

B.Sc. CHEMISTRY
CHOICE BASED CREDIT SYSTEM (CBCS)

Syllabus
2020-2021



DEPARTMENT OF CHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established under section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari (Post), Coimbatore- 641 021,
Tamil Nadu, India

Phone: 0422 – 2980011 – 15 Fax No: 0422 – 2980022-23

Email: info@karpagam.com Web: www.kahedu.edu.in

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established under Section 3 of UGC Act, 1956)

Eachanari Post, Coimbatore - 641 021, India

FACULTY OF ARTS, SCIENCE AND HUMANITIES

UNDER-GRADUATE PROGRAMMES

REGULAR MODE

REGULATIONS - 2020

The following Regulations are effective from the academic year 2020-2021 and are applicable to candidates admitted to Under Graduate Degree (UG) programmes in the Faculty of Arts, Science, and Humanities, Karpagam Academy of Higher Education (KAHE) from the academic year 2020-2021 onwards.

1 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

1.1 U.G. Programmes Offered

A candidate may undergo a programme in any one of the under graduate programme approved by the KAHE as given below.

S. No.	DEGREE	DISCIPLINE
1	B. Sc.	Biochemistry
2	B. Sc.	Biotechnology
3	B. Sc.	Computer Science
4	B.Sc.	Mathematics
5	B.Sc.	Physics
6	B. Sc.	Chemistry
7	B. Sc.	Microbiology
8	B. Sc.	Information Technology
9	B. Sc.	Computer Technology
10	B.Sc.	Computer Science with Cognitive Systems
11	BCA	Computer Application
12	B.Sc.	Applied Science (Material Science)
13	B.Sc.	Applied Science (Foundry Science)
14	B. Com.	Commerce
15	B.Com (CA)	Commerce with Computer Applications
16	B. Com. (PA)	Commerce with Professional Accounting
17	B. Com. (BPS)	Commerce with Business Process Services
18	B.B.A.	Business Administration

1.2 Mode of Study

Full-Time

All programs are offered under Full-Time Regular mode. Candidates admitted under 'Full-Time' should be present in the KAHE during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

1.3 Admission Requirements (Eligibility)

A candidate for admission to the first year of the UG Degree programme shall be required to have passed the Higher Secondary Examination (10 + 2) [Academic or Vocational] prescribed by the Government of Tamil Nadu Board or any similar examination of any other Board accepted by the KAHE as equivalent thereto.

2. DURATION OF THE PROGRAMMES

- 21 The minimum and maximum period for the completion of the U.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
B.Sc., B.Com, BCA, BBA	6	12

- 22 Each semester normally consists of 90 working days or 450 Instructional hours of study. Examination shall be conducted at the end of every semester for the respective courses.

3. CHOICE BASED CREDIT SYSTEM

- 3.1. All programmes are offered under Choice Based Credit System with a total credit of 140 for UG Programmes.

3.2. Credits

Credit means the weightage given to each course of study by the experts of the Board of Studies concerned. Total credits 140 as per UGC Guidelines for the UG programme (Three Years).

4. STRUCTURE OF THE PROGRAMME

- 41 Tamil or any one of the Indian Languages viz, Malayalam, Hindi, French, Sanskrit and English are offered for Science Programme in the first year. Four credits are awarded for each course and the examinations will be conducted at the end of the each semester.

Tamil or any one of the Indian Languages viz, Malayalam, Hindi, French, Sanskrit (for six credits) and English (for four credits) are offered for Arts Programme in the first year. The examinations will be conducted at the end of the each semester.

Further for Arts programme, there are two courses (English III and IV) offered during the Second year - third and fourth semesters. Six credits are awarded for each course, and the examinations will be conducted at the end of the respective semester.

42. Core Course, Discipline Specific Elective, Generic Elective, Skill Enhancement Course, Project, Ability Enhancement Course are part of curricular structure.

4.2.1. Core Course

Core course consists of theory and practical for Department domains for which examinations shall be conducted at the end of each semester. The students have to study 12 Core Courses compulsorily.

4.2.2. Discipline Specific Electives (DSE)

DSE is offered in the fifth and sixth semesters of third year. The examination shall be conducted at the end of each semester. Final year students (V and VI Semesters) will have to choose the elective courses in V semester and VI Semester from the list of elective courses given in the curriculum, in addition to the project work.

4.2.3. Generic Elective

Generic elective is an elective course chosen generally from an unrelated discipline/subject, with an intention to provide exposure in other areas of interest also to students.

The students have to choose two Generic Electives- one each in the First year (3 or 4 courses) and second year (3 or 4 courses) of the programme from the list of elective courses given in the curriculum.

Note: A particular elective course will be offered only if at least one third of the students in a class opt that course.

4.2.4. Skill Enhancement Courses

Skill Enhancement Courses are offered in the third and fourth semesters of second year programme and in the fifth and sixth semesters of the third year programme. Second year students (III and IV Semesters) will have to choose atleast one elective course each in both III and IV Semesters from the list of elective courses given in the

curriculum. Similarly final year students (V and VI Semesters) will have to choose atleast one elective course each in both V and VI Semesters from the list of elective courses given in the curriculum. The examination shall be conducted at the end of each semester.

Note: A particular elective course will be offered only if at least one third of the students in a class opt that course.

4.2.5. Project Work

The project work shall start at the beginning of sixth semester and the Project Report has to be submitted at the end of the sixth semester. The project may be an individual or group task. HoD of the department concerned shall assign a project supervisor who in turn shall monitor the project work of the student(s). A project/ dissertation work may be given *in lieu* of a discipline-specific elective paper.

4.2.6. Ability Enhancement Course

Ability Enhancement Course-1

The course (English for Science Programme / Business Communication for Arts Programme) shall be offered during the first and second semester for which examinations shall be conducted at the end of the semester. And Business Communication for Arts Programme shall be offered during the first semester for which examinations shall be conducted at the end of the semester.

Ability Enhancement Compulsory Course-2

Students shall study the course Environmental Studies in the First / Second Semester for which examinations shall be conducted at the end of the semester.

4.2.7. Internship

The student shall undergo 15 days internship in the end of II and IV semester.

5.0 Value Added Courses

Courses of varying durations but not less than 30 hours which are optional and offered outside the curriculum that add value and helping the students in getting placement. Students of all programmes are eligible to enroll for the value added course. The student can choose one Value-added course per semester from the list of Value-added courses available in KAHE. The examinations shall be conducted at the end of

the value added course at the Department level and the student has to secure a minimum of 50% of marks to get a pass. The certificate for the value added course for the passed out students shall be issued duly signed by the HOD and Dean of the Faculty concerned.

6.0 Online Course

Student shall study at least one online course from SWAYAM / NPTEL / MOOC in any one of the first five semesters for which examination shall be conducted at the end of the course by the respective external agencies if any. The student can register to the courses which are approved by the Department. The student shall produce a Pass Certificate from the respective agencies before the end of the fifth semester. The credit(s) earned by the students will be considered as additional credit(s) over and above the credits minimum required to earn a particular degree.

7.0 Extension Activities

Every student is encouraged to participate in at least any one of the following Extension activities:

- NSS
- NCC
- Sports / Mass drill
- YRC
- Club activities
- Other Co-curricular and Extra curricular activities

The student's performance shall be examined by the staff in-charge of Extension Activities along with the faculty mentor and the Head of the respective department on the following parameters.

- 75 % weightage for active participation in Extension Activities in / out of the KAHE.
- 25 % weightage for Exemplary Awards / Honours / Prizes secured.

8.0 Marks for Co-curricular and Extra-curricular shall be sent to the CoE before the commencement of the Sixth End Semester Examinations.

The above activities shall be conducted outside the regular working hours of the KAHE.

5. MEDIUM OF INSTRUCTION

The medium of instruction and examinations for the courses under Language I – Tamil / Hindi / Malayalam / French / Sanskrit shall be in the language concerned. For all other courses, the medium of instruction and examination shall be in English.

6. MAXIMUM MARKS

Each of the theory and practical courses shall carry a maximum of 100 marks. Out of which 40 marks is awarded for Continuous Internal Assessment (CIA) and 60 marks for End Semester Examinations (ESE).

Evaluation: Evaluation in the courses comprises two parts, one is the Continuous Internal Assessment (CIA) and the other one is the End Semester Examination (ESE).

7. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. Ideally, every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate has been satisfactory during the course.

b. A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed minimum attendance requirements and shall be permitted to appear for the examination on the recommendation of the Head of the Department concerned and Dean to condone the shortage of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean concerned. However, the candidate has to pay the prescribed condonation fee to the KAHE.

c. However, a candidate who has secured attendance less than 64% in the current semester due to any reason shall not be permitted to appear for the current semester examinations. But he/she will be permitted to appear for his/her supplementary examinations, if any and he/she has to re-do the same semester with the approval of the “Students’ Affairs Committee” and Registrar.

8. a. FACULTY MENTOR

To help students in planning their courses of study and for general advice on the academic programme, the HoD shall allot twenty students to a faculty who will function as faculty mentor throughout their period of study. Faculty mentor shall advise the students and monitor their behavior and academic performance. Problems if any shall be counseled by them periodically. The Faculty mentor is also responsible to inform the parents of their wards' progress. Faculty mentor shall display the cumulative attendance particulars of his / her ward students' periodically (once in 2 weeks) on the Notice Board to enable the students, know their attendance status and satisfy the **clause 7** of this regulation.

b. ONLINE COURSE COORDINATOR

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a coordinator for the online courses. The Online course coordinator shall identify the courses which students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinators shall advice the students regarding the online courses and monitor their course.

9. CLASS COMMITTEE

Every class shall have a Class Committee consisting of the faculty members of the various courses of the class concerned, student representatives (Minimum 2 boys and 2 girls of various capabilities and Maximum of 6 members) and the concerned HoD / senior faculty as Chairperson. The objective of the Class Committee Meeting is all about the teaching – learning process. Class Committee shall be convened at least once in a month. The functions of the Class Committee shall include

- Analysing and solving problems experienced by students in the class room and in the laboratories.
- Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.
- The Class Committee of a particular class of any department is normally constituted by the HoD / Chairperson of the Class Committee. However, if the students of different departments are mixed in a class, the Class Committee shall be constituted by the respective Dean of the Faculty.
- The class committee shall be constituted during the first week of each semester.

- The HoD / Chairperson of the Class committee is authorized to convene the meeting of the class committee.
- The respective Dean of the Faculty has the right to participate in any Class committee meeting.
- The Chairperson is required to prepare the minutes of every meeting, and submit the same to Dean concerned within two days after having convened the meeting. Serious issues if any shall be brought to the notice of the Registrar by the HoD / Chairperson immediately.

10. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or department shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the course coordinator shall be made by the respective Dean depending upon whether all the teachers handling the common course belong to a single department or to various other departments. The ‘Course Committee’ shall meet in order to arrive at a common scheme of evaluation for the tests to ensure a uniform evaluation of the tests. If feasible, the course committee shall prepare a common question paper for the Internal Assessment test(s).

11. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

11.1 Attendance and assessment: Every Faculty is required to maintain an **Attendance and Assessment Record (Log book)** which consists of attendance of students marked for each lecture / practical / project work class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the HoD once in a fortnight for checking the syllabus coverage and the records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to respective Dean once in a month. After the completion of the semester the HoD should keep this record in safe custody for five years. Because records of attendance and assessment shall be submitted for Inspection as and when required by the KAHE / any other approved body.

11.2 Continuous Internal Assessment (CIA): The performance of students in each course will be continuously assessed by the respective faculty as per the guidelines given below:

Theory Courses

S. No.	Category	Maximum Marks
1.	Assignment*	5
2.	Attendance	5
3	Seminar	5
4.	Test – I (1 ½ units- Unit I and II)	8
5	Test – II (1 ½ units Unit II and III)	8
6	Test III (2 units Unit IV and V)	9
Continuous Internal Assessment : Total		40

* Two Assignments (Assignment I before Internal Test – I and assignment II before Internal Test – II).

Practical Courses

S. No.	Category	Maximum Marks
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model Examination	20
5.	<i>Viva – voce</i> [Comprehensive]*	5
Continuous Internal Assessment: Total		40

* Includes *Viva- voce* conducted during the model Exam practical.

Every practical Exercise / Experiment shall be evaluated based on the conduct of Exercise/ Experiment and records maintained.

113 Pattern of Test Question Paper

Portions for Internal Test – I : First 1 ½ Units (Unit I and II)

Portions for Internal Test – II : Second 1 ½ Units (Unit II and III)

Portions for Internal Test – III : Two units (Unit IV and V)

Instruction	Remarks
Maximum Marks	50 marks
Duration	2 Hours
Part – A	Objective type (20x1=20)
Part - B	Short Answer Type (3 x 2 = 6)
Part - C	3 Eight mark questions 'either – or' choice (3 x 8 = 24 Marks)

114 Attendance

Marks Distribution for Attendance

S. No.	Attendance (%)	Maximum Marks
1	90.1 - 100	5.0
2	80.1 - 90	4.0
3	75.0 - 80	3.0
4	Less than 74.99	0

12. ESE EXAMINATIONS

121 End Semester Examination (ESE): End Semester Examination will be held at the end of each semester for each course. The question paper is for a maximum 60 marks.

Pattern of ESE Question Paper:

Instruction	Remarks
Maximum Marks	60 marks for ESE.
Duration	3 hours (½ Hr for Part – A Online & 2 ½ Hours for Part – B and C
Part - A	20 Questions of 1 mark each (20 x 1 = 20 Marks) Question No. 1 to 20 Online Multiple Choice Questions
Part- B	5 Questions of 2 marks each(5 x 2 = 10 Marks) Covering all the five units of the syllabus Question No. 21 to 25
Part- C	5 six mark Questions of 6 marks each (5 x 6 = 30 Marks.) Question No. 26 to 30 will be ‘either-or’ type, covering all five units of the syllabus; i.e., Question No. 26: Unit - I, either 26 (a) or 26 (b), Question No. 27: Unit - II, either 27 (a) or 27 (b), Question No. 28: Unit - III, either 28 (a) or 28 (b), Question No. 29: Unit - IV, either 29 (a) or 29 (b), Question No. 30: Unit - V, either 30 (a) or 30 (b)

122 **Practical:** There shall be combined valuation. The pattern of distribution of marks shall be as given below.

Experiments	: 40 Marks
Record	: 10 Marks
Viva-voce	: 10 Marks
Total	: 60 Marks

Record Notebooks for Practical Examination

Candidate taking the practical examination should submit Bonafide Record Notebook prescribed for the practical examination; failing which the candidate will not be permitted to take the practical examination.

In case of failures in Practical Examination, the marks awarded for the Record at the time of first appearance of the Practical Examination shall remain the same at the subsequent appearance also by the candidate.

12.3. Evaluation of Project Work

12.3.1 The project work shall carry a maximum of 100 marks. (CIA - 40 and ESE – 60*)

*Combined valuation of Internal and External Examiners.

12.3.2 The project report prepared according to the approved guidelines and duly signed by the supervisor(s) shall be submitted to HoD.

12.3.3 The evaluation of the project will be based on the project report submitted and a *viva-voce* Examination by a team consisting of the supervisor, who will be the Internal Examiner and an External Examiner who shall be appointed by the COE. In case the guide is not available, the HoD shall act as an Internal Examiner for the same.

12.3.4 If a candidate fails to submit the project report on or before the specified date given by the Examination Section, the candidate is deemed to have failed in the Project Work and shall re-enroll for the same in a subsequent semester.

If a candidate fails in the respective viva-voce examinations he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. For this purpose the same Internal and External examiner shall evaluate the resubmitted report.

12.3.5 Copy of the approved project report after the successful completion of *viva-voce* examinations shall be kept in the KAHE library.

13. PASSING REQUIREMENTS

13.1 Passing minimum: There is a passing minimum 20 marks out of 40 marks for CIA and the passing minimum is 30 marks out of 60 marks in ESE. The overall passing in each course is 50 out of 100 marks (Sum of the marks in CIA and ESE examination).

13.2 If a candidate fails to secure a pass in a particular course (either CIA or ESE or Both) as per clause 13.1, it is mandatory that the candidate has to register and reappear for the examination in that course during the subsequent semester when examination is conducted for the same till he / she receives a pass both in CIA and ESE (vide Clause 12.1).

- 133 Candidate failed in CIA will be permitted to improve CIA marks in the subsequent semesters by writing tests and by re-submitting Assignments.
- 134 CIA marks (if it is pass) obtained by the candidate in the first appearance shall be retained by the Office of the Controller of Examinations and considered valid for all subsequent attempts till the candidate secures a pass in ESE
- 135 Candidate who is absent in ESE in a Course / Practical / Project Work after having enrolled for the same shall be considered to have **failed** in that examination.

14. IMPROVEMENT OF MARKS IN THE COURSES ALREADY PASSED

Candidates desirous to improve the marks secured in a passed course in their first attempt shall reappear once (**only in ESE**) in the subsequent semester. **The improved marks shall be considered for classification but not for ranking.** If there is no improvement there shall be no change in the marks awarded earlier.

15. AWARD OF LETTER GRADES

All assessments of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each course as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AAA	-	-	ABSENT

16. GRADE SHEET

After the declaration of the results, Grade Sheets will be issued to each student which will contain the following details:

- i. The list of courses enrolled during the semester and the grade scored.
- ii. The Grade Point Average (**GPA**) for the semester and
- iii. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.
- iv. Remark on Extension Activities (only in the 6th Semester Grade Sheet)

GPA of a Semester and CGPA of a programme will be calculated as follows.

$$\text{GPA of a Semester} = \frac{\text{Sum of the product of the GP by the corresponding credits of the courses offered in that Semester}}{\text{Sum of the credits of the courses of that Semester}}$$

$$\text{i.e. GPA of a Semester} = \frac{\sum_i C_i GP_i}{\sum_i C_i}$$

Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme

$$\text{CGPA of the entire programme} = \frac{\text{Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

$$\text{i.e. CGPA of the entire programme} = \frac{\sum_n \sum_i C_{ni} GP_{ni}}{\sum_n \sum_i C_{ni}}$$

where,

C_i is the credit fixed for the course 'i' in any semester
 GP_i is the grade point obtained for the course 'i' in any semester
 'n' refers to the Semester in which such courses are credited.

