom transaction (Units)

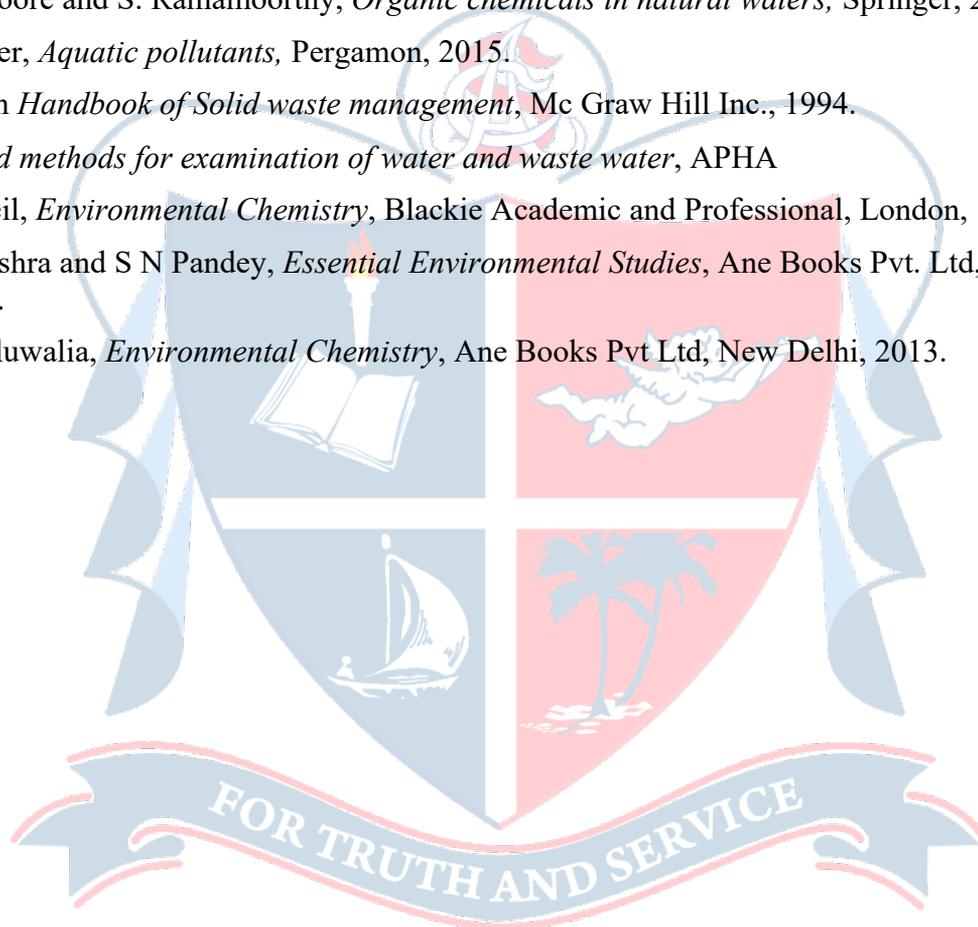
Module	Units	Course description	Hrs	CO No.
1	Environmental Management, Impact Assessment and Chemical Toxicology			
	1.1	Basic principles, concepts and scope of environmental planning, Conservation of energy - Renewable and non-renewable energy sources- nuclear energy, solar energy, hydrogen, non-conventional energy sources.	3	1
	1.2	Environmental pollution - concepts and definition. Impact assessment- aim, concepts and methods. Environmental management system - ISO-14001.	3	1
	1.3	Toxicity -effects, toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, CO, NO _x , SO ₂ , O ₃ , PAN, CN, pesticides and carcinogenic substances	9	2
2	Water Pollution			
	2.1	Types, effects and sources of water pollution. Thermal pollution.	3	3
	2.2	Sampling and measurement of water quality - odour, colour, EC, turbidity, TDS, salinity, COD, BOD, DO, coliform, pH, acidity, CO ₂ , alkalinity, hardness, phosphate, fluoride, chloride, cyanide, sulphide, sulphate and metals- As, Cd, Fe, Pb and Hg.	12	4
3	Air Pollution and Lithosphere			
	3.1	Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution - acid rain, ozone layer depletion.	4	5
	3.2	Air pollution accidents - Bhopal and Chernobyl, air quality standards. Sampling and analysis of pollutants - CO, SO ₂ , H ₂ S, hydrocarbons, SPM.	4	5
	3.3	Composition of soil - reactions in soil. Wastes and pollutants in soil. Sampling procedures and analysis of soil- cation exchange capacity, lime status, lime requirement, gypsum requirement, pH, N, P, K, S, Ca, and Mg. Management of solid waste.	7	6

Effluent and Waste Management				
4	4.1	Effluent - definition and characteristics. Methods for water and wastewater treatment and systems (physical, chemical, and biological).	5	7
	4.2	Plants, animals and microorganisms for controlling pollution and treatment of effluents. Waste management- definition, characterization, sources and classification.	5	7
	4.3	Waste Management – 3Rs. Waste treatment and disposal –Methods for management for hazardous and toxic wastes.	5	8
5	Teacher Specific content			
Teaching and Learning Approach	<p style="text-align: center;">Classroom Procedure (Mode of transaction)</p> <ul style="list-style-type: none"> • Lecture (chalk & board, powerpoint presentation) • Group discussion • Case studies • Debates • Quizzes 			
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT Assignment //Quiz / Class Test – MCQ</p> <p>A. Continuous Comprehensive Assessment (Total 30 marks) Theory Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>B. Semester end examination Theory- 70 marks – 2 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>			

REFERENCES

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		<h2 style="margin: 0;">Department of Chemistry</h2> <h3 style="margin: 0;">St. Albert's College (Autonomous)</h3> <h3 style="margin: 0;">Ernakulam</h3>				
Programme	BSc (Hons) CHEMISTRY					
Course Name	Nanotechnology for Energy Applications					
Type of Course	DSE					
Course Code	24SACCHE5DE304					
Course Level	300-399					
Course Summary	This course explores the intersection of nanotechnology and energy systems. It covers the applications of nanotechnology in the field of energy conversion and storage.					
Semester	V	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	60
		4				
Pre-requisites, if any	Basic understanding of synthesis and properties of nanomaterials.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Develop a comprehensive knowledge base regarding global energy needs, consumption patterns, classification of energy sources and the energy conservation.	A	1, 2,3,6,7
2	Differentiate between conventional and non-conventional energy sources.	An	1, 2,3,6,7
3	Analyse various photovoltaic technologies, including Solar Cells.	An	1, 2,3,6,7
4	Explain the working principle and architecture of energy storage devices including batteries and capacitors	U	1, 2,3,6,7
5	Discuss about hydrogen storage technologies	U	1, 2,3,6,7
6	Develop a comprehensive knowledge of nanostructured materials	U	1, 2,3,6,7
7	Build a strong foundation in the role of MOFs and two-dimensional materials in energy related applications	A	1, 2,3,6,7

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
	Introduction to energy technologies			
1	1.1	Global energy requirements and consumption. Classification of renewable and non-renewable energy technologies. Conventional energy sources – pros and cons (<i>with relevant case studies</i>). Challenges in the development and implementation of renewable energy technologies	9	1
	1.2	Non-conventional sources of energy: Tidal energy, geothermal energy and biomass.	2	1,2
	1.3	Energy conversion, transport, and storage- challenges and outlooks	4	1
	Nanomaterials for Energy Conversion			
2	2.1	Principles of photovoltaic energy conversion (PV): Types of Solar cells: DSSC, OPV , Bulk Hetero Junction (BHJ-SC) , Quantum dots, ,Perovskites and Silicon Solar cells	8	3
	2.2	Nano, micro, poly crystalline and amorphous silicon solar cells. Nano and micro Si-composite structure, various techniques of Si deposition.	4	3
	2.3	Fuel Cells: Working principle and architecture, micro-fuel cell technologies.	3	3
	Nanomaterials for Storage Technology			
3	3.1	Introduction to battery technology (<i>working principle and architecture</i>), primary and secondary batteries (Lithium-ion Batteries), cathode and anode materials.	5	4,6
	3.2	Capacitors- Principles and materials design. Electrical double layer model. Pseudocapacitor, electrochemical supercapacitors.	5	4,6
	3.3	Hydrogen storage: Materials and methods, MOFs, metal hydrides and hydrogen storage capacity.	5	5,6
	State-of-the-art materials in Energy storage and conversion			
4	4.1	Nanostructured carbon-based materials, nano-oxides, novel hybrid electrode materials.	5	6

	4.2	Introduction to MOFs and its role in energy storage and conversion. COFs (<i>elementary idea only</i>).	5	7
	4.3	Elementary idea of the state-of-the-art two-dimensional materials: graphene, boron nitride, carbon nitride, metal chalcogenides (MoS ₂ , MoSe ₂ , etc.).	5	7
5	Teacher Specific content			
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Case studies ● Debates ● Quizzes 			
Assessment Types	MODE OF ASSESSMENT			
	A. Continuous Comprehensive Assessment (Total 30 marks) Theory Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities B. Semester end examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20			

REFERENCES

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Department of Chemistry St. Albert's College (Autonomous) Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Medicinal Chemistry					
Type of Course	DSE					
Course Code	24SACCHE5DE305					
Course Level	300-399					
Course Summary	This course explores fundamental aspects of medicinal chemistry such as drug discovery, drug action, different classes of drugs, adverse effects of drugs and drug delivery systems.					
Semester	V	Credits				4
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		4		0		
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyse the fundamental aspects of medicinal chemistry such as drug discovery and drug effectiveness.	An	1, 2,3
2	Examine various aspects of drug action.	An	1, 2,3
3	Describe different classes of drugs with suitable examples.	U	1, 2,3,6
4	Explain adverse effects of drugs.	U	1, 2,3
5	Discuss advanced drug delivery systems.	U	1, 2,3,7

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Introduction to Medicinal Chemistry			
	1.1	Overview of medicinal chemistry: definition and scope of medicinal chemistry. Drugs: classification, sources and routes of administration.	5	1
	1.2	Drug discovery: target identification and validation, lead identification and optimisation, preclinical testing, pharmacology/toxicology and clinical studies- phase I, II and III. Ways of identification of lead compounds.	7	1
	1.3	Effectiveness of a drug: chemotherapeutic index and therapeutic index. Drug selectivity.	3	1
2	Drug Action			
	2.1	The pharmacokinetic phase: absorption, distribution, metabolism and elimination (ADME) of the drug. Bioavailability of a drug. The pharmacodynamics phase.	5	2
	2.2	Drug metabolism: sites of drug metabolism and phase I and phase II reactions. Prodrugs.	6	2
	2.3	Drug receptors (elementary idea only), agonists and antagonists, partial agonists. Elementary idea of induced fit theory of drug action.	4	2
3	Classes of Drugs			
	3.1	Definition of the following classes of drugs with use of the given example: anaesthetics- thiopentone sodium, sedatives- phenobarbital, anti-epileptic drugs- clobazam, anxiolytic agents- benzodiazepine, narcotic analgesics – morphine and anticancer drugs- cisplatin.	5	3
	3.2	Definition of the following classes of drugs with use of the given example: adrenergic stimulants- adrenaline, adrenergic blockers- tolazoline, cholinergic stimulants- acetylcholine, cholinergic blockers- dicyclomine and cardiotoxic drugs- digoxin.	5	3

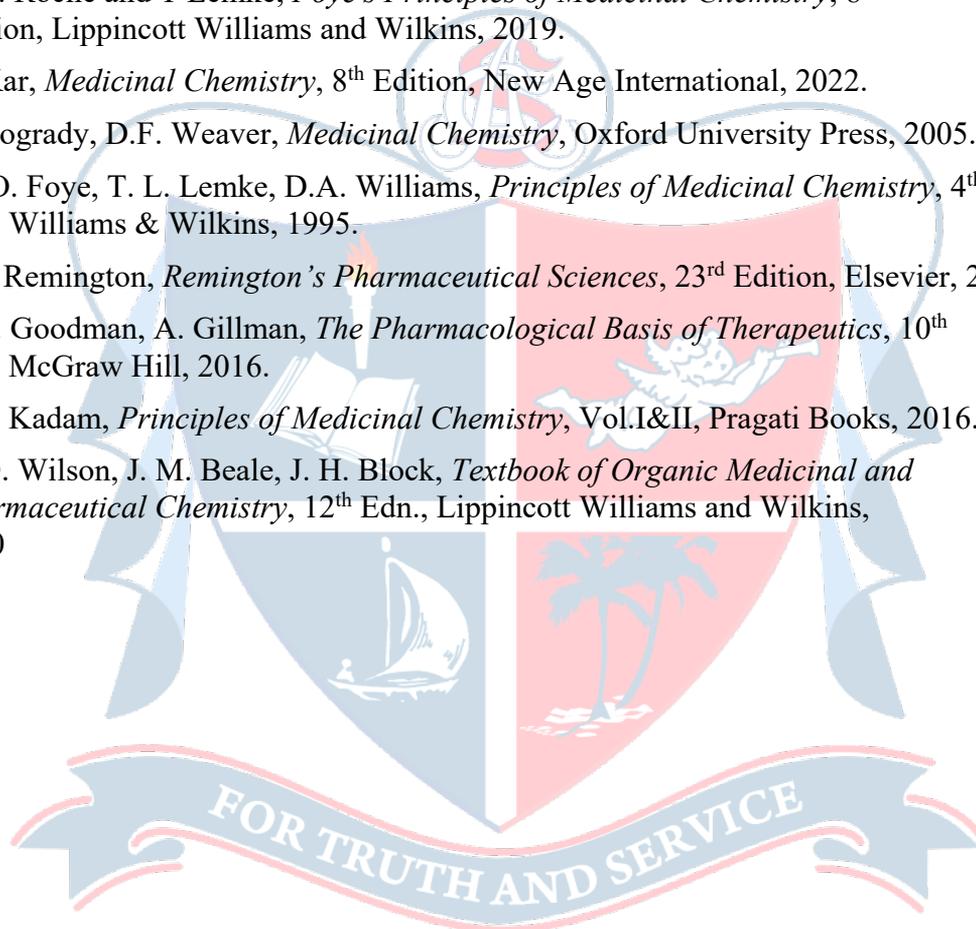
	3.3	Definition of the following classes of drugs with use of the given example: antibiotics- chloramphenicol, antiviral drugs: amantadine, antimalarials- chloroquine, tranquilisers: benzodiazepines and antipsychotics- phenothiazine. chloroquine, tranquilisers: benzodiazepines and antipsychotics- phenothiazine.	5	3
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	Adverse Drug Effects and Drug Delivery Systems			
4	4.1	Adverse drug effects: predictable and unpredictable drug reactions and severity. Classification of adverse drug effects, pharmacovigilance and prevention of adverse drug effects.	7	4
	4.2	Drug formulations- sustained-release, controlled release, programming the release and prodrugs. Nanomaterials in drug delivery: liposomes, polymer nanoparticles, chitosan nanoparticles, nanosponge and targeted drug delivery in cancer using nanoparticles. Gene delivery: applications of nanoparticles in gene delivery.	8	5
5	Teacher Specific Content			

Teaching and Learning Approach	<p style="text-align: center;">Classroom Procedure (Mode of transaction)</p> <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Peer teaching ● Demonstration of experiments
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (Total 30 marks)</p> <p>Theory</p> <p>Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>B. Semester end examination</p> <p style="text-align: center;">Theory- 70 marks – 2 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>

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Department of Chemistry St. Albert's College (Autonomous) Ernakulam

Programme	BSc (Hons) CHEMISTRY				
Course Name	Main Group Elements				
Type of Course	DSE				
Course Code	24SACCHE5DE306				
Course Level	300-399				
Course Summary	This course explores the basic aspects of main group elements				
Semester	V	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4			60
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the classification of S block elements in the periodic table: general trends and properties of elements and structure of molecules	U	1,2
2	Apply knowledge of fundamental chemical principles to explain and predict the behavior of P-block elements and compounds	A	1,2
3	Analyse the structural aspects of boron and silicon compounds	An	1,2
4	Apply knowledge of halogens and interhalogens to predict the outcomes of simple reactions.	A	1,2
5	Apply Valence Bond and Molecular Orbital theories to explain bonding in noble gas compounds	A	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) an ation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
Chemistry S Block Elements				
1	1.1	General characteristics: melting point, flame colouration, reducing nature, diagonal relationships and anomalous behaviour of first member of each group. Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water. Common features such as ease of formation, thermal stability, energetics of dissolution, and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates.	8	1
	1.2	Complex formation tendency of s-block elements; structure of the following complexes: crown ethers and cryptates of Group I; basic beryllium acetate, beryllium nitrate, EDTA complexes of calcium and magnesium. Solutions of alkali metals in liquid ammonia and their properties	7	1
Chemistry of p-Block Elements				
2	2.1	Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, Catenation, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group. Synthetic diamonds (elementary idea)	8	2
	2.2	Catenation and heterocatenation` in inorganic compounds. Types of inorganic polymers. Comparison with organic polymer, preparation and uses of borazine - similarities in structure with benzene. Boron nitrides- comparison with graphite.	7	2
Important Group 13 and Group14 compounds				

3	3.1	Comparative studies including diagonal relationship of group 13 and 14 elements. Anomalous behaviour of Boron. Preparation, structure, and bonding of diborane, uses of diborane. STYX numbers and WADE's rule, (Closo, nido, arachno) e.g. $B_{12}H_{12}^{2-}$, B_5H_9 and B_4H_{10}	8	3
	3.2	Boron nitrides, boranes, carboranes and metallocarboranes. Silicates and classification, aluminosilicates, natural and synthetic zeolites and application of zeolites as molecular sieves. Silicon based polymers-silicones, silicon rubbers (preparation, important properties and uses)	7	3
Halogen and Noble Gas Compounds				
	4.1	Properties of halogens. Interhalogens - classification- general preparation- structures of AB , AB_3 , AB_5 and AB_7 types. Reactivity (ClF , ICl_3 , ClF_3 , IF_5 and IF_7). Comparison of pseudohalogens with halogens.	7	4
	4.2	Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2 , XeF_4 and XeF_6 ; Bonding in noble gas compounds (Valence bond and MO treatment for XeF_2), Shapes of noble gas compounds (VSEPR theory).	8	5
5	Teacher Specific Content			

Teaching and Learning Approach	<p style="text-align: center;">Classroom Procedure (Mode of transaction)</p> <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Case studies ● quizzes
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p style="text-align: center;">A. Continuous Comprehensive Assessment (Total 30 marks)</p> <p style="text-align: center;">Theory</p> <p>Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p>

	<p>B. Semester end examination</p> <p>Theory- 70 marks – 2 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>
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		Department of Chemistry St. Albert's College (Autonomous) Ernakulam			
Programme	B.Sc (Honours) Chemistry				
Course Name	Chemistry of Drugs				
Type of Course	DSE				
Course Code	24SACCHE5DE307				
Course Level	300-399				
Course Summary	The mission of the Medicinal Chemistry course is to help students gain a comprehensive understanding of the fundamental concepts related to the actions and clinical uses of major classes of drugs from their chemical structures. This course would help the students to relate the pharmacological activities, mechanisms of action, ADME (adsorption, distribution, metabolism, and excretion), and pharmacokinetic properties of drugs to their chemical structures.				
Semester	V	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	
		4		-	60
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand and explain the structure, function, and mechanism of action of various drug molecules.	K,U	1,2,3
2	Explain how drugs interact with biological targets to produce therapeutic effects.	K,U, A	1,2,3
3	Develop and demonstrate depth and breadth of knowledge in biomedical, pharmaceutical, social/administrative/behavioral, and clinical sciences.	K,U, A	1,2,3
4	Integrate knowledge from foundational sciences to explain how specific drugs or drug classes work and evaluate their potential value in individuals and populations.	K, U, A, An, E	1, 2,3

5	Apply knowledge in foundational sciences to solve therapeutic problems.	A	2,3
6	Students will analyze and evaluate the ethical, legal, and social implications of the use and abuse of central nervous system (CNS) drugs, particularly focusing on addictive substances.	An, E	1, 2,3, 6,7,8
7	Critically analyze scientific literature related to drugs and disease to enhance clinical decision making.	An, C,	1, 2,3, 6,7.8
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
General aspects of drug action				
1	1.1	Definition - Classification of Drugs By Chemical structure- Classification of Drugs Based on Effects- Classification of Drugs by Legal Definition- Schedule V, Schedule IV, Schedule III, Schedule II, Schedule I	3	1,2,3,4,5,6,7
	1.2	Drug metabolism- Phases of Metabolism-Metabolic Enzymes-Pharmacokinetics –Metabolic pathways of some common type of drugs	7	
	1.3	Bioisosterism, Stereochemistry and QSAR of drugs	5	
Cardiovascular Drugs				
2	2.1	Introduction to Cardiovascular system, Diseases of Cardiovascular system, Mode of action of cardiovascular drugs.	3	1,2,3,4,5,6,7
	2.3	Enalapril, (alpha amino acids), Isosorbide dinitrate(Nitrates), Atenolol (Aryloxy propanol amines), Nifedipine (pyridines), Chlorthiazide (Thiazides), Mode of action of Atenolol	7	
Central Nervous system Drugs				
3	3.1	Introduction to Central Nervous system, Pharmacological actions	2	1,2,3,4,5,6,7

	3.2	Concept of sedation, hypnosis, anesthesia; Hallucinogens, Stimulants, and Related Drugs of Abuse and Their Therapeutic Potential	3	
	3.3	Phenobarbitone(Barbiturates), Phenytoin (Hydantoins), Trimethadione (Oxazolidinediones), Piracetam (Pyranones), Midazolam, Alprazolam (Benzodiazepines), Methylphenidate, (Piperidines), Chlorpromazine (Phenothiazines), Fluoxetine (phenyl propyl amines)	5	
	3.4	Synthesis of Trimethadione; Methylphenidate; Phenytoin.	3	
	3.5	Mode of action of Barbiturates as sedatives and hypnotics.	1	
	3.6	Antidepressants, Serotonin Receptors and Drugs Affecting Serotonin Neurotransmission	1	
Some other pharmacodynamics agents and screening of Chemotherapeutic agents				
4	4.1	Antihistaminic and Antiallergic drugs	4	1,2,3,4,5 6,7
	4.2	Drugs acting on GI tract	2	
	4.3	General Screening of chemotherapeutic agents	2	
	4.4	Mode of action of certain antibiotics (chloramphenicol) , antifungal agents , antimalarials and antiviral drugs	7	

Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction) Lecture sessions, Experts led Interactive sessions to include students actively, visual aids like presentations and videos to improve students' comprehension. Assign group projects where students can work together to research and present on specific drugs or therapeutic areas.</p>
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (Total 30 marks) Theory Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p>

	<p style="text-align: center;">B. Semester end examination</p> <p style="text-align: center;">Theory- 70 marks – 2 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 = 30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>
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Department of Chemistry

St. Albert's College (Autonomous)

Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Fundamentals of Biochemistry					
Type of Course	DSE					
Course Code	24SACCHE5DE308					
Course Level	300-399					
Course Summary	This course covers structure and biological functions of amino acids, proteins, enzymes, carbohydrates, nucleic acids and lipids and general features of metabolism.					
Semester	V	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain fundamental features of biochemistry such as functions of subcellular organelles, membranes and membrane transport,	U	1,2
2	Analyse the classification, properties and functions of amino acids, proteins, enzymes, lipids and carbohydrates.	An	1,2
3	Describe the catalytic activity of enzymes and enzyme inhibition	U	1,2
4	Examine the functions of DNA and RNA	E	1,2
5	Analyse various metabolic pathways and phases.	An	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Foundations of Biochemistry			
	1.1	Introduction to biochemistry: scope of biochemistry, historical development and significance	2	1
	1.2	Subcellular organelles: nucleus, endoplasmic reticulum, golgi apparatus, lysosomes, peroxisomes and mitochondria. Marker enzymes.	5	1
	1.3	Plasma membrane and membrane proteins.	2	1
	1.4	Membrane transport: active and passive transports and pumps. Ion channels, ligand-gated channels, voltage-gated channels, ionophores. Sodium pump and calcium pump.	6	1
Amino acids and Proteins				
2	2.1	Amino acids Classification-based on structure, side chain, metabolism and nutritional requirements. Physical properties of amino acids, isoelectric point, optical activity and peptide bond formation. Colour reactions of amino acids and proteins- ninhydrin, biuret and xanthoproteic tests.	6	2
	2.2	Peptides and proteins. Primary structure and numbering of amino acids in proteins. Secondary structure- alpha helix and beta pleated sheets. Tertiary structure-relationship between structure and function of proteins. Quaternary structure of proteins.	5	2
	2.3	Classification of Proteins based on function, composition, shape and nutritional value.	2	2
	2.4	Physical properties and precipitation reactions of proteins. Quantitative estimation of proteins by Kjeldahl's method.	2	2
3	Enzymes			
	3.1	Enzymes; Characteristics, six major classes of enzymes, IUMB system of classification of enzymes-explanation with one example.	6	2
		Coenzymes- Classification, nicotinamide adenine		

		dinucleotide (NAD ⁺) and coenzyme A. Cofactors. Metallo-enzymes.		
	3.2	Catalytic power and specificity of enzymes. Mode of action of enzymes- active site, substrate binding, lock and key principle, induced-fit model, entropy effect and stabilisation of transition state. Coupled reactions.	7	3
	3.3	Enzyme inhibition- types.	2	3
4	Carbohydrates, Nucleic acids, Lipids and Metabolism			
	4.1	Carbohydrates- Biological functions of mono, di and polysaccharides. Regulation of Blood Glucose; insulin and diabetes mellitus.	4	2
	4.2	Nucleotides and nucleic acids, DNA and RNA, functions of DNA and RNA.	4	4
	4.3	Lipids- classification of lipids and fatty acids and functions of lipids.	3	2
	4.4	Metabolism: types of metabolic pathways, phases of metabolism, metabolic profile of brain, skeletal muscles and liver.	4	5
5		Teacher Specific Content		