Note: RA grade will be excluded for calculating **GPA** and **CGPA**.

17. REVALUATION

A candidate can apply for revaluation and retotalling of his / her semester examination answer script (**theory courses only**), within 2 weeks from the date of declaration of results, on payment of a prescribed fee. For the same, the prescribed application has to be sent to the Controller of Examinations through the HoD. **A candidate can apply for revaluation of answer scripts not exceeding 5 courses at a time.** The Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate through the HoD concerned. Revaluation is not permitted for supplementary theory courses.

18. TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Re-totaling is allowed on representation (clause 17). Student may get the Xerox copy of the answer script on payment of prescribed fee, if he / she wishes. The student may represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the KAHE), HoD of the Department concerned, the faculty of the course and Dean from other discipline nominated by the KAHE and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

19. ELIGIBILITY FOR THE AWARD OF THE DEGREE

A student shall be declared to be eligible for the conferment of the Degree if he / she has

- Successfully completed all the components prescribed under Parts I to Part IV in the CBCS pattern to earn the minimum required credits as specified in the curriculum corresponding to his / her programme within the stipulated period vide class 2.1.
- Not any disciplinary action pending against him / her.
- The award of the degree must be approved by the Board of Management.

20. CLASSIFICATION OF THE DEGREE AWARDED

20.1 Candidate who qualifies for the award of the Degree (vide clause 19) having passed the examination in all the courses in his / her first appearance, within the specified minimum number of semesters and securing a **CGPA not less than 8** shall be declared to have passed the examination in **First Class with Distinction**.

- 202 Candidate who qualifies for the award of the Degree (vide clause 19) having passed the examination in all the courses within the specified maximum number of semesters (vide clause 2.1), securing a **CGPA not less than 6.5** shall be declared to have passed the examination in **First Class**.
- 203 All other candidates (not covered in clauses 20.1 and 20.2) who qualify for the award of the degree (vide Clause 19) shall be declared to have passed the examination in **Second Class**.

21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

- 21.1 Candidate, may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.
- 21.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.
- 21.3 Withdrawal of application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the HoD / Dean concerned and approved by the Registrar.
- 21.3.1 Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.
- 21.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during **VI semester**.
- 21.5 Withdrawal from the End semester examination is **NOT** applicable to arrears courses of previous semesters.
- 21.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

22. PROVISION FOR AUTHORISED BREAK OF STUDY

- 22.1 **Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme.** However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for

valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Registrar, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Department stating the reasons therefore and the probable date of rejoining the programme.

- 222 The candidate thus permitted to rejoin the Programme after the break shall be governed by the Curriculum and Regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the Regulations in force at that period of time.
- 223 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (Vide Clause 20). However, additional break of study granted will be counted for the purpose of classification.
- 224 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 2.1 irrespective of the period of break of study (vide clause 22.1) in order that he/she may be eligible for the award of the degree.
- 225 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' or 'Withdrawal' (Clause 21 and 22) is not applicable for this case.

23. RANKING

A candidate who qualifies for the UG Degree programme passing all the Examinations in the first attempt, within the minimum period prescribed for the programme of study from Semester I through Semester VI to the programme shall be eligible for ranking. Such ranking will be confined to 10% of the total number of candidates qualified in that particular programme of study subject to a maximum of 10 ranks.

24. SUPPLEMENTARY EXAMINATION

Supplementary Examination will be conducted only for the final semester students within ten days from the date of publication of results for students who have failed in one theory course only. Such students shall apply with prescribed fee to the Controller of Examinations within the stipulated time.

25. DISCIPLINE

25.1. If a student indulges in malpractice in any of the Internal / External Examination he / she shall be liable for punitive action as prescribed by the KAHE from time to time.

25.2. Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the KAHE. The erring students will be referred to the disciplinary committee constituted by the KAHE, to enquire into acts of indiscipline and recommend the disciplinary action to be taken.

26. REVISION OF REGULATION AND CURRICULUM

The KAHE may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary.

Annexure I

S.No	Programme	Subject	Eligibility
1	B. Sc.	Biochemistry	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany or Zoology or chemistry as subjects at the Higher Secondary level.
2	B. Sc.	Biotechnology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany or Zoology or chemistry as subjects at the Higher Secondary level.
3	B. Sc.	Computer Science	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10 th or 10+2 pattern of education taking computer science/maths as one of the subject.
4	B.Sc.	Mathematics	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Mathematics /statistics as subjects at the Higher Secondary level. (OR) 3 year diploma after 10 th or 10+2 pattern of education taking maths as one of the subject.
5	B.Sc.	Physics	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Physics as one of the subjects at the Higher Secondary level (OR) 3 year diploma after 10 th or 10+2 pattern of education taking physics as one of the subject.
6	B. Sc.	Chemistry	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Chemistry as one of the subjects at the Higher Secondary level.

7	B. Sc.	Microbiology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany Zoology or chemistry as subjects at the Higher Secondary level.
8	B. Sc.	Information Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10 th or 10+2 pattern of education taking computer science/maths as one of the subject.
9	B. Sc.	Computer Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10 th or 10+2 pattern of education taking computer science/maths as one of the subject.
10	B.Sc.	Computer Science with Cognitive Systems	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10 th or 10+2 pattern of education taking computer science/maths as one of the subject.
11	BCA	Computer Application	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10 th or 10+2 pattern of education taking computer science/maths as one of the subject.
12	B.Sc.	Applied Science (Material Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Physics as one of the subjects at the Higher Secondary level (OR) 3 year diploma after 10 th or 10+2 pattern of education taking the respective subject as one of the subject.

13	B.Sc.	Applied Science (Foundary Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Physics as one of the subjects at the Higher Secondary level (OR) 3 year diploma after 10 th or 10+2 pattern of education taking the respective subject as one of the subject.
14	B. Com.	Commerce	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
15	B.Com (CA)	Commerce with Computer Applications	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
16	B. Com. (PA)	Commerce with Professional Accounting	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
17	B. Com. (BPS)	Commerce with Business Process Services	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
18	B.B.A.	Business Administration	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level

DEPARTMENT OF CHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES

UG PROGRAM (CBCS) – B.Sc. Chemistry
(2020–2021 Batch and onwards)

Course code	Name of the course	Course nature	Objectives & Outcomes		Instruction hours per week			Credits	Maximum Marks			Page No.
			PEO's	PO's	L	T	P			CIA	ESE	
SEMESTER I												
20LSU101	Language I	AEC	6	1,2,3, 10,9	4	0	0	4	40	60	100	13
20ENU 101	English I	AEC	6	1,2,3, 10,9	4	0	0	4	40	60	100	16
20CHU101	Mathematics I	Allied	2,4	1,6,5	4	0	0	4	40	60	100	17
20CHU102	Inorganic Chemistry I:Atomic structure and Chemical Bonding	CC	1,3,5 ,7	1,3,6, 7,8	5	0	0	5	40	60	100	19
20CHU103	Organic Chemistry I: Basics and Hydrocarbons	CC	1,3,5 ,7	1,3,6, 7,8	5	0	0	5	40	60	100	21
20CHU111	Mathematics Practical I	Allied	2,4	1,6,5	0	0	4	2	40	60	100	23
20CHU112	Atomic structure and Chemical Bonding- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	2	1	40	60	100	24
20CHU113	Basics and Hydrocarbons- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	2	1	40	60	100	25
	Semester Total							26	320	480	800	
SEMESTER II												
20LSU201	Language II	AEC	6	1,2,3, 10,9	4	0	0	4	40	60	100	27
20ENU201	English II	AEC	6	1,2,3, 10,9	4	0	0	4	40	60	100	30
20CHU201	Mathematics II	Allied	2,4	1,6,5	4	0	0	4	40	60	100	31
20CHU202	Physical Chemistry I: Chemical Thermodynamics and its Application	CC	1,3,5 ,7	1,3,6, 7,8	5	0	0	4	40	60	100	33
20CHU203	Organic Chemistry II: Oxygen Containing Functional Groups	CC	1,3,5 ,7	1,3,6, 7,8	6	0	0	5	40	60	100	35
20CHU212	Chemical Thermodynamics and its Application- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	2	1	40	60	100	37
20CHU213	Oxygen Containing Functional Groups- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	2	1	40	60	100	38
20AEC201	Environmental Studies		6,1	1,2,3, 10,9	3	0	0	3	40	60	100	40
	Internship	-	-	-	-	-	-	-	-	-	-	
	Semester Total							26	320	480	800	
SEMESTER III												
20CHU301	Physics I	Allied	2,4	1,6,5	04	0	0	4	40	60	100	43
20CHU302	Inorganic Chemistry II: Coordination Chemistry	CC	1,3,5 ,7	1,3,6, 7,8	04	0	0	4	40	60	100	45
20CHU303	Physical Chemistry II: Phase Equilibria and Chemical Kinetics	CC	1,3,5 ,7	1,3,6, 7,8	04	0	0	4	40	60	100	47
20CHU311	Physics Practical-I	Allied	2,4	1,6,5	0	0	4	2	40	60	100	49
20CHU312	Coordination Chemistry- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	4	2	40	60	100	50
20CHU313	Phase Equilibria and Chemical Kinetics- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	4	2	40	60	100	51

20CHU304A	Pharmaceutical chemistry	SEC	2,4	1,6,1 0,9	03	0	0	3	40	60	100	52
20CHU304B	Herbal Technology and Renewable resources	SEC										54
20CHU314A	Pharmaceutical chemistry- Practical	SEC	2,4	1,6,1 0,9	0	0	3	1	40	60	100	56
20CHU314B	Herbal Technology and Renewable resources-practical	SEC										57
	Semester Total							22	320	480	800	
SEMESTER IV												
20CHU401	Physics II	Allied	2,4	1,6,5	04	0	0	4	40	60	100	58
20CHU402	Physical Chemistry III: Electrochemistry	CC	1,3,5 ,7	1,3,6, 7,8	04	0	0	4	40	60	100	60
20CHU403	Organic Chemistry III : Organic Spectroscopy	CC	1,3,5 ,7	1,3,6, 7,8	04	0	0	4	40	60	100	62
20CHU411	Physics Practical-II	Allied	2,4	1,6,5	0	0	4	2	40	60	100	64
20CHU412	Physical Chemistry III: Electrochemistry- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	4	2	40	60	100	65
20CHU413	Organic Spectroscopy- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	4	2	40	60	100	66
20CHU404A	Green Methods in Chemistry	SEC	2,4	1,6,1 0,9	03	0	0	3	40	60	100	67
20CHU404B	Analytical clinical Biochemistry	SEC	2,4	1,6,1 0,9								69
20CHU414A	Green Methods in Chemistry- Practical	SEC	2,4	1,6,1 0,9	0	0	3	1	40	60	100	71
20CHU414B	Analytical clinical Biochemistry- Practical	SEC	2,4	1,6,1 0,9								72
	Internship	-	-	-	-	-	-	-	-	-	-	
	Semester Total							22	320	480	800	
SEMESTER V												
20CHU501A	Cheminformatics	SEC	2,4	1,6,1 0,9	03	0	0	3	40	60	100	73
20CHU501B	Chemistry of Cosmetics and perfumes	SEC	2,4									75
20CHU511A	Cheminformatics- Practical	SEC	2,4	1,6,1 0,9	0	0	3	1	40	60	100	76
20CHU511B	Chemistry of Cosmetics and perfumes- Practical	SEC	2,4									77
20CHU502A	Polymer Chemistry	DSE	1,3,5 ,7	1,5,6, 7	04	0	0	4	40	60	100	78
20CHU502B	Novel inorganic Solids	DSE	1,3,5 ,7	1,5,6, 7								80
20CHU503	Organic Chemistry IV: Nitrogen containing functional groups, Heterocyclic Chemistry and Natural products	CC	1,3,5 ,7	1,3,6, 7,8	04	0	0	4	40	60	100	82
20CHU504	Inorganic Chemistry III: Metallurgy, s-block and p-block Elements	CC	1,3,5 ,7	1,3,6, 7,8	04	0	0	4	40	60	100	84
20CHU512A	Polymer Chemistry- Practical	DSE	1,3,5 ,7	1,5,6, 7	0	0	4	2	40	60	100	86
20CHU512B	Novel inorganic Solids- Practical	DSE	1,3,5 ,7	1,5,6, 7								88
20CHU513	Nitrogen containing functional groups, Heterocyclic Chemistry and Natural products – Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	04	2	40	60	100	89
20CHU514	Inorganic Chemistry III: Metallurgy, s-block and p-block Elements - Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	04	2	40	60	100	90
	Semester Total							22	320	480	800	
SEMESTER VI												
20CHU601A	Basic Analytical Chemistry	SEC	2,4	1,6,1 0,9	03	0	0	3	40	60	100	91
20CHU601B	Pesticide, insecticide and herbicide	SEC	2,4									93

	Chemistry											
20CHU611A	Basic Analytical Chemistry-Practical	SEC	2,4	1,6,1 0,9	0	0	3	1	40	60	100	95
20CHU611B	Pesticide, insecticide and herbicide Chemistry - Practical	SEC	2,4									
20CHU602	Inorganic Chemistry IV: Organometallic Chemistry	CC	1,3,5 ,7	1,3,6, 7,8	04	0	0	4	40	60	100	97
20CHU603	Physical Chemistry IV: States of Matter and Ionic Equilibrium	CC	1,3,5 ,7	1,3,6, 7,8	04	0	0	4	40	60	100	99
20CHU612	Organometallic Chemistry- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	04	2	40	60	100	101
20CHU613	Physical Chemistry IV: States of Matter and Ionic Equilibrium- Practical	CC	1,3,5 ,7	1,3,6, 7,8	0	0	04	2	40	60	100	102
20CHU691	Project work	CC	1,3,5	1,3,6, 7,8	0	0	08	06	40	60	100	104
	Semester Total							22	280	420	700	
ECA / NCC / NSS / Sports / General interest /etc											Good	
	G. Total							140	1880	2820	4700	

Ability Enhancement Courses (AEC)			
Semester	Elective	Course Code	Name of the Course
I	AEC-1	20LSU101	Language –I
	AEC-2	20ENU 101	English I
II	AEC-3	20LSU201	Language –II
	AEC-4	20ENU202	English II
	AEC-5	20AEC201	Environmental Studies

Generic Elective Courses (GEC) / Allied Courses			
Semester	Elective	Course Code	Name of the Course
I	GEC-1	20CHU101	Mathematics I
		20CHU111	Mathematics I Practical
II	GEC-2	20CHU201	Mathematics II
III	GEC-3	20CHU301	Physics I
		20CHU311	Physics I Practical
IV	GEC-4	20CHU401	Physics II
		20CHU411	Physics II Practical

Core Courses			
Semester		Course Code	Name of the Course
I	CC-1	20CHU102	Inorganic Chemistry I: Atomic structure and Chemical Bonding
		20CHU112	Inorganic Chemistry I: Atomic structure and Chemical Bonding-Practical
	CC-2	20CHU103	Organic Chemistry I: Basics and Hydrocarbons
		20CHU113	Organic Chemistry I: Basics and Hydrocarbons-Practical
II	CC-3	20CHU202	Physical Chemistry I: Chemical Thermodynamics and its Application
		20CHU212	Physical Chemistry I: Chemical Thermodynamics and its Application Practical
	CC-4	20CHU203	Organic Chemistry practical II: Oxygen Containing Functional Groups
		20CHU213	Organic Chemistry practical II: Oxygen Containing Functional

			Groups Practical
III	CC-5	20CHU302	Inorganic Chemistry II: Coordination Chemistry
		20CHU312	Inorganic Chemistry II: Coordination Chemistry Practical
	CC-6	20CHU303	Physical Chemistry II: Phase Equilibria and Chemical Kinetics
		20CHU313	Physical Chemistry II: Phase Equilibria and Chemical Kinetics Practical
IV	CC-7	20CHU402	Physical Chemistry IV: Electrochemistry
		20CHU412	Physical Chemistry III: Electrochemistry Practical
	CC-8	20CHU403	Organic Chemistry: Organic Spectroscopy
		20CHU413	Organic Chemistry III: Organic Spectroscopy Practical
V	CC-9	20CHU503	Organic Chemistry IV: Heterocyclic Chemistry
		20CHU513	Organic Chemistry IV: Heterocyclic Chemistry Practical
	CC-10	20CHU504	Inorganic Chemistry III: s-block and p-block Elements
		20CHU514	Inorganic Chemistry III: s-block and p-block Elements Practical
VI	CC-11	20CHU602	Inorganic Chemistry IV: Organometallic Chemistry
		20CHU612	Inorganic Chemistry IV: Organometallic Chemistry Practical
	CC-12	20CHU603	Physical Chemistry IV: States of Matter and Ionic Equilibrium
		20CHU613	Physical Chemistry IV: States of Matter and Ionic Equilibrium Practical
	CC-13	20CHU691	Project work

Skill Enhancement Elective Courses			
Semester		Course Code	Name of the Course
III	SEC-1	20CHU304A	Pharmaceutical chemistry
		20CHU314A	Pharmaceutical chemistry Practical
	SEC-2	20CHU304B	Herbal Technology and Renewable resources
		20CHU314B	Herbal Technology and Renewable resources Practical
IV	SEC-3	20CHU404A	Green Methods in Chemistry
		20CHU414A	Green Methods in Chemistry practical
	SEC-4	20CHU404B	Analytical clinical Biochemistry
		20CHU414B	Analytical clinical Biochemistry Practical
V	SEC-5	20CHU501A	Chem-informatics
		20CHU511A	Chem-informatics practical
	SEC-6	20CHU501B	Chemistry of Cosmetics and perfumes
		20CHU511B	Chemistry of Cosmetics and perfumes Practical
VI	SEC-7	20CHU601A	Basic Analytical Chemistry
		20CHU611A	Basic Analytical Chemistry Practical
	SEC-8	20CHU601B	Pesticide, insecticide and herbicide Chemistry
		20CHU611B	Pesticide, insecticide and herbicide Chemistry-Practical

Discipline Specific Elective			
Semester		Course Code	Name of the Course
VI	DSE-1	20CHU502A	Polymer Chemistry
		20CHU512A	Polymer Chemistry Practical
VI	DSE-2	20CHU502B	Novel Inorganic Solids
		20CHU512B	Novel Inorganic Solids Practical

Curriculum is the heart of any educational system. It can be focused either to achieve the objectives of each course of the programme or on the expected outcomes from each course. Chemistry is referred to as the science that systematically studies the composition, properties, and reactivity of matter at atomic and molecular level. The scope of chemistry is very broad. The key areas of study of chemistry comprise Organic chemistry, Inorganic Chemistry, Physical Chemistry and Analytical Chemistry. Organic chemistry deals with study of substances containing carbon mostly; inorganic chemistry deals with study of all other elements/compounds/substances and their chemical properties. Physical chemistry deals with applications of concepts, laws to chemical phenomena. Analytical chemistry, in general, deals with identification and quantification of materials. Development of new interdisciplinary subjects like nano-materials, biomaterials, etc. and their applications from chemistry point of view added new dimension to materials chemistry. Thus, the degree programme in chemistry also intended to cover overlapping areas of chemistry with physics, biology, environmental sciences. Further, a broad range of subjects such as materials chemistry, biomaterials, nanomaterials, environmental chemistry, etc., has also been introduced which can be helpful for students/faculty members to broaden the scope of their studies and hence applications from job prospective point of view. Therefore, as a part of efforts to enhance employability of graduates of chemistry, the curricula also include learning experience with industries and research laboratories as interns. In addition, industrial visits/industrial projects are encouraged and added to the curriculum in order to enhance better exposure to jobs/employment opportunities in industries, scientific projects and allied sectors.