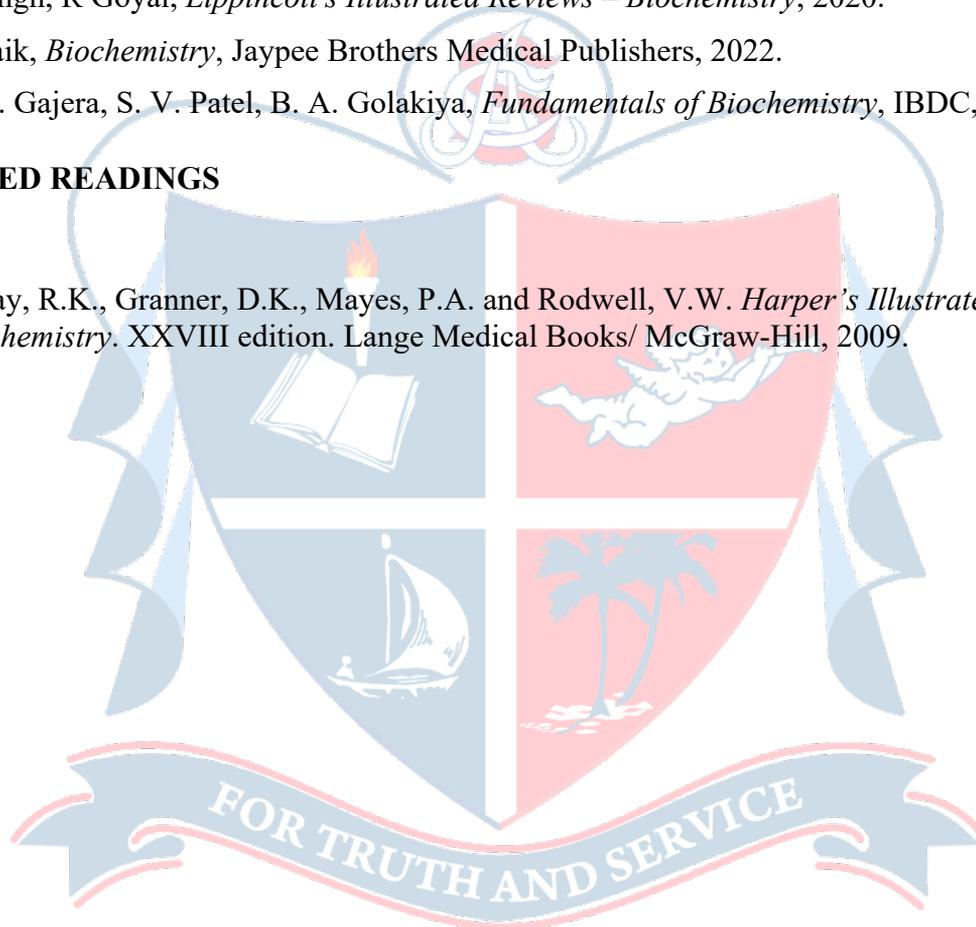
Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <p>Lecture sessions, interactive sessions including discussions and demonstrations, to engage students actively and visual aids like presentations and videos to enhance understanding.</p>
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (Total 30 marks) Theory</p> <p>Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>B. Semester end examination</p> <p style="text-align: center;">Theory- 70 marks – 2 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20</p> <p>ii) Short essay 6 questions (out of 8): 6 X 5 =30</p> <p>iii) Essay 2 question (out of 4): 2 X 10 = 20</p>

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1. D M Vasudevan, S Sreekumari, *Textbook of Biochemistry for Medical Students*, Jaypee Brothers Medical Publishers, 2023.
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7. P Naik, *Biochemistry*, Jaypee Brothers Medical Publishers, 2022.
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Department of Chemistry
St. Albert's College (Autonomous)
Ernakulam

Programme	BSc Chemistry Honours with Specialisation in Industrial Chemistry					
Course Name	Unit Processes and Unit Operations in Chemical Industries					
Type of Course	DSE					
Course Code	24SACCHE5DE309					
Course Level	300-399					
Course Summary	This course aims to develop a strong foundation in students for understanding and designing complex industrial processes like halogenation, oxidation, amination, nitration, hydrogenation etc., for bulk production of organic chemicals. This knowledge is valuable in various fields such as chemical engineering, environmental engineering, food processing, pharmaceuticals, and biotechnology. Students will also learn about various fundamental unit operations such as distillation, filtration, centrifugation, crystallization, absorption, drying and evaporation used in chemical plants for product separation. They will gain knowledge of the equipment involved, the underlying principles, and their applications in different industries.					
Semester	V		Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
			4			
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the concept of unit processes and its importance in Industrial Chemistry.	U	1, 2
2	Application of industrial unit processes in the production of key chemicals.	A	1, 2
3	Understand the operating principles of different unit operations and its importance in chemical industries.	U	1, 2
4	Application of appropriate unit operations for product isolation in chemical industries.	A	1, 2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
Industrial Processes-I				
1	1.1	Types of alkylation and acylation, Alkylating & Acylating agents; Catalysts used. Industrial production of detergents (through alkylation of benzene), nylon (using acylation).	3	1, 2
	1.2	Importance of esters in industries, Types of esterification, Commercial manufacture of aspirin.	2	1, 2
	1.3	Types of Hydrolysis, Hydrolysing agents; Production of biodiesel, Enzymatic Hydrolysis- Hydrolysis of starch to dextrose.	3	1, 2
	1.4	Common oxidizing agents, Liquid and Vapour phase oxidation processes, Oxidation of alkenes, oxidation processes in waste water treatment, Commercial manufacture of acetic acid and phthalic anhydride.	3	1, 2
	1.5	Introduction, Homogeneous versus Heterogeneous hydrogenation, Industrial catalysts-Supported metal catalysts, Wilkinson's catalyst, Factors affecting hydrogenation reactions, Industrial Applications of Hydrogenation-Hydrogenation of vegetable oils, Hydrocracking of Petroleum.	4	1, 2

Industrial Processes-II				
2	2.1	Introduction, Halogenating agents, Commercial production of DDT, BHC, Chloral.	2	1, 2
	2.2	Introduction, Nitrating Agents-Mixed acid ($\text{HNO}_3/\text{H}_2\text{SO}_4$), Nitric acid (HNO_3). Commercial manufacture of TNT, guncotton	2	1, 2
	2.3	Introduction, Sulphonating Agents-Conc. H_2SO_4 , Oleum, SO_3 gas phase sulphonation. Commercial production of sodium dodecylbenzene sulphonate (SDBS) detergent.	3	1, 2
	2.4	Introduction. Different polymerisation techniques (bulk, solution, emulsion & suspension). Types of molding (extrusion, compression, blow, injection and rotational molding). Dry Rubber compounding, Vulcanisation. Industrial production of polystyrene and NBR.	5	1, 2
	2.5	Introduction, Industrial amination methods-reductive amination, alkylation of ammonia, Amination using azides or phthalimides, catalytic amination. Industrial production of aniline.	3	1, 2
Industrial Operations -I				
3	3.1	Introduction - Evaporators: Types and Applications – Falling film evaporators, Forced circulation evaporators, Rising film evaporators, Freeze drying. Entrainment; Fouling and scaling in evaporators, its prevention techniques, cleaning methods.	5	3, 4

	3.2	Filtration: Introduction: Filter media and filter aids. Equipments -Plate and frame filter press, Nutch filter, Rotary drum filter, Sparkler filter, Candle filter, Bag filter. Centrifuges- Factors affecting separation efficiency: particle size, density, viscosity and rotor geometry. Ultracentrifugation.	6	3, 4
	3.3	Drying: Introduction: free moisture, bound moisture, drying curve, Equipments – tray dryer, rotary dryer, flash dryer, fluid bed dryer, drum dryer, spray dryer. Effect of shrinkage during drying.	4	3, 4
Industrial Operations -II				
4	4.1	Introduction, Principle of distillation Types of Distillation – Simple, Fractional, Steam, Vacuum distillation. Advanced distillation techniques - Extractive distillation (Soxhlet extraction), Azeotropic distillation. Types of columns: Plate columns and packed columns, rectification.	6	3, 4
	4.2	Introduction. Selection criteria for solvent. Equipments-Packed towers, Spray towers, bubble columns. Packed and plate columns. Liquid distribution devices, Applications of Absorption.	5	3, 4
	4.3	Introduction: Steps involved – nucleation & crystal growth. Cooling crystallisers & Evaporative crystallisers.	4	3, 4

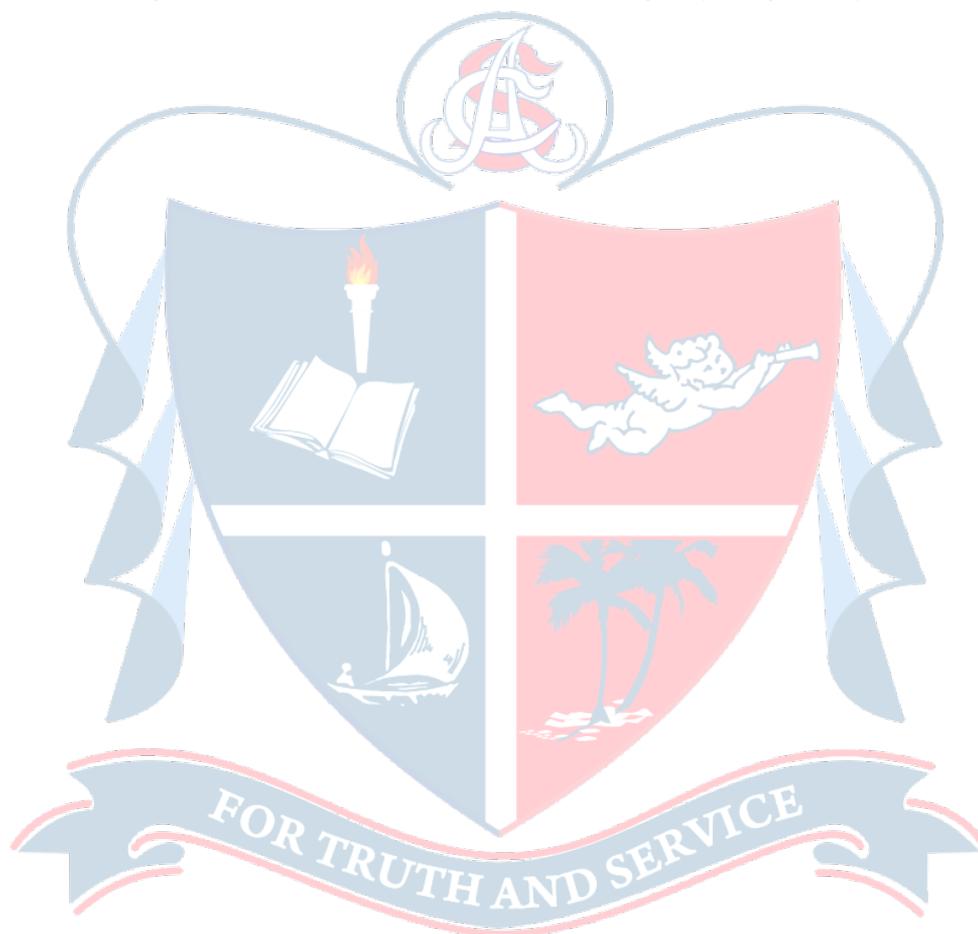
Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <p>Lecture sessions, Experts led Interactive sessions to ensure active participation of students, visual aids like presentations and videos to improve students' comprehension. Group activities.</p>
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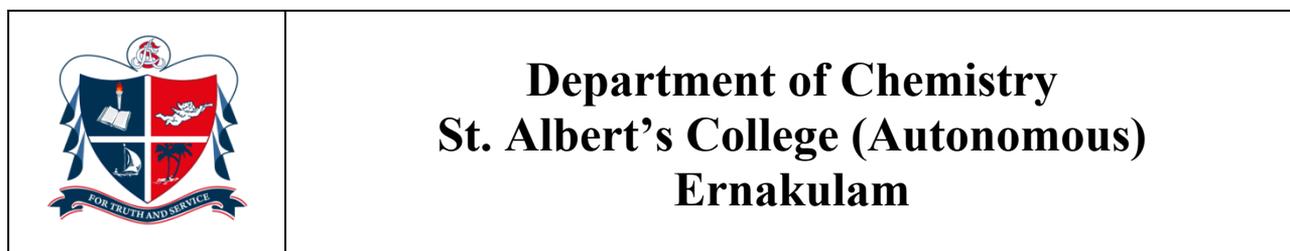
MODE OF ASSESSMENT	
Assessment Types	A. Continuous Comprehensive Assessment (Total 30 marks) Theory Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	B. Semester end examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

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Department of Chemistry
St. Albert's College (Autonomous)
Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Analytical Chemistry and Professional skills					
Type of Course	SEC					
Course Code	24SACCHE5SE301					
Course Level	300-399					
Course Summary	This course provides a comprehensive introduction to analytical chemistry, focusing on interdisciplinary concepts, precision in analysis, and practical applications in soil and water studies. It incorporates hands-on experiences, including workshops, interview training, industrial visits, and expert interactions, culminating in a career-oriented project for enhanced professional readiness.					
Semester	V	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Outline the fundamentals of analytical chemistry	U	1,2
2	Conduct soil and water analysis	An	1,2,4,10
3	Explain the principles of chromatographic techniques	U	1,2
4	Apply the principles of Thin Layer Chromatography and column chromatography for purification and separation purposes.	A	1,2,10

5	Develop professional skills effectively and contribute meaningfully to their chosen fields.	E	4,9, 10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT**Content for Classroom transactions (Units)**

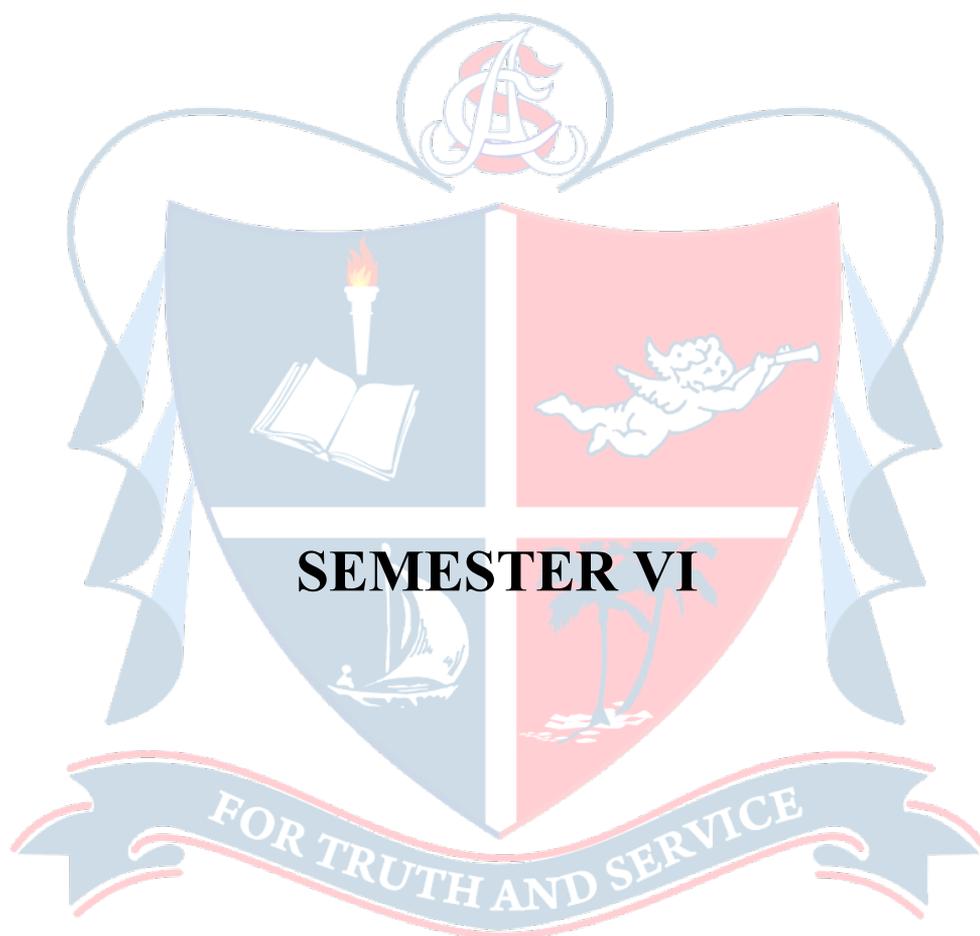
Module	Units	Course description	Hrs	CO No.
	Analytical Chemistry			
1	1.1	Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision, and sources of error in analytical measurements.	3	1
	1.2	Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators. a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions in soil by complexometric titration.	6	2
	1.3	Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, and water purification methods. a. Determination of pH, acidity, and alkalinity of a water sample. b. Determination of the Hardness of water.	6	2
	Chromatographic techniques			
2	2.1	Introduction to chromatography: Basic principles of chromatography, types of chromatography	2	3
	2.2	Theory and Application -Gas chromatography, High- Performance Liquid Chromatography (HPLC)	5	3
	2.3	Theory, application, and demonstration of Thin Layer Chromatography and Column Chromatography (Hands on Training)	8	4

		Professional Development		
3		<ul style="list-style-type: none"> • Workshop on career awareness • Training sessions for interviews • Industrial visit • Interaction with industrial experts • Create minor project 	15	5
4		Teacher-Specific content		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures, discussions, group activities, seminars, industrial visits and study tours
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Total : 25 marks Performance in activities Industrial visit report Project work
	B. End Semester examination (50 marks)-1.5 hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10

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2. D. A. Skoog, D. M. West, F. J. Holler, *Fundamentals of Analytical Chemistry*, 6th Ed., Cengage Learning India Pvt. Ltd., 2022.
3. D. C. Harris, *Quantitative Chemical Analysis* 7th Edn. W. H. Freeman and Co., New York, 2007
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6. J. A. Dean, *Chemical separation methods*, Von Nostrand Reinhold, New York
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Department of Chemistry
St. Albert's College (Autonomous)
Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Inorganic Chemistry-2					
Type of Course	DSC A					
Course Code	24SACCHE6DA301					
Course Level	300-399					
Course Summary	This course explores concepts of coordination chemistry, organometallic compounds and bioinorganic chemistry. This course also provides the basic analytical skills on qualitative and quantitative analysis of inorganic ions.					
Semester	VI	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	Inorganic Chemistry-1					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Compare the theories of coordination chemistry	An	1,2
2	Explain the mechanisms of substitution reactions	U	1,2
3	Describe the key concepts of inorganic and organometallic chemistry	E	1,2
4	Illustrate stability of organometallic compounds, clusters and their application in industrial catalysts.	U	1, 2, 10
5	Explain the importance of various metal ions in biological systems	U	1,2,10
6	Analyse different complexes based on colourimetry and electronic spectra	An	1,2,10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Coordination Chemistry- 2			
	1.1	Merits and demerits of VBT and CFT	1	1
	1.2	Crystal field splitting in tetragonally distorted octahedral geometry, Jahn-Teller distortion in Cu (II) complexes.	2	1
	1.3	MO theory, evidences for metal-ligand covalency- Nephelauxetic effect, MO diagram of complexes of octahedral symmetry (sigma bonding only)	3	1
	1.4	Spectral and magnetic properties of metal complexes- d-d transition, electronic absorption spectrum of [Ti (H ₂ O) ₆] ³⁺ ion. Charge transfer spectra e.g. KMnO ₄ , K ₂ Cr ₂ O ₇ (Elementary idea). Types of magnetic behavior, spin-only formula, calculation of magnetic moments.	3	1
	1.5	Reactivity of metal complexes-Labile and inert complexes	1	2
	1.6	Ligand substitution reactions : -S _N 1 and S _N 2 , ligand substitution reactions in square planar and octahedral complexes	3	2
	1.7	Trans effect- theories and applications- polarization and π- bonding theory.	2	1
2	Organometallic Compounds			
	2.1	Introduction to organometallic compounds, hapticity	1	3
	2.2	18- electron rule, numerical problems and stability	2	3
	2.3	Ferrocene: Preparation, structure, aromaticity and reactions (acetylation, alkylation).	2	3
	2.4	Metal-alkene complexes – Preparation and structure of Zeise's salt	1	3

	2.5	Catalytic properties of organometallic compounds - Zeigler Natta catalyst in the polymerization of alkene. Wilkinson catalyst in the hydrogenation of alkene (mechanism not expected).	2	4
	2.6	Preparation and structure of mononuclear carbonyls- $\text{Mo}(\text{CO})_6$, $\text{Fe}(\text{CO})_5$ and $\text{Ni}(\text{CO})_4$	3	4
	2.7	Polynuclear carbonyls, bridged carbonyls and bonding in metal carbonyls – $\text{Mn}_2(\text{CO})_{10}$ and $\text{Fe}_2(\text{CO})_9$.	2	4
	2.8	Synergic effect and use of IR data in metal carbonyls to explain extent of back bonding	1	4
	2.9	Quadruple bond structure of $[\text{Re}_2\text{Cl}_8]^{2-}$. Quintuple bond (non-evaluative)	1	4
	Introduction to Bioinorganic Chemistry			
3	3.1	Essential and non – essential metals	1	5
	3.2	Mechanism of ion transport- Ion pump (Na^+ and K^+)	2	5
	3.3	Porphyrins, Oxygen carriers- hemoglobin and myoglobin- structure and functions, oxygen transport mechanism, cooperativity effect, Bohr effect	3	5
	3.4	Cytochromes- Structure and functions of Cytochrome P-450	1	5
	3.5	Non-heme proteins- structure and functions of hemocyanin & hemerythrin	1	5
	3.6	Photosynthesis- Chlorophylls (Structure not needed) – Z- scheme (only)	2	5
	3.7	Electron transfer proteins- structure and functions of ferredoxin, rubredoxin. Zinc containing metalloenzymes: carbonic anhydrase and carboxypeptidase. Vitamin B_{12} (structure not expected)	3	5
	3.8	Toxicity of metals - Cd, Hg, Pb and Cr, with specific examples.	1	5
	3.9	Treatment of metal toxicity by chelation therapy (EDTA)	1	5
	Inorganic Chemistry-2 Practicals			

4	4.1	Colorimetric estimation of Fe, Cu, Ni, Mn, Cr, NH_4^+ , nitrate and phosphate ions. Or UV- Visible spectral studies of different coordination compounds	15	6
	4.2	Study of the reactions of the following radicals with a view to their identification and confirmation. Pb^{2+} , Al^{3+} , Zn^{2+} , Mn^{2+} , Ni^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , NH_4^+ , CO_3^{2-} , SO_4^{2-} , Cl^- , Br^- , CH_3COO^- Systematic qualitative analysis of mixtures containing two acid and two basic radicals from the above list without interfering radicals by Semi- micro method only. (Minimum of 5 mixtures to be analysed)	15	6
5	Teacher-Specific content			
Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <ul style="list-style-type: none"> • Lecture (chalk & board, powerpoint presentation) • Group discussion • Peer teaching • Demonstration of experiments • Hands-on training 			
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p style="text-align: center;">A. Continuous Comprehensive Assessment</p> <p style="text-align: center;">Theory: 25 marks</p> <p style="text-align: center;">Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p style="text-align: center;">Practical: 5 marks</p> <p style="text-align: center;">Lab involvement and skill</p> <p style="text-align: center;">Report of lab works done</p>			

	<p style="text-align: center;">B. Semester end examination</p> <p style="text-align: center;">Theory- 50 marks – 1.5 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p>Practical (20 marks) -1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>
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3. Catherine E. Housecroft, Alan G. Sharpe C. E. Barnes, *Inorganic Chemistry* 4th Edn. Journal of Chemical Education, 2003.
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Department of Chemistry
St. Albert's College (Autonomous)
Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Physical Chemistry- 3					
Type of Course	DSC A					
Course Code	24SACCHE6DA302					
Course Level	300-399					
Cours Summary	This course deals with the principles of surface chemistry, colloids, chemical kinetics, electrochemistry, and electromotive force.					
Semester	VI	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Assess different kinds of adsorption and adsorption isotherms.	E	1,2
2	Explain different types of colloidal systems, purification methods and properties of colloidal particles.	U	1,2
3	Interpret nature of various chemical reactions and describe the kinetics of parallel and chain reactions.	An	1,2
4	Make use of the principles of chemical kinetics to study the mechanism of homogeneous and heterogeneous catalysis.	A	1,2
5	Describe the mechanism and factors affecting electrolytic conductance. Analyse properties of electrolytic conductance.	A	1,2
6	Utilize conductance measurements in quantitative analysis.	A	1,2

7	Categorise different electrodes based on their function and apply Nernst equation to calculate electrode potential.	A	1,2
8	Apply the theoretical concepts of electrolytic conductance, adsorption and viscosity in practical experiments.	A	1, 2, 10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
SURFACE CHEMISTRY AND COLLOIDAL STATE				
1	1.1	Adsorption – types, adsorption of gases by solids – factors influencing adsorption, Freundlich adsorption isotherm, Langmuir adsorption isotherm – derivation of Langmuir adsorption isotherm.	5	1
	1.2	Types of solutions – true, colloid and suspensions, Classification of colloids: Lyophilic, lyophobic, macromolecular, multimolecular and associated colloids with examples, purification of colloids – ultra filtration and electro dialysis.	5	2
	1.3	Properties of colloids: Brownian movement, Tyndall effect, electrophoresis. Electrical double layer and zeta potential. Coagulation of colloids, Hardy- Schulz rule. Micelles and critical micelle concentration, sedimentation and streaming potential.	5	2
CHEMICAL KINETICS				
2	2.1	Arrhenius equation, concept of activation energy, Collision theory - kinetic theory of collisions, steric factor. Types of complex reactions - consecutive reactions, opposing reactions, parallel reactions, Chain reactions. Steady state approximation.	5	3
	2.2	Catalysis: Homogeneous catalysis, enzyme catalysis – Heterogeneous catalysis – Surface catalysis, Elementary idea about Autocatalysis.	2	4

ELECTROCHEMISTRY AND ELECTROMOTIVE FORCE				
3	3.1	Ionic mobility: - relation with ionic conductance (with derivation), influence of temperature on ionic conductance, ionic conductance and viscosity –	5	5
		Walden's rule. Abnormal ionic conductance of H^+ and OH^- .		
	3.2	Debye-Hückel theory of strong electrolytes – the concept of ionic atmosphere, asymmetry and electrophoretic effect, Debye-Hückel-Onsager equation (no derivation). Activity, mean ionic activity coefficient, ionic strength, Debye-Hückel limiting law (no derivation).	5	5
	3.3	Applications of conductance measurements – determinations of degree of dissociation of weak electrolytes, determination of solubility and solubility products of sparingly soluble salts, conductometric titrations involving strong acid-strong base, weak acid-strong base, strong acid-weak base, mixture of a strong acid and weak acid against strong base and precipitation titrations.	5	6
	3.4	Reversible cells - Daniel cell. Reference electrodes – Standard Hydrogen Electrode, Calomel electrode. Electrode potential – Electrochemical series. Representation of cells (IUPAC), Electrode reactions and cell reactions.	4	7
	3.5	Derivation of Nernst equation for electrode potential and cell potential, Calculation of equilibrium constant from EMF data. Applications of emf measurements –determination of pH using glass electrode. Potentiometric titrations- acid-base and redox reaction.	4	7

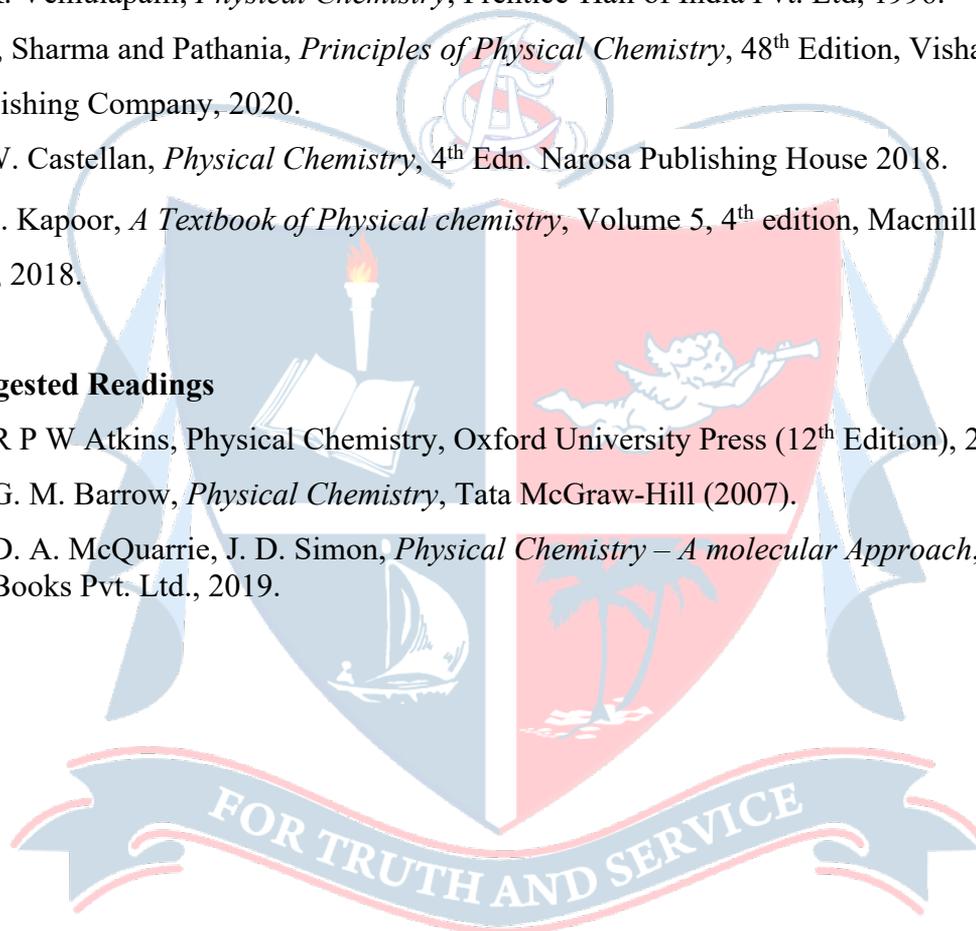
Physical chemistry – 3 Practicals				
4		1. Viscosity – Determination of viscosity of sucrose/glycerol. 2. Determination of composition of binary liquid mixture using viscometry (toluene-nitrobenzene) 3. Determination of molecular weight of a polymer using viscometry (polystyrene in toluene) 4. Viscometry: Verification of Kendall's equation-full experiment 5. Conductometry •Determination of equivalent conductance of an electrolyte •Determination of dissociation constant and degree of dissociation of a weak acid •Verification of Onsager equation 6. Adsorption: •Verification of Freundlich and Langmuir adsorption isotherm - Charcoal Acetic acid or Charcoal-Oxalic acid system. Determination of concentration of given acid using the isotherm	30	8
5	Teacher-Specific content			
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> • Lecture sessions, (chalk & board, powerpoint presentation) • Interactive sessions and simulations, • Visual aids like videos and models to enhance understanding. • Peer discussions. • Laboratory experiments and hands-on training 			
Assessment Types	MODE OF ASSESSMENT			
	A. Continuous Comprehensive Assessment (CCA) Theory : 25 marks Pop quiz/Assignments /Class tests/ MCQ /Viva / Involvement in classroom activities Practical : 5 marks Lab involvement and skill Report of lab works done			
	B. Semester end examination Theory- 50 marks – 1.5 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 = 20 iii) Essay 1 question (out of 2): 1 X 10 = 10 Practical (20 marks) -1 hr. i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5			

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2. G. Raj, *Advanced Physical Chemistry*, Goel publishing house, 2016.
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8. K. L. Kapoor, *A Textbook of Physical chemistry*, Volume 5, 4th edition, Macmillan India Ltd., 2018.

Suggested Readings

1. R P W Atkins, *Physical Chemistry*, Oxford University Press (12th Edition), 2020.
2. G. M. Barrow, *Physical Chemistry*, Tata McGraw-Hill (2007).
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Department of Chemistry
St. Albert's College (Autonomous)
Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Organic Chemistry-4					
Type of Course	DSE					
Course Code	24SACCHE6DE301					
Course Level	300-399					
Course Summary	This course examines the structure and biological importance of polypeptides, amino acids, proteins, nucleic acids, carbohydrates, natural products, lipids, vitamins, steroids, and hormones. Practical part of the course comprises extraction of natural products.					
Semester	VI	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Predict the synthetic pathway of polypeptides and amino acids	A	1,2
2	Identify the structure and biological importance of proteins and nucleic acids	A	1,2,3
3	Examine the structure, properties, and industrial applications of carbohydrates	An	1,2
4	Predict the interconversion of carbohydrates	A	1,2
5	Identify the structure and properties of natural products and lipids	A	1,2

6	Describe the classification structure and biological significance of vitamins, steroids, and hormones	U	1,2,3
7	Make use of theory to synthesis and extract various components of oils and tea leaves	A,S	1,2,3,4,10
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Amino Acids, Peptides, Proteins and Nucleic Acids			
	1.1	Amino Acids-Classification. Synthesis-Gabriel phthalimides synthesis, Strecker synthesis, Ionic properties and Ninhydrin reaction. Zwitterion structure and Isoelectric point.	4	1
	1.2	Polypeptides- Synthesis -DCC method. Merrifield's solid phase peptide synthesis.	3	1
	1.3	Primary, secondary, tertiary and quaternary structure of proteins: α -helix and β -pleated sheets. Denaturation of proteins.	4	2
	1.4	Nucleicacids: Components of nucleic acids, nucleosides and nucleotides. Structure of DNA, Watson, and Crick model. Differences between DNA and RNA. Protein biosynthesis, Replication of DNA	4	2
2	Carbohydrates			
	2.1	Classification of carbohydrates.	1	3
	2.2	Fischer and Haworth projections of glucose and fructose. Cyclic structure of glucose. Reactions of glucose and fructose - osazone formation, Tollen's reagent.	4	3

	2.3	Epimers, mutarotation and anomers.	3	3
	2.4	Chain lengthening and chain shortening of aldoses - Kiliani-Fischer synthesis and Wohl degradation. Interconversion of aldoses and ketoses.	3	4
	2.5	Sucrose-Structure, reactions and uses of sucrose	1	3
	2.6	Structure and properties of starch and cellulose (elementary idea). Industrial applications of cellulose.	3	3
	Natural products, Lipids ,Vitamins, Steroids and Hormones			
	3.1	Natural products. Terpenoids: Classification, isoprene rule. Essential oils - citral and geraniol –chemical properties and uses. Alkaloids: Classification based on source, isolation, general properties, physiological effects of coniine and nicotine.	4	5
3	3.2	Lipids. Oils and fats: Biological functions. Trans fat and their effect. Hydrogenation, Rancidity. Acid value, Saponification value, Iodine value and RM value. Soaps - Types and cleansing action. Synthetic detergents - Comparison between soaps and detergents.	5	5
	3.3	Vitamins. Classification, structure, biological functions and deficiency diseases of vitamins A, B ₁₂ and C	2	6
	3.4	Steroids Diels' hydrocarbon. Structure and functions of cholesterol. Elementary idea of HDL and LDL.	2	6
	3.5	Hormones Biological functions of steroid hormone - Estrogen, peptide hormone-Insulin and amine hormone–Thyroxine. (Structure not required). Artificial hormone –Birth control pill.	2	6
	Organic Chemistry IV Practical			
4	4.1	1.Extraction of caffeine from tea leaves/tea dust powder 2. Extraction of volatile oils by Clevenger's method (Hydro distillation method). 3.Solvent extraction -isolation of lycopene from tomato 4. Determination of saponification value of the fat and oils by taking any real sample	30	7

		5. Determination of acid value of the fat and oils by taking any real sample		
5	Teacher-Specific Content			

Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <ul style="list-style-type: none"> • Lecture (chalk & board, powerpoint presentation) • Group discussion • Peer teaching • Demonstration of experiments • Hands-on training
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA) Theory: 25 marks</p> <p>Quiz / Assignments / Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>Practical : 5 marks</p> <p>Lab involvement and skill Report of lab works done</p>
	<p>B. Semester end examination</p> <p>Theory- 50 marks – 1.5 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p>Practical (20 marks) -1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

REFERENCES

1. Clayden, J; Greeves, N; Warren, S. *Organic chemistry*; Oxford University Press, 2012.
2. Finar, I. L. *Organic Chemistry*; Vol. 1& 2; Dorling Kindersley (India) Pvt. Ltd (Pearson Education).
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	Department of Chemistry St. Albert's College (Autonomous) Ernakulam
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Programme	BSc (Hons) CHEMISTRY				
Course Name	Rubber Technology				
Type of Course	DSE				
Course Code	24SACCHE6DE302				
Course Level	300-399				
Course Summary	This course explores the basic aspects of rubber its modifications and applications				
Semester	VI	Credits			Total Hours
Course Details	Learning Approach	3	1		75
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the basics of rubber and latex chemistry	U	1,2,3
2	Apply knowledge on different aspect of Vulcanization and Compounding in rubber	A	1,2,3
3	Understand the different application of rubber in different sectors	U	1,2,3
4	Analyse physical and chemical properties of latex and dry rubber	An, S	1,2,3,10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Int appreciation (Ap)*

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
Natural rubber and latex				
1	1.1	Origin – Natural Rubber Latex, tapping, processing, properties and applications – Conversion of Latex into dry rubber – Properties of dry rubber – Classification based on technical specifications Natural rubber, isoprene rubber, butyl rubber, nitrile rubber, chloroprene rubber and styrene-butadiene rubber	8	1
	1.2	Definition of latex, classification, latex particle size and distribution, stability and destabilization of lattices, comparison between lattices and polymer solution Natural rubber latex –origin, tapping, bulking and preservation, composition of field latex, properties, preservation, methods of concentrating latex - creaming, centrifuging, & evaporation,– Specification and testing-(national and ISO) for latex grades (ASTM D 1076)	7	1
2	Vulcanization and Compounding			
	2.1	Theory and mechanism of sulphur and non-sulphur vulcanization (with and without accelerators), rheo-curve of compounded rubber, properties of vulcanized rubber - Vulcanizing ingredients & their sequence of mixing: Activators and accelerators: mechanisms of action. Other cure systems based on metal oxides, peroxides, etc. retarders, inhibitors anti-reversion agents.	4	2

	2.2	Fillers: Carbon black-Its preparation, structure, properties and their effect on rubber properties. Silica fillers & coupling agents. Other fillers: Clay, calcium carbonate, titania etc. Nano-fillers: Reinforcement by filler: Reinforcement, factors influencing elastomers reinforcement, fillers characteristics, main effects of fillers on vulcanizate properties, influence of fillers characteristics on the cross linking process, filler incorporation, the role of bound rubber, reinforcement and crosslink density.	6	2
	2.3	Processing aids, plasticizers, process additives, release agents, Other additives like colourants, blowing agents, factice, fire retardants, antistatic agents, deodorants and reodorants, biocides and fungicides etc. Anti-degradants: Introduction, autoxidation of hydrocarbon polymers, amine & phenolic antioxidants & other types, anti-zonants, Prevention of ozone attack with the use of waxes & saturated polymer for ozone protection.	5	2
3	Application of Rubber in Different Sectors			
	3.1	Functions of tyres– Role of rubber and unique properties of rubbers for the applications. Tyre constructions – generic design features and materials. Tubeless tyres – comparison. Mechanics of rubber – Cord composites. Inflation pressure – Contact area, tyre deflections – Design factors and principles. Classifications of tyres – Essential design criteria. Rolling resistance, friction, mechanical loss on tyre behaviour. Tyre endurance and life related properties	8	3

	3.2	<p>Overview of rubber's use in various industrial and consumer products such as hoses, belts, gaskets, and seals, as well as in footwear, sports equipment, and household items.</p> <p>Medical Devices: Examination of rubber's critical role in healthcare, including in the manufacture of gloves, catheters, contraceptives, and various medical devices where flexibility and biocompatibility are essential.</p> <p>Aerospace Industry: Discussion on the use of rubber in the aerospace industry, such as in seals, gaskets, and fuel tank linings, highlighting rubber's resistance to extreme temperatures and conditions.</p>	7	3
4	Rubber Technology Practicals			
	4.1	<p>I. Latex Analysis</p> <ol style="list-style-type: none"> 1. Determination of total solid content of latex 2. Determination of alkalinity of latex 3. Determination of dry rubber content of latex 4. Determination of volatile fatty acid number of latex 5. Determination of viscosity of latex 6. Determination of KOH number 7. Determination of coagulum 8. Determination of sludge 9. Determination of mechanical stability time (MST) 10. Determination of density <p>II. Dry Rubber Analysis</p> <ol style="list-style-type: none"> 1. Determination of dirt 2. Determination of Po and PRI 3. Determination of ash 4. Determination of nitrogen 5. Determination of volatile matter <p>III. Mixing behaviour of NR on two roll mill</p>	30	4
5		Teacher Specific Content		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures (Chalk & Board, Multimedia presentations) Group Discussions Case studies Quizzes
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA) Theory : 25 marks</p> <p>Quiz/ Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p style="text-align: center;">Practical : 5 marks</p> <p>Lab involvement and skill Report of lab works done</p>
	<p>B.Semester End examination</p> <p style="text-align: center;">Theory- 50 marks – 1.5 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p style="text-align: center;">Practical (20 marks) -1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

REFERENCES

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	<h2 style="margin: 0;">Department of Chemistry</h2> <h3 style="margin: 0;">St. Albert's College (Autonomous)</h3> <h3 style="margin: 0;">Ernakulam</h3>
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Industrial Inorganic Chemistry and Nuclear Chemistry					
Type of Course	DSE					
Course Code	24SACCHE6DE303					
Course Level	300-399					
Course Summary	This course is designed to provide students with a comprehensive understanding of the industrial processes involved in the production of inorganic compounds and the principles governing nuclear reactions.					
Semester	VI	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
Pre-requisites, if any		4				60

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyse different industrially important inorganic materials.	An	1,2, 6
2	Evaluate the important processes involved in metallurgy	E	1,2 ,6
3	Explain the catalytic properties of inorganic materials	E	1,2,6
4	Illustrate the basics of chemical explosives and rocket propellants	U	1,2,6,10
5	Analyse different aspects of nuclear chemistry, its applications and associated problems.	An	1,2,6,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
	Glass, Ceramic and Cements			
1	1.1	Glass -Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate glass, coloured glass and photosensitive glass.	5	1
	1.2	Ceramics -Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications. Bioceramics.	5	1
	1.3	Cement -Classification of cement, ingredients and their role, manufacture of cement and the setting process, quick setting cements. Biocement- Living building materials	5	1
2		Metallurgy		
	2.1	Minerals in India, mineral processing, chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents.	5	2
	2.2	Electrolytic reduction, hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: electrolytic process, Van Arkel-de Boer process and Mond's process, Zone refining.	7	2
	2.3	Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.	3	2
3	Introduction to Chemical Explosives, rocket propellants and catalysis			
	3.1	General principles and properties of catalysts, homogenous catalysis, and heterogenous catalysis (catalytic steps and examples), their industrial applications, deactivation, or regeneration of catalysts. Phase transfer catalysts, application of zeolites and metal organic frameworks as catalysts.	7	3

	3.2	Origin of explosive properties in inorganic compounds. Categorisation of explosives (low explosives – high explosives – primary, secondary, intermediary, tertiary). Explosive properties of Gun powder, lead azide, TNT, PETN, cyclonite (RDX).	6	4
	3.3	A Brief History and introduction of chemical rocket propellants. Liquid propellants, ecofriendly propellants and solid propellants	2	4
Nuclear Chemistry				
	4.1	Nucleus and its classification, nuclear forces, nuclear stability, binding energy, nuclear models. Radioactive decay, radioactive elements, general characteristics of radioactive decay, decay kinetics - decay constant, half-life, mean life period, units of radioactivity.	5	5
4	4.2	Measurement of radioactivity, Geiger-Muller detector, scintillation detectors, nuclear reactor: classification of reactors, uranium reactor, breeder reactor. Nuclear reactors in India (Brief Idea). Nuclear fusion and stellar energy. Units of radiation energy (Rad, Gray, Rontgen)	5	5
	4.3	Nuclear pollution and radiological safety: interaction of radiation with matter, radiolysis of water, radiation dosimetry. Radioactive isotopes and their applications, isotopic dilution analysis, neutron activation analysis, disposal of nuclear waste, nuclear disaster (nuclear accidents–case study).	5	5
5	Teacher-Specific content			

Teaching and Learning Approach	Classroom Procedure (Mode of transaction)
	Lecture (chalk & board, powerpoint presentation) Group discussion Peer teaching Industrial Visit/ visit to a nuclear Reactor (IGCAR/KNPP etc.)
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: 30 marks Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities

	B. Semester end examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20
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Programme	BSc (Hons) CHEMISTRY				
Course Name	Spectroscopic Methods of Chemical Analysis				
Type of Course	DSE				
Course Code	24SACCHE6DE304				
Course Level	300-399				
Course Summary	This course covers various spectroscopic methods, including principles, instrumentation and applications.				
Semester	VI	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	
		4		0	
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domain	PO No
1	Discuss instrumentation in IR, NMR and electronic spectroscopic techniques.	U	1,2
2	Describe the fundamental principles of Raman, EPR, NQR, Mossbauer, Fluorescence and X-ray spectroscopic techniques in chemical analysis.	U	1,2
3	Evaluate the advantages and limitations of Raman spectroscopy, EPR spectroscopy and NQR spectroscopy in different scientific and industrial applications.	E	1,2,10
4	Assess the utility of Mössbauer spectroscopy, Fluorescence spectroscopy and X-ray spectroscopy in various fields.	E	1,2
5	Describe the fundamental principles of AAS, AES and FES.	U	1,2

6	Compare and contrast the advantages and limitations of AAS, AES, and FES in elemental analysis.	U	1,2
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT**Content for Classroom transaction (Units)**