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

Objectives of Bachelor's degree programme in Chemistry

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

1. Broad and balance knowledge in chemistry in addition to understanding of key chemical concepts, principles and theories.
2. To develop students' ability and skill to acquire expertise over solving both theoretical and applied chemistry problems.
3. To provide knowledge and skill to the students' thus enabling them to undertake further studies in chemistry in related areas or multidisciplinary areas that can be helpful for self employment/entrepreneurship.
4. To provide an environment that ensures cognitive development of students in a holistic manner. A complete dialogue about chemistry, chemical equations and its significance is fostered in this framework, rather than mere theoretical aspects.

5. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A chemistry graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
6. To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.
7. To enable the graduate prepare for national as well as international competitive examinations, especially UGC-CSIR NET and UPSC Civil Services Examination.

Program Outcomes

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

1. **Core competency:** Students will acquire core competency in the subject Chemistry, and in allied subject areas.

- i. Systematic and coherent understanding of the fundamental concepts in Physical chemistry, Organic Chemistry, Inorganic Chemistry, Analytical Chemistry and all other related allied chemistry subjects.
- ii. Students will be able to use the evidence based comparative chemistry approach to explain the chemical synthesis and analysis.
- iii. The students will be able to understand the characterization of materials.
- iv. Students will be able to understand the basic principle of equipment's, instruments used in the chemistry laboratory.
- v. Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Chemistry.

2. Disciplinary knowledge and skill (Additional Academic Knowledge):

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

3. Skilled communicator:

The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

4. Critical thinker and problem solver:

The course curriculum also includes components that can be helpful to graduate students to develop critical thinking ability by way of solving problems/numerical using basic chemistry knowledge and concepts.

5. Sense of inquiry:

It is expected that the course curriculum will develop an inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation.

6. Team player:

The course curriculum has been designed to provide opportunity to act as team player by contributing in laboratory, field based situation and industry.

7. Skilled project manager:

The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about chemistry project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

8. Digitally literate:

The course curriculum has been so designed to impart a good working knowledge in understanding and carrying out data analysis, use of library search tools, and use of chemical simulation software and related computational work.

9. Ethical awareness/reasoning:

A graduate student requires understanding and developing ethical awareness/reasoning which the course curriculum adequately provides.

10. Lifelong learner:

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

The core courses would fortify the students with in-depth subject knowledge concurrently; the discipline specific electives will add additional knowledge about applied aspects of the program as well as its applicability in both academia and industry. Generic electives will introduce integration among various interdisciplinary courses. The skill enhancement courses would further add additional skills related to the subject as well as other than subject. In brief the student graduated with this type of curriculum would be able to disseminate subject knowledge along with necessary skills to suffice their capabilities for academia, entrepreneurship and Industry.

Attributes of a Chemistry Graduate

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

1. **Core competency:** The chemistry graduates are expected to know the fundamental concepts of chemistry and applied chemistry. These fundamental concepts would reflect the latest understanding of the field, and therefore, are dynamic in nature and require frequent and time-bound revisions.
2. **Communication skills:** Chemistry graduates are expected to possess minimum standards of communication skills expected of a science graduate in the country. They are expected to read and understand documents with in-depth analyses and logical arguments. Graduates are expected to be well-versed in speaking and communicating their idea/finding/concepts to wider audience
3. **Critical thinking:** Chemistry graduates are expected to know basics of cognitive biases, mental models, logical fallacies, scientific methodology and constructing cogent scientific arguments.
4. **Psychological skills:** Graduates are expected to possess basic psychological skills required to face the world at large, as well as the skills to deal with individuals and students of various sociocultural, economic and educational levels. Psychological skills may include feedback loops, self-compassion, self-reflection, goal-setting, interpersonal relationships, and emotional management.
5. **Problem-solving:** Graduates are expected to be equipped with problem-solving philosophical approaches that are pertinent across the disciplines;
6. **Analytical reasoning:** Graduates are expected to acquire formulate cogent arguments and spot logical flaws, inconsistencies, circular reasoning etc.
7. **Research-skills:** Graduates are expected to be keenly observant about what is going on in the natural surroundings to awake their curiosity. Graduates are expected to design a scientific experiment through statistical hypothesis testing and other a priori reasoning including logical deduction.
8. **Teamwork:** Graduates are expected to be team players, with productive cooperations involving members from diverse socio-cultural backgrounds.
9. **Digital Literacy:** Graduates are expected to be digitally literate for them to enroll and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning. Graduates should be able to spot data fabrication and fake news by applying rational scepticism and analytical reasoning.
10. **Moral and ethical awareness:** Graduates are expected to be responsible citizen of India and be aware of moral and ethical baseline of the country and the world. They are expected to define their core ethical virtues good enough to distinguish what construes as illegal and crime in Indian constitution. Emphasis be given on academic and research ethics, including fair Benefit Sharing, Plagiarism, Scientific Misconduct and so on.

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

Mapping of the courses

Core Courses

S.No.	Programme Outcome	CC-1	CC-2	CC-3	CC-4	CC-5	CC-6	CC-7	CC-8	CC-9	CC-10	CC-11	CC-12	CC-13
1	Core competency	√	√	√	√	√	√	√	√	√	√	√	√	√
2	Critical thinking	√	√	√	√	√	√	√	√	√	√	√	√	√
3	Analytical reasoning	√	√	√	√	√	√	√	√	√	√	√	√	√
4	Research-skills	√	√	√	√	√	√	√	√	√	√	√	√	√
5	Team work	√	√	√	√	√	√	√	√	√	√	√	√	√

Discipline Specific Electives

S.No.	Programme Outcome	DSE-1	DSE-2	DSE-3
1	Additional Academic knowledge	√	√	√
2	Problem Solving	√	√	√
3	Analytical skills	√	√	√
4	Research Skills	√	√	√

Skill Enhancement Courses

S.No.	Programme Outcome	SEC-1	SEC-2	SEC-3	SEC-4	SEC-5	SEC-6	SEC-7	SEC-8
1	Additional Knowledge Enhancement	√	√	√	√	√	√	√	√
2	Exposure Beyond Discipline	√	√	√	√	√	√	√	√
3	Analytical reasoning	√	√	√	√	√	√	√	√
4	Moral and Ethical Awareness	√	√	√	√	√	√	√	√
5	Digital literacy	√	√	√	√	√	√	√	√

Generic Elective Courses

S.No.	Programme Outcome	SEC-1	SEC-2	SEC-3	SEC-4	SEC-5	SEC-6	SEC-7	SEC-8
1	Additional Knowledge Enhancement	√	√	√	√	√	√	√	√
2	Exposure Beyond Discipline	√	√	√	√	√	√	√	√
3	Analytical reasoning	√	√	√	√	√	√	√	√
4	Moral and Ethical Awareness	√	√	√	√	√	√	√	√
5	Digital literacy	√	√	√	√	√	√	√	√

Generic Elective Courses

S.No	Programme Outcome	GEC-1	GEC-2	GEC-3	GEC-4
1	Additional Knowledge Enhancement	√	√	√	√
2	Exposure Beyond Discipline	√	√	√	√
3	Analytical reasoning	√	√	√	√
4	Problem solving	√	√	√	√

Ability Enhancement Courses

S.No	Programme Outcome	AEC-1	AEC-2	AEC-3	AEC-4
1	Additional Knowledge Enhancement	√	√	√	√
2	Communication	√	√	√	√
3	Moral and ethical awareness	√	√	√	√
4	Leadership readiness	√	√	√	√
5	Psychological skills	√	√	√	√

Mapping between PEO's and PO's

PEO/PO	1	2	3	4	5	6	7	8	9	10
A	√	√		√	√		√	√	√	√
B			√	√	√		√			
C		√		√		√	√		√	
D	√	√		√		√		√	√	√
E			√		√		√	√		
F		√		√		√		√		√
G	√		√				√	√		√
H		√		√		√			√	

முதல் பருவம்

20LSU101

பகுதி – I தமிழ், தாள் 1

4H 4C

கற்பிக்கும் நேரம்/வாரம் : 4 மணி

மதிப்பெண்: அகமதிப்பீடு / எழுத்துத்தேர்வு: 40 / 60

தேர்வு நேரம்: 3 மணி நேரம்

பாடத்திட்டப் பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், ஆய்வுநோக்கையும் மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப் பயன் விளைவு

1. இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்னோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்கு உறுதுணையாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை.

அலகு – I : தமிழ் இலக்கிய வரலாறு – I

(8 மணிநேரம்)

முச்சங்க வரலாறு - சங்க இலக்கியத்தொகுப்பு - பாட்டும் தொகையும் - சங்கஇலக்கியச் சிறப்பியல்புகள் - சங்கம் மருவிய காலம் - பதினெண்கீழ்க்கணக்கு நூல்கள் - திருக்குறள் -நாலடியார் - நான்மணிக்கடிகை - பழமொழி நானூறு - பிற்கால அறஇலக்கியங்கள் - கொன்றை வேந்தன் - நீதிநூல் - காப்பியங்கள் - தமிழில் காப்பிய இலக்கணம் - தமிழில் பெருங்காப்பியங்களும் சிறு காப்பியங்களும் - இரட்டைக்காப்பியங்களாகச் சிலம்பும் மேகலையும்.

அலகு - II: சங்க இலக்கியம்

(12 மணிநேரம்)

அ). எட்டுத்தொகை

நற்றிணை : கொண்டல் மாமழை – குறிஞ்சி – தலைவன் கூற்று - 140

குறுந்தொகை : வாரார் ஆயினும், வரினும் –முல்லை– தலைவி கூற்று - 110

ஐங்குறுநூறு : மருதம் –தோழி கூற்று–வேட்கைப்பத்து: வாழிஆதன் வாழி
அவினி - 6

பதிற்றுப்பத்து : சிதைந்தது மன்ற - 27

பரிபாடல்: புறத்திரட்டு- மதுரை நகர்ச்சிறப்பு – உலகம் ஒரு
நிறையாத்தான்-7, மாயோன் கொப்பூழ்-8, செய்யாட்டு இழைத்த-9,
கார்த்திகை காதில்-10, ஈவாரைக் கொண்டாடி-11.

கலித்தொகை : பாலைக்கலி- செவிலி – எறித்தரு கதிர்தாங்கி-9

அகநானூறு : அன்னை அறியினும் அறிக – தோழி - நெய்தல் - 110

புறநானூறு : யாதும் ஊரே யாவருங் கேளிர் –பொதுவியல்- 192

ஆ). பத்துப்பாட்டு: நெடுநல்வாடை - கார்காலச் சிறப்பு : வையகம் பனிப்ப -1-

70

அலகு – III : அற இலக்கியம்

(10 மணிநேரம்)

1. திருவள்ளுவர்- திருக்குறள்- அதிகாரம் 67 – வினைத்திட்டம்,
அதிகாரம் 100 - பண்புடைமை
2. முன்றுறையரையனார் – பழமொழி நானூறு 5 பாடல்கள்
உணற்கு இனிய 5, பரந்த திறலாரை 32, நெடியது காண்கிலாய் 46, இனி
யாரும் 153, உரைசான்ற 195.
3. ஔவையார் – கொன்றை வேந்தன் (1- 50 பாடல்கள்)
அன்னையும் பிதாவும் – புலையும் கொலையும் களவும் தவிர்
4. வேதநாயகம்பிள்ளை - நீதிநூல் - (அதிகாரம்-7-தாய்தந்தையரைப்
போற்றுதல்- தேர்ந்தெடுக்கப்பட்ட 5 பாடல்கள்)
சின்னவோர் பொருள், கடவுளை வருந்தி, எப்புவிகளும், வைத்தவர், ஈன்றவர்

அலகு - IV : காப்பிய இலக்கியம்

(10 மணிநேரம்)

(அ). சிலப்பதிகாரம் (5 மணிநேரம்)

மங்கல வாழ்த்துப் பாடல்: (21-29)- நாக நீள் நகரொடு-கண்ணகி என்பாண்
மன்னோ . வழக்குரை காதை, (48-56) - நீர்வார் கண்ணை-புகா ரென்பதியே .

வஞ்சின மாலை: (5-34) - வன்னிமரமும் – பிறந்த பதிப் பிறந்தேன்.

நடுகற் காதை: (207-234) - அருத்திற லரசர் – மன்னவ ரேறென்

வாழ்த்துக்காதை: (9) - என்னேயிஃ தென்னே – மீவிகம்பிற் றோன்றுமால்.

Bachelor of Science, Chemistry, 2020. Karpagam Academy of Higher Education, Coimbatore - 641 021, India.

(ஆ). மணிமேகலை (5 மணிநேரம்)

பசியின் கொடுமை: பாத்திரம் பெற்ற காதை:

‘போதி நீழல்’ - ‘பெருகியதன்றோ’ , ‘ஆற்றுநர்க்களிப்போர்’ - ‘நல்லறம் கண்டனை’ (73-98).

சிறைக்கோட்டம் அறக்கோட்டமாக்கிய காதை: மாவண் கிள்ளிக்கு காவலன் உரைத்தவை:

‘பைஞ்சேறு மெழுகாப் பசும்பொன் மண்டபத்து -

அறவோர்க் காக்கினன் அரசாள் வேந்தன்’ (116-163).

அலகு- V : அடிப்படை இலக்கணமும் பயன்பாட்டுத்தமிழும் - I (8 மணிநேரம்)

அ). எழுத்து, சொல், பொருள் இலக்கணங்கள் (4 மணிநேரம்)

1. முதல் மற்றும் சார்பெழுத்துகள் - பெயர், வினை, இடை, உரிச்சொல் முதலான அடிப்படை இலக்கண விளக்கப் பயிற்சிகள்
- 2). அகத்திணை மற்றும் புறத்திணை இலக்கணங்கள்

ஆ). கடிதப்பயிற்சி (4 மணிநேரம்)

1. தன்விவரக் குறிப்புடன் வேலை வேண்டி விண்ணப்பம் எழுதுதல்
2. பல்கலைக்கழகப் பன்னாட்டுக்கருத்தரங்கச் செய்தியை நாளிதழில் வெளியிட வேண்டி நாளிதழின் பதிப்பாசிரியருக்குக் கடிதம்
3. கருத்தரங்கப் பங்கேற்புக்கு அனுமதிக் கடிதம்
4. பல்கலைக்கழக விழாவுக்குத் தலைமையேற்க வேண்டி, மாவட்ட ஆட்சியருக்கு விண்ணப்பம்
5. கல்விகடன் வேண்டி வங்கிமேலாளருக்கு விண்ணப்பம்
6. வசிப்பிடத்திற்கு அடிப்படை வசதி வேண்டி வட்டாட்சியருக்கு விண்ணப்பம்
7. தேசியவிருது பெற்ற நண்பனுக்குப் பாராட்டுக் கடிதம்
8. புத்தகங்கள் அனுப்பி உதவவேண்டி, பதிப்பகத்தாருக்கு விண்ணப்பம்.

Instruction Hours/week: L: 4 T: 0 P: 0**Marks: Internal: 40****External: 60 Total: 100
End Semester Exam: 3 Hours****Course Objectives**

- To enable the learners to acquire English language skills at a faster pace.
- To train the learners to reflect on the literary works and communicate flexibly.
- Know about the Interpersonal & LSRW skills
- To develop the Short Story:
- Learn about Vocabulary, Grammar and Composition:
- Know about Prose and poem

Course Outcomes

- 1.Enable the learners to acquire English language skills at a faster pace.
- 2.Trained the learners to reflect on the literary works and communicate flexibly.
- 3.Knowledge about the Interpersonal & LSRW skills
4. Development of the Short Story:
- 5.Learnt about Vocabulary, Grammar and Composition:
- 6.Knowledge about Prose and poem

UNIT - I: Grammar

Types of Sentences, Subject and Predicate, Parts of Speech, Tenses, Preposition and Articles

UNIT – II: Communication Exercise

Importance of Business Language- Words often Confused- Words often Misspelt- Common Errors in English- Charts and Pictorial Writing.