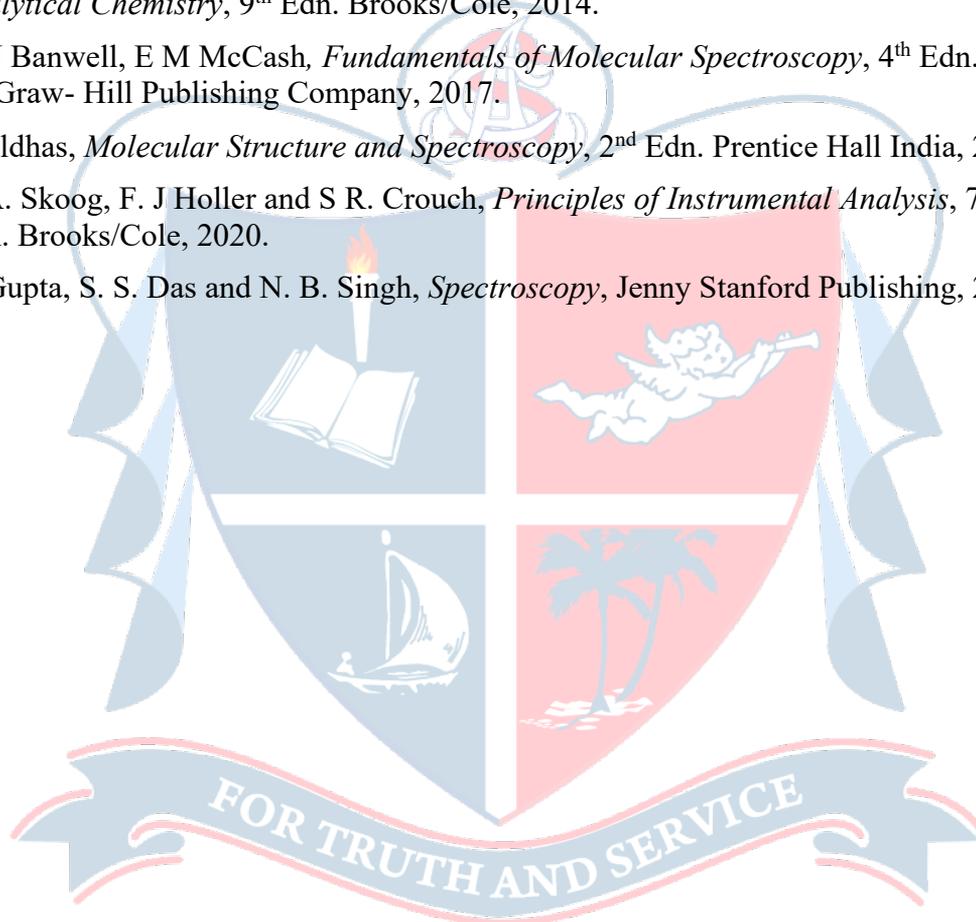
Module	Units	Course description	Hrs	CO No.
Instrumentation in Electronic, IR and NMR Spectroscopic Techniques				
1	1.1	Instrumentation in UV/ Visible Spectroscopy: Light sources, wavelength dispersion (gratings, prisms, interference filters, lasers). Sample holders, detection of signals (photocells, photo multipliers, and diode arrays), Sensitivity and S/N ratio. Single and double beam instruments.	5	1
	1.2	Instrumentation in IR Spectroscopy: Light sources, infrared detectors, sample preparation techniques; liquids, solids. Dispersive I R spectrometer. (FTIR- basic idea only)	5	1
	1.3	Instrumentation in NMR Spectroscopy: Magnet: Types of magnets used in NMR (permanent, resistive, superconducting), Probes and RF coils. Sample handling and temperature control.	5	1
Raman and EPR Spectroscopic Techniques				
2	2.1	Raman Spectroscopy: Scattering of light, polarizability and classical theory of Raman spectrum, rotational and vibrational Raman spectrum, Stokes and anti-Stokes lines: their intensity difference, complementarities of Raman and IR spectra, mutual exclusion principle, applications of Raman spectroscopy.	8	2,3
	2.2	EPR Spectroscopy: Electron spin in molecules, interaction with magnetic field, g factor, factors affecting g values, fine structure and hyperfine structure, Kramers' degeneracy, applications of ESR spectroscopy.	7	2,3
NQR, Mossbauer and Fluorescence Spectroscopic techniques				
3	3.1	Theory and important applications of NQR Spectroscopy.	3	2,3

	3.2	Mossbauer Spectroscopy: Principle, Doppler effect, recording of spectrum, chemical shift, factors determining chemical shift, application to complexes of iron.	6	2,4
	3.3	Fluorescence Spectroscopy. Instrumentation: light source, monochromator, optical filters, photomultiplier tube, polarizers, application- fluorescence sensing.	6	2,4
4	Atomic Spectroscopic Techniques			
	4.1	Atomic absorption spectroscopy (AAS), principle of AAS, absorption of radiant energy by atoms, measurement of atomic absorption, instrumentation: Radiation Sources, Atomizers, Detectors. Analytical Applications of AAS.	5	5,6
	4.2	Atomic emission spectroscopy (AES), advantages and disadvantages of AES, origin of spectra, principle and instrumentation, applications.	5	5,6
	4.3	Flame emission spectroscopy (FES), flames and flame temperature, spectra of metals in flame, instrumentation, applications.	5	5,6
5		Teacher Specific content		

Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <p>Lecture sessions, interactive sessions including discussions and demonstrations, to engage students actively and visual aids like presentations and videos to enhance understanding. Utilize case studies from various scientific fields (like environmental science, pharmaceuticals, forensics) to illustrate how spectroscopy is applied practically. Form study groups to discuss concepts, compare approaches, and explain concepts to one another.</p>
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p style="text-align: center;">A. Continuous Comprehensive Assessment (CCA)</p> <p style="text-align: center;">Total marks: 30</p> <p style="text-align: center;">Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p style="text-align: center;">B. Semester end examination (70 marks)- 2 hrs.</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>

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5. C N Banwell, E M McCash, *Fundamentals of Molecular Spectroscopy*, 4th Edn. McGraw- Hill Publishing Company, 2017.
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Programme	B.Sc Chemistry					
Course Name	Forensic Chemistry					
Type of Course	DSE					
Course Code	24SACCHE6DE305					
Course Level	300-399					
Course Summary	This comprehensive syllabus covers key areas of forensic chemistry, providing students with theoretical knowledge essential for a career in forensic science.					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4		Nil		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate understanding of the scientific method.	U	1,2
2	Apply knowledge in the analysis of toxic substances, discerning their effects on the human body, and their relevance in forensic investigations.	A	1,2
3	Explain how the principles and techniques of forensic chemistry are applied in criminal investigations	An	1,2,3
4	Analyse the basic principles, concepts, terms, and scientific techniques associated with forensic chemistry	An	1,2,3
5	Evaluate the relationships between science, technology, and society as these affect forensic issues.	E	1,2,3, 6,8
6	Critically analyse and evaluate information to select and expertly describe appropriate methods for the analysis of a range of forensic evidence types	An, E	1,2,3, 6,8

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Forensic Toxicology			
	1.1	<p>Definition, Areas of forensic toxicology, Elements of Forensic Toxicology</p> <p>Nature of cases, Role of the Forensic Toxicologists, Laws related to Forensic Toxicology.</p> <p>Poisons- Definition of Poison, Toxin and Toxicant, Ideal Poison, Classification of poisons based on their origin and Chemical nature, mode of action.</p>	3	1,3,4
	1.2	<p>Types and trends of poisoning- Animals and Human poisoning in India with special reference to Suicidal, Homicidal and accidental poisons.</p> <p>Animal Poisons: Insects and animal toxins and their examination, Composition of Snake venoms, Sites and mode of action, Effect on the body as a whole, and tests for identifications.</p> <p>Plant poisons: Classification and characteristics, method of extraction and stripping of plant poisons in matrices and analysis by chemical and instrumental techniques.</p> <p>Gaseous Poisoning: Carbon Monoxide, Hydrogen Cyanide and Phosphine gas, significance, signs and symptoms, methods of diagnosis, tests for identification.</p> <p>Major vesicants used as chemical-warfare agents.</p> <p>Factors affecting the poisoning, methods of administration.</p>	7	1,2,3,4,5,6
	1.3	Extraction methods of some important poisons and their forensic identification.	2	1,2,3,4,5,6
2	Forensic Drugs			
	2.1	Introduction and classification of Drugs of Abuse (Narcotics, Stimulants, Depressant	3	1,2,3,4,5,6

		and hallucinogens), Status of Drug abused in India, Introduction to Club drugs		
	2.2	Drugs as Evidence. Introduction and brief analysis of Phenolphthalein in Trap case,	2	1,2,3 ,4,5, 6
	2.3	Drug abuse in Sports-Introduction, International Olympic Committee (IOC), World Anti-Doping Agency (WADA), classification of commonly prohibited substances and Performance enhancing Drugs, Steroids, Stack and Pyramid methods, Dope test and Blood Doping, Sampling techniques, analytical approaches.	5	1,2,3 ,4,5, 6
	2.4	Definition, classification of liquors based on origin (Indian Made Foreign Liquors, Country Made Liquors and Illicit liquors), Characteristics of Beer, wines and Whisky, Congeners in alcoholic beverages, Laws and Penalties as per Excise/ Act. Laboratory methods of determination alcoholic strength, Forensic analysis of distilled and fermented liquors including illicit liquors.	5	1,2,3 ,4,5, 6
	Theory of forensic analysis			
	3.1	Sample Collection and Sample Integrity	1	1,2,3 ,4,5, 6
3	3.2	Theory of Forensic Analysis-Identification-Presumptive Analysis and Confirmatory Analysis; Presumptive Drug Testing by Color/spot test, Microcrystalline testing. Comparative Analysis-Class Characteristics and Individual Characteristics	3	1,2,3 ,4,5, 6
	3.3	Instrumental Techniques Employed in Forensic Chemistry: Nuclear Magnetic Resonance Spectrophotometry; Neutron Activation Analysis; Gas Chromatography Mass Spectroscopy; Fourier Transform Infrared Spectrophotometry; UV- VIS- NIR Spectrophotometry; Microscopy Thin Layer Chromatography: Basic Principle, Setup, visualization and Forensic applications etc.	6	1,2,3 ,4,5, 6
	3.4	Case studies based on Forensic significance of Cosmetics: Introduction to cosmetics of forensic interest and their role in crime investigation, General Chemistry of Colorants, Dyes, Pigments & Polymers.	5	6
	Fire, Arson and Explosives			
4	4.1	Arson and Burning cases: Legal definition of Arson and its motives.	7	1,2,3 ,4,5, 6

	Types and chemistry of fire, Role of forensic science in the investigation of fire, cause of ignition and evidence collection Degrees of Arson, Forensic and legal Concepts, Determining origin and cause; Fire patterns, Collection/Preservation of Arson Evidences, Flashover, Backdraught, Live or dead at time of arson		
4.2	Fire safety and firefighting techniques. Prevention of fire,	2	1,2,3 4,5, 6
4.3	Definition of Explosives, Definition as per Indian Explosive Acts. History of Explosives, Chemistry of explosives, Deflagration and Detonation phenomenon; Properties of explosives, Classification of explosives.-High and low, Primary and secondary, military and commercial etc.	6	1,2,3 4,5, 6
4.4	Theory and types of Non-explosive explosions. Explosive and improvised explosive devices. Explosive investigation Laws: IPC Sections related to Arson and Explosives; EC Act; Petroleum Act.	3	1,2,3 4,5, 6
5	Teacher Specific Module		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture sessions, Experts led Interactive sessions to include students actively, visual aids like presentations and videos to improve students' comprehension. Provide case studies that demonstrate the use of forensic analysis.
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: 30 mark Quiz /Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	B. Semester end examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: 20 X 1 = 20

	ii) Short essay 6 questions (out of 8): $6 \times 5 = 30$ iii) Essay 2 question (out of 4): $2 \times 10 = 20$
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Programme	B.Sc. Chemistry (Honours) with specialization in Industrial Chemistry						
Course Name	INDUSTRIAL CHEMISTRY III						
Type of Course	DSE						
Course Code	24SACCHE6DE306						
Course Level	300-399						
Course Summary	This course provides a comprehensive understanding of instrumentation principles, process instrumentation techniques, optical and microprocessor-based methods, and electroanalytical instrumentation, preparing students for various applications in measurement and instrumentation fields.						
Semester	VI	Credits				4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	60	
		4					
Pre-requisites, if any							

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Outline the basics of analytical instrumentation and its analytical performance characteristics and compare the characteristics of various types of transducers.	U, An	1,2
2	Explain the working principles of various pressure gauges and thermometers.	U	1,2
3	Summarize the working of optical and microprocessor based techniques.	U	1,2

4	Examine the principles of different electroanalytical methods and select the most appropriate method to separate and analyse the given matrix.	A	1,2
<i>*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
Principles of Instrumentation (15 Hours)				
Module I	1.1	Characteristics of measurement system: Accuracy & Precision, Functional units	2	1
	1.2	Classification of instruments – automatic, manual type, self-operated, power operated, analogue, digital. Zero order instrument and first order instrument	3	1
	1.3	Performance characteristics of instruments – Static, dynamic characteristics. Signal and noise, types of noises - chemical and instrumental noise. Types of instrumental noise – thermal, shot, flicker and environmental noise, S/N ratio and its significance.	5	1
	1.4	Transducers: characteristics of transducers – static and dynamic characteristics, sensitivity and transfer function.	2	1
	1.5	Some typical examples of transducers - Photoemissive, photoconductive and photovoltaic systems, photomultiplier and photodiode.	3	1
Process Instrumentation (15 hours)				
Module II	2.1	Difference between Process Instrumentation and Laboratory Instrumentation, concept of measurement and accuracy.	2	2
	2.2	Temperature measurement: Introduction, Definition, Scales used for Temperature measurements. Liquid in Glass thermometers, bimetallic thermometers, pressure spring thermometer, vapour	1	2

		filled thermometers, resistance thermometers, radiation pyrometers.	1	
	2.3	Pressure measurement: Introduction, Definition, Terminology: Absolute, Atmospheric, Gauge, Vacuum, Static and Dynamic pressure. Manometers-Single column, U- tube, Expanded bulb U-tube, Inclined U tube, Inverted U-tube, Ring balance Manometer. Barometers- Mercury barometer, Aneroid barometer.	1 3 1	2
	2.4	Mechanical Gauges: Bourdon tubes, Diaphragm, Bellows. Low pressure gauges: McLeod Gauge, Pirani gauge. Electrical pressure transducer (Linear Variable Differential Transformer type)	2 2 2	2
Optical and Microprocessor Based methods (15 Hours)				
Module III	3.1	Polarimetry: Principle, instrumentation and applications of polarimetry.	3	3
	3.2	Refractometry: Principle, instruments and application of refractometry.	3	3
	3.3	Nephelometry: Principle, instruments, factors affecting intensity of scattered radiations and application of nephelometry.	3	3
		Turbidimetry: Principle, difference between nephelometry and turbidimetry, factors affecting measurement of turbidity, applications of turbidimetry.	2	
3.4	Telemetry: Pneumatic- electrical (voltage telemetering) -frequency telemetering, multiplexing Modulation of digital data- transmission channels- fibre optics.	4	3	
Electro Analytical Instrumentation (15 Hours)				
Module IV	4.1	Potentiometric methods: Principle-technique and detection limit, method of analysis.	3	4
	4.2	Conductometry – Principle, instrumentation, working & applications	2	4

	4.3	Polarography - Principle, instrumentation, working & applications (c) Amperometry - Principle, instrumentation, working & applications (d) Anodic stripping analysis - Principle, instrumentation, working & applications (e) Coulometry (primary and secondary)- Principle, instrumentation, working & applications	4 3 3 3	4
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Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> • Lecture • Power point presentations • Group Discussion • Industrial Visit • Attending Seminars and Conferences
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: 30 marks Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	B. Semester end examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Data Analysis using Python and Soft skills					
Type of Course	SEC					
Course Code	24SACCHE6SE301					
Course Level	300- 399					
Course Summary	This interdisciplinary course provides a comprehensive exploration of scientific investigation, statistical analysis, and python programming in the context of chemistry.					
Semester	VI	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				45
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Apply scientific methods for designing experiments systematically	A	1,2,3
2	Interpret data using various statistical tools.	U	1,2,3
3	Understand the basics of Python	U	1,2,3
4	Utilize Python in data visualization and analysis	A	1,2,3
5	Develop ideas in chemistry that can be grown into startups	C	4,5,9,10
6	Develop comprehensive scientific communication skills	C	4,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transactions (Units)**

Module	Units	Course description	Hrs	CO No.
		Data Analysis		
1	1.1	The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments.	3	1
	1.2	Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests.	4	1,2
	1.3	Chemometrics. Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r, and its abuse. Basic aspects of multiple linear regression analysis.	8	2
		Introduction to Python		
2	2.1	Introduction to Python Programming Defining numbers, Variables, Strings, Lists and Loops, Comparisons of flow control, functions, data structures, file input/output, Basic Numpy	9	3
	2.2	Data Visualization with Python Matplotlib, drawing line plots with a single line, line plots with multiple line, adding legend, drawing bar plots, scatter plots, plot title and axis labels. Saving plots,	6	4
		Soft skills for chemists		
3	3.1	<ul style="list-style-type: none"> ● Presentation on a hypothetical start-up idea incorporating chemistry background. ● Review of recent research articles (writing) ● Poster design and presentation skills ● Plotting of data using different software (excel, origin etc.) ● Fitting of data 	15	5,6
4		Teacher-Specific content		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures, demonstrations, discussions, hands-on training, seminars, presentations and assignments.
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Assessment Types	MODE OF ASSESSMENT
	<p style="text-align: center;">A. Continuous Comprehensive Assessment</p> <p style="text-align: center;">(CCA) Total marks: 25 marks</p> <p style="text-align: center;">Presentation /writing skills Data analysis skill/ Examination</p>
	<p style="text-align: center;">B. Semester end examination</p> <p style="text-align: center;">Total marks:50 marks-1.5 hrs</p> <p style="text-align: center;">i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p>

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Intellectual Property Rights					
Type of Course	VAC					
Course Code	24SACCHE6VA301					
Course Level	300-399					
Course Summary	This course covers various aspects of intellectual property law, including patents, trademarks, and copyrights.					
Semester	VI	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyse the fundamental principles of intellectual property rights, distinguishing between patents, copyrights, and trademarks.	An	1,2
2	Interpret the ethical and legal implications of intellectual property infringement in diverse contexts.	U	1,2
3	Evaluate the criteria for patentability, including novelty, non-obviousness, and utility.	E	1,2
4	Identify the fundamental concepts and legal framework surrounding trademarks.	U	1,2
5	Analyse and interpret the fundamental principles and theories underlying copyright law.	An	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	INTRODUCTION TO IPR			
	1.1	Meaning of property, origin, nature, meaning of intellectual property rights	4	1
	1.2	Kinds of Intellectual property rights—copy right, patent, trade mark, trade secret and trade dress, design, layout design, geographical indication, plant varieties and traditional knowledge.	7	1,2,4
	1.3	Significance of IPR and their protection	3	1,2
2	INTERNATIONAL ORGANIZATIONS & TREATIES			
	2.1	Paris Convention for the Protection of Industrial Property, Patent Cooperation Treaty (PCT), World Trade Organization (WTO)	5	1,2,3
	2.2	Trade Related Aspects of Intellectual Property TRIPS, TRIMS, WIPO	5	1,2,3
	2.3	Budapest treaty on the international recognition of the deposit of microorganisms for the purpose of patent procedure, international convention for the protection of new varieties of plants (UPOV)	5	1,2,3
3	PATENT RIGHTS AND COPYRIGHTS			
	3.1	Types of patents, inventions which are not patentable, the patent's act 1970- patentable invention, registration procedure, rights and duties of patentee, assignment and licence, restoration of lapsed patents, surrender and revocation of patents, infringement, remedies & penalties.	10	1,2,3
	3.2	Types of copyright, registration procedure, assignment & licence, terms of copyright, piracy, infringement, remedies, copy rights with special reference to software	5	1,2,5
4	Teacher-Specific content			

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures, discussions, group activities and presentations by students.
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Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Total marks: 25 Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities B. Semester end examination Theory- 50 marks – 1.5 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10
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St. Albert's College (Autonomous)
Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Research Methodology for Chemistry					
Type of Course	VAC					
Course Code	24SACCHE6VA302					
Course Level	300-399					
Course Summary	This course covers a wide range of topics aimed at preparing students to conduct a scientific project in chemistry. The aim is to equip students with the skills and knowledge necessary to design, conduct, analyse, and communicate scientific research effectively in the field of chemistry.					
Semester	VI	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Apply the tools for literature survey in chemistry in doing and reporting a chemistry project.	A	1,2
2	Describe the methodology of scientific research.	U	1,2
3	Apply the knowledge of scientific writing in preparing a project report.	A	1,2
4	Discuss the ethical aspects of chemistry research.	U	1,2
5	Apply the basic principles of research methodology in the conducting, reporting and presenting a chemistry project.	A	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

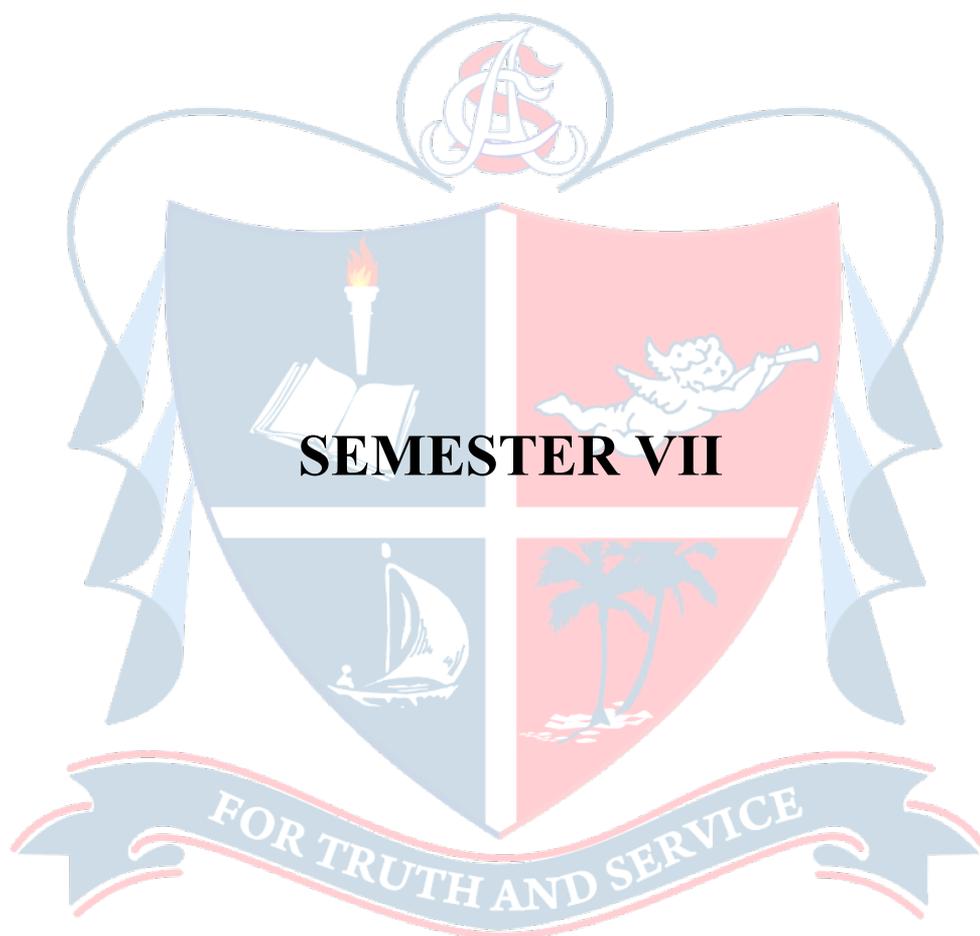
COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Literature Survey			
	1.1	Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples	6	1
	1.2	Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki- Databases, ChemSpider, Science Direct, Beilstein, SciFinder, Scopus. Information Technology and Library Resources: The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information.	9	1
2	Methods of Scientific Research and Writing Scientific Papers			
	2.1	Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation.	5	2,3
	2.2	Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work.	5	2,3
	2.3	Ethical challenges in chemistry research, Responsible conduct of research, Writing Ethics, Avoiding plagiarism.	5	4
3	Training on writing a project report			
	3.1	<ul style="list-style-type: none"> ❖ Project selection ❖ Literature Survey ❖ Conducting the project ❖ Preparing a report ❖ Preparing and displaying a poster ❖ ICT enabled oral presentation 	15	1,2,3,4,5
4		Teacher-Specific content		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures, discussions, group activities and presentations by students.
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Total marks : 25 Poster presentation/ Oral presentation / Project report/ Classroom participation (participation in class activities)
	B. Semester end examination Theory- 50 marks – 1.5 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10

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1. A T Tyowua, *A Practical Guide to Scientific Writing in Chemistry: Scientific Papers, Research Grants and Book Proposals*, CRC Press, 2023.
2. F. H. Jardine, *How to do your Student Project in Chemistry*, Springer, 1994.
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6. D Angelo, G John, *Ethics in Science: Ethical Misconduct in Scientific Research*, Chapman and Hall/CRC, 2018.
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	Department of Chemistry St. Albert's College (Autonomous) Ernakulam
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Coordination and Organometallic Chemistry					
Type of Course	DCC					
Course Code	24SACCHE7CC401					
Course Level	400-499					
Course Summary	This course provides a comprehensive understanding of the structure, bonding, and reactivity of coordination complexes, electronic spectral properties, synthesis, and catalytic applications of organometallic compounds.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Inorganic Chemistry-2					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Compare the stability of metal complexes.	E	1,2
2	Examine the structure and bonding in coordination and organometallic compounds using the concepts of crystal field theory and molecular orbital theory.	An	1,2
3	Construct correlation diagrams and explain the spectral properties of metal complexes.	A	1,2
4	Analyse the reactions of organometallic compounds.	An	1,2
5	Examine the catalytic properties of various organometallic compounds and their applications.	An	1,2,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Structure and Bonding in Coordination Complexes			
	1.1	Classification of complexes based on coordination numbers and possible geometries, σ and π bonding ligands such as CO, NO, CN^- , R_3P , and Ar_3P .	2	1
	1.2	Stability of complexes, kinetic and thermodynamic aspects of complex formation - Irving William order of stability.	2	1
	1.3	Splitting of d orbitals in octahedral, tetrahedral, square planar, square pyramidal and trigonal bipyramidal fields.	2	1
	1.4	Crystal Field Stabilization Energy (CFSE) and Dq values, Jahn Teller (JT) distortion ($d^1 - d^{10}$ systems), static and dynamic JT distortion, consequences of JT distortion, theoretical failure of crystal field theory, Ligand Field Stabilization Energy (LFSE) and evidence of covalency in the metal-ligand bond.	4	1
	1.5	Ligand field theory and molecular orbital theory - diagrams for octahedral and tetrahedral complexes without and with π -bonding, experimental evidences for π -bonding.	5	2
2	Electronic Spectral Properties of Metal Complexes			
	2.1	Electronic spectra of complexes: term symbols and microstates of d^n systems, Racah parameters, splitting of terms in weak and strong octahedral and tetrahedral fields, selection rules for electronic transitions - effect of spin-orbit coupling and vibronic coupling.	5	3
	2.2	Correlation diagrams: Orgel and Tanabe – Sugano diagrams.	3	3
	2.3	Electronic spectra of metal complexes and their interpretation. Charge transfer spectra, luminescence spectra.	5	3
	2.4	Electronic spectra of lanthanide and actinide complexes.	2	3

3	Organometallic Compounds-Synthesis, Structure and Bonding			
	3.1	Ligands and their bonding with metals: CO, CN, NO, N ₂ , H ₂ , alkene, alkyne, PR ₃ , arenes, dienes, allyl, carbenes – carbynes (Fischer and Schrock) and alkyl.	5	1
	3.2	Preparation of metal nitrosyl, dinitrogen, alkyl, aryl, alkene, alkyne, carbenes - carbynes (Fischer and Schrock), arene and phosphine complexes.	3	1
	3.3	18 electron rule.	1	1
	3.4	Bridging and non-bridging (polynuclear) metal carbonyls, IR spectra of metal carbonyls, carbonyl clusters, Wade-Mingos rules.	3	1
	3.5	Isolobal analogy.	1	1
	3.6	Cyclopentadienyl complexes - fluxionality.	1	1
	3.7	Ferrocene: structure and bonding.	1	1
4	Reactions of Organometallic Compounds and Catalysis			
	4.1	Unique reactions in organometallic chemistry: oxidative addition (concerted and stepwise, C _{aryl} -H activation – orthometallation), reductive elimination, migratory insertion (1,1 and 1,2), β -hydride abstraction/elimination. Agostic interactions, σ -bond metathesis (Zr(IV) and Lu(III)).	6	4
	4.2	Homogeneous/heterogeneous catalysis: Tolman catalytic loops, hydrogenation by Wilkinson catalyst, olefin isomerization, Wacker process, hydroformylation (Co & Rh), Monsanto & Cativa acetic acid process, Ziegler-Natta polymerization including metallocene based Zr catalyst, water gas shift reaction and the Fischer-Tropsch reaction (synthesis of gasoline).	7	5
	4.3	Grubbs (I generation & II Generation) and Schrock catalysts – preparation and characteristics, olefin metathesis, ROMP.	2	5
5	Teacher Specific Content			

Teaching and Learning Approach	<p>Classroom Procedure (mode of transaction)</p> <ul style="list-style-type: none"> • Lecture (chalk & board, powerpoint presentation) • Group discussion • Peer teaching
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA) Marks: 30</p> <p>Quiz</p> <p>Assignment</p> <p>Class Test (MCQ/written)</p>
	<p>B. Semester end examination</p> <p>Theory: Written examination (70 Marks)- 2hrs.</p> <p>i) MCQ 20 questions: 20 X 1 = 20</p> <p>ii) Short essay 6 questions (out of 8): 6 X 5 =30</p> <p>iii) Essay 2 question (out of 4): 2 X 10 = 20</p>

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Department of Chemistry
St. Albert's College (Autonomous)
Ernakulam

Programme	BSc (Hons) CHEMISTRY					
Course Name	Organic Chemistry-5					
Type of Course	DCC					
Course Code	24SACCHE7CC402					
Course Level	400-499					
Course Summary	This course delves into the concepts of organic chemistry, focusing on reactive intermediates and the underlying physical principles governing their behaviour. It also investigates concerted reactions and advanced stereochemical aspects of organic reactions.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Predict the reaction mechanism and rationalize the outcome of various organic reactions and obtain practical experience.	A	1, 2, 4, 10
2	Illustrate and practice the transformations and rearrangements of reactive intermediates.	An	1, 2, 4, 10
3	Correlate the reactivity of organic molecules to HSAB concept and various kinetic and thermodynamic conditions and obtain hands-on experience in this area.	An	1, 2, 4, 10
4	Distinguish and predict the stereoselectivity, regioselectivity, and feasibility of pericyclic reactions and their applications.	E	1, 2, 3, 4, 10
5	Master in determining and differentiating chirality, topicity of organic molecules and explore the chemical consequences and applications of conformational equilibria.	C	1, 2, 4, 9, 10
6	Perform raw mechanisms and schemes using chemistry software.	A	1, 2, 4, 10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Organic Reactivity and Mechanistic Insights: Exploring Reactive Intermediates and Physical Principles			
	1.1	Mechanical aspects of SN1, SN2, SNAR, SRN1, SNi, SE1, SE2, effect of substrate, reagent, leaving group, solvent and neighboring group on nucleophilic substitution (SN2 and SN1).	5	1
	1.2	Reactive Intermediates: non-classical carbocations. Structure, generation and reactions of carbenes and nitrenes: insertion reaction of carbene. Simmons-Smith reaction, Lossen reaction, Curtius reaction, Wolff rearrangement and Hoffmann rearrangement.	5	2
	1.3	Physical organic chemistry: kinetic versus thermodynamic control of product formation Hammond postulate, Hammett equation, hard and soft acids and bases – HSAB principle and its applications (organic reactions only).	5	3
2	Symmetry and Molecular Transformations: Insights into Concerted Reactions			
	2.1	Classification: electrocyclic, sigmatropic, cycloaddition, chelotropic, ene and diotropic reactions. Woodward-Hoffmann rules – frontier orbital and orbital symmetry correlation approaches - PMO method (for electrocyclic and cycloaddition reactions only).	5	4
	2.2	Pericyclic reactions in organic synthesis such as Claisen, Cope, Wittig, and Mislow-Evans rearrangements. Diels-Alder and ene reactions (with stereochemical aspects), dipolar cycloaddition (introductory).	5	4
	2.3	Unimolecular pyrolytic elimination reactions of acetates, xanthates and tertiary amine oxides, chelotropic elimination.	5	4

	Advanced Stereochemistry & Conformational Stability and Reactivity			
3	3.1	Axial, planar and helical chirality with examples, stereochemistry and absolute configuration of allenes, biphenyls and binaphthyls, ansa and cyclophanic compounds, spiranes, exo-cyclic alkylidenecycloalkanes.	5	5
	3.2	Topicity and prostereoisomerism, topicity of ligands and faces as well as their nomenclature, NMR distinction of enantiotopic /diastereotopic ligands.	5	5
	3.3	Conformation and reactivity of cyclohexane systems: dehalogenation, dehydrohalogenation, semipinacolic deamination and pyrolytic eliminations, Grob fragmentation. Chemical consequence of conformational equilibrium - Curtin Hammett principle.	5	5
	Organic Chemistry-5 Practical			
4		(i) Practice Chemdraw (Use ChemDraw /other software to draw and manipulate different organic chemistry structures and reactions) (ii) Virtual Synthesis of aspirin (enable students to undertake an aspirin synthesis, perform recrystallization, Thin Layer Chromatography and calculation of yield using a digital resource). iii) Synthesis of aspirin iv) Experiment on Hammett equation (Experimentally determine the acid dissociation constant (K_a) of a series of substituted benzoic acids, correlate the K_a values with known substituent constants (σ_x) and use the correlation generated above to calculate the substituent constants for 'unknown' substituted benzoic acid compounds.		6
5	Teacher Specific Content			

	Classroom Procedure (Mode of transaction)
Teaching and Learning Approach	<ul style="list-style-type: none"> ● Lecture using PowerPoint presentation ● Google classroom ● Group learning ● Laboratory work
Assessment Types	<p>MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p>Theory : 25 marks Pop quizzes/ Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>Practical : -5 Marks Quiz/ Lab involvement</p>
	<p>B. Semester end examination</p> <p>Theory- 50 marks – 1.5 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 4 questions (out of 6): 4 X 5 =20 iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p>Practical (20 marks) -1 hr.</p> <p>i) Lab skill and Lab involvement - 5 ii) Lab report: 3 iii) Viva : 5 iv) Writing procedure: 2 v) Lab test -5</p>

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Molecular Spectroscopy					
Type of Course	DCE					
Course Code	24SACCHE7CE401					
Course Level	400-499					
Course Summary	This course deals with structure elucidation of organic compounds by means of combined spectral techniques such as IR, UV, NMR and mass spectrometry.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture 4	Tutorial	Practical	Others	
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Outline the theoretical aspects of various spectroscopic techniques.	U	1,2
2	Illustrate the basic concepts of infrared spectroscopy.	U	1,2
3	Apply the principles of electronic spectroscopy to organic compounds.	A	1,2
4	Demonstrate the underlying principles of NMR spectroscopy.	U	1,2
5	Explain the concepts of mass spectrometry.	U	1,2
6	Deduce the structure of organic compounds by means of combined spectral techniques such as IR, UV, NMR and mass spectrometry.	E	1,2,4,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

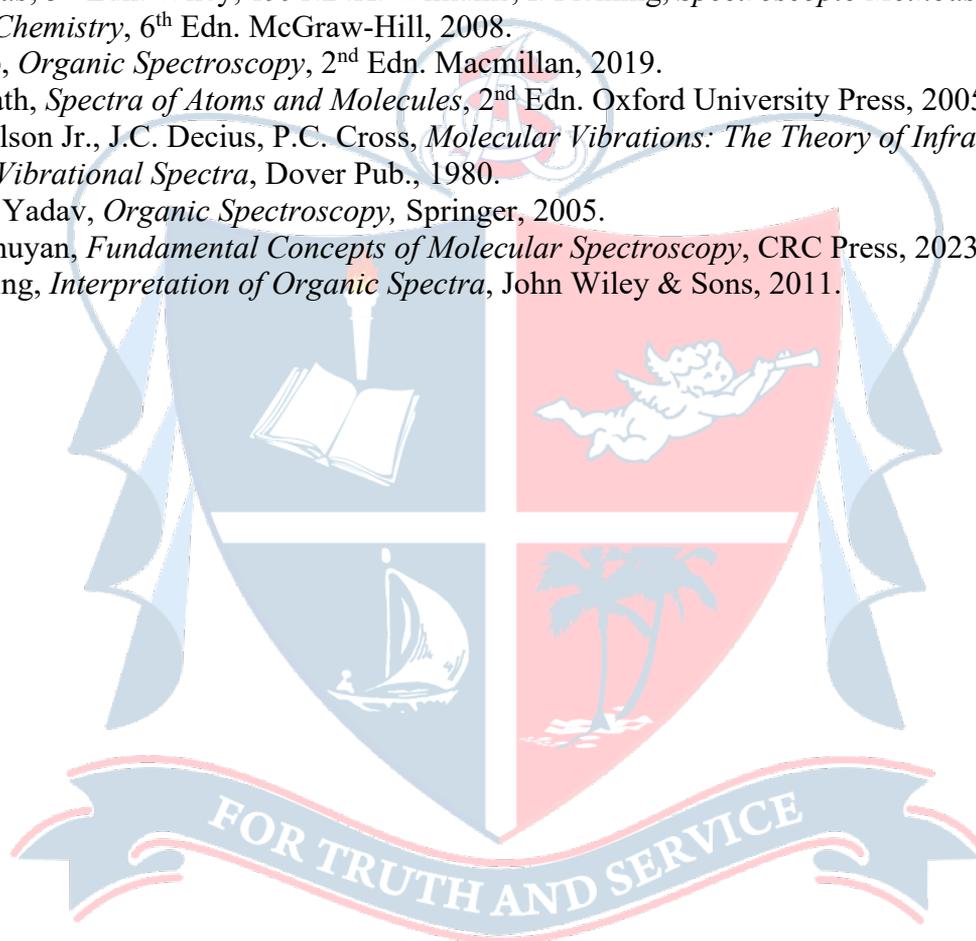
Module	Units	Course description	Hrs	CO No.
1	Infrared and Electronic Spectroscopic Techniques			
	1.1	Hooke's law, bond properties and absorption trends, fundamental vibrations, characteristic regions of the spectrum (fingerprint and functional group regions), influence of substituent, ring size, hydrogen bonding and solvent effect.	3	1,2
	1.2	IR spectra of O-H bonds (alcohols and carboxylic acids), C=C bonds (olefins and arenes), C=O bonds (acids, aldehydes, ketones, and esters) and C-H bonds (alkanes, alkenes and alkynes). Spectral interpretation and problems.	4	1.2
	1.3	Nature of electronic transitions, chromophore, auxochrome, representation of electronic spectra, bathochromic shift, hypsochromic shift, hyperchromic shift and hypochromic shift.	2	1,3
	1.4	Influence of substituents, solvent effect, conjugation, ring size and strain on spectral characteristics.	2	1,3
	1.5	Calculations of λ_{max} of enones, aromatic hydrocarbons and conjugated polyenes based on Woodward-Fieser and Fieser-Kuhn rules. Spectral interpretation and problems.	4	1,3
Nuclear Magnetic Resonance Spectroscopy				
2	2.1	NMR phenomena based on ^1H & ^{13}C nuclei, ^1H & ^{13}C NMR spectra, relaxation processes.	3	1,4
	2.2	Chemical shift, magnetic anisotropy and shielding/deshielding, chemical equivalence and number of NMR signals. Population densities of nuclear spin states-intensity of the signal.	3	1,4
	2.3	Spin-spin splitting, coupling constant, geminal coupling, Karplus curve, Pople notation - AX, AX ₂ , A ₂ X ₃ , AB, AB ₂ type coupling, first order and non-first order spectra, homotopic, enantiotopic and diastereotopic protons.	4	1,4
	2.4	Simplification of non-first order spectra to first order spectra: spin decoupling and double resonance, off resonance decoupling, NOE and cross polarization and DEPT. Spectral interpretation and problems.	5	1,4

Mass Spectrometry				
3	3.1	Basic principles. Ionization methods: Gas phase ionization methods– electron impact ionization (EI) and chemical ionization (CI); desorption ionization methods – SIMS, FAB and MALDI. Electrospray ionisation (ESI). Comparison between EI and CI. Mass analysers - time of flight analyser and quadrupole analyzer. Nitrogen and ring rules. Determination of molecular weight and molecular formula. HRMS. Tandem mass spectrometry (MS-MS) (concept only).	7	1,5
	3.2	Fragmentation and structural analysis: types of peaks involved (molecular ion, quasi molecular ion, isotopic peak, base peak, parent ion, daughter ion, fragment ion, metastable ion). Fundamental fragmentation processes – Stevenson's rule, α cleavage, two-bond cleavage, retro Diels- Alder cleavage and McLafferty rearrangements. Fragmentation pattern of hydrocarbons, alcohols, phenols, ethers, carbonyl compounds and amines. Mass spectral analysis and problem solving.	8	1,5
4	Structure Elucidation of Organic Compounds			
	4.1	Identification of structures of organic compounds based on the data from mass spectrometry, UV-Vis, IR, ^1H NMR and ^{13}C NMR spectroscopy. Interpretation of the given UV-Vis, IR and NMR spectra.	15	6
5	Teacher Specific Content			

Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction) Lecture (chalk & board, powerpoint presentation, flipped classroom) Group discussion – thought problems; mind mapping Peer interaction Demonstration using simulations / models</p>
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA) Total Marks: 30 Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p>
	<p>B. Semester End examination</p> <p style="text-align: center;">Theory- 70 marks – 2 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>

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1. D.L. Pavia, G.M. Lampman, G.S. Kriz, *Introduction to Spectroscopy*, 3rd Edn. Brooks Cole, 2000.
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Drug Therapy and Drug Design					
Type of Course	DCE					
Course Code	24SACCHE7CE402					
Course Level	400-499					
Course Summary	This course explores the fundamental concepts of drug therapy, drug discovery and design, drug delivery systems and computer aided drug design.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
Pre-requisites, if any		4				60

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the principles of drug therapy.	U	1,2,3
2	Analyse the concepts of drug design, leads, analogues, prodrugs and combinatorial synthesis.	An	1,2,3
3	Develop the concepts of enzymes and receptors as targets of drug design.	A	1,2,3,10
4	List the importance of various drug delivery systems.	U	1,2,3
5	Discuss the principles of computer aided drug design.	U	1,2,3,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

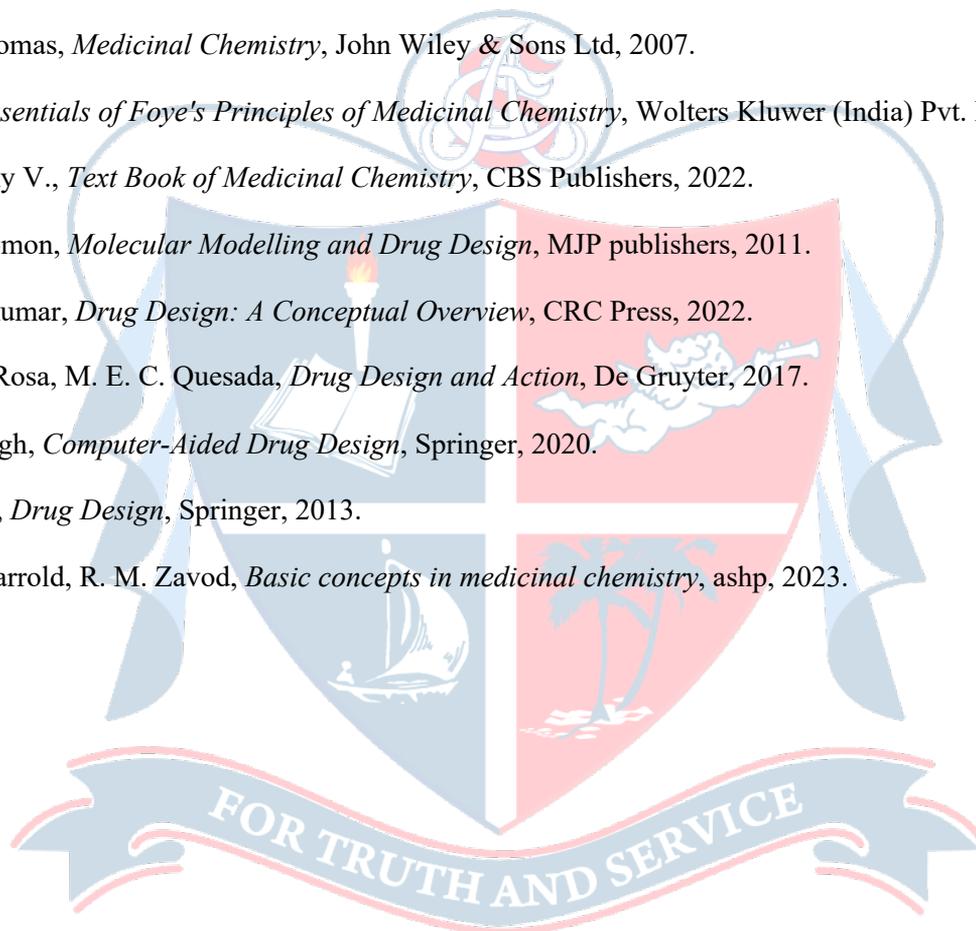
Module	Units	Course description	Hrs	CO No.
1	Principles of Drug Therapy			
	1.1	Introduction to drugs. General Principles of drug therapy. Relationship between chemical structure, lipid solubility and biological activity of drugs. Stereochemistry and biological activity. The importance of water solubility.	6	1
	1.2	Drug action: the pharmacokinetic phase- ADME of the drug. The pharmacodynamic phase.	2	1
	1.3	Drug metabolism: sites of drug metabolism and phase I and phase II reactions. Prodrugs.	4	1
	1.4	Classification of drugs: based on chemical structure, pharmacological action and physiological classification.	3	1
2	Drug discovery and design			
	2.1	Historical outline, rational drug design. The general stages in modern-day drug discovery and design.	2	2
	2.2	Leads and analogues: bioavailability, solubility, structure and stability.	2	2
	2.3	Sources of leads and drugs. Approaches to lead optimisation.	4	2
	2.4	Prodrug design and applications: prodrug forms of various functional groups, prodrugs and intellectual property rights.	4	2
	2.5	Combinatorial Chemistry: introduction, solid-phase and solution phase strategies.	3	2
3	Enzymes, Receptors and Drug Delivery Systems			
	3.1	Enzymes as targets of drug design: enzyme inhibition and activation, approaches to the rational design of enzyme inhibitors.	3	3
	3.2	Receptors as targets of drug design: receptor theory, receptor complexes and allosteric modulators, molecular biology of receptors, receptor models and nomenclature, receptor binding assays, lead compound discovery of receptor agonists and antagonists.	7	3
	3.3	Drug delivery systems: general consideration, macromolecular drug carrier systems, bioprecursor prodrugs, oxidative activation and reductive activation.	5	4

Computer-Aided Drug Design				
4	4.1	Basic concepts of CADD, molecular modelling: energy minimization, geometry optimization, conformational analysis, global conformational minima determination; approaches and problems; bioactive vs. global minimum conformations. Automated methods of conformational search.	5	5
	4.2	Molecular docking and dynamics: rigid docking, flexible docking, manual docking; advantages and disadvantages of flex-X, flex-S, autodock and dock softwares with suitable examples; Monte Carlo simulations and molecular dynamics in performing conformational search and docking.	5	5
	4.3	QSAR: changing size and shape and introduction of new substituents, lipophilicity, electronic and steric effects, Hansch analysis. Structure activity relationships and pharmacological activity. CoMFA analysis, 3D-QSAR.	5	5
5	Teacher Specific Content			

Teaching and Learning Approach	<p style="text-align: center;">Classroom Procedure (Mode of transaction)</p> <p>Lecture Sessions, interactive sessions including discussions</p>
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p style="text-align: center;">Total marks : 30</p> <p>Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <hr/> <p style="text-align: center;">B. Semester end examination</p> <p>Theory- 70 marks – 2 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20</p>

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Industrial Chemistry					
Type of Course	DCE					
Course Code	24SACCHE7CE403					
Course Level	400-499					
Course Summary	This course covers the manufacture and applications of inorganic and organic chemicals, petroleum refining, industrial safety and pollution prevention.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the manufacture and uses of common inorganic and organic chemicals.	U	1,2
2	Describe various processes involved in petroleum refining.	U	1,2
3	Discuss safety aspects of the chemical industry.	U	1,2
4	Analyze various aspects of industrial pollution prevention.	An	1,2

**Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Inorganic Chemicals			
	1.1	Manufacture and applications of sulphuric acid, phosphoric acid, lime, soda ash, titanium dioxide and sodium chloride.	7	
	1.2	Manufacture and uses of syn gas, nitrogen, oxygen, hydrogen and ammonia.	4	
	1.3	Production of potable water: break-point chlorination and ozonation, flocculation and sedimentation, filtration, removal of dissolved inorganic impurities, activated charcoal treatment. Production of deionized water. Production of freshwater from seawater and brackish water.	4	
2	Petroleum Refining			
	2.1	Primary raw materials for petrochemicals- natural gas, crude oil (composition, properties and classification), coal, oil shale, tar sand and gas hydrates.	5	
	2.2	Introduction to petroleum refining, desalting, distillation, hydrotreating or hydroprocessing, cracking or hydrocracking, coking, visbreaking, steam cracking, alkylation, catalytic reformers, removal of the natural gas fraction, sulfur recovery.	7	
	2.3	Hydrocarbon intermediates and liquid petroleum fractions, chemicals based on methane.	3	
3	Organic Chemicals			
	3.1	Manufacture and uses of methanol, formaldehyde, formic acid and hydrocyanic acid.	5	
	3.2	Manufacture and uses of ethylene, propene and acetylene.	3	
	3.3	Hydroformylation of olefins, industrial hydroformylation.	2	
	3.4	Manufacture and uses of ethanol, acetaldehyde and acetic acid.	3	
	3.5	Chemicals based on benzene, toluene and xylenes.	2	