UNIT – III: Interpersonal Skills

Greetings & Introduction- Giving & Denying Permission- Telephone Etiquette- Oral Presentation – Plan, PowerPoint Presentation- Preparation of Speech- Audience psychology- Secrets of Good Delivery

UNIT - IV: LSRW Skills

Listening- Listening and its types, Basic Listening Lessons

Speaking- Basics of speaking, Regular English, Business English, Interview English

Reading- Reading and its purposes, Types of Reading, Reading Techniques

Writing- Types of Writing, Components of Writing, Language and Style with accordance to the contexts

UNIT - V: Literature

Prose: Let's Do What India Needs from Us - Dr. A.P.J. Abdul Kalam

Poem: A Prayer for My Daughter - W.B. Yeats

Short Story: Sparrows- K. Ahmad Abbas

SUGGESTED READINGS

1. Hewings Martin, 2013 Advanced Grammar in Use, Cambridge University Press
2. Haines Simon, 2015 Advanced Skills, A resource Book of Advanced- Level Skill Activities

Course Objectives

This course enables the students,

- To know the determinant, Eigenvalues and Eigenvectors of a real matrix.
- To provide the basic knowledge of Trigonometry and hyperbolic functions.
- To give basic knowledge about Mathematical concepts in Differential calculus.
- The concepts of Integral calculus and evaluation of different types of integrals.
- To solve the ordinary differential equations.
- To study about basic concepts in mathematics and it is useful to understand the science equations.

Course Outcomes (CO's)

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

1. Understanding the concept of characteristic equations to find Eigen Values and Eigen Vector.
2. Gain knowledge of trigonometric functions and related problems.
3. Achieve the knowledge of calculating higher order derivatives.
4. Evaluate definite and indefinite integrals.
5. Apply suitable methods for solving first order and second order differential equations.
6. Understood the basic concepts in mathematics and it is useful to understand the science equations.

UNIT I: MATRICES

Definition of the Matrix – Algebra of Matrices – Types of a Matrices – Determinant – Inverse of Matrices – Eigen Values and Eigen vectors – Cayley-Hamilton theorem (without proof) – Verification and computation of inverse.

UNIT II: TRIGONOMETRY

Expansions of $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ – Expansions of $\sin^n \theta$, $\cos^n \theta$ – Expansions of $\sin \theta$, $\cos \theta$ and $\tan \theta$ in terms of θ – Hyperbolic and inverse hyperbolic functions and their properties – Logarithm of a complex number – General principal values – problems.

UNIT III: DIFFERENTIAL CALCULUS

The tangent line and the derivative of a function – Numerical differentiation, differentials of higher order derivatives, discontinuities, stationary points, maximum-minimum problems, inflexion points, limiting values of functions: L'Hospital's rule, combining limits, Calculus of several variables: Functions, change of variables, total differential, chain rule, partial differentiation, Euler's theorem.

UNIT- IV: INTEGRAL CALCULUS

Integration, odd-even functions, indefinite integrals, standard integrals, methods of integration (by part, substitution, partial fractions and other) Reduction formula.

UNIT V: ORDINARY DIFFERENTIAL EQUATIONS

Higher order linear differential equations with constant coefficients –Method of variation of parameters – Simultaneous first order linear differential equations with constant coefficients.

SUGGESTED READINGS

1. Manickavasagam Pillai.T.K , and S. Narayanan, (2002).“Calculus”, Volume I, and Volume II S.V Printers & Publishers, Chennai, India
2. Veerarajan. T, (2011). Engineering Mathematics, Third edition, Tata McGraw-Hill Education-India.
3. Rasinghania M. D, (2017).Ordinary and Partial Differential Equations, S. Chand Publication India.
4. T. K. Manickavasagam Pillai and S. Narayanan (2004). Trigonometry, Vijay Nicole Imprints Pvt, Ltd, c-7, Nelson Manickam Road, Chennai-600029.
5. Venkataraman. M. K,(1998).Engineering Mathematics, The National Publications & Co., Chennai, India.

e-Resources

1. <https://youtu.be/SJOTtb1FTfs>
2. <https://youtu.be/N-Ejf2jCwn4>
3. <https://www.youtube.com/watch?v=F2NqTlej98Q>
4. <https://www.digimat.in/nptel/courses/video/111105122/L01.html>

Course Objectives

Students should be able

- To discuss the limitations of classical mechanics and its drawbacks.
- To discuss the radial and angular part of orbitals
- To explain the fundamentals of quantum mechanics and Schrödinger equation for simple atoms.
- To predict and write the electronic configuration of elements.
- To explain a different types of bonding like ionic and covalent bonding.
- To interpret a knowledge about the various theories of bonding like VSEPR, Valence Bond Theory and Molecular Orbital Theory of covalent bonding.

Course Outcomes

1. Explain the atomic theory of matter, composition of the atom, which defines the identity of a given element.
2. Understood the radial and angular part of orbitals
3. Explain the relative sizes, masses, and charges of the proton, neutron, and electron, and their assembly to form different atoms.
4. Define the term isotope, and their atomic and mass numbers.
5. Use the Periodic Table to rationalize similarities and differences of elements, including physical and chemical properties and reactivity.
6. Predict common ionic charges of group 1A, 2A, 3A, 6A, and 7A elements based on position in the periodic table.

UNIT I

Atomic Structure: Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom.

UNIT II

Quantum Numbers: Significance of quantum numbers, Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Types of bonding: Sigma, pi. Hydrogen bonding - Inter and intra-molecule hydrogen bonding. Van Der Waals' force- Dipole-dipole interaction, Ion-dipole interaction and London forces. Factors determining Van Der Waals forces. Electron deficient compound- Structure and bonding in diborane.

UNIT III

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

UNIT IV

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, tri-gonal planar, square planar, tetrahedral, tri-gonal bi-pyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

UNIT V

MO Approach: Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for $s-s$, $s-p$ and $p-p$ combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homo-nuclear diatomic molecules of 1st and 2nd periods (including idea of $s-p$ mixing) and hetero-nuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approaches.

SUGGESTED READINGS

1. Lee, J.D. (2010). Concise Inorganic Chemistry. ELBS.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. (2008). Basic Inorganic Chemistry. 3rd ed. John Wiley & sons.
3. Madan, R. L. (2015). Chemistry for Degree Students, S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi.
4. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. (2010). Concepts and Models in Inorganic Chemistry. John Wiley & Sons.
5. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2006). Inorganic Chemistry: Principles of Structure and Reactivity. Pearson Education India.

Course objectives

- To describe knowledge on the basics of organic chemistry
- To gain knowledge in particularly the shapes of molecules, electron displacement effects, reagents, intermediates and fundamental types of reactions.
- To explain the students about the stereochemistry, projection formulae of molecules, geometrical isomerism and optical isomerism
- To explain the preparation and conformation analysis of alkanes.
- To paraphrase a knowledge about the preparation and properties of alkenes and alkynes, mechanisms of reactions and rules behind the reactions.
- To summarise a knowledge about the aromaticity of molecules and about electrophilic aromatic substitutions.

Course outcomes

1. Describe molecular structure and bonding in organic molecules.
2. Classify organic compounds by structure, use the IUPAC nomenclature, and identify conformational effects in organic compounds.
3. Predict the products of reactions of alkenes and describe the mechanisms showing how the products are formed.
4. Draw and interpret reaction coordinate diagrams, and relate the energetic changes associated with chemical reactions to equilibrium constants and rate; and differentiate kinetic versus thermodynamic control of reactions.
5. Identify the types of isomerism in organic compounds, to identify and classify chiral centers, and explain the physical and chemical consequences of chirality.
6. Correctly represent the structures and bonding of alkynes, and describe the mechanisms for reactions of alkynes and predict the products of such reactions.
7. Identify compounds in which resonance is important, predict the effect of resonance on the stability of compounds and reactive intermediates, and draw resonance structures.
8. Identify conjugated pi systems and explain the effect of conjugation on molecular structure and reactivity; and predict the products of reactions of dienes.
9. Describe mechanisms for substitution and elimination reactions, and predict the effect of nucleophile, leaving group, and solvent on the relative rates of S₁ versus S₂ reactions, and E₁ versus E₂ reactions, as well as on the relative rates of substitution versus elimination.

UNIT I**Basics of Organic Chemistry**

Hybridization, Shapes of molecules

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyper-conjugation and dipole moment; Hydrogen bonding (Applications to be discussed with relevant topics) Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Types, shape and relative stability of Carbocation, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

UNIT II

Stereochemistry:

Fischer, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans , syn-anti and E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Diastereoisomers, meso structures, racemic mixture and their resolution. Relative and absolute configuration: D/L and R/S designations.

UNIT III

Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon sigma bonds

General methods of preparation, physical and chemical properties of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation-relative reactivity and selectivity.

Cycloalkanes and Conformational Analysis

Conformational analysis of alkanes: Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory: Chair, Boat and Twist boat forms of cyclohexane with energy diagrams; Relative stability of mono substituted cycloalkanes.

Unit IV

Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon pi bonds:

General methods of preparation, physical and chemical properties of alkenes and alkynes, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Electrophilic additions and their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT V

Aromatic Hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

SUGGESTED READINGS

1. Morrison, R. N. & Boyd, R. N. (2012). Organic Chemistry. India: Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. (2012). Organic Chemistry. Volume 1. India: Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Madan, R. L. (2015). Chemistry for Degree Students, S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi.
4. Finar, I. L. (2012). Organic Chemistry: Stereochemistry and the Chemistry of Natural Products. Volume 2. India: Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

5. Eliel, E. L. & Wilen, S. H. (2010). Stereochemistry of Organic Compounds, Wiley. London
6. Kalsi, P. S. (2012). Stereochemistry Conformation and Mechanism. New Age International.
7. Jain M.K. & Sharma S.C. (2015). Modern Organic Chemistry, 4th Edition, Vishal publishing Co New Delhi.

Course Objectives

This course enables the students

- To develop skills for quantitative estimation using computer language.
- To code various differentiation equation
- To code various integration equation
- To code various differentiation and integration methods in a modern computer language.
- To plot the graphs of function
- To carryout the mean , median , standard deviations.

Course Outcomes (COs)

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

- 1.Solve complicated matrix related problems like matrix inverse and matrix multiplication. Acquire problem-solving skills through computer programming.
- 2.Plot various functions and parametric curves.
- 3.Worked the various differentiation equation
- 4.Worked t the various integration equation
- 5.Woked the mean , median , standard deviations.

Contents

1. Finding addition, multiplication of two matrices.
2. Finding Inverse of a matrix and Determinant of a matrix.
3. Plotting of graphs of function e^{ax+b} , $\log(ax+b)$, $1/(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $|ax+b|$ and to illustrate the effect of a and b on the graph.
4. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
5. Evaluating definite integrals. (Line integral)
6. Evaluating integrals using Reduction formulae.
7. Solution of second order ordinary differential equations with initial conditions.
8. Solving system of linear differential Equations.

SUGGESTED READING

1. Scilab Textbook Companion for Numerical Methods for Scientists and Engineers by K. S. Rao, PHI Learning Pvt. Ltd., New Delhi, 2004.

Instruction Hours/week:L: 0 T:0 P: 2**Marks: Internal:40 External: 60 Total:100
End Semester Exam: 3 hrs****Course objectives**

- To illustrate the principles of volumetric analysis.
- To categorize a versatile knowledge of solution preparations
- To prepare solutions with appropriate concentrations, titrations
- How to handle the apparatus while doing a titration.
- To analyse the knowledge about the calculations involved in the estimation of compounds using volumetric analysis.
- To estimate the amount of solution present quantitatively.

Course outcomes (CO's)

The Students are able

1. Summarize the principles of volumetric analysis.
2. Gained knowledge about the preparations of solutions
3. Understood the preparation of appropriate concentrations, titrations
4. Handled the respective apparatus while doing a titration.
5. Analyse the calculations involved in volumetric analysis and in the estimation of compounds using volumetric analysis.
6. The lab will also provide hands-on opportunities to develop and apply this knowledge

Contents***Inorganic Chemistry - Volumetric Analysis***

1. Calibration and use of apparatus.
2. Preparation of 1N solution of NaOH and HCl
3. Preparation of 1M solution of KMnO_4
4. Use of primary and secondary standard solutions.
5. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
6. Estimation of oxalic acid by titrating it with KMnO_4 .
7. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
8. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
9. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

SUGGESTED READINGS

1. Svehla, G. (2012). Vogel's Qualitative Inorganic Analysis. Pearson Education.
2. Mendham, J. (2009) Vogel's Quantitative Chemical Analysis, Pearson.

Course objectives

Develop the skills,

- To perform the purification of organic compounds by crystallisation.
- To solve the calibration of the thermometer, determine the melting point, and to analyse the effect of impurities on the melting point.
- To predict the boiling point of a liquid by distillation method.
- To explain the principles of chromatography and to separate organic compounds by paper and thin layer chromatography.
- To detect the elements present in an organic compound.
- To demonstrate the preparation of few organic compounds using standard organic reactions.

Course Outcomes (CO's)

The student will be able to

- 1.Purify organic compounds by crystallisation.
- 2.Characterisation of the compounds by elemental analysis, melting point, and effect of impurities on the melting point.
- 3.Separation of organic compounds by paper chromatographic and TLC methods
- 4.Preparation of organic compounds by standard organic reactions.
- 5.The lab will also provide hands-on opportunities to develop and apply this knowledge.
- 6.Understood the principles of chromatography and to separate organic compounds by paper and thin layer chromatography

Contents

1. Calibration of a thermometer
2. Purification of organic compounds by crystallization using the following solvents:
a. Water, b. Alcohol, c. Alcohol-Water
3. Determination of the melting points of unknown organic compounds.
4. Effect of impurities on the melting point – mixed melting point of two unknown organic Compounds
5. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation)
6. Chromatography
a. Separation of a mixture of two amino acids by ascending paper chromatography
b. Separation of a mixture of two sugars by ascending paper chromatography
c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)
7. Qualitative elemental analysis (N,S, halogens)
8. Organic Preparations
(i) Preparation of Benzophenone oxime.
(ii) Preparation of Phenyl benzoate

SUGGESTED READINGS

1. Mann, F.G. & Saunders, B.C. (2009). Practical Organic Chemistry. Pearson Education.
2. Veeraiyan V, Venkateswaran R, and Vaithiyalingam A.R. (2015). Basic Principles of Practical Chemistry, S. Chand & Sons Ltd.
3. Raj K. Bansal, (2012). Laboratory Manual of Organic Chemistry, New Age International Publishers (P) Ltd.
4. Thomas A.O. (2003). Practical Chemistry for B.Sc Main Students, Scientific Book Centre, Cannore-1, Kerala.
5. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell A.R. (2012). Practical Organic Chemistry. 5th Ed. Pearson.

பாடத்திட்டப் பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கை மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப் பயன் விளைவு

1. இந்திய குடியரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்னோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.
6. மொழிபெயப்புத் துறைசார்ந்த வேலைவாய்ப்புத் திறன் பெற்றிருத்தல்

அலகு - I : தமிழ் இலக்கிய வரலாறு- II**(5 மணிநேரம்)**

தமிழ் இலக்கிய வரிசையில் திருமுறைகளும் நாலாயிரத் திவ்யப்பிரபந்தமும் -பன்னிரு திருமுறைகள் அறிமுகம் - திருமுறை ஆசிரியர்களின் இலக்கியப் பங்களிப்பு- திருமுறைகளில் பக்திநெறியும் சமுதாய நோக்கும் - சமயக்குரவரின் அருள்நெறி - பன்னிரு ஆழ்வார்கள் வரலாறு - ஆழ்வார்களின் இலக்கியப் பங்களிப்பு - திவ்யப் பிரபந்தத்தில் பக்திநெறியும் இலக்கிய நயமும் - தமிழில் சிற்றிலக்கியக் காலமும் கருத்தும் - தொண்ணூற்றாறு வகைச் சிற்றிலக்கிய வரிசை - தமிழ் மொழியின் கவிதை - சிறுகதை - உரைநடை -இலக்கியங்களின் தோற்றம் - வளர்ச்சி - உத்திகள் - நாட்டுப்புற இலக்கியங்கள்-கொங்குநாட்டார் வாய்மொழி வழக்காறுகள்.

அலகு - II : பக்தி இலக்கியமும் சிற்றிலக்கியமும்:**(12 மணிநேரம்)****அ). பக்தி இலக்கியம் (6 மணிநேரம்)****1. சைவம் - பெரியபுராணம் - இளையான்குடிமாறநாயனார் புராணம் - (19 பாடல்கள்) .****(அம்பொன் நீடிய, கொண்டு வந்து, ஆளு நாயகர், செல்வம் மேவிய, மாரிக் காலத்து, ஈர**

மேனியை, நமக்கு முன்பிங்கு, செல்லல் நீங்க, மற்றம் மாற்றம், உள்ளம் அன்பு, காலினால் தடவி, வந்தபின் மனைவியாரும், முறித்தவை அடுப்பின், வழிவரும் இளைப்பினோடும், மனைவியார் கொழுநர், கணவனார் தம்மை, அழுந்திய இடருள், மாலயற் கரிய, அன்பனே அன்பர் பூசை)

2. வைணவம் – ஆண்டாள் நாச்சியார் திருப்பாவை: (11 பாடல்கள்): மார்கழித்திங்கள், வையத்து வாழ்வீர்காள், ஓங்கி உலகளந்த, ஆழி மழைக்கண்ணா, மாயனை மன்னுவட மதுரை, சிற்றம் சிறுகாலே, ஒருத்தி மகனாய், மாலே மணிவண்ணா, கூடாரை வெல்லும், கறவைகள் பின்சென்று, வங்கக்கடல் கடைந்த.