Safety Considerations and Industrial Pollution Prevention				
4	4.1	OSHA (Occupational Safety and Health Administration) and PSM (Process Safety Management).	2	
	4.2	Types of hazards in industries: heat and temperature, pressure, electrical, and mechanical hazards, toxic materials, fire and explosion, radiation, noise and vibrations. risk management plan	6	
	4.3	Types of industrial wastes, public concern over pollution, legislation to waste management, industrial pollution prevention. Waste management: recycling, waste treatment and disposal.	7	
5	Teacher Specific Content			

Teaching and Learning Approach	Classroom Procedure (mode of transaction) Lecture Sessions, interactive sessions including discussions
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Total marks : 30 Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	B. Semester end examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

REFERENCES

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Advanced Chemistry of Main Group Elements					
Type of Course	DCE					
Course Code	24SACCHE7CE404					
Course Level	400-499					
Course Summary	This course explores the advanced aspects of properties and chemistry of main group elements.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
Pre-requisites, if any		4				60

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the advanced chemistry of main group elements.	U	1,2
2	Analyse the coordination and aqueous chemistry of group 1 and 2 metals.	An	1,2
3	Analyse the compounds and coordination complexes of group 13 and 14 elements.	An	1,2
4	Analyse the properties and chemistry of group 15 and 16 elements.	An	1,2
5	Compare the chemistry of halogens, and noble gases.	An	1, 2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Group 1 and Group 2 Metals			
	1.1	Aqueous solution chemistry of group 1 metal compounds, complex formation of group 1 metals with crown ethers, sandwich complexes with crown ethers, cryptates of group 1 metal ions, sodide ion in cryptates, alkali ions of higher alkali metals, uses of alkali metal cryptands.	5	1,2
	1.2	Non-aqueous coordination chemistry of alkali metals. Zintl phases containing alkali metals. Compound formation with aromatic compounds, sodium and potassium alkyls.	4	1,2
	1.3	Complex ions of group 2 metals in aqueous solution, complexes of group 2 metal ions with EDTA, $[P_3O_{10}]^{5-}$, crown ethers and cryptands. Complexes of group 2 metal ions with amido and alkoxy ligands.	6	1,2
2	Group 13 and 14 Elements			
	2.1	Biological aspects of boron, toxicity of aluminium, aqua ions of Al, Ga, In and Tl, coordination complexes of M^{3+} ions of Al, Ga and In. Metal borides- synthesis, structure and applications.	4	1, 3
		Zintl phases of group 13 elements. Spinel and tricalcium aluminate. Chalcogenides of Al, Ga, In and Tl.	4	1, 3
	2.2	Complexes containing a naked carbon atom, complexes containing naked dicarbon ligands. Carbides, silicides, germides, stannides and plumbides. Zintl ions containing Si, Ge, Sn and Pb. Polyatomic anions of Ge, Sn, and Pb. Sila- and germa-aromatic compounds.	7	1,3
3	Group 15 and 16 Elements			
	3.1	Hydrogen azide and azide salts. Nitrides, phosphides, arsenides, antimonides and bismuthides. Organometallic compounds of arsenic, antimony, and bismuth. π -Coordination complexes of phosphorus-carbon compounds.	7	1,4
	3.2	Polyanions and polycations of sulfur, selenium, and tellurium. Polysulfides, polyselenides and polytellurides. Compounds of sulfur and selenium with nitrogen.	4	1,4
	3.3	Allotropes of selenium and tellurium. Polyatomic cations and anions of selenium and tellurium. Biological aspects of oxygen, sulphur and selenium.	4	1,4

Group 17 and 18 Elements				
4	4.1	Industrial extraction of fluorine, fluoridation of water. Polyhalogen cations, polyhalide anions, oxofluorides of chlorine, bromine and iodine.	4	1,5
	4.2	Aqueous solution chemistry of chlorine, bromine and iodine. Biological aspects of fluorine, chlorine, bromine and iodine. Chemistry of astatine.	4	1,5
	4.3	Chemistry and uses of helium. Synthesis, structure and reactions of xenon insertion compounds, organoxenon compounds and compounds containing metal-xenon bonds.	4	1,5
	4.4	Compounds of argon, krypton and radon and coordination compounds of noble gases. Biological aspects of noble gases.	3	1,5
5	Teacher Specific Content			

Teaching and Learning Approach	Classroom Procedure (mode of transaction) Lecture sessions, interactive sessions including discussions
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Total marks : 30 Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	B. Semester end examination Theory- 70 marks – 2 hrs i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Statistical Thermodynamics and Bioenergetics					
Type of Course	DSE					
Course Code	24SACCHE7DE401					
Course Level	400-499					
Course Summary	This course covers the principles of statistical thermodynamics and applications of thermodynamics and statistical thermodynamics to various biological processes.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
Pre-requisites, if any						60

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the basic principles of statistical thermodynamics.	U	1,2,3
2	Apply the principles of statistical thermodynamics to biological processes.	A	1,2,3
3	Analyse the energy changes associated with various biological processes.	An	1,2,3
4	Apply the principles of thermodynamics to various biological processes.	An	1,2,3

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Statistical Thermodynamics -1			
	1.1	Probability, Stirling's approximation, macrostates and microstates, ensemble, types of ensembles.	3	1
	1.2	Boltzmann distribution law, partition function and its physical significance, relation between molecular partition function and molar partition function, distinguishable and indistinguishable particles, partition function and thermodynamic functions, separation of partition function-translational, rotational, vibrational, and electronic partition functions. The equipartition theorem.	7	1
	1.3	Thermodynamic properties: internal energy, heat capacity, entropy, enthalpy and Gibbs free energy. Statistical basis of chemical equilibrium.	5	1
2	Statistical Thermodynamics -2			
	2.1	Need for quantum statistics, bosons and fermions, Bose-Einstein statistics:, Bose-Einstein distribution law, Bose-Einstein condensation, first order and higher order phase transitions, liquid helium, Fermi- Dirac statistics:, Fermi-Dirac distribution law, application in electron gas, thermionic emission. Comparison of three statistics.	10	1
	2.2	Applications of statistical mechanics to biological processes: helix– coil Transitions, cooperative transitions, internal energy and heat capacity of biological macromolecules, protein heat capacity functions.	5	2
3	Bioenergetics			
	3.1	Bioenergetics, standard free changes in biochemical reactions, coupled reactions, ATP and its role in bioenergetics, high energy bond, free energy and entropy change in ATP hydrolysis.	8	3
	3.2	Thermodynamics of synthesis of ATP, thermodynamic aspects of metabolism and respiration, glycolysis, biological redox reactions and citric acid cycle.	7	3
4	Thermodynamic Aspects of Biological Processes			
	4.1	Thermodynamic aspects of photosynthesis, osmosis, dialysis, enzyme-substrate interactions, binding of oxygen to myoglobin and haemoglobin, cooperativity, allostery and proton binding by biomolecules.	8	4

	4.2	Thermodynamic aspects of transport of ions across biological membranes, biosynthesis of proteins, buffer action in blood, protein structure, mechanisms of protein folding and unfolding and DNA melting.	7	4
5	Teacher Specific Content			

Teaching and Learning Approach	Classroom Procedure (mode of transaction) Lecture sessions, interactive sessions including discussions
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p style="text-align: center;">Continuous Comprehensive Assessment (CCA)</p> <p>Total marks: 30</p> Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	<p style="text-align: center;">Semester end examination</p> <p style="text-align: center;">Theory- 70 marks – 2 hrs</p> i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

REFERENCES

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Programme	BSc (Hons) CHEMISTRY				
Course Name	Novel Inorganic Solids				
Type of Course	DCE				
Course Code	24SACCHECE405				
Course Level	400-499				
Course Summary	This course covers the synthetic route to novel inorganic solids, properties and applications of inorganic nanomaterials, engineering materials, composite materials and speciality polymers.				
Semester	VII	 Credits	4		Total Hours
Course Details	Learning Approach	 Lecture 4	 Tutorial	 Practical	
Pre-requisites, if any					
					60

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe different types of novel solids.	U	1,2
2	Discuss synthetic methods of inorganic solids.	U	1,2
3	Explain the synthesis, properties and applications of novel inorganic nanomaterials.	U	1,2
4	Analyse various inorganic engineering materials and composite materials.	An	1,2
5	Describe the synthesis, properties and applications of inorganic polymers.	U	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
Types of Novel Inorganic Solids and Synthetic Methods				
1	1.1	Solid electrolytes – cationic, anionic and mixed. Inorganic pigments – coloured solids. Molecular material and fullerenes, one- dimensional metals, molecular magnets, inorganic liquid crystals.	7	1
	1.2	Synthetic methods: conventional heat and beat methods, co-precipitation, sol-gel, chemical vapour deposition, ceramic, alloying, hydrothermal, electrochemical and intercalation methods. Microwave synthesis.	8	2
Nanomaterials				
2	2.1	Metal oxide nanostructures: synthesis-sol-gel and electrochemical deposition, applications in photovoltaics, lithium ion batteries, catalysis, gas sensing and biomedical applications.	4	3
	2.2	Magnetic nanomaterials for energy storage: synthesis- co-precipitation and chemical oxidation, applications of Fe ₂ O ₃ and Fe ₃ O ₄ nanomaterials for energy storage.	4	3
	2.3	Transition metal dichalcogenide nanomaterials: Synthesis-chemical vapour deposition, doping, applications in electronics, photonics and gas sensing.	3	3
	2.4	Inorganic nanotubes: general synthetic methods- sol-gel and hydrothermal methods, applications.	2	3
	2.5	Inorganic nanowires: synthesis-vapour phase growth, properties and applications.	2	3
Engineering Materials for Mechanical Construction and Composite Materials				
3	3.1	Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes, cutting tool materials, super alloys, thermoplastics, thermosets and composite materials.	7	4
	3.2	Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.	8	4
Speciality Polymers				
4	4.1	Pre-ceramic inorganic polymers: carbon Fiber, silicon carbide (SiC), silicon nitride (Si ₃ N ₄), boron nitride (BN), boron carbide (B ₄ C), aluminum nitride (AlN), phosphorus nitride. Poly(ferrocenylsilanes) as ceramic precursors.	8	5
	4.2	Sulfur-based inorganic polymers: polythiazyl and polythiol.	3	5

	4.3	Ferrocene based polymers: synthetic methods, Fc-based polypyrrole and cyclodextrin- synthesis and applications.	4	5
5	Teacher Specific Content			

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture sessions, interactive sessions including discussions
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Total marks: 30 Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	Semester end examination Total Marks : 70- 2 hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

REFERENCES

1. P. W. Alkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, *Inorganic Chemistry*, 5th Edn. Oxford University Press, 2012.
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Analytical Chemistry					
Type of Course	DSE					
Course Code	24SACCHE7DE402					
Course Level	300-399					
Course Summary	This course covers the fundamentals of analytical chemistry and discusses topics such as precision, accuracy and errors. Additionally, it encompasses qualitative analysis techniques, safety protocols, titrimetric analysis, and the principles and applications of chromatography.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain fundamental measurement concepts, and errors in analytical chemistry.	U	1, 2,3,10
2	Develop safe laboratory methods of chemical analysis.	An	1,2,3
3	Develop a comprehensive knowledge of titrimetric analysis including redox titrations, complexometric titrations, conductometric titrations and potentiometric titrations.	A	1, 2,3
4	Apply the principles of gravimetric analysis.	A	1, 2,3
5	Analyse various separation and purification techniques of compounds.	An	1, 2,3
6	Distinguish between different chromatographic methods based on their principle and mechanism.	An	1, 2,3,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO
1	Introduction			
	1.1	The role of analytical chemistry, qualitative and quantitative analysis, general features of a typical quantitative analysis-choosing a method, acquiring the sample, processing the sample, eliminating interferences, calibration and measurement, calculation and evaluation of results. Case study illustrating the use of analytical chemistry to solve a problem.	6	1
	1.2	Calculations used in analytical chemistry: units of measurement- mass and weight, the mole, concentrations of solutions, p- functions, density and specific gravity. Chemical stoichiometry and stoichiometric calculations.	5	1
	1.3	Errors in chemical analysis: mean and median, precision and accuracy, absolute error and relative error. Random, systematic and gross errors. Sources and effects of systematic errors. Minimising systematic errors.	4	1
2	Chemicals apparatus and unit operations of analytical chemistry			
	2.1	Selecting and handling reagents and other chemicals.	2	2
	2.2	Cleaning and marking of laboratory ware.	2	2
	2.3	Evaporating liquids, measuring mass, equipment and manipulations associated with weighing, measuring volume, calibrating volumetric glassware.	3	2
	2.4	The laboratory notebook.	1	2
	2.5	Sampling, standardization, and calibration.	4	2
	2.6	Safety in the laboratory- the four principles of safety, personal protective equipment: eye protection, lab coat, shoes and long pants, gloves, respiratory protection and masks, hair, lead apron and shields.	3	2

Titrimetric and Gravimetric Analysis				
3	3.1	Titrimetric analysis – basic concepts of redox reactions, redox titrations involving KMnO_4 , and $\text{K}_2\text{Cr}_2\text{O}_7$, titration curves, redox indicators.	4	3
	3.2	Complexometric titrations – direct, indirect, back and replacement titrations, EDTA titrations. Precipitation titrations - methods of argentometric titration-indicators.	6	3
	3.3	Conductometric and potentiometric titrations – principle, examples and graphical representation.	2	3
	3.4	Gravimetric analysis: unit operations in gravimetric analysis - illustrations using iron and barium estimation.	3	4
Separation and Purification of compounds				
4	4.1	Separation and purification techniques: filtration, recrystallization, precipitation, distillation, fractional distillation, solvent extraction and sublimation.	4	5
	4.2	Chromatography- principle and classification. Chromatographic techniques: paper chromatography, thin layer chromatography, R_f -values.	3	6
	4.3	Principle and applications of column chromatography, high-performance liquid chromatography (HPLC), gas chromatography, gel permeation chromatography (GPC), ion exchange chromatography, and reverse phase chromatography.	8	6
5	Teacher Specific content			

Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <ol style="list-style-type: none"> 1. Lecture (chalk & board, powerpoint presentation) 2. Group discussion 3. Peer teaching 4. Demonstration of experiments 5. Hands-on training
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Assessment Types	MODE OF ASSESSMENT
	<p>A. Continuous Comprehensive Assessment (CCA)</p> <p>Total marks: 30</p> <p>Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p>
	<p>B. Semester end examination</p> <p>Total Marks : 70- 2 hrs.</p> <p>i) MCQ 20 questions: $20 \times 1 = 20$</p> <p>ii) Short essay 6 questions (out of 8): $6 \times 5 = 30$</p> <p>iii) Essay 2 question (out of 4): $2 \times 10 = 20$</p>

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Biophysical Chemistry					
Type of Course	DSE					
Course Code	24SACCHE7DE403					
Course Level	300-399					
Course Summary	This course explores how the principles of thermodynamics, chemical equilibrium, chemical kinetics and quantum mechanics are applied to biological processes.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Apply the principles of thermodynamics to life processes.	A	1,2
2	Analyse biological equilibrium processes.	An	1,2
3	Examine kinetic aspects of biological processes.	An	1,2
4	Apply the principles of quantum mechanics to simple chemical and biological systems.	A	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Thermodynamics			
	1.1	Work, heat, internal energy, enthalpy, heat capacity. The first law of thermodynamics. The enthalpy of phase transition- case study- thermal denaturation of a protein.	5	1
	1.2	The second law of thermodynamics, entropy and entropy change. Entropy change and life. The Third Law of thermodynamics.	4	1
	1.3	Spontaneity and Gibbs free energy. Free energy as maximum work. Proteins- primary, secondary, tertiary and quaternary structures. Gibbs energy change of protein assembly. Basic idea of metabolism and free energy changes of metabolic cycles.	6	1
2	Equilibrium			
	2.1	Molar free energy of reaction. Reactions at equilibrium and Gibbs free energy change. Relationship between the Gibbs energy and equilibrium constant. Acid–base equilibria. Catalysts and equilibrium	6	2
	2.2	Temperature and equilibrium, coupled reactions. Active transport. Binding of oxygen to myoglobin and haemoglobin-thermodynamic aspects, cooperativity and allosteric effect. Standard Gibbs energy of formation and calculation of standard reaction Gibbs energy.	9	2
3	Chemical Kinetics			
	3.1	Rate of reaction, rate laws and rate constants, order of a reaction, first order and second order reactions. The temperature dependence of reaction rates- the Arrhenius equation and Arrhenius parameters. Reaction rates near equilibrium.	7	3
	3.2	Enzymes as biological catalysts- substrate binding, active site and lock and key principle. Enzyme catalysis: the Michaelis–Menten mechanism. The catalytic efficiency of enzymes. Enzyme inhibition. Pharmacokinetics. Fast events in protein folding.	8	3

4	Quantum Mechanics			
	4.1	Basics of quantum mechanics, electromagnetic radiation, wave properties of matter, quantization of energy and fundamentals of spectroscopy. Types of spectroscopy. The uncertainty principle.	7	4
	4.2	The particle in a box- the electronic structure of β - carotene. Quantum mechanical tunnelling- Scanning probe microscopy (STM and AFM). Particle on a ring- the electronic structure of phenylalanine.	8	4
5	Teacher Specific content			

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture sessions, interactive sessions including discussions	
Assessment Types	MODE OF ASSESSMENT	
	Continuous Comprehensive Assessment(CCA) Total marks: 30 Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities	
	Semester end examination Total Marks : 70- 2 hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20	

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Programme	BSc (Hons) CHEMISTRY				
Course Name	Nanochemistry and Technology				
Type of Course	DSE				
Course Code	24SACCHE7DE404				
Course Level	300-399				
Course Summary	This course explores fundamental concepts of nanotechnology covering synthesis, characterization, properties and applications of nanomaterials.				
Semester	VII	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3		1	
					75
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the fundamental concepts of nanomaterials.	U	1,2
2	Compare bottom-up and top-down approaches in nanomaterial synthesis.	C	1,2
3	Describe various characterization techniques of nanomaterials.	An	1,2
4	Explain the properties of different types of nanomaterials.	U	1,2
5	Analyse the applications of nanomaterials in various fields.	An	1,2,3,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

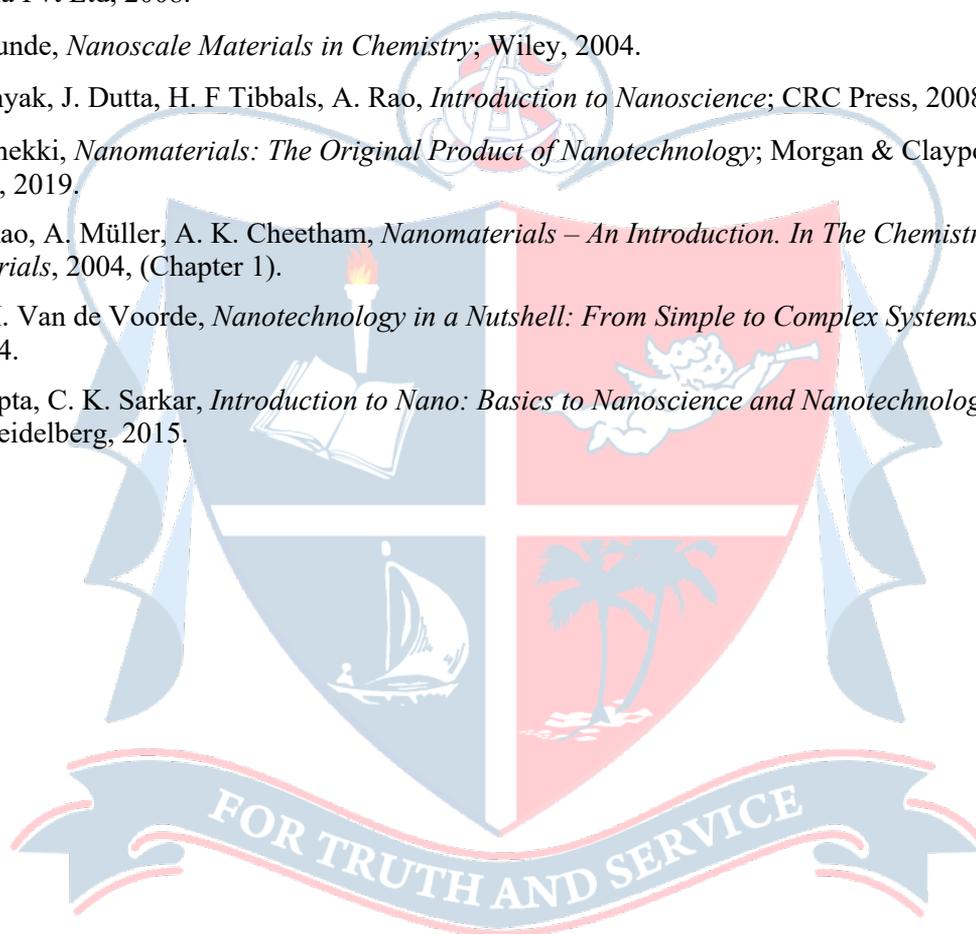
Module	Units	Course description	Hrs	CO No.
1	Introduction			
	1.1	Feynman's hypothesis- scales of nanosystems- Moore's law.	2	1
	1.2	Different types of nanomaterials. Classification of nanomaterials based on dimensions and origin.	3	1
	1.3	Nano in nature: lotus-leaf effect, Gecko's feet, butterfly wings, and magneto-tactic bacteria.	2	1
	1.4	Bottom-up techniques for the synthesis of nanomaterials: chemical vapour deposition, reduction techniques, solvothermal, sonochemical, biomimetic, molecular self-assembly and sol-gel methods.	4	2
	1.5	Top-down techniques: mechano-chemical, laser ablation, arc-discharge, sputtering, etching, lithography and electrospinning methods.	4	2
Characterisation of Nanomaterials				
2	2.1	Imaging through electron microscopy: interaction of electron beam with sample. Scanning electron microscope and transmission electron microscope- comparison, advantages, applications and basic instrumental features.	4	3
	2.2	Scanning probe microscopy: scanning tunneling microscope and atomic force microscope- comparison, applications and basic instrumental features.	4	3
	2.3	Characterisation through spectroscopy: UV-visible, IR, X-ray photoelectron and Auger electron spectroscopy. Secondary ion mass spectrometry. X-ray diffraction, dynamic light scattering and zeta potential analysis methods.	7	3
3	Properties of Nanomaterials			
	3.1	Size effects: quantum confinement, the density of states and high surface area.	2	4
	3.2	Thermal properties: surface energy, thermal conductivity and melting of nanomaterials.	3	4
	3.3	Electronic and electrical properties: one dimensional conduction-ballistic conduction,	4	4

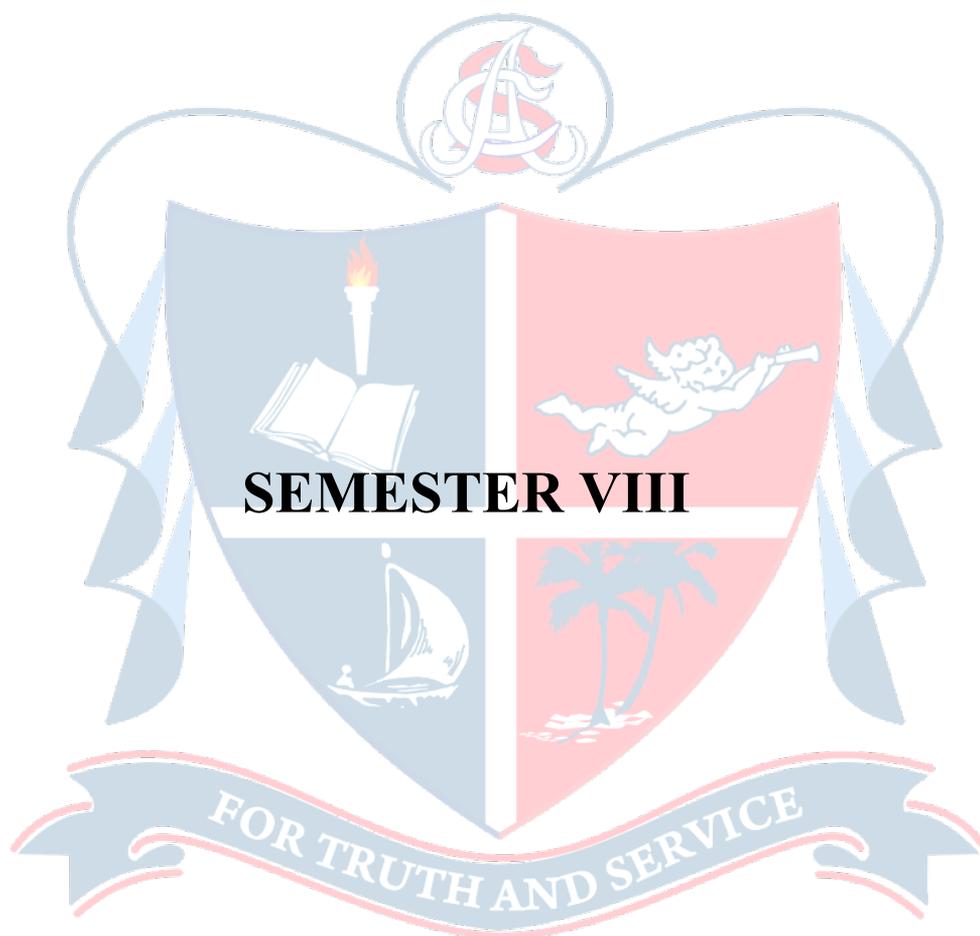
		the Coulomb blockade effect, the electron density of states and superconductivity.		
	3.4	Magnetic properties: giant magnetoresistance, finite-size effects and surface effects.	3	4
	3.5	Optical properties: colour of quantum dots, surface plasmon resonance and quantum fluorescence.	3	4
	Applications of Nanoparticles			
	4.1	Medicine and healthcare: applications of nanomaterials in medical diagnosis, advanced drug delivery systems, targeted drug delivery and therapy.	4	5
	4.2	Applications of nanotechnology in integrated circuits, data storage and displays.	2	5
	4.3	Applications of nanotechnology in water purification and air pollution control.	2	5
	4.4	Piezoelectric nanomaterials, hydrogen generation and storage, batteries and solar energy harvesting.	2	5
	4.5	Chemical and biosensors using nanomaterials and defence applications of nanotechnology.	2	5
	4.6	Applications of graphene, carbon nanotubes and fullerenes.	3	5
5	Teacher Specific Content			

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> · Interactive instruction (chalk & board method, multimedia presentation) · Group discussion · Peer teaching · Experimental demonstrations · Practical training
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (Total 30 marks) Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	Semester end examination Total marks : 70- 2hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Advanced Coordination and Organometallic Chemistry					
Type of Course	DCC					
Course Code	24SACCHE8CC401					
Course Level	400-499					
Course Summary	This course offers a comprehensive exploration of advanced topics in inorganic chemistry, covering magnetic properties, substitution mechanisms, organometallic catalysis including asymmetric catalysis, practical gravimetric analysis, and the separation and identification of cation mixtures.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2		2		90
Pre-requisites, if any	Basic Knowledge in Coordination and Organometallic Chemistry					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyse and explain the magnetic properties of coordination complexes.	An	1,2
2	Evaluate the kinetics and mechanism of ligand substitution reactions in coordination complexes.	E	1,2
3	Analyse the applications of organometallic compounds in organic synthesis and catalysis.	An	1,2
4	Explain the properties and utility of polyferrocenylsilanes.	U	1,2
5	Apply gravimetric analysis techniques in estimating metal ions, including nickel (II), copper, iron, and aluminum.	A	1,2
6	Apply qualitative analysis techniques to distinguish and confirm the presence of specific cations, showcasing a comprehensive understanding of cation separation.	A	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT

Content for Classroom Transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Magnetic Properties and Ligand Substitution Mechanisms in Coordination Complexes			
	1.1	Magnetic properties of complexes - paramagnetic and diamagnetic complexes, molar susceptibility, Gouy method for the determination of magnetic moment of complexes, spin only magnetic moment.	3	1
	1.2	Temperature dependence of magnetism- Curie's law, Curie-Weiss law, temperature independent paramagnetism (TIP).	2	1
	1.3	Kinetics and mechanism of octahedral substitution- water exchange, dissociative, associative and interchange mechanisms, acid hydrolysis, base hydrolysis, S _N iCB mechanism.	4	2
	1.4	Electron transfer reactions: outer sphere mechanism – Marcus' theory, inner sphere mechanism- Taube mechanism, mixed outer and inner sphere reactions, two electron transfer and intramolecular electron transfer.	4	2
	1.5	Δ and Λ isomers, linkage isomerism: electronic and steric factors affecting linkage isomerism.	2	2
2	Organometallic Homogeneous Catalysis & Asymmetric versions			
	2.1	Organometallic reagents in organic synthesis –Petasis, Schwartz reagents for organic transformations. Reppe reaction, Dötz reaction	4	3
	2.2	Hydrogenation reactions- H ₂ hydrogenation and isopropanol transfer hydrogenations catalyzed by Ru(II) complexes, ionic hydrogenation, hydrosilylation	3	3
	2.3	Asymmetric catalysis- chiral phosphine ligands (structure only) - P-chiral ligands, BINAP, DIOP, ferrocene based ligands - Josiphos, asymmetric hydrogenation, Noyori hydrogenations, Shvo catalyst, transfer hydrogenation of ketones and imines, metal-ligand bifunctional catalysis-cooperative effect.	5	3
	2.4	Preparation of L-DOPA drug, Matalachlor herbicide	1	3

	2.5	Organometallic polymers: synthesis, properties and applications of polyferrocenylsilanes.	2	4
Inorganic Practical -4				
3		Part-1 Gravimetric Analysis		
		i. Estimation of nickel (II) using dimethylglyoxime (DMG). ii. Estimation of copper as CuSCN iii. Estimation of iron as Fe ₂ O ₃ by precipitating iron as Fe(OH) ₃ . Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine) ₃ (aluminium oxinate).	30	5
4		Part-2 Separation and identification of a mixture of four cations (a mixture of two familiar ions such as Ag ⁺ , Hg ²⁺ , Pb ²⁺ , Cu ²⁺ , Bi ²⁺ , Cd ²⁺ , As ³⁺ , Sn ²⁺ , Sb ³⁺ , Fe ²⁺ , Fe ³⁺ , Al ³⁺ , Cr ³⁺ , Zn ²⁺ , Mn ²⁺ , Co ²⁺ , Ni ²⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺ , Mg ²⁺ , Li ⁺ , Na ⁺ , K ⁺ and NH ₄ ⁺ and two less familiar metal ions such as Tl, W, Se, Mo, Ce, Th, Ti, Zr, V, U and Li). Minimum four mixtures to be given.	30	6
5		Teacher Specific Content		

Teaching and Learning Approach	<p>Classroom Procedure (mode of transaction)</p> <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Peer teaching ● Demonstration of experiments ● Hands-on training
	<p>Mode of Assessment</p> <p>A. Continuous Comprehensive Assessment Theory: 15 marks</p> <p>Quiz</p> <p>Theory: Test for each unit (MCQ/Written)</p> <p>Practical: 15 marks</p> <p>Lab involvement/report /Lab test</p>

Assessment Types	B. Semester-end Examination Theory: Written examination (35 Marks) – 1 hr. i) MCQ 15 questions: 15 X 1 = 15 ii) Short essay 4 questions (out of 6): 4 X 5 =20 Practical: Certified report + procedure + viva voce (10+15+10=35 Marks) - 1 hr. 35 marks
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Physical Chemistry- 4					
Type of Course	DCC					
Course Code	24SACCHE8CC402					
Course Level	400-499					
Course Summary	This course covers advanced aspects of kinetic theory of gases, chemical kinetics, surface chemistry and physical chemistry practicals.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2		2		90
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the molecular velocities of gases, mean free path, collision diameter and effusion.	U	1.2
2	Illustrate the theories of reaction rates and correlate the thermodynamically measurable parameters.	A	1.2
3	Compare the nature of reactions in the gas as well as in the solvent phase.	An	1.2
4	Assess the theories and applications of adsorption with the help of adsorption isotherms.	E	1.2
5	Explain different methods for the molar mass determination of macromolecules.	U	1.2
6	Experiment with three component systems, kinetics, polarimetry and refractometry practicals.	A,S	1,2,9,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
UNIT 1: KINETIC THEORY OF GASES (10 HRS)				
1	1.1	Derivation of Maxwell's law of distribution of velocities, graphical representation, experimental verification of the law, most probable velocity, derivation of average, RMS and most probable velocities.	5	1
	1.2	Collision diameter, collision frequency in a single gas and in a mixture of two gases, mean free path, frequency of collision, effusion, the rate of effusion, time dependence of pressure of an effusing gas, the law of corresponding states, transport properties of gases.	5	1
UNIT 2: CHEMICAL KINETICS: (10 HRS)				
2	2.1	Theories of reaction rates: potential energy surfaces. Conventional transition state theory, comparison of the collision theory and conventional transition state theories.	4	2
	2.2	Thermodynamic formulation of the reaction rate- Eyring equation. Significance of ΔG^\ddagger , ΔH^\ddagger and ΔS^\ddagger , volume of activation. Effect of pressure and volume on velocity of gaseous reactions. Reactions in solution: Effect of solvent on reaction rate, cage effect. Effect of dielectric constant and ionic strength on reaction rate - Bronsted-Bjerrum equation.	6	2,3
UNIT 3: SURFACE CHEMISTRY (10 HRS)				
3	3.1	Multilayer adsorption-BET theory, use of BET isotherms for surface area determination.	3	4
	3.2	Application of Langmuir adsorption isotherm in surface catalysed reactions, the Eley-Rideal mechanism and the Langmuir-Hinshelwood mechanism, flash desorption. Macromolecules: Different averages, methods of molecular mass determination - osmotic, viscosity, sedimentation and light scattering methods.	7	4,5

Physical Chemistry IV- Practicals			
	1. Construction of phase diagram of three component system with one pair of partially miscible liquids.		6
	2. Kinetics of simple reactions e.g. acid hydrolysis of methyl /ethyl acetate.		6
	3. Kinetics of reaction between $K_2S_2O_8$ and KI.		6
	4. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant).		6
	5. Polarimetry: <ul style="list-style-type: none"> ● Kinetics of the inversion of sucrose in presence of HCl. ● Determination of the concentration of a sugar solution. ● Determination of the concentration of HCl. ● Determination of the relative strength of acids. 	60	6
	6. Refractometry: <ul style="list-style-type: none"> ● Identification of pure organic liquids and oils. ● Determination of molar refractions of pure liquids. ● Determination of concentration of solutions (KCl-water, glycerol—water). ● Determination of molar refraction of solids. ● Study of complex formation between potassium iodide and mercuric iodide system. 		6
5	Teacher Specific Content		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> ● Lecture sessions (chalk & board, powerpoint presentation) ● Interactive sessions and simulations ● Visual aids like videos and models to enhance understanding ● Peer discussions ● Laboratory experiments and hands-on training
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Assessment Types	Mode of Assessment A. Continuous Comprehensive Assessment Theory:15 marks Quiz Theory: Test for each unit (MCQ/Written) Practical: 15 marks Lab involvement/report /Lab test
	B. Semester-end Examination Theory: Written examination (35 Marks) – 1 hr. i) MCQ 15 questions: 15 X 1 = 15 ii) Short essay 4 questions (out of 6): 4 X 5 =20 Practical: Certified report + procedure + viva voce (10+15+10=35 Marks) - 1 hr. 35 marks

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Suggested Readings

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Organic Chemistry-6					
Type of Course	DCE					
Course Code	24SACCHE8CE401					
Course Level	400-499					
Course Summary	A comprehensive study of organic synthesis.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Apply the knowledge of synthetic reagents and reactions in organic transformations.	A	1,2,3
2	Summarize the stereoselective transformations in organic synthesis.	U	1,2,3
3	Analyse the structure and formulate a retrosynthetic scheme for the given organic molecule.	An	1,2,3
4	Develop a synthetic route for an organic molecule.	A	1,2,3,6
5	Synthesise biologically important molecules.	A, S	1, 2, 4

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Content for Classroom Transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	Synthetic Reagents and Reactions			
	1.1	Phosphorous based- triphenylphosphine-Mitsunobu reaction, Wittig reaction, Staudinger reaction; Sulphur based-sulphonium salts, sulfur ylides- Corey-Cheykovsky reaction; Si based reagents- silyl ethers-TMS, TBDMS, TBDPS, TES, TIPS, Julia olefination, Peterson's olefination, - NBS, DDQ and DCC, Gilman reagent.	5	1,4
	1.2	Carbon-carbon bond formation through coupling reactions - Heck, Suzuki, Stille, Sonogoshira, Negishi, Kumada, Hiyama, Tsuji-Trost, olefin metathesis and McMurry reaction.	5	1,4
	1.3	Baylis-Hillman reaction, Kulinkovich reaction, Ritter reaction, Sakurai reaction, Tishchenko reaction, Tebbe olefination, multi component reactions- Passerini reaction and Biginelli reaction, Click reactions- Huisgen 1,3-dipolar addition.	5	1,4
2	Oxidation and Reduction			
	2.1	Metal based and non-metal based oxidations of (a) Alcohols to carbonyls- Collins oxidation, Sarett oxidation, PCC; Oppeneur oxidation, Swern oxidation. (b) Alkenes to diols- Prevost reaction and Woodward modification.	3	1,4
	2.2	(c) Alkenes to alcohols/carbonyls without bond cleavage hydroboration-oxidation, Selenium/chromium based allylic oxidation. (d) Ketones to ester/lactones- Baeyer-Villiger oxidation.	3	1,4
	2.3	Reduction : (a) Catalytic hydrogenation (heterogeneous: Pd, Pt, Rh and Ni; homogeneous: Wilkinson's catalyst) (b) Metal based reductions -Birch reduction, pinacol formation, acyloin formation (c) Hydride transfer reagents from group III and group IV in reductions - NaBH ₄ , LiAlH ₄ and DIBAL-H	4	1,4

3	Stereoselective and Total Syntheses			
	3.1	Asymmetric induction- Felkin-Ahn model, Zimmerman-Traxler chair-like transition states.	2	2
	3.2	Noyori asymmetric hydrogenation, Sharpless epoxidation, CBS reduction, Brown allylation and crotylation reactions.	4	2
	3.3	Evans aldol reaction, proline based asymmetric aldol reaction, Jacobsen epoxidation, asymmetric Diels-Alder reaction.	4	2
	3.4	Retrosynthesis- basic concepts, Umpolung reactivity – formyl and acyl anion equivalents, protecting group chemistry- protection and deprotection of hydroxy, carboxyl, carbonyl, and amino groups.	4	3,4
3.5	Retrosynthetic analysis and total synthesis of atropine, papaverine, longifolene and juvabione.	6	3,4	
Organic Chemistry-6 Practicals				
4	Synthesis of biologically important molecule I. Preparation of phenytoin: - i) Preparation of benzoin using coenzyme catalysed reaction. ii) Preparation of benzil from benzoin. iii) Preparation of phenytoin from benzoin. II. Preparation of benzocaine i) Preparation of <i>p</i> -aminobenzoic acid from <i>p</i> -nitrobenzoic acid. ii) Preparation of benzocaine from <i>p</i> -aminobenzoic acid. III. Preparation of fluorescein. iii) Preparation of 7-hydroxy- 4-methyl coumarin from resorcinol.		30	4
5	Teacher Specific Content			
Teaching and Learning Approach	Classroom Procedure (mode of transaction) <ul style="list-style-type: none"> ● Lecture (chalk & board, powerpoint presentation) ● Group discussion ● Peer learning ● Demonstration of experiments ● Hands-on learning 			
Mode of assessment	A. Continuous Comprehensive Assessment (CCA) Theory : 25 marks Pop quiz /Assignment/ Written tests Practical: 5 marks Lab involvement/report /Lab test			

<p>B. Semester-end examination</p> <p>Theory- 50 marks – 1.5 hrs</p> <p>i) MCQ 20 questions: 20 X 1 = 20</p> <p>ii) Short essay 4 questions (out of 6): 4 X 5 =20</p> <p>iii) Essay 1 question (out of 2): 1 X 10 = 10</p> <p>Practical (20 marks) -1 hr.</p> <p>i) Lab skill and Lab involvement - 5</p> <p>ii) Lab report: 3</p> <p>iii) Viva : 5</p> <p>iv) Writing procedure: 2</p> <p>v) Lab test -5</p>
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7. K. N. Jayaveera, S. Subramanyam, K. Y. Reddy, *Practical Medicinal Chemistry*, S. Chand, 2014.

SUGGESTED READINGS

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Programme	BSc (Hons) CHEMISTRY					
Course Name	Group Theory and Quantum Chemistry					
Type of Course	DCE					
Course Code	24SACCHE8CE402					
Course Level	400-499					
Course Summary	This course deals with the applications of quantum chemistry and group theory and fundamental concepts of computational chemistry.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture 4	Tutorial	Practical	Others	
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Summarize the quantum mechanical principles of translational, vibrational and rotational motion.	U	1,2
2	Identify the principles of spherical harmonics in solving hydrogen and hydrogen-like systems.	E	1,2
3	Evaluate the many-body problem, recognize the necessity of approximation methods in quantum mechanics and to outline the basics concepts of bonding in molecules.	A	1,2
4	Outline the basic concepts of different computational chemistry techniques such as Ab initio, semi empirical, density functional theory and molecular mechanics.	U	1,2
5	Construct the character tables for specific point group based on group theoretical principles	A	1,2
6	Utilise the group theoretical aspects to predict the vibrational modes and electronic transition modes.	A	1,2

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT**Content for Classroom transaction (Units)**

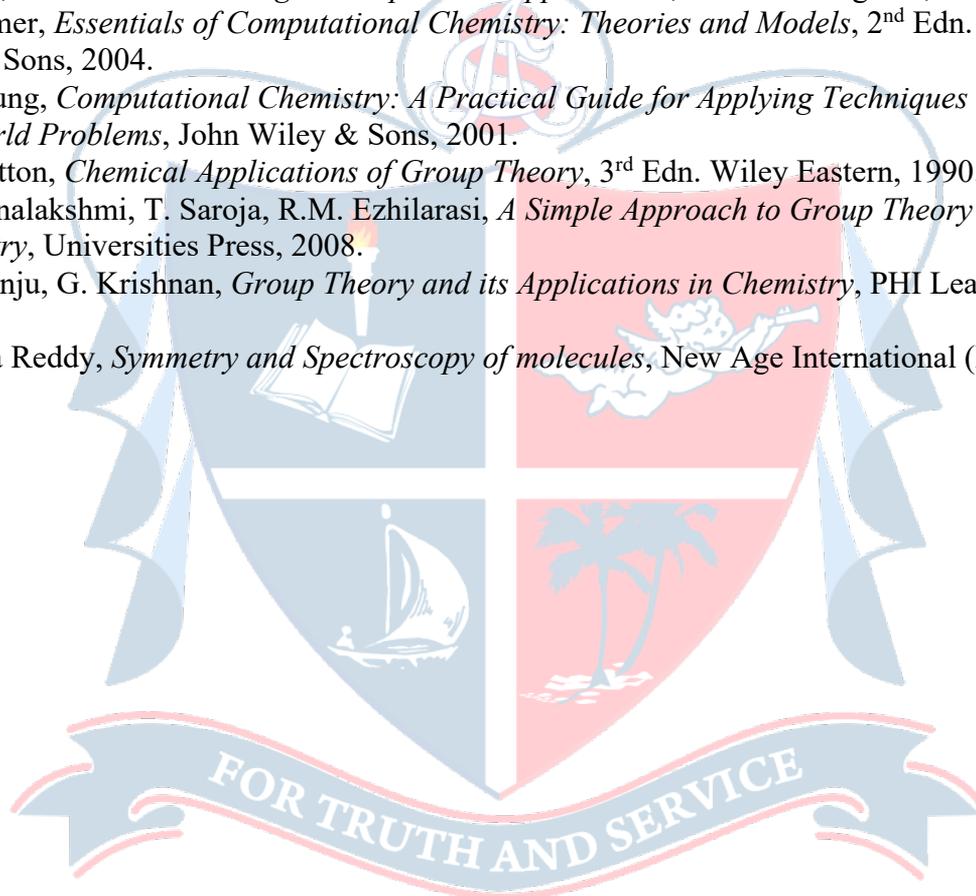
Module	Units	Course description	Hrs	CO No.
1	Application of Quantum Mechanics to solvable systems			
	1.1	Translational motion: free particle in one-dimension, penetration into and through barriers (a barrier with finite width-tunnelling), wave function in region I, II & III and their plots. Concept of transmittance and reflection.	4	1
	1.2	Vibrational motion: one-dimensional harmonic oscillator (complete treatment), Hermite equation (solving by method of power series), Hermite polynomials, wave functions- their sketch, energies, harmonic oscillator model and molecular vibrations.	5	1
	1.3	Quantization of angular momentum, quantum mechanical operators corresponding to angular momenta (L_x , L_y , L_z and L^2).	4	1
2	Rotational Motion and Hydrogen Like Atoms			
	2.1	Rotational motion: the particle on a ring and its solution. Rigid rotor and its solution for energies and wave function, polar diagrams of spherical harmonics. Spherical harmonics as eigen functions of angular momentum operators L_z and L^2 .	6	1
	2.2	Quantum mechanics of hydrogen-like atoms: Potential energy of hydrogen-like systems. The wave equation in spherical polar coordinates: separation of variables-r, theta and phi equations and their solutions, wave functions and energies of hydrogen-like atoms. Orbitals: Radial functions, radial distribution functions, angular functions, and their plots.	6	2
	Many Body Systems and Computational Chemistry			
	3.1	Many-body problem and the need of approximation methods. Born-Oppenheimer approximation. Variation method- illustration of variation theorem using the trial function $\chi(a-x)$ for particle in a 1D-box and using the trial function e^{-ar} for the hydrogen atom.	5	3
	3.2	Perturbation method: time-independent perturbation method (non-degenerate case only), first order correction to energy and wave function, illustration by application to particle in a 1D-box with slanted bottom.	5	3

3	3.3	Chemical bonding: Schrödinger equation for molecules, valence bond (VB) theory, VB theory of H ₂ molecule (elementary idea only) Molecular Orbital (MO) theory, MO theory of H ₂ molecule (elementary idea only). Comparison of MO and VB theories.	5	3
	3.4	Introduction to computational chemistry: scope, potential energy surfaces, global minimum, local minima, saddle points. Tools (methods) of computational chemistry: molecular mechanics, semi empirical methods, <i>Ab initio</i> methods, density functional theory – general introduction. Comparison of <i>ab initio</i> , semi empirical and DFT methods	5	4
4	Group Theory and its Applications			
	4.1	Reducible and irreducible representations, statement of great orthogonality theorem (GOT) and properties of irreducible representations.	3	5
	4.2	Character table and description of its layout, construction of character tables for C _{2v} and C _{3v} .	3	5
	4.3	<i>Application to vibrational spectroscopy</i> : Standard reduction formula, normal mode analysis of H ₂ O and NH ₃ employing cartesian coordinate method and internal coordinate method. Prediction of IR and Raman activity, rule of mutual exclusion.	4	6
	4.4	<i>Application to electronic spectroscopy</i> : Transition moment integral, direct product, transitions between non-degenerate states – criteria for allowed transitions, prediction of electronic transitions in C _{2v} and C _{3v} using direct product terms. Electronic transitions due to the carbonyl chromophore in formaldehyde	5	6
5	Teacher Specific Content			

Teaching and Learning Approach	Classroom procedure (mode of transaction) Lecture (chalk & board, powerpoint presentation, flipped classroom) Group discussion – thought problems; mind mapping Peer interaction Demonstration using simulations / models
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: 30 marks Quiz / Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities B. End Semester examination Theory: 70 marks- 2 hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

REFERENCES

1. P.W. Atkins, R.S. Friedman, *Molecular Quantum Mechanics*, 4th Edn. Oxford University Press, 2005.
2. N. Levine, *Quantum Chemistry*, 7th Edn. Pearson Education Inc., 2016.
3. D.A. McQuarrie, *Quantum Chemistry*, University Science Books, 2008.
4. R.K. Prasad, *Quantum Chemistry*, New Age International, 2001.
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6. E.G. Lewars, *Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics*, 2nd Edn. Springer, 2011.
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Instrumental Methods of Chemical Analysis					
Type of Course	DCE					
Course Code	24SACCHE8CE403					
Course Level	400- 499					
Course Summary	This course deals with the theory, instrumentation and applications of various chromatographic techniques, and surface and thermal analytical methods.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the basic principles and instrumentation of various chromatographic techniques.	U	1,2
2	Evaluate the efficiency and effectiveness of different chromatographic methods.	E	1,2
3	Analyse the basic principles, instrumentation, limitations and applications of various techniques for surface analysis	An	1,2
4	Analyse the basic principles, instrumentation and applications of various thermal analytical techniques.	An	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
1	Introduction to chromatography			
	1.1	Adsorption and partition column chromatography- methodology, advantages, limitations and applications.	3	1,2
	1.2	Thin-layer chromatography- introduction, principle, methodology, Rf values, advantages, limitations, and applications.	4	1,2
	1.3	Paper chromatography- Introduction, methodology, development techniques, advantages, limitations, and applications	4	1,2
	1.4	Electrophoresis-introduction, factors affecting electrophoretic mobility, techniques of paper, gel and capillary electrophoresis and its applications.	4	1,2
2	GC, HPLC and Ion exchange chromatography			
	2.1	Gas chromatography - introduction, theory, instrumentation, derivatization, temperature programming, advantages, limitations and applications, hyphenated GC techniques (GC-MS, GC-IR, GC-GC, or 2D GC).	6	1,2
	2.2	High-performance liquid chromatography (HPLC)- introduction, theory, instrumentation, advantages and applications, hyphenated techniques in HPLC.	5	1,2
	2.3	Ion exchange chromatography- introduction, classification, ion exchange resins, properties, mechanism of the ion exchange process, factors affecting ion exchange, methodology and applications.	4	1,2
3	Surface Analysis			
	3.1	X-Ray photoelectron spectroscopy- instrumentation and sample introduction, applications.	3	3
	3.2	Auger electron spectroscopy- instrumentation and applications.	3	3
	3.3	Secondary ion mass spectrometry- instrumentation, applications, ToF-SIMS.	3	3

	3.4	SEM- basic principles, instrumentation and applications.	2	3
	3.5	STM- basic principles, instrumentation, and applications.	2	3
	3.6	AFM- basic principles, instrumentation, and applications.	2	3
4	Thermal Analysis			
	4.1	Thermogravimetry (TGA)- instrumentation, analytical applications of thermogravimetry, derivative thermogravimetry	3	4
	4.2	Differential Thermal Analysis (DTA)- instrumentation and analytical applications.	3	4
	4.3	Differential Scanning Calorimetry (DSC)- instrumentation and applications.	3	4
	4.4	Hyphenated thermal methods.	1	4
	4.5	Thermometric titrimetry.	1	4
	4.6	Microcalorimetry- basic principles and applications of micro-DSC.	2	4
	4.7	Thermomechanical analysis and Dynamic mechanical analysis- applications of TMA and DMA.	2	4
5	Teacher Specific Content			
Teaching and Learning Approach	Lecture sessions/interactive sessions/ case studies/ from various scientific fields (like environmental science, pharmaceuticals, forensics) to illustrate how different techniques are applied practically.			

Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: 30 marks Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities
	B. End Semester examination Theory: 70 marks-2 hrs. i) MCQ 20 questions: 20 X 1 = 20 ii) Short essay 6 questions (out of 8): 6 X 5 =30 iii) Essay 2 question (out of 4): 2 X 10 = 20

REFERENCES

1. J W. Robinson, E M. Skelly Frame, G M. Frame II, *Undergraduate Instrumental Analysis*, 7th Edition, Taylor & Francis, 2014.
2. M D Graef, M E. McHenry, *Introduction to TEM, SEM, and AFM: The Practical Approach to Materials Characterization*, 1st Edition, CRC Press, 2018.
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Molecular Modelling					
Type of Course	DCE					
Course Code	24SACCHE8CE404					
Course Level	400-499					
Course Summary	This course provides a comprehensive insight into molecular modelling covering Hartree Fock Method & Post Hartree Fock Methods, various computational chemistry methods and applications of computational chemistry softwares.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate the need for the approximations to the Hamiltonian.	U	1,2
2	Classify different types of basis sets.	U	1,2
3	Compare and contrast different methods of computational chemistry.	An	1,2,3
4	Utilize GAMESS software to solve molecular systems.	A	1,2,4,9,10
5	Utilize Autodock software to predict protein-ligand interactions.	A	1,2,3,4,9,10

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
	Hartree Fock Method & Post Hartree Fock Methods			
1	1.1	Multi-electron atoms. Hartree method, spin multiplicity, Slater determinant, properties of Slater determinant, Hartree- Fock (HF) equations. Secular determinant, restricted and unrestricted HF models.	5	1
	1.2	The Fock matrix, Roothan Hall equations, elements of the Fock matrix (elementary ideas only), steps for HF calculation, Koopmann theorem.	5	1
	1.3	The need for post HF methods. electron correlation, post HF methods: configuration interaction and Møller Plesset perturbation theory (elementary ideas only)	3	1
	1.4	Roothan's concept of basis functions, Slater type orbitals (STO), Gaussian type orbitals (GTO), sketches of STO and GTO. Differences between STOs and GTOs.	3	2
	1.5	Classification of basis sets – minimal basis sets; Pople basis sets (with polarization and diffuse functions), correlation consistent basis sets; double zeta, triple zeta and quadrupole zeta basis sets, split valence basis set, Hartree Fock limit.	4	2
2	Computational Methods			
	2.1	Semiempirical methods: introduction, neglect of differential overlap method (NDO), complete neglect of differential overlap (CNDO), modified neglect of differential overlap (MNDO); Austin Model 1, parametric method 3 (PM3), zero differential overlap (ZDO) (concepts only). Comparison of semiempirical methods. Software used for semiempirical calculations.	5	3

	2.2	Ab Initio method: introduction, computation of correlation energy, computation of Slater determinant of excited states, Möller-Plesset perturbation and coupled cluster method.	4	3
	2.3	Density functional theory: introduction, electron density, development of DFT, The functional, Hohenberg and Kohn theorem, Kohn and Sham method, density functionals – exchange and correlation functionals with examples, DFT methods, applications of DFT, performance of DFT, advantages of DFT in biological chemistry.	6	3
	2.4	Molecular Mechanics (MM): introduction, basic theory- bond stretching, angle bending, torsional strain, non bonded interactions. Force fields – MM2, MM3, MM4, AMBER, CHARMM, merck molecular force field, consistent force field, parameterization.	4	3
	2.5	Comparison between semiempirical, Ab Initio, DFT and MM methods – merits and demerits.	1	3
	Computational Software			
3	3.1	Introduction to GAMESS. Setting up the input file with run type - geometry optimization, frequency calculation and single point energy calculations. \$ groups, format for input file. Hands-on training using the software.	5	4
	3.2	Input for molecule – cartesian coordinates and Z-matrix. Z matrix- rules, z-matrix for linear molecules like diatomic molecules, acetylene, hydrogen cyanide and polyatomic molecules like water, ammonia, boron hydride and methane.	5	4
	Docking			
4	4.1	Introduction to docking (basic ideas only), protein ligand interactions; setting up the protein and ligand using babel and pymol; predicting ADMET of the molecule using PreADMET application; docking procedures using autodock software and result analysis with visualization of interactions using discovery studio. Hands-on training using the software.	10	5
5	Teacher Specific Content			

Teaching and Learning Approach	Classroom procedure (mode of transaction) Lecture (chalk & board, powerpoint presentation, flipped classroom) Group discussion – thought problems; mind mapping Peer interaction Demonstration using simulations / models
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory: 30 marks Quiz/ Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities B. End Semester examination Theory: 70 marks-2 hrs. i) MCQ 20 questions: $20 \times 1 = 20$ ii) Short essay 6 questions (out of 8): $6 \times 5 = 30$ iii) Essay 2 question (out of 4): $2 \times 10 = 20$

REFERENCES

1. K. I. Ramachandran, G. Deepa, K. Namboori, *Computational Chemistry and Molecular Modeling Principles and Applications*, Springer, 2008
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3. A. Szabo, N. S. Ostlund, *Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory*, Dover Books on Chemistry, 1996.
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6. J.H. Jensen, *Molecular Modeling Basics*, CRC Press, 2010.
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Programme	BSc (Hons) CHEMISTRY					
Course Name	Crystallography and Electrochemistry					
Type of Course	DCE					
Course Code	24SACCHE8CE405					
Course Level	400-499					
Course Summary	This is an advanced physical chemistry course dealing with crystallography, electrochemistry and electro analytical techniques.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the basic concepts of crystal systems like unit cell, lattice and deduce the crystal structure of NaCl and KCl from XRD patterns.	An	1,2,3
2	Distinguish different diffraction methods and correlate the structure factor with the peak intensity.	A	1,2,3
3	Describe the structure of ionic solution and interpret the laws governing ionic conductivity.	U	1,2
4	Explain the features of concentration cells and fuel cells.	U	1,2
5	Explain the causes of corrosion, prevention methods.	U	1,2
6	Learn the basic principles of voltammetry and describe voltammogram by analysing the peak current and peak potential.	U	1,2
7	Apply the theory behind electroanalytical techniques to quantitative and qualitative analysis.	A	1,2

***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**

COURSE CONTENT**Content for Classroom transaction (Units)**

Module	Units	Course description	Hrs	CO No.
UNIT 1: CRYSTALLOGRAPHY (15 HRS)				
1	1.1	Symmetry in crystals: symmetry elements – proper rotation (order of axis – 1, 2, 3, 4 and 6 – derivation), mirror plane, rotary inversion axis. 32 crystallographic point groups (derivation not expected), Hermann-Mauguin notation and corresponding Schoenflies notations, translational symmetry elements - glide planes and screw axes, fourteen Bravais lattices, space groups (concept only). Space groups of triclinic and monoclinic systems.	5	1
	1.2	Miller indices, inter-planar spacing and method of determining lattice types, reciprocal lattices. X-ray diffractometer: single crystal and powder pattern methods (experimental part). Analysis of powder diffraction patterns of NaCl and KCl. Debye-Scherrer equation.	6	1
	1.3	Crystal growth techniques. Structure factor: atomic scattering factor, coordinate expression for structure factor.	4	2
UNIT 2: ADVANCED ELECTROCHEMISTRY (30 HRS)				
2	2.1	Debye-Huckel theory, derivation of Debye-Huckel-Onsager equation, validity of DHO equation for aqueous and non-aqueous solutions, Debye-Huckel limiting law (no derivation) qualitative and quantitative tests of Debye-Huckel limiting law, deviations from DHLL.	10	3
	2.2	Concentration cells – with and without transference, liquid junction potential, electrode double layer, electrode- electrolyte interface, different models of double layer, theory of multilayer capacity, electro capillary, Lippmann equation, membrane potential. Fuel cells- theory and working of fuel cells- methanol fuel cell, H ₂ -O ₂ fuel cell and solid oxide fuel cells.	10	4
	2.3	Corrosion and methods of prevention, Pourbaix diagram and Evans diagrams. Electrode polarization:- overvoltage: hydrogen and oxygen overvoltage, theories of overvoltage, Tafel equation and its significance.	10	5

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) <ul style="list-style-type: none"> ● Lecture sessions (chalk & board, powerpoint presentation) ● Interactive sessions and simulations ● Visual aids like videos and models to enhance understanding ● Peer discussions ● Laboratory experiments and hands-on training
Assessment Types	<p style="text-align: center;">MODE OF ASSESSMENT</p> <p>A. Continuous Comprehensive Assessment (CCA)</p> <p style="text-align: center;">Theory; 30 marks</p> <p>Quiz/ Assignments /Class tests/ MCQ /Viva /Involvement in classroom activities</p> <p>B. End Semester End examination</p> <p style="text-align: center;">Theory: Written examination (70 Marks)- 2 hrs.</p> <p>i) MCQ 20 questions: 20 X 1 = 20</p> <p>ii) Short essay 6 questions (out of 8): 6 X 5 =30</p> <p>iii) Essay 2 question (out of 4): 2 X 10 = 20</p>

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1. R P W Atkins, *Physical Chemistry*, 12th Edn. Oxford University Press, 2018.
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3. A. McQuarrie, J. D. Simon, *Physical Chemistry – A molecular Approach*, Viva Books Pvt. Ltd., 2019.
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Suggested Readings

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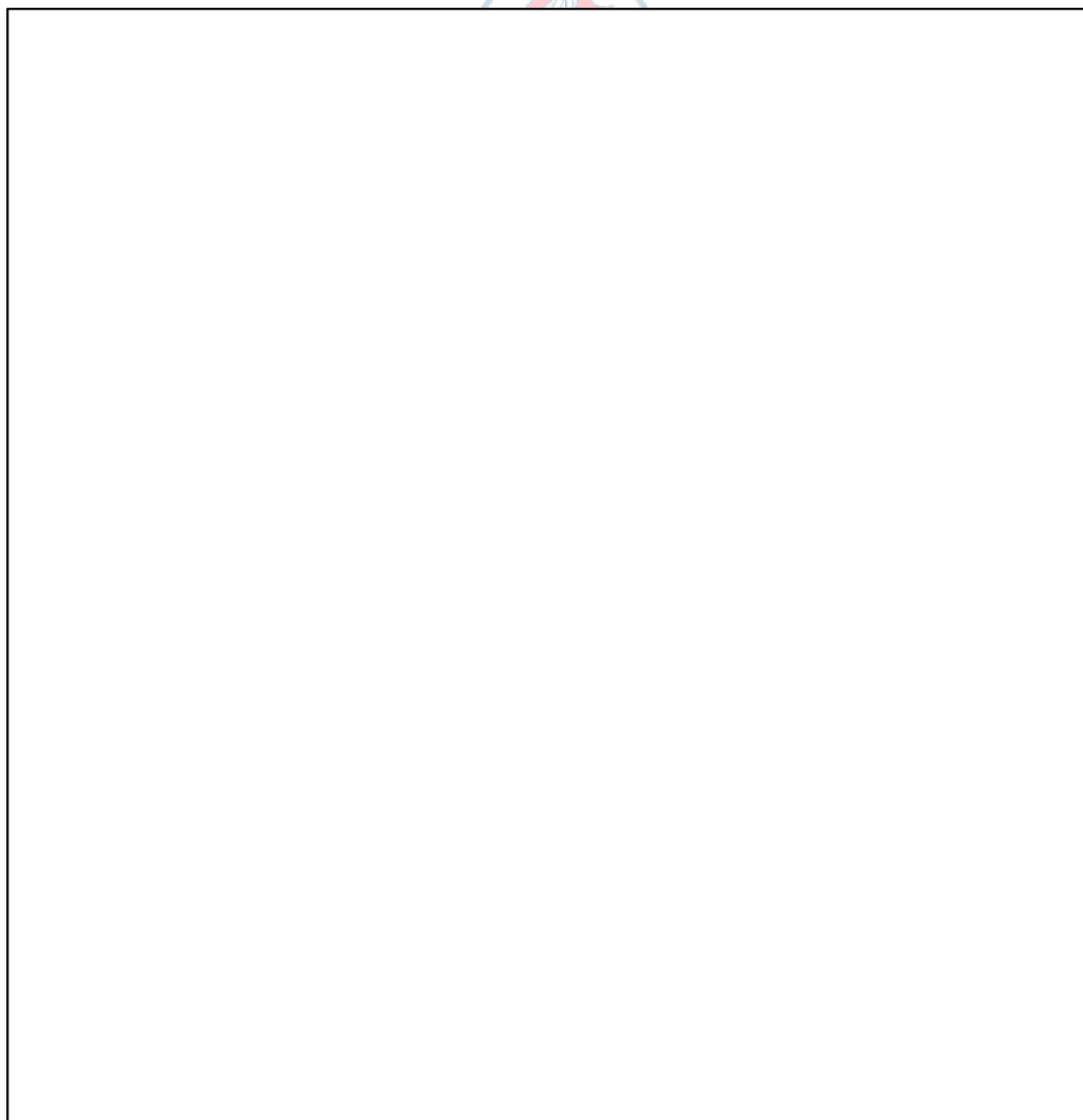
Internship Evaluation

All students shall undergo summer internship or apprenticeship in a firm, industry or organization; or training in labs with faculty and researchers or other higher education institutions (HEIs) or research institutions after completion of the fourth semester.

Evaluation scheme (total 50 marks)

1) Internal Evaluation (15 marks)

(Internal marks may be obtained from the organisation/institution where the student is doing internship using the following format)



Chemistry Undergraduate Student Evaluation Form for Internship

Internship Details:

Student Name:

Date of Evaluation:

Duration of Internship:

Mentor Name:

Instructions: Please rate the student's performance based on their abilities, skills, and behaviour during the internship. Provide specific examples or comments where applicable to support your ratings.

1. Technical Skills and Problem Solving (Marks out of 3) :

2. Communication Skills and Collaboration (Marks out of 3) :

3. Professionalism (Marks out of 3) :

4. Adaptability (Marks out of 3) :

5. Overall Performance (Marks out of 3) :

Total (out of 15) :

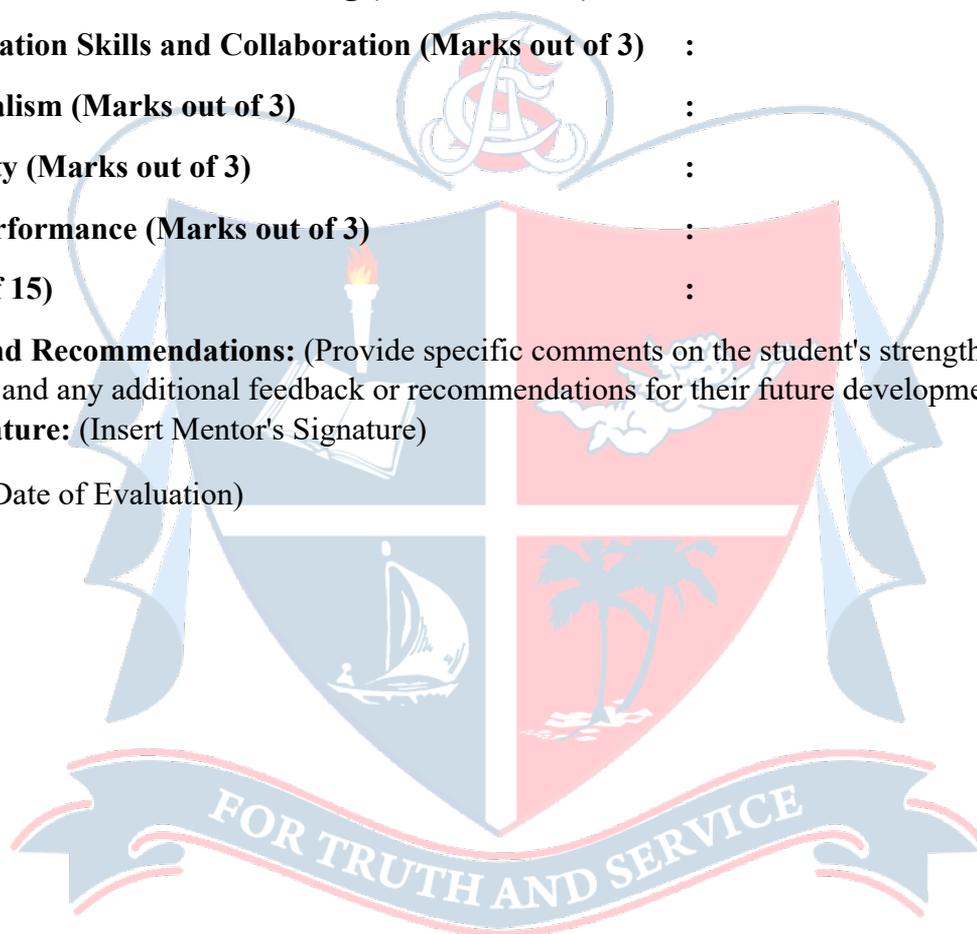
Comments and Recommendations: (Provide specific comments on the student's strengths, areas for improvement, and any additional feedback or recommendations for their future development.)

Mentor Signature: (Insert Mentor's Signature)

Date: (Insert Date of Evaluation)

:

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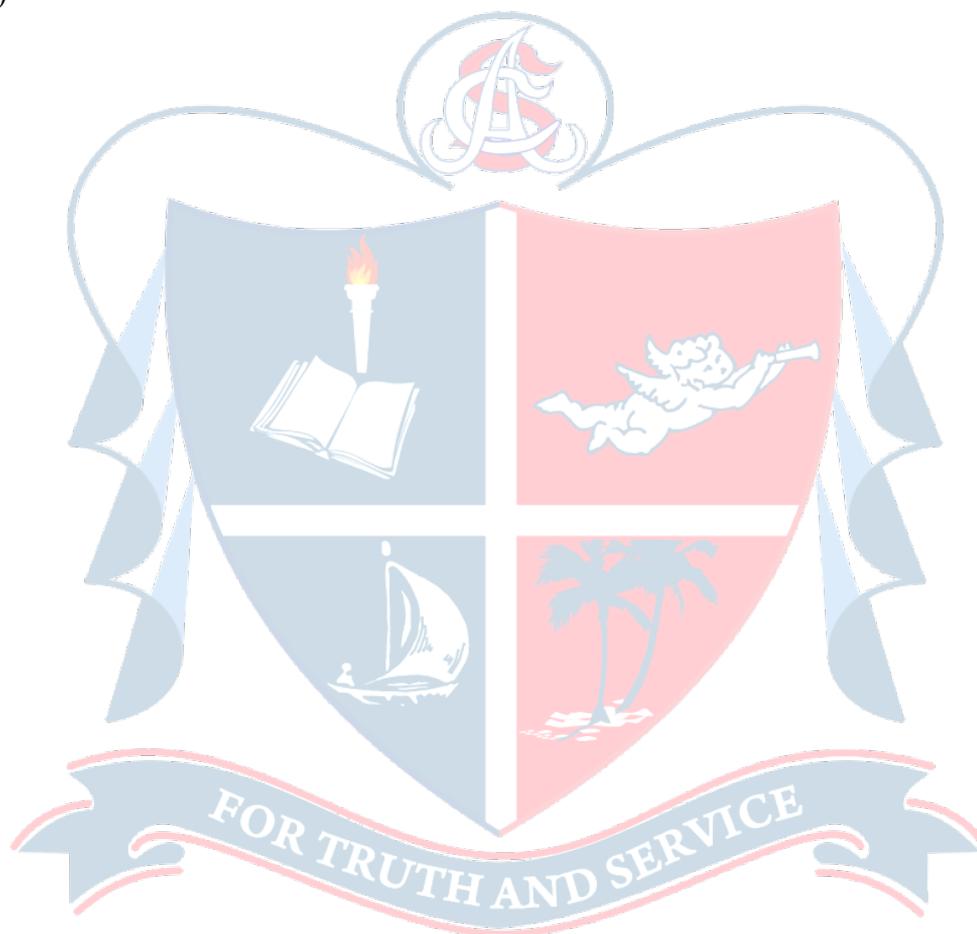
2) Final Evaluation (35 marks)

Report (20 marks)

- i) Relevance : 5 marks
- ii) Professionalism & ethical considerations : 5 marks
- iii) Result Analysis : 5 marks
- iv) Conclusions : 5 marks

Viva voce (15 marks)

(Student's skills, work ethics, professionalism and contribution to the organisation may be evaluated through viva)



Project Evaluation- 24SACCHE8PR401

I. Project with 12 credits (200 marks)

1) Internal Evaluation (60 marks)

- i) Initiative and Independence : 10 marks
- ii) Technical Skills : 10 marks
- iii) Problem Solving : 10 marks
- iv) Communication Skills : 10 marks
- v) Professionalism : 10 marks
- vi) Overall Performance : 10 marks

(If the student is doing project in any outside institution, internal marks may be obtained from there (from the project supervisor))

2) Final Evaluation (140 marks)

- i) Novelty of the work : 20 marks
- ii) Experimental Section : 10 marks
- iii) Results and Discussion : 20 marks
- iv) Conclusion : 10 marks
- v) Literature Survey : 10 marks
- vi) Presentation of the work : 30 marks
- vii) Viva voce : 40 marks

(If the student is doing project in any outside institution, internal marks may be obtained from there (from the project supervisor))