ஆ). சிற்றிலக்கியம் (6 மணிநேரம்)

1. முக்கூடற் பள்ளு - 2 பாடல்கள் - சித்திரக் காலிவாலான் (நெல்வகைகள் குற்றாலத் திரிகூட மால்வரை (மீன் வகைகள்)
2. நந்தி கலம்பகம் - 5 பாடல்கள்- என்னையே புகழ்ந்தேன், பதிதொறு புயல்பொழி, இந்தப்புவிமில், அடிவிளக்கும் துகில், வானுறுமதியை
3. மதுரைச் சொக்கநாதர் தமிழ்விடு தூது – தமிழின் சிறப்பு பாடியருள பத்துப்பாட்டும்- விளம்பக்கேள்.

அலகு – III: கவிதையும் சிறுகதையும் (16 மணிநேரம்)

அ). கவிதை இலக்கியம் (8 மணிநேரம்)

- | | |
|---------------------------------|------------------------------------|
| 1. மகாகவி பாரதியார் | – கண்ணன் – என் சீடன் |
| 2. புரட்சிக்கவிஞன் பாரதிதாசன் | – இளையார் ஆத்திசூடி - அழுபவன் கோழை |
| 3. கவிமணி தேசிக விநாயகம் பிள்ளை | – கோயில் வழிபாடு |
| 4. கவிக்கோ. அப்துல்ரகுமான் | – பாருக்குள்ளே நல்ல நாடு |
| 5. சிற்பி பாலசுப்பிரமணியன் – | மலையாளக் காற்று |
| 6. கவிஞர் தாமரை | – தொலைந்து போனேன் |
| 7. கவிஞர் கரிகாலன் | – விடுதலை |

ஆ). சிறுகதை இலக்கியம் (8 மணிநேரம்)

- | | |
|---------------------|-------------------|
| 1. சாபவிமோசனம் | – புதுமைப்பித்தன் |
| 2. நகரம் | – சுஜாதா |
| 3. அந்நியர்கள் | – ஆர். சூடாமணி |
| 4. இந்நாட்டு மன்னர் | – நாஞ்சில்நாடன் |

அலகு – IV : உரைநடை இலக்கியம் (8 மணிநேரம்)

1. ஆளுமைத்திறன் அறிவோம் - தன்னம்பிக்கை மாத இதழிலிருந்து
2. திருக்குறளும் சமுதாயவியலும் – முனைவர் புரிசை நடராசன்
3. தமிழ் – உயர்தனிச் செம்மொழி – முனைவர் இரா. குணசீலன்
4. நொய்யல் – முனைவர் ப. தமிழரசி

அலகு- V : அடிப்படை இலக்கணமும் பயன்பாட்டுத்தமிழும் – II (7 மணிநேரம்)

இலக்கணப் பயிற்சி: 1. அணி இலக்கணம்

உவமையணி - பிறிது மொழிதல் அணி - சிலேடை அணி - தீவக அணி - ஏகதேச உருவக அணி - வேற்றுமையணி - பின்வருநிலையணிக்கான விளக்கங்கள்.

2. துறை சார் கலைச்சொல் பயன்பாட்டாக்கம்

3. படைப்பிலக்கியப் பயிற்சிகள்

1. மரபுக்கவிதை, புதுக்கவிதை, சிறுகதை, கட்டுரை படைப்பாக்க உத்திகள் - பயிற்சிகள்

2. எழுத்தாளருடனான நேர்காணல் மற்றும் கள ஆய்வுக்கான வினா நிரல் தயாரித்தல் நுட்பங்களும் பயிற்சிகளும்.

4. மொழிபெயர்ப்புப்பயிற்சிகள்

1. தமிழ்-ஆங்கில மொழிபெயர்ப்புப் பயிற்சிகள் -2.

2. ஆங்கிலம்-தமிழ் மொழிபெயர்ப்புப் பயிற்சிகள்-2.

பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.

கற்பகம் உயர்கல்வி கலைக்கழகத் தமிழ்த்துறை வெளியீடு.

Course Objectives

- To enable the learners to acquire English language skills at a faster pace.
- To train the learners to reflect on the literary works and communicate flexibly.
- Know about the Interpersonal & LSRW skills
- To develop the Short Story:
- Learn about Vocabulary, Grammar and Composition:
- Know about Prose and poem

Course Outcomes

- 1.Enable the learners to acquire English language skills at a faster pace.
- 2.Trained the learners to reflect on the literary works and communicate flexibly.
- 3.Knowledge about the Interpersonal & LSRW skills
- 4.Development of the Short Story:
- 5.Learnt about Vocabulary, Grammar and Composition:
- 6.Knowledge about Prose and poem

UNIT –I – Grammar

Voice, Idioms and Phrases, Clauses and Reported Speech

UNIT –II –Business and Technical Reports

Business Correspondence – Memo, Notices, Agenda, Minutes- Resume

Writing- Report Writing- Letter Writing- Personal and Social Letters- E-mail Writing

UNIT –III – Communication Practice

Verbal and Non-Verbal Communication- Group Discussion and Seminars-
Note-Taking and Note-Making

UNIT –IV – LSRW Skills

Listening - Listening Talks and Presentations

Speaking - Public Speaking- Preparatory steps, Time Management,
Handling Questions and Meeting unexpected situations

Reading - Language of Newspapers, Magazines and Internet

Writing - Writing Paragraphs and Essays- Content Writing

UNIT –V – Literature

Prose- Morals in the Indian Context by Francis Nicholas Chelliah

Poetry- Telephone Conversation by Wole Soyinka

Short Stories- The Last Leaf by O' Henry

SUGGESTED READING

Oxford Handbook of Writing: St. Martins Handbook of Writing 2013

CU Press Sound Business, Julian Treasure 2012OUP

Course Objectives

This course enables the students,

- To demonstrate vector differential operators to identify solenoidal and irrotational vectors.
- To get the ability of solving Partial differential equations.
- To expand the given function into Fourier series.
- To give basic knowledge in evaluating double and triple integrals.
- To apply the Numerical techniques of differentiation and integration.
- To know about basic knowledge about differentiation and integration methods.

Course Outcomes (CO's)

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

1. Analyzing the differential operator to find Gradient, Divergence and Curl.
2. Form and solve partial differential equations of first order
3. Understand the nature of Fourier series that represent even and odd functions.
4. Evaluate line, surface and volume integrals
5. Apply the numerical concepts in solving the differentiation and integration.
6. Understand the basic knowledge about differentiation and integration methods.

UNIT-I: VECTOR CALCULUS

Scalar and vector fields –Differentiation of vectors – Gradient, Divergence and Curl -Integration of vectors – line integral – surface integral – Green's theorem in the plane – Gauss divergence theorem – Strokes theorem – (Statements only).

UNIT II: PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations by elimination of arbitrary constants and functions - Definitions of general, particular and complete solutions - solving standard forms $f(p, q) = 0$, $f(x,p,q) = 0$, $f(y,p,q) = 0$, $f(z, p, q) = 0$, $f(x,p) = f(y,q)$, $z = px +qy + f(p,q)$ - Lagrange's Differential equations $Pp+Qq = R$.

UNIT III: FOURIER SERIES

Dirichlet's Conditions – Definition of Fourier series – Finding Fourier Coefficients for a given periodic function 2π with interval $(0,2\pi)$ and $(-\pi, \pi)$ – Odd Functions – Even functions – Half Range Sine Series – Half Range Cosine series – Harmonic Analysis.

UNIT IV: MULTIPLE INTEGRAL

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variables between Cartesian and polar coordinates – Triple integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral.

UNIT V: NUMERICAL METHODS

Solving simultaneous equations–Gauss Elimination method, Gauss Jordan method, Gauss Jacobi Method, Gauss – Seidel method. Numerical Integration – Trapezoidal Rule and Simpson's Rule.

SUGGESTED READINGS

1. Rasinghania M. D, (2017), Ordinary and Partial Differential Equations, S. Chand Publication India.
2. Kandasamy, P Thilagavathy K and Gunavathi K ,(2015), Numerical Methods S. Chand Publication, India.
3. Balaji. G, (2015), Engineering Mathematics-II, G.Balaji Publication, India.
4. Narayanan. S and Pillai, T. K. M (2011). Calculus Vol 1 and Vol 2, Viswanathan Publishers, India.
5. Kandasamy. P & Thilagarathy. K (2000). Mathematics for B.Sc .Vol I and. II, S. Chand and Co, India.
6. Shanthi Narayanan & Kapoor J. N (2014). A Text book of calculus, S. Chand & Co India.
7. S.Ranganatham & V.Rameshbabu(2014).Fourier series and integral transform, S. Chand & Co India.

e-Resources:

<https://www.youtube.com/watch?v=ma1QmE1SH3I>

<https://youtu.be/ISqwmuGkOXQ>

<https://www.youtube.com/watch?v=aqu6v4vdfd4>

<https://www.youtube.com/watch?v=UKHBWzoOKsY>

Course Objectives

- To outline the basics of chemical thermodynamics and the concept of first law of Thermodynamics.
- To discuss the knowledge about the thermo chemistry and to explain about the 2nd law of Thermodynamics.
- To explain the concepts of third law of thermodynamics and systems of variable composition.
- To explain about the usage of chemical thermodynamics in chemical equilibrium.
- To recognise the forces which drive the chemical reactions in forward direction and the concept of the interchange of energy in a system.
- To paraphrase a knowledge about solutions and colligative properties.

Course Outcomes

1. Apply the basic concepts of calculus to concepts in chemistry.
2. Describe the Three Laws of Thermodynamics and their development.
3. Use the Maxwell equations and other thermodynamic relations to compute thermodynamic quantities from thermodynamic data tables.
4. Derive the relationships between thermodynamic quantities; Interpret phase diagrams and explain phase equilibria in terms of chemical potentials.
5. Recognise the forces which drive the chemical reactions in forward direction and the concept of the interchange of energy in a system.
6. Explain the use of electrical energy for initiating chemical reactions and also how chemical reactions can be utilized to produce electrical energy, and the basic principle used in the formation of cells and batteries.

UNIT I

Chemical Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems.

First law: Concept of heat, Q, work, W, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of Q, W, ΔU and ΔH for reversible, irreversible and free expansion of gases (ideal and Van der Waals) under isothermal and adiabatic conditions.

UNIT II

Thermochemistry: Heats of reactions: standard states; enthalpy of formation and enthalpy of combustion and its applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes.

UNIT III

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient

and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Systems of Variable Composition: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

UNIT IV

Characteristics of chemical equilibrium: The state of chemical equilibrium, Law of mass action, Law of chemical equilibrium, Relationship between K_p and K_c , Free energy change of a reaction, Thermodynamic derivation of the law of chemical equilibrium, Equilibrium constants and their quantitative dependence on temperature, pressure and concentration (Le-Chatelier Principle, Quantitatively).

UNIT V

Solutions and Colligative Properties: Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

SUGGESTED READINGS

1. Peter, A. & Paula, J. de. (2011). Physical Chemistry. 9th Ed. Oxford University Press.
2. Castellan, G. W. (2004). Physical Chemistry. 4th Ed. Narosa.
3. Madan, R. L. (2015). Chemistry for Degree Students, S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi.
4. Engel, T. & Reid, P. (2012). Physical Chemistry. 3rd Ed. Prentice-Hall
5. McQuarrie, D. A. & Simon, J. D. (2004). New Delhi: Molecular Thermodynamics Viva Books Pvt. Ltd.
6. Assael, M. J., Goodwin, A. R. H., Stamatoudis, M., Wakeham, W. A. & Will, S. (2011). Commonly Asked Questions in Thermodynamics. NY: CRC Press.
7. Levine, I. N. (2010). Physical Chemistry. 6th Ed. Tata Mc Graw Hill.
8. Metz, C.R. (2006). 2000 solved problems in chemistry. Schaum Series

Course Objectives

To describe the students a knowledge on

- Chemistry of halogenated compounds like alkyl halides
- Chemistry of aryl halides and their uses
- The preparation, properties and relative reactivity of carboxylic acids, alcohols and phenols
- Preparation, properties and standard reactions of carbonyl compounds.
- Chemistry of Organometallic compounds, Ethers and Epoxides and Addition reactions
- Chemistry of carbohydrates

Course Outcomes (CO's)

The students will able to

1. Explain the chemistry of alkyl halides .
2. Explain the chemistry of aryl halides.
3. Contrast the preparation, properties and relative reactivity of carboxylic acid, alcohols and phenols
4. Summarise Preparation, properties and standard reactions of carbonyl compounds
5. Discuss the preparations, reactions and applications of epoxides, ethers and organometallic compounds
6. List the preparations, properties of carbohydrates and explain its structure.

UNIT I**Chemistry of Halogenated Hydrocarbons:**

Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions – S_N1 , S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent; nucleophilic substitution vs. elimination.

Aryl halides: Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; S_NAr , Benzyne mechanism.
Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

UNIT II**Acids, Alcohols, Phenols:**

Acids: General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength. Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides. Claisen condensation, Hofmann-bromamide degradation.

Alcohols: Preparation, properties and relative reactivity of 1° , 2° , 3° alcohols, Bouvaelt-Blanc Reduction; Oxidation of diols by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity and factors affecting it, Ring substitution reactions, Reimer–Tiemann Reactions, Fries rearrangements with mechanism;

UNIT III

Carbonyl Compounds:

Structure, reactivity, preparation and properties; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α – substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH_4 , NaBH_4 , MPV, PDC)

UNIT IV

Organometallic Compounds, Ethers and Epoxides and Addition Reactions

Organometallic compounds of Mg (Grignard reagent) – Use in synthesis of organic compounds.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH_4

Addition reactions of α , β - unsaturated carbonyl compounds: Michael addition. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

UNIT V

Carbohydrates

Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Inter-conversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose. Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

SUGGESTED READINGS

1. Morrison, R. N. & Boyd, R. N. (2012). *Organic Chemistry*. India: Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Madan, R. L. (2015). *Chemistry for Degree Students*, S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi-110055
3. Soni, P.L. and Chawla, H.M. (2003) *Text book of Organic Chemistry*. Sulthan Chand & Sons, Educational publishers, New Delhi.
4. Finar, I. L. (2013). *Organic Chemistry*. Volume 1. Edition-VI. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Graham Solomons, T.W. (2012). *Organic Chemistry*. John Wiley & Sons, Inc.
6. Jain M.K. & Sharma S.C. (2015). *Modern Organic Chemistry*, 4th Edition, Vishal publishing Co New Delhi.

Instruction Hours/week:L: 0 T:0 P:2**Marks: Internal:40 External: 60 Total:100
End Semester Exam: 3 hrs****Course Objectives**

The Students have a present knowledge

- To measure the heat capacity of a calorimeter
- To determine the enthalpy of neutralisation.
- To determine the ionisation of solution.
- To determine the enthalpy of hydration of salt.
- To measure the integral enthalpy of solution
- To determine the basicity of a diprotic acid

Course Outcomes (CO's)

It enables the students calculate

1. The heat capacity of a calorimeter
2. The enthalpy of neutralisation,
3. Calculated the ionisation of solution.
4. Calculated the enthalpy of hydration of salt.
5. The integral enthalpy of solution
6. The basicity of a diprotic acid

Contents

- (a) Determination of heat capacity of a calorimeter for different volumes using (i) change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution of sulphuric acid or enthalpy of neutralization), and (ii) heat gained equal to heat lost by cold water and hot water respectively
- (b) Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
- (c) Determination of the enthalpy of ionization of ethanoic acid.
- (d) Determination of integral enthalpy (endothermic and exothermic) solution of salts.
- (e) Determination of basicity of a diprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
- (f) Determination of enthalpy of hydration of salt.
- (g) Study of the solubility of benzoic acid in water and determination of ΔH .

SUGGESTED READINGS

1. Khosla, B. D.; Garg, V. C. & Gulati, A. (2011). *Senior Practical Physical Chemistry*. New Delhi: R. Chand & Co.
2. Athawale, V. D. & Mathur, P. (2011). *Experimental Physical Chemistry*. New Delhi: New Age International.

Course Objectives

The Students have a present knowledge

- To analyse the organic functional groups like alcohols, phenols carbonyl and carboxylic acid groups
- To demonstrate the preparations of organic compounds by acylation reactions
- To demonstrate the preparations of organic compounds by benzylation reactions.
- To carry out the iodoform reactions and selective reductions.
- To prepare semicarbazone derivatives of ketones
- To prepare S-Benzylisothiuronium salt of aromatic acids.

Course Outcomes

The student know to classifying the

1. Identification the organic functional groups like alcohols, phenols carbonyl and carboxylic acid groups
2. Preparation organic compounds by acylation reactions
3. Preparation organic compounds by benzylation reactions.
4. Iodoform reactions and selective reductions.
5. Preparations semicarbazone derivatives of ketones
6. Preparations S-Benzylisothiuronium salt of aromatic acids.

Contents

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:
 - i. Acetylation of one of the following compounds: amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and phenols (β -naphthol, vanillin, salicylic acid) by any one method:
 - a. Using conventional method.
 - b. Using green approach
 - ii. Benzylation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (β -naphthol, resorcinol, p- cresol) by Schotten-Baumann reaction.
 - iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
 - iv. Selective reduction of meta dinitrobenzene to m-nitroaniline.
 - v. Hydrolysis of amides and esters.
 - vi. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
 - vii. S-Benzylisothiuronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
 - viii. Aldol condensation using either conventional or green method.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

SUGGESTED READINGS

1. Mann, F.G. & Saunders, B.C. (2009). *Practical Organic Chemistry*. Pearson Education.
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. (2012). *Practical Organic Chemistry*. 5th Ed., Pearson.
3. Veeraiyan V, Venkateswaran R, and Vaithiyalingam A.R. (2015). *Basic Principles of Practical Chemistry*, S. Chand & Sons Ltd.
4. Raj K. Bansal, (2012). *Laboratory Manual of Organic Chemistry*, New Age International Publishers (P) Ltd.
5. Thomas A.O. (2003). *Practical Chemistry for B.Sc Main Students*, Scientific Book Centre, Cannore-1, Kerala.
6. Ahluwalia, V.K. & Aggarwal, R. (2000). *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*. University Press.
7. Ahluwalia, V.K. & Dhingra, S. (2000). *Comprehensive Practical Organic Chemistry: Qualitative Analysis*. University Press.

20AEC201	ENVIRONMENTAL STUDIES	Semester-II
		3H 3C
Instruction Hours/week:L: 3 T:0 P:0	Marks: Internal: 40 External: 60 Total:100	
	End Semester Exam: 3 hrs	

Course Objectives

It enables the students to

- The fundamental terms and definitions of environment
- Recall the Renewable and Non-renewable Resources.
- Quote the Biodiversity and Its Conservation
- Outline about Environmental Pollution
- Discuss the disaster management
- Discuss the Social Issues and the Environment

Course outcomes (CO's)

The students know about the explanation of

1. Fundamental terms and definitions of environment
2. Renewable and Non-renewable Resources.
3. Biodiversity and Its Conservation
4. Environmental Pollution
5. Gained knowledge about disaster management
6. Social Issues and the Environment

Unit I – Introduction - Environmental Studies & Ecosystems

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit II - Natural Resources - Renewable and Non-Renewable Resources

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources -Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources- Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit III - Biodiversity and Its Conservation

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Unit IV - Environmental Pollution

Bachelor of Science, Chemistry, 2020. Karpagam Academy of Higher Education, Coimbatore - 641 021, India.

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Case studies.

Unit V - Social Issues and The Environment

Concept of sustainability and sustainable development. Water conservation -Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols). Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Human population growth: Impacts on environment, human health and welfare.

SUGGESTED READINGS

1. Anonymous. (2010). *A text book for Environmental Studies*, University Grants Commission and Bharat Vidapeeth Institute of Environmental Education Research, New Delhi.
2. Anubha Kaushik., and Kaushik, C.P. (2018). *Perspectives in Environmental Studies*. New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. (2011). *A Textbook of Environmental Science*. APH Publishing Corporation, New Delhi.
4. Daniel, B. Botkin., and Edward, A. Keller. (2014). *Environmental Science* John Wiley and Sons, Inc., New York.
5. Mishra, D.D. (2010). *Fundamental Concepts in Environmental Studies*. S.Chand & Company Pvt. Ltd., New Delhi.
6. Odum, E.P., Odum, H.T. and Andrews, J. (2004). *Fundamentals of Ecology*. Philadelphia: Saunders.
7. Rajagopalan, R. (2016). *Environmental Studies: From Crisis to Cure*, Oxford University Press.
8. Sing, J.S., Sing. S.P. and Gupta, S.R. (2014). *Ecology, Environmental Science and Conservation*. S. Chand & Publishing Company, New Delhi.
9. Singh, M.P., Singh, B.S., and Soma, S. Dey. (2004). *Conservation of Biodiversity and Natural Resources*. Daya Publishing House, New Delhi.
10. Tripathy. S.N., and Sunakar Panda. (2014). *Fundamentals of Environmental Studies* (2nd edition). Vrianda Publications Private Ltd, New Delhi.
11. Verma, P.S., and Agarwal V.K. (2018). *Environmental Biology (Principles of Ecology)*. S. Chand and Company Ltd, New Delhi.
12. Uberoi, N.K. (2010). *Environmental Studies*. Excel Books Publications, New Delhi.

Course Objectives:

- To understand basic theories and experiments in Physics.
- To understand the fundamentals of physics.
- To educate and motivate the students in the field of science
- To Know about analog electronics and Mechanics
- To learn about Thermal physics, optics and Laser physics
- To study about Elasticity and surface tension

Course Outcomes:

- 1.Students will demonstrate proficiency in mathematics and the mathematical concepts to understand physics.
- 2.Students will design and conduct an experiment (or series of experiments) demonstrating their understanding of the scientific method and processes.
- 3.Students will demonstrate an understanding of the analytical methods required to interpret and analyze results and draw conclusions as supported by their data.
4. Knowledge about analog electronics and Mechanics
- 5.Learnt about Thermal physics, optics and Laser physics
- 6.Study about Elasticity and surface tension.

UNIT-I

ELASTICITY: Elastic constants of an isotropic solid -Stress – Strain - Relations connecting them - Poisson's ratio - Bending of beams - Uniform and non-uniform bending - Bending moment of a bent beam - cantilever - Static and dynamic methods - Torsion in a wire - Rigidity modulus determination by Static and dynamic methods.

SURFACE TENSION: Surface tension and Surface energy- Angle of contact - Vapour pressure over a flat and curved surface-Hare's apparatus (Difference between two different liquids).

UNIT-II

MECHANICS: Motion of bodies in 2-D- Newton's laws - projectile motion – range- maximum height – projectile from space flight- Rotational motion – Rotation with constant angular acceleration –angular momentum of particles – rigid body – spinning top – conservation of angular momentum – Planetary motion – Kepler's laws – universal law of gravitation.

Moment of inertia of a rod, disc, spherical shell, solid and hollow spheres - Theory of compound pendulum and simple pendulum- Determination of 'g'. Relation between G and g.

UNIT-III

THERMAL PHYSICS: Laws of thermodynamics – Reversible and irreversible process – Heat engine – Carnot's theorem-Conduction- Convection- Radiation- Black body - Specific Heat- Experimental Methods- Expansion of solids, liquids and Gases (concepts)–Ideal Gas equation- Stefan's law – Newton's law of cooling – Experimental determination of Stefan's constant – Wien's displacement law – Rayleigh – Jean's law – Planck's law.

UNIT-IV

OPTICS: Nature of Light (Theories) - Reflection – Refraction – Snell's law – Total internal reflection – Interference – Diffraction – Polarization – Coherence-Spectrometer.

LASER PHYSICS: Stimulated emission and absorption – Einstein's theory of radiation - population inversion – optical pumping – meta stable state – conditions for laser actions – Ruby laser – Helium – neon laser – applications of lasers – Raman effect – Raman shift – stokes and anti-stokes lines – Laser Raman Spectrometer.

UNIT-V

BASIC ELECTRONICS: Intrinsic and extrinsic semiconductor – PN Junction diode – (Biasing of PN junction – V-I characteristics) – Rectifiers – Half wave – Full wave and bridge rectifiers – Characteristics of Zener diode – Voltage regulator – Transistor – Characteristics of transistor – CB, CE mode –Oscillators & its Classification.

SUGGESTED READINGS

1. Murugesan. R., Modern Physics, S.Chand & Co, New Delhi.
2. Brijlal and N. Subramanyam, 2004, Properties of matter, S. Chand & Company, New Delhi.
3. Aruldas and P.Rajagopal, Modern Physics, Prentice Hall of India, New Delhi.
4. Mathur. D.S., 2003, Elements of properties of matter - Shyamlal Charitable Trust, New Delhi.
5. Principles of Electronics, V K Mehta and Rohit Mehta, S.Chand & Company Ltd. Revised Eleventh Edition 2008.
6. F. W. Sears and G. L. Salinger, Thermodynamics, Kinetic theory, and Statistical Thermodynamics, IIIrd ed., Narosa Publishing House (1998).

20CHU302

**INORGANIC CHEMISTRY II:
Coordination Chemistry**

4H 4C

Instruction Hours/week:L:4 T:0 P:0

Marks: Internal: 40 External: 60 Total: 100

End semester Exam: 3 hrs

Course Objectives

The students should be able

- To discuss the key features of coordination compounds,
- Understand the nomenclature, isomerism and types in coordination compounds.
- To describe the various theories to explain the characteristics of coordination compounds.
- To contrast the nature of transition elements and their compounds.
- To contrast about the fundamentals of Inorganic reaction mechanisms.
- To discuss about the solubility and substitution reactions.

Course Outcomes

The students have gained knowledge to summarise

1. Recognise the role played by transition metal complexes in Inorganic Chemistry.
2. Understand the nomenclature, isomerism and types in coordination compounds.
3. Describe the structure and bonding theories, electronic and magnetic properties of the transition metal complexes and their kinetic studies.
4. Explain the theories of bonding in coordination compounds and their experimental behaviour.
5. Recognise and explain the interaction of metal ions with biological ligands.
6. Explain the role of Inorganic “substances” in living systems and the use of metal ions in medicinal therapy and diagnosis.

UNIT I**Coordination Chemistry I:**

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

UNIT II**Coordination Chemistry II:**

Werner's theory, valence bond theory (inner and outer orbital complexes), electro neutrality principle and back bonding. Crystal field theory, measurement of $10 Dq$ (Δ_o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of $10 Dq$ (Δ_o , Δ_t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

UNIT III**Transition Elements:**

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer diagrams) Difference between the first, second and third transition series. Chemistry of Cr, Mn, Fe and Co in various oxidation states with special reference to the following compounds: peroxo compounds of chromium, potassium dichromate, potassium

permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.

UNIT IV

Inorganic Reaction Mechanism

Introduction to inorganic reaction mechanisms. Classification of inorganic reactions, Substitution reactions in square planar complexes, Trans- effect, theories of trans effect.

UNIT V

Stability and Substitution Reaction in Complex

Stability of co-ordination complex, Concept of thermodynamic and Kinetic stability, Factors influence the stability of co-ordination compounds, Ligand Substitution reaction in octahedral complex, Rates and mechanism of substitution reactions, Redox reaction.

SUGGESTED READINGS

1. Cotton, F.A., Wilkinson, G. & Gaus, P.L. (2010). Advanced Inorganic Chemistry. 3rd ed. John Wiley & sons.
2. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2013). *Inorganic Chemistry: Principles of Structure and Reactivity (10th impression)*. Pearson Education India.
3. Greenwood, N.N. & Earnshaw A. (2006). *Chemistry of the Elements*. Butterworth-Heinemann. Miessler, G. L. & Tarr, Donald A. (2009). *Inorganic Chemistry*. 3rd Ed. (adapted), Pearson.
4. Wahid U Malik, Tuli G.D., and Madan, R.D., (2009). *Selected topics in inorganic chemistry (re-print)* S.Chand & company, New Delhi.

Course Objectives

This course enables the students,

- To remember the concept of phases, components and degrees of freedom.
- To understand the theory behind three component systems
- To explain the kinetics of different types of reactions.
- To understand the mechanisms of theories of kinetics and catalysis.
- To study about the various types of catalyst in different chemical reactions.
- To understand the fundamentals of surface chemistry

Course Outcomes (CO's)

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

1. Discuss the concept of Phase equilibrium and phase diagrams
2. Illustrate the three component systems and their characteristic properties
3. Determine and distinguish the rate laws for different types of reactions.
4. Distinguish the various theories behind the chemical kinetics and catalysis.
5. List out the various types of catalyst in different chemical reactions
6. Differentiate types of adsorption and adsorption isotherms in surface chemistry.

UNIT I

Phase Equilibrium: Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems (H_2O and S), with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points.

UNIT II

Three Component Systems: triangular plots, water-chloroform-acetic acid system. Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

UNIT III

Chemical Kinetics: Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions

and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Unit IV

Chemical Kinetics:

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

Catalysis: Types of catalyst, specificity and selectivity, mechanisms of catalysed reactions at solid surfaces. Michaelis-Menten mechanism, Types of catalysis -Enzyme catalysis, acid-base catalysis and uses of catalysis in batteries.

UNIT V

Surface Chemistry: Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich). nature of adsorbed state. Qualitative discussion of BET. The role of surface chemistry in chromatography (TLC and Column) and Gibb's adsorption isotherm. **Emulsion in surface chemistry- Types, properties, application and mechanism of emulsification.**

SUGGESTED READINGS

1. Peter Atkins & Julio De Paula. (2010). *Physical Chemistry*. 9th Ed. Oxford University Press.
2. Castellan, G. W. (2004). *Physical Chemistry*. 4th Ed. Narosa.
3. McQuarrie, D. A. & Simon, J. D. (2004). *Molecular Thermodynamics*. New Delhi: Viva Books Pvt. Ltd.
4. Engel, T. & Reid, P. (2012). *Physical Chemistry*. 3rd Ed. Prentice-Hall
5. Assael, M. J., Goodwin, A. R. H., Stamatoudis, M., Wakeham, W. A. & Will, S. (2011). *Commonly Asked Questions in Thermodynamics*. NY: CRC Press.
6. Zundhal, S.S. (2011). *Chemistry concepts and applications*. Cengage India
7. Ball, D. W. (2012). *Physical Chemistry*. Cengage India.
8. Mortimer, R. G. (2009). *Physical Chemistry*. 3rd Ed. Elsevier: NOIDA, UP.
9. Levine, I. N. (2011). *Physical Chemistry*. 6th Ed. Tata McGraw-Hill.
10. Metz, C. R. (2009). *Physical Chemistry*. 2nd Ed. Tata McGraw-Hill.
11. Jain and Jain (2017). *Engineering chemistry (16th Edition)*.

Course Objective

- To acquire basic understanding of laboratory technique and
- To educate and motivate the students in the field of Physics
- To allow the students to have a deep knowledge of fundamentals of optics.
- To work efficient in the Young modulus, rigidity modulus
- Refractive Index of a liquid prism-Spectrometer
- Thickness of a thin wire-Air wedge method

Course outcome

Students can able to

- 1.Perform basic experiments in mechanics and electricity and analyze the data.
- 2.Acquire engineering skills and Practical knowledge, which help the student in their everyday life.
- 3.Knowledge about the physical Principles and applications of Electronics.
- 4.Work efficiently in the Young modulus, rigidity modulus
- 5.Refractive Index of a liquid prism-Spectrometer
- 6.Thickness of a thin wire-Air wedge method

Contents**ANY TEN EXPERIMENTS****Experiments**

1. Young's Modulus-Non Uniform bending-Optic lever
2. Young's Modulus-Static cantilever
3. Acceleration due to gravity-Compound pendulum
4. Determination of spring constant of the given spring.
5. Determine the radius of capillary tube using microscope.
6. Refractive Index of a solid prism (I-d) curve-Spectrometer
7. Co-efficient of thermal conductivity-Lee's disc method
8. Wavelength of spectral lines -Grating-minimum deviation method-Spectrometer.
9. Characteristics of a Zener and Junction diode
10. μ of a lens-Newton's ring method
11. Thickness of a thin wire-Air wedge method
12. Determine the surface tension - Drop weight method
13. Determine the wavelength of He-Ne laser.
14. Determination of the Coefficient of Viscosity of a given liquid using Burette method
15. Construct a single stage amplifier using transistor

SUGGESTED READINGS

1. Ouseph C.C., U.J. Rao and V. Vijayendran 2007, Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai
2. Singh S.P., 2003, Advanced Practical Physics – 1, 13th Edition, Pragathi Prakashan, Meerut
3. Singh S.P., 2000, Advanced Practical Physics – 2, 12th Edition, Pragathi Prakashan, Meerut

Course Objectives

The student should be able to

- Explain the principle of gravimetric analysis
- To estimate the amount of nickel present in the NiDMG
- Prepare coordination complexes
- To measure the 10Dq by spectrophotometrically.
- Justify the properties of coordination complexes
- To synthesise the ligand transfer reaction by substitution method.

Course outcomes

The students have to

1. Determine metals like Ni, Cu and Fe using the principle of gravimetric analysis
2. Estimate the amount of nickel present in the NiDMG
3. Prepare coordination complexes
4. Measurement of 10 Dq by spectrophotometric method
5. Justify the properties of coordination complexes
6. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g.bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Contents**Gravimetric Analysis:**

- i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
- ii. Estimation of copper as CuSCN
- iii. Estimation of iron as Fe₂O₃ by precipitating iron as Fe(OH)₃.

Inorganic Preparations:

- i. Tetraamminecopper (II) sulphate, [Cu(NH₃)₄]SO₄.H₂O
- ii. Acetylacetonate complexes of Cu²⁺/Fe³⁺
- iii. Tetraamminecarbonatocobalt (III) nitrate
- iv. Potassium tri(oxalato)ferrate(III)

Properties of Complexes

- i. Measurement of 10 Dq by spectrophotometric method
- ii. Synthesis of ammine complexes of Ni (II) and its ligand exchange reactions (e.g.bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

SUGGESTED READINGS

1. Vogel, A.I. (2002). *A text book of Quantitative Analysis*. ELBS.
2. Marr, G. & Rockett, B.W. (1972). *Practical Inorganic Chemistry*. Van Nostr and Reinhold.
3. Gulati, S., Sharma, J.L. Monocha, S. (2017). *Practical Inorganic Chemistry*. CBS Publishers & Distributors, Ernakulam, Kerala.

**20CHU313 PHASE EQUILIBRIUM AND CHEMICAL KINETICS-
PRACTICAL****Semester-III
4H 2C****Instruction Hours/week: L: 0 T:0 P:4****Marks: Internal:40****External: 60 Total:100
End Semester Exam: 3 hrs****Course Objectives**

It enables the students to Paraphrase the

- To Determine of critical solution temperature (CST) and
- To Determine of eutectic temperature
- To Determine distribution coefficients of two immisible solutions.
- To construct of the phase diagram using cooling curves or ignition tube method: a. simple eutectic and b. congruently melting systems.
- To apply their knowledge in Potentiometry to laboratory.
- To perform the potentiometric titrations.

Course Outcomes

The students able to determine,

1. Apply their knowledge in Phase equilibria
2. Determination of critical solution temperature (CST) and
3. Determination of eutectic temperature
4. Determination distribution coefficients of two immisible solutions.
5. Apply their knowledge in Potentiometry to laboratory.
6. Perform the titrations potentiometrically.

Contents**Phase Equilibrium**

- I. Determination of critical solution temperature and composition at CST of the phenol-water system
- II. The effect of impurities of sodium chloride and succinic acid on CST of the phenol-water system.
- III. Phase equilibria: Construction of the phase diagram using cooling curves method: a. simple eutectic
- IV. Construction of the phase diagram using cooling curves method: congruently melting systems.
- V. Distribution of acetic/ benzoic acid between water and chloroform or cyclohexane.
- VI. Study the equilibrium of at least one of the following reactions by the distribution method:
 - (i) $I_2(aq) + I^-(aq) \rightarrow I_3^-(aq)$
 - (ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n^{2+}$

Potentiometry

- V. Perform the following potentiometric titrations: i. Strong acid vs. Strong base ii. Weak acid vs. Strong base. iii. Dibasic acid vs. Strong base iv. Potassium dichromate vs. Mohr's salt

SUGGESTED READINGS

1. Khosla, B. D., Garg, V. C. & Gulati, A. (2011). *Senior Practical Physical Chemistry*.25.

New Delhi: R. Chand & Co.

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. (2003). *Experiments in Physical Chemistry*. 8th Ed. McGraw-Hill: New York.
3. Halpern, A. M. & McBane, G. C. (2003). *Experimental Physical Chemistry*. 3rd Ed. New York: W.H. Freeman & Co.

Course Objectives

The course enables the students to

- Perform the drug discovery process.
- To utilize the software to predict the ADMET.
- Build the synthesis of analgesic, antipyretic, anti-inflammatory agents
- Build the synthetic process of Central Nervous System and cardiovascular drugs.
- Restate the fermentation process
- Modify to prepare antibiotics and related compounds.

Course Outcome

The students have knowledge to create about the

1. Drug discovery
2. Utilization of the software using prediction of ADMET
3. Procedures to prepare analgesic, antipyretic, anti-inflammatory agents
4. Synthesis of Central Nervous System and cardiovascular drugs.
5. Fermentation process and preparation of antibiotics.
6. Modified the preparation of antibiotics and related compounds

UNIT 1

Drug Design and Development: Drug discovery- Stages of drug discovery, lead discovery, identification, validation and diversity of drug targets. Design and development; Basic Retrosynthetic approach. Pharmacokinetic ADMET properties, Synthon, FGI, Lipinski's rule of five, Chem-informatics tools.

UNIT II

Study on the Representative Drugs of the Following Classes: analgesic agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides, Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), **Anti-hypertensive drugs (Cilazapril, Sapisartan), H1 and H2 receptor antagonists (Dimetindene, Olopatadine, Lafutidine), oral hypoglycemic (Omargliptin, Dulaglutide) and antineoplastic agents (Alectinib, Capacitabine).**

UNIT III

Synthesis of The Representative Drugs of The Following Classes: Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine). **Adrenergic agents (Celiprolol, Olodaterol), cholinergic agents (Sazetidine-A), antidepressants (Vortioxetine, Levomilnacipram), anticonvulsants (Levetiracetam, Perampanel) and psychoactive drugs (Brexipiperazole, Iloperidone).**

UNIT IV

Fermentation

Active pharmaceutical ingredient (API), drug formulations, types, ingredients required for making a formulation, roles of excipients, Principles of fermentation, Aerobic and anaerobic fermentation. Production of Ethyl alcohol and citric acid, Enzyme kinetics and principles of enzyme inhibitors, enzyme inhibitors in medicine.

UNIT V

Anti-Biotic, Amino acid, Enzyme and Vitamins: Production of Antibiotics- Penicillin, Cephalosporin, Chloromycetin and Streptomycin. Corona virus, Superbugs, Causes for drug resistance, strategies to combat drug resistance in antibiotics therapy. Production of amino acid- Lysine, Glutamic acid. Production of Vitamins- Vitamin B2, Vitamin B12 and Vitamin C.

SUGGESTED READINGS

1. Asthana Abhilasha, Asthana Reetesh kumar, (2016). *Text book of pharmaceutical chemistry*, S. Chand and Company.
2. Donald cavins, (2012). *Essential of pharamaceutical chemistry* (3rd Edition),
3. Patrick, G.L. (2013). *Introduction to Medicinal Chemistry* (5th Edition). UK: Oxford University Press
4. Hakishan, V.K. Kapoor, (2017). *Medicinal and Pharmaceutical Chemistry*, New Delhi: Vallabh Prakashan. Pitampura.
5. William O. Foye, Thomas L., Lemke & David A. William. (2012). *Principles of Medicinal Chemistry*. New Delhi: B.I. Waverly Pvt. Ltd.

20CHU304B	Herbal Technology and Renewable resources	Semester-III
		3H 3C
Instruction Hours/week: L:3 T:0 P:0		Marks: Internal: 40 External: 60 Total:100
End Semester Exam: 3hrs		

Course Objectives

This course enables the students,

- To understand herbal technology
- To recognise the active principle in herbal products.
- To remember the botanical name and chemical constituents
- To evaluate the drug adulteration through the biological testing.
- To create value added processing/storage/quality control for better use of herbal medicine.
- To create skills for cultivation of plants and their value added processing/ storage/ quality control.

Course Outcomes (CO's)

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

1. Recognize the terms of herbal technology.
2. Define and describe the principle of making herbal products.
3. List the major herbs, their botanical name and chemical constituents
4. Evaluate the drug adulteration through the biological testing
5. Formulate the value added process/storage/quality control for the better use of herbal medicine.
6. Develop the skills for cultivation of plants and their value added processing/ storage/ quality control.

UNIT I

Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine and overview of AYUSH (Traditional Indian system of medicine); Cultivation-harvesting-processing-storage of herbs and herbal products.

Herbal products recognized in India; Major herbs used as herbal medicine, nutraceuticals, cosmetics and biopesticides.

UNIT II

Pharmacognosy- Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, Catharanthus roseus, Withania somnifera, Cantella asiatica, Achyranthes aspera, Kalmegh, Giloe (tinospora), Saravar. Herbal foods, future of pharmacognosy.

UNIT III

Analytical pharmacognosy- Morphological and microscopic examination of herbs, Evaluation of drug adulteration- types, methods of drug evaluation – Biological testing of herbal drugs – Phytochemical screening test for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds). Plant gene banks, Cultivation of Plants and their value added processing/ storage/ quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of some medicinal plants (neem and tulsi).

UNIT IV

Renewable Energies (solar): Introduction to renewable energy sources-Solar, wind, small, hydro, biomass, geothermal and ocean energy, energy flow in eco system, Solar energy resources- solar radiation, Spectrum of EM radiation, sun structure and characteristics- extra-terrestrial radiation, solar constant, air mass, beam, diffused and total solar radiation.

UNIT V

Renewable Energies (Bio gas)

Basic biomass resources: plant derived, residues, aquatic and marine biomass, various wastes, photosynthesis. Estimation- woody biomass, non woody biomass and wastes.

Chemical composition of biomass cellulose, hemicelluloses and lignin content in common agriculture residues and their estimation, protein content in biomass, extractable, COD.

SUGGESTED READINGS

1. Agarwal, P. Shashi, Alok, Fathima, A. and Verma, A. (2013). *Current scenario of Herbal Technology worldwide: an overview*, Int. J. Pharm. Sci. Res; 4(11): 4105-17
2. Aburjai, t. and Natesheh, F.M. (2003). *Plants used in cosmetics*. Phototherapy Research, 17; 987-1000.
3. Evans , W.C (2009): Trease and Evans PHARMACOGNOSY (16 th Edition), SAAUNDERS/ Elsevier.
4. Patri, F. and Silano, V. (2002). Plants in cosmetics: plants and plant preparations used as ingredients for cosmetic products-volume 1.
5. Kokate, C. K (2003). Practical Pharmacognosy. Vallabh Prakashan, pune.
6. Miller, L and Miller, B. (2017). Ayurveda & Aromatherapy: The earth Essential Guide to Ancient Wisdim and Modern Healing. *Motilal Banarsidass*, (4th Edition).
7. AYUSH- www.indianmedicine.nic.in)

20CHU314A	PHARMACEUTICAL CHEMISTRY - PRACTICAL	Semester-III
		3H 1C
Instruction Hours/week:L:0 T:0 P: 3	Marks: Internal:40	External: 60 Total:100
		End Semester Exam: 3hrs

Course Objective

The course enables the student to

- Develop the synthesis of pharmaceutical drugs like aspirin
- Synthesis of magnesium bisilicate.
- Determine the melting point of aspirin
- Analyze the spectral characterization of aspirin
- Determine the melting point of antacid
- Analyze the spectral characterization of antacid

Course Outcome

The students restate the

- 1.Synthesis of pharmaceutical drugs like aspirin
- 2.Synthesis of magnesium bisilicate.
- 3.Determination of the melting point of aspirin
- 4.Analyzes the spectral characterization of aspirin
- 5.Determine the melting point of antacid
- 6.Analyzes the spectral characterization of antacid

Contents**PRACTICAL'S**

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).
3. Preparation of paracetamol
4. Preparation of metformin
5. Purification techniques of solvents by fractional distillation
6. Preparation of acid/basic Salts of drugs and evaluation of their physicochemical Properties.(Benzilic Acid & Sodium Benzoate
7. Synthesis of Benzimidazole.
8. Synthesis of Sulphanilamide.

SUGGESTED READINGS

1. Patrick G.L. (2013): Introduction to *Medicinal Chemistry*. UK: Oxford University Press.
2. Hakishan, V.K. Kapoor, (2017) *Medicinal and Pharmaceutical Chemistry*. New Delhi: Vallabh Prakashan. Pitampura.
3. William O. Foye, Thomas L., Lemke & David A. William. (2012). *Principles of Medicinal Chemistry*. New Delhi: B.I. Waverly Pvt. Ltd.

20CHU314B	Herbal Technology and Renewable resources - Practical	3H 1C
Instruction Hours/week: L:0 T:0 P:3	Marks: Internal: 40 External: 60 Total:100	
	End Semester Exam: 3hrs	

Course Objectives

This course successfully enables the students,

- To remember important medicinal plants.
- To understand the procedures to extract phytoconstituents from the medicinal plants.
- To learn how to extract essential oils from plant materials
- To know about preparation of bio-gas from kitchen waste
- To learn about the antioxidant activity of plant materials
- To analyze the alkaloids, flavonoids, steroids and phenolic compounds using screening test.

Course Outcome (CO's)

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

1. List out important medicinal plants.
2. Extract phytoconstituents from the medicinal plants.
3. Extract essential oils from plant materials
4. Understood the preparation technique of bio-gas from waste material
5. Learned about the anti-oxidant activity of plant materials
6. Differentiated the flavonoids, alkaloids, steroids and phenolic compounds using screening test.

Contents

- a. Extraction of biologically active compounds from the following Herbs
 1. Neem
 2. Turmeric
 3. Tulsi
 4. Ginger
 5. Funegreek
- b. Characterisation of plant extracts.
- c. Screening test for flavonoids, alkaloids, steroids and phenolic compounds
- d. Bio-gas Production from Kitchen waste
- e. Extraction of essential oil from bark and leaves of medicinal plants.
- f. Antioxidant activity of plant extracts.

SUGGESTED READINGS

1. Kokate, C. K (2003). Practical Pharmacognosy. Vallabh Prakashan, pune.
2. Aburjai, t. and Natesheh, F.M. (2003). *Plants used in cosmetics*. Phytotherapy Research, 17; 987-1000.
3. AYUSH- www.indianmedicine.nic.in

Course Objectives:

- Many basic natural processes in nature can be explained by physics. So it is essential to know basic physics any science student. This paper is aimed at giving some insight into the basic physics, theory as well as experiment.
- To gain a knowledge of elasticity of solids.
- To understand the basics of surface tension
- To learn Eienstein's photoelectric effect.
- To knowledge about laser physics
- To gain a knowledge about solar physics.

Course Outcomes

The students have gained knowledge about

1. Basic natural processes of Physics
2. Gain knowledge about the elasticity of solids.
3. Learn about Eienstein's photoelectric effect.
4. Understand the basics of surface tension.
5. Laser physics
6. Gained knowledge about solar physics

UNIT – I

Electrostatics: Coulombs law – electric field – lines of force - electric potential – electric flux- Gauss's law and its applications – potential – potential due to various charge distribution. Parallel plate capacitors - series plate capacitor– dielectrics- current –ohm's law- resistivity- conductivity- galvanometer – voltmeter – ammeter- potentiometer- comparison of EMF of a given cell.

UNIT - II

Magnetism: Introduction to magnet- Magnetic dipole-Earth as a magnet- Coloumb's inverse square Law- Magnetic field-Tangent Galvanometer –Deflection magnetometer-Tan A position- Tan B- Tan C -Comparison of magnetic moments -Biot Savart's law – B due to a solenoid – Magnetic properties of matter –Dia, para and ferro - Cycle of magnetization – Hysteresis – B-H curve – Applications of B-H curve.

UNIT - III

Modern Physics: Einstein's Photoelectric effect- Einstein's photo electric equations- verification of Einstein's photo electric equation by Millican's experiment – photo electric cells – applications.

Wave Mechanics: Compton effect-matter waves-De-Broglie Hypothesis -characteristics and calculation of De Broglie wave length. Experimental study of De Broglie matter wave by G.P.Thomson experiment -Heisenberg's uncertainty principle- Applications-Schrödinger's equation- particle in a box.

UNIT-IV

Atomic and Nuclear Physics: Atom Models: Sommerfield's and Vector atom Models – Pauli's exclusion Principle – Various quantum numbers and quantization of orbits. X-rays : Continuous and Characteristic X-rays – Mosley's Law and importance – Bragg's Law.

Nuclear forces –characteristics - nuclear structure by liquid drop model – Binding energy – mass defect – **Shell Model**- particle accelerators – cyclotron and betatron – nuclear Fission and nuclear Fusion.

UNIT - V

Digital Electronics: Decimal – binary – octal and hexadecimal numbers– their representation, inter-conversion, addition and subtraction, negative numbers. Sum of products – product of sums – their conversion – Simplification of Boolean expressions - Basic logic gates – AND, OR, NOT, NAND, NOR and EXOR gates – NAND and NOR as universal building gates – Boolean Algebra – Laws of Boolean Algebra – De Morgan's Theorems – Their verifications using truth tables.

SUGGESTED READINGS

1. Narayanamurthi, Electricity and Magnetism, The National Publishing Co, First edition, 1988.
2. J. B. Rajam, Atomic Physics., S. Chand & Company Limited, New Delhi, First edition, 1990.
3. B. N. Srivastava, Basic Nuclear Physic, Pragati Prakashan, Meerut, 2005.
4. Albert Paul Malvino, Digital principles and Applications, McGraw-Hill International Editions, New York, 2002.
5. Digital fundamentals – by Floyd 8th edition Pearson education 2006
6. R. S. Sedha, A text book of Digital Electronics, S. Chand & Co, New Delhi, First edition ,2004.

Course Objectives

This course enables the students,

- To analyse the various types of conductance measurements and the factors affecting it
- To understand the ionic mobilities and the applications of conductance measurements
- To explain the basic principles of electrochemistry
- To describe the basic concepts in electrochemical cells.
- To classify about the different types of available batteries.
- To understand the need for energy storage, devices and technologies available and their applications

Course Outcome (CO's)

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

1. Differentiate the types of conductance measurements and the factors affecting it
2. Discuss the ionic mobilities and the applications of conductance measurements
3. Recognise the fundamental principles of electrochemistry.
4. Understand the basic concepts in electrochemical cells.
5. Classified about the various types of available batteries.
6. Appreciate the need for energy storage, and develop devices and technologies for such systems.

UNIT I

Conductance: Quantitative aspects of Faraday's laws of electrolysis Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules.

UNIT II

Electrochemistry: Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

UNIT III

Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and $\text{SbO/Sb}_2\text{O}_3$ electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

UNIT IV

Electrochemical Cells: Redox reaction, electrode potential-origin of electrode potential - oxidation potential-reduction potential, measurement and applications-electrochemical series and its significance- Nernst equation (derivation and problems)

Type of Batteries: Alkaline battery-Lead storage battery-Nickel-Cadmium battery- Lithium battery and super capacitor.

Unit V

Electro-chemical energy conversion and storage

Characteristics of electricity, Electricity and the roles of EES, Emerging needs for EES, The roles of electrical energy storage technologies.

Electro-chemical energy conversion and storage: Introduction to batteries, elements and operation of electrochemical cells, theoretical cell voltage and capacity, losses in cells. Battery classification, factors effecting battery performance, Advance lead-acid batteries.

Advanced Lithium Batteries: Li-ion batteries, Principle, Battery components and design Electrode, cell and battery fabrications, Building block cells, battery modules and packs. The function of solar cells. Different solar cell technologies and fabrication methods.

SUGGESTED READINGS

1. Atkins, P.W & Paula, J.D. (2011). *Physical Chemistry (9th Edition)*. Oxford University Press.
2. Castellan, G. W. (2004). *Physical Chemistry (4th Edition)*. Narosa.
3. Mortimer, R. G. (2009). *Physical Chemistry (3rd Edition)*. Elsevier: NOIDA, UP.
4. Barrow, G. M. (2006). *Physical Chemistry (5th Edition)*. New Delhi: Tata McGraw Hill.
5. Engel, T. & Reid, P. (2012). *Physical Chemistry (3rd Edition)*. Prentice-Hall.
6. Rogers, D. W. (2010). *Concise Physical Chemistry*. Wiley.
7. Silbey, R. J., Alberty, R. A. & Bawendi, M. G. (2005). *Physical Chemistry (4th Edition)*. John Wiley & Sons, Inc.

Course Objectives

This course enables the students,

- To understand the principle and the theory behind the UV spectroscopy.
- To apply the principle and theory of IR spectroscopy to predict the structure of simple molecules
- To analyse the principle and the theory behind the NMR spectroscopy.
- To classify the factors which are affects the NMR spectral values of the compounds
- To apply the knowledge about identification of organic compounds by using NMR spectral values.
- To discuss about the basic fundamentals of Mass Spectroscopy

Course Outcomes (CO's)

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

1. Apply the principle of the UV spectroscopy to identify structural details.
2. Implement the principle and the theory of IR spectroscopy to identify the structure of compound.
3. Use the principle and the theory of NMR spectroscopy to sketch the structure of compounds.
4. Classified the factors which are affects the NMR spectral values of the compounds.
5. Interpret the structure of simple molecules from their spectral values.
6. Understand the basic fundamentals of Mass spectroscopy

UNIT 1**ORGANIC SPECTROSCOPY**

General principles to absorption and emission spectroscopy.

UV Spectroscopy: Types of electronic transitions, λ_{\max} , Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ_{\max} for the following systems: α,β -unsaturated aldehydes, ketones, carboxylic acids and esters;

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

UNIT II

NMR Spectroscopy: Nuclear spin, Basic principles of NMR- classical and quantum mechanical method. Principle of Proton Magnetic Resonance, Spin angular momentum, Instrumentation, Relaxation: spin-spin, spin-lattice, Shielding constant, Shielding and De-shielding, Chemical Shift, Factors influencing chemical shift.

UNIT III

NMR Spectroscopy: Spin-spin coupling, Spin decoupling, Spin tickling, Solvents and Chemical reagents used in NMR, TMS, Coupling constant (J) and calculation, Geminal, Vicinal and Long range coupling, Factors influencing coupling constant. Introduction to ^{13}C NMR- elementary treatment.

UNIT IV

Mass spectroscopy: Introduction and instrumentation of Mass spectroscopy. Various methods of ionization, Rules for fragmentation, rule of 13, nitrogen rule, Stevenson rule, McLafferty rearrangement. Application of fragmentation data to specific compounds.(alcohol and aldehydes)

UNIT V

Problems: Application of UV and IR for identification of simple organic molecule having functional group aldehydes, ketones, acids, alcohols, ester, amine, amide.(Basic Treatment)
Chemical shift and correlation of ^1H and ^{13}C NMR of aromatic and aliphatic (aldehydes, ketones, acids, alcohols, ester, amine, amide) (Basic Treatment)

SUGGESTED READINGS

1. Sharma Y. R., (2013). *Elementary Organic Spectroscopy: Principles and applications*. S. Chand and Company.
2. Robert Silverstein M., (2014). *Spectrometric identification of organic compounds (Revised Edition)*. Wiley.
3. William Kemp. (2019). *Organic Spectroscopy (3rd Edition)*. Palgrave, USA.
4. Ahluwalia V.K., (2011). *Organic Spectroscopy*. Ane Books Pvt. Ltd.
5. Kalsi P.S., (2007). *Spectroscopy of organic compound*, New Age International Publisher

Course objectives

The students are able to

- Determine Field Intensity-Circular coil- Vibration magnetometer
- Co-efficient of thermal conductivity-Lee's disc method
- Refractive Index of a prism (I-I') curve-Spectrometer
- Moment of a magnet-Circular coil-Deflection Magnetometer
- Analyse the Temperature coefficient of resistance of a thermistor-Post office box
- Comparison of viscosities of two liquids
- To Study of logic gates using IC's
- To Study of NOR gate as Universal building block.
- To Study of NAND gate as Universal building block.
- Determine the Verification of Basic logic gates using discrete components.
- Determine the Cauchy's constant – Spectrometer
- AC frequency – Sonometer

Course Outcomes

- 1.Field Intensity-Circular coil- Vibration magnetometer
- 2.Co-efficient of thermal conductivity-Lee's disc method
- 3.Refractive Index of a prism (I-I') curve-Spectrometer
- 4.Moment of a magnet-Circular coil-Deflection Magnetometer
- 5.Temperature coefficient of resistance of a thermistor-Post office box
- 6.Comparison of viscosities of two liquids
- 7.Study of logic gates using IC's
- 8.Study of NOR gate as Universal building block.
- 9.Study of NAND gate as Universal building block.
10. Verification of Basic logic gates using discrete components.
11. Determination of Cauchy's constant – Spectrometer
12. AC frequency – Sonometer

Contents**Any 8 Experiments**

1. Determine the magnetic dipole moment (m) of a bar magnet - Tan A
2. Determine the magnetic dipole moment (m) of a bar magnet - Tan B
3. Circular coil- Vibration magnetometer
4. Moment of a magnet-Circular coil-Deflection Magnetometer
5. Study of logic gates using IC's.
6. Study of NOR gate as Universal building block.
7. Study of NAND gate as Universal building block.
8. Verification of Basic logic gates using discrete components.
9. Tangent galvanometer
10. Comparison of EMF of two given cell.

SUGGESTED READINGS

1. Ouseph C.C., U.J. Rao and V. Vijayendran 2007, Practical Physics and Electronics, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai
2. Singh S.P., 2003, Advanced Practical Physics – 1, 13th Edition, Pragathi Prakashan, Meerut
3. Singh S.P., 2000, Advanced Practical Physics – 2, 12th Edition, Pragathi Prakashan, Meerut

Course Objectives

This course enables the students to

- Perform in the conductance measurement,
- Determine of cell constant
- Determine the conductometric titrations
- Determine the kinetic aspects and rate measurements of different types of reactions.
- Determine the Acid hydrolysis of methyl acetate with hydrochloric acid.
- Determine the Saponification of ethyl acetate

Course Outcome

The Student have interpreted to

- 1.Measured the conductance
- 2.Determination of the cell constant
- 3.Determination of conductometric titrations
- 4.The kinetic aspects and rate measurements of different types of reactions.
- 5.Determination the Acid hydrolysis of methyl acetate with hydrochloric acid.
- 6.Determination of the Saponification of ethyl acetate

Conductometry:

- I. Determination of cell constant
- II. Determination of conductivity, molar conductivity, degree of dissociation and dissociation constant of a weak acid.
- III. Perform the following conductometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Mixture of strong acid and weak acid vs. strong base iv. Strong acid vs. weak base

Chemical Kinetics:

- IV. Study the kinetics of the following reactions.
 1. Iodide-persulphate reaction (i) Initial rate method; (ii) Integrated rate method
 2. Acid hydrolysis of methyl acetate with hydrochloric acid.
 3. Saponification of ethyl acetate.
 4. Comparison of the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate.

SUGGESTED READINGS

1. Khosla, B. D., Garg, V. C. & Gulati, A. (2011). *Senior Practical Physical Chemistry*. New Delhi: R. Chand & Co.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P.(2003). *Experiments in Physical Chemistry*. 8th Ed. New York : McGraw-Hill
3. Halpern, A. M. & McBane, G. C. (2003). *Experimental Physical Chemistry*. 3rd Ed. New York: W.H. Freeman & Co.

Course Objectives

This course enables the students,

- To apply the knowledge in the extraction process of biologically active compounds from tea leaves.
- To understand the preparation and characterisation of methyl orange
- To know about the preparation of urea formaldehyde resin
- To explain the qualitative analysis of unknown organic compounds
- To carryout the qualitative analysis of bi-functional group in organic compounds.
- To identify the simple organic compounds from their spectral data.

Course Outcomes (COs)

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

- 1.Demonstrate the extraction of biologically active compounds from tea leaves.
- 2.Describe the preparation of methyl orange
- 3.Discuss the preparation of urea formaldehyde resin
- 4.Identify unknown organic compounds from their spectral data
- 5.Carried out the qualitative analysis of bi-funcational groups.
- 6.Interpret the spectral data of simple organic compounds by IR spectroscopy and NMR spectroscopy

Contents**Spectroscopic methods UV, IR and NMR**

1. Extraction of caffeine from tea leaves.
2. Preparation of Methyl Orange/ urea formaldehyde resin.
3. Qualitative analysis of unknown organic compounds containing mono-functional groups(carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bi-functional groups, e.g. salicylic acid, cinnamic acid, nitro-phenols etc.
4. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).

SUGGESTED READINGS

1. Vogel, A.I. (2012).*Quantitative Organic Analysis*. Part 3. Pearson.
2. Mann, F.G. & Saunders, B.C. (2009). *Practical Organic Chemistry*. Pearson Education
3. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. &Tatchell, A.R. (2012). *Practical Organic Chemistry*. 5th Ed. Pearson.
4. Ahluwalia, V.K. & Aggarwal, R. (2000). *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*. University Press.
5. Ahluwalia, V.K. & Dhingra, S. (2000).*Comprehensive Practical Organic Chemistry: Qualitative Analysis*. University Press.

20CHU404A	GREEN METHODS IN CHEMISTRY	Semester-IV
		3H 3C
Instruction Hours/week: L:3 T:0 P:0		Marks: Internal:40 External: 60 Total:100
		End semester Exam: 3hrs

Course objectives

This course enables the students,

- To Summarize the twelve principles of green chemistry
- To know the special emphasis of an atom economy.
- To explain the catalysis and alternate sources of energy.
- To Describe the process involved in the real word cases like Surfactants for CO₂
- To Synthetic azo pigments to replace toxic organic and inorganic pigments.
- To Determination of environmentally safe marine antifoulant and plastic (poly lactic acid) made from corn.

Course outcome

1. Recognise the impact of green chemistry on human health and the environment.
2. Knowledge about the special emphasis of an atom economy.
3. Demonstrate the knowledge of the twelve principles of Green Chemistry which they can apply to a range of work places for a safer, less toxic and healthier environment.
4. Describe the process involved in the real word cases like Surfactants for CO₂
5. Synthetic azo pigments to replace toxic organic and inorganic pigments.
6. Determination of environmentally safe marine antifoulant and plastic (poly lactic acid) made from corn.

UNIT I

Theory and Hand-On Experiments

Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents,

UNIT II

Source of Energy: Types of energy sources- renewable and non-renewable energy, Green Chemistry and catalysis, **Chemicals from renewable sources**, Green energy and sustainability Green energy (micro wave, ultra sound and sono-chemist), Solar energy.

UNIT III

The Following Real World Cases In Green Chemistry Should Be Discussed:

Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO₂ for precision cleaning and dry cleaning of garments. **Designing of environmentally safe marine anti-foulant.**

UNIT IV

Synthetic Products

Right fit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

Healthier Fats and oil by green chemistry: Enzymatic Inter esterification for production of no Trans-Fats and Oils

UNIT V

Bachelor of Science, Chemistry, 2020. Karpagam Academy of Higher Education, Coimbatore - 641 021, India.

Green Approach

Green Synthesis of adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis). Microwave assisted reactions in water: (Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols) and reactions in organic solvents (Diels-Alder reaction and Decarboxylation reaction). Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)

SUGGESTED READINGS

1. Anastas, P.T. & Warner, J.K. (2005). *Green Chemistry- Theory and Practical*. Oxford University Press.
2. Matlack, A.S. (2005). *Introduction to Green Chemistry*. Marcel Dekker.
3. Cann, M.C. & Connely, M.E. (2000). *Real-World cases in Green Chemistry*, American Chemical Society. Washington.
4. Ahluwalia, V.K, Kidwai, M.R, (2005). *New trends in Green Chemistry*, Anamalaya Publishers

Course Objectives

This course enables the students,

- To understand the basic structure of carbohydrates
- To apply a knowledge to predict the basic structures of protein
- To describe the basic concept about enzymes and bio-catalysis
- To understand to identify the basic structures of lipids
- To remember the basic structures of hormones
- To analyse the biochemistry of diseases.

Course Outcomes (CO's)

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

1. Discuss the basic structure of carbohydrates
2. Sketch the basic structures of protein
3. Described the basic concepts about enzymes and bio-catalysis.
4. Identify the basic structures of lipids
5. State the functions and structures of hormones
6. Examine the biochemistry of diseases.

Unit I

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle. Isolation and characterization of poly-sachharides.

Unit II

Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α -helix and β -pleated sheets, Isolation, characterization, denaturation of proteins.

Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereo-specificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Factors affecting enzyme activity-effect of pH, temperature on enzyme activity, enzyme inhibition.

Introduction to Bio-catalysis: Importance in "Green Chemistry" and Chemical Industry.

Unit III

Lipids: Classification. Biological importance of triglycerides and phosphor glycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and under lying applications. Lipoproteins.

Unit IV

Hormone: Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones.

Nucleotides: Structure of DNA(Watson - Crick Model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.

Unit V

Biochemistry of Disease: A Diagnostic Approach by Blood/ Urine Analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples .Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

Urine: Collection and preservation of samples. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

SUGGESTED READINGS

1. Cooper, T.G. (1977). *Tool of Biochemistry*. John Wiley and Sons.
2. Keith Wilson & John Walker.(2009).*Practical Biochemistry*. Cambridge University Press.
3. Alan H Gowenlock, (2005). Varley's. *Practical Clinical Biochemistry*.CBS Publisher.
4. Thomas M. Devlin. (2009).*Textbook of Biochemistry*. Academic Internet Publishers.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L.(2002).*Biochemistry*. W.H. Freeman.
6. Nelson, D. L. & Cox, M. M. (2008).*Lehninger's Principles of Biochemistry*. 7th Ed.W. H. Freeman.
7. Harwood. (1990). *Series on Analytical Chemistry*. John Wiley & Sons.

Course objectives

This course enables the student to

- Apply the principles and the practical aspects of green chemistry
- Prepare biodiesel from vegetable oil.
- Prepare phthalocyanine complex of Cu (II).
- Characterise the biodiesel.
- Mechano chemical solvent free synthesis of azomethine.
- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II)

Course outcome

The students have to use

- 1.The basic principles and practical aspects like preparations and characterization in green approach.
- 2.Preparation and characterization of biodiesel from vegetable oil.
- 3.Characterization of biodiesel from vegetable oil.
- 4.Preparation of phthalocyanine complex of Cu(II).
- 5.Mechano chemical solvent free synthesis of azomethine.
- 6.Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).

Contents

1. Preparation and characterization of biodiesel from vegetable oil.
2. Photoreduction of benzophenone to benzopinacol in presence of sunlight.
3. Mechano chemical solvent free synthesis of azomethine.
4. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).
5. Calculation of atom economy for addition, elimination, substitution and rearrangement reactions
6. Aldol condensation in conventional and microwave assisted methods.
7. Microwave assisted reactions using green solvents.

SUGGESTED READINGS

1. Anastas, P.T. & Warner, J.K. (2005). *Green Chemistry- Theory and Practical*. Oxford University Press.
2. Matlack, A.S. (2001). *Introduction to Green Chemistry*. Marcel Dekker
3. Cann, M.C. & Connely, M.E. (2000). *Real-World cases in Green Chemistry*, American Chemical Society. Washington.
4. Ryan, M.A. & Tinnes and, M. (2002). *Introduction to Green Chemistry*. American Chemical Society. Washington.
5. Lancaster, M. (2010). *Green Chemistry: An introductory text*. (2nd Edition). RSC publishing.

20CHU414B**ANALYTICAL CLINICAL BIOCHEMISTRY–
PRACTICAL****3H 1C****Instruction Hours/week: L:0 T:0 P:3****Marks: Internal: 40 External: 60 Total:100****End Semester Exam: 3 hrs****Course outcome**

The course enables the students

- To Identify and estimate the carbohydrates.
- To estimate and identify the lipids.
- To examine the iodine number of oils
- To determine the saponification number of oils.
- To identify the Cholesterol by using Libermann-Burchard reaction.
- To know about the isolation and identification of proteins

Course outcome

The students have to perform

- 1.The Identification and estimation of carbohydrates, iodine number and saponification number of oils
- 2.The Identification and estimation of lipids.
- 3.Estimation of the iodine number of oils
- 4.Determination the saponification number of oils.
- 5.Identify the Cholesterol by using Libermann-Burchard reaction.
6. Known about the isolation and identification of proteins

Contents**Identification and estimation of the following:**

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Bur chard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.
9. Determination of nucleic acids
10. **Test of urine and blood**

SUGGESTED READINGS

1. Cooper, T.G. (1977). *Tool of Biochemistry*. John Wiley and Sons.
2. Keith Wilson & John Walker. (2009). *Practical Biochemistry*. Cambridge University Press.
3. Alan H Gowenlock, (2005). Varley's. *Practical Clinical Biochemistry*. CBS Publisher.
4. Thomas M. Devlin. (2009). *Textbook of Biochemistry*. Academic Internet Publishers.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. (2002). *Biochemistry*. W.H. Freeman.
6. Nelson, D. L. & Cox, M. M. (2013). *Lehninger's Principles of Biochemistry (7th Edition)* W. H. Freeman.
7. Harwood. (1990). *Series on Analytical Chemistry*. John Wiley & Sons.
8. Ahluwalia, V.K. & Dhingra, S. (2000). *Comprehensive Practical Organic Chemistry: Qualitative Analysis*. University Press

UNIT V

20CHU501A	CHEMINFORMATICS	Semester-V
		3H 3C
Instruction Hours/week: L:3 T:0 P:0	Marks: Internal:40	External: 60 Total:100
		End Semester Exam: 3 hrs

Course Objectives

This course enables the students,

- To understand the principles of chem-informatics
- To remember the representation of molecules and chemical reactions
- To understand the search methods using chemical structures
- To know the properties of molecules using computational methods
- To understand how to determine the structures using computer assisted structure elucidations.
- To analyze the chemistry related softwares and applied it to predict the physio-chemical property of unknown compounds

Course Outcomes (CO's)

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

- 1.Explain the principles of chem-informatics
- 2.State the representation of molecules and chemical reactions
- 3.Perform the searching data on the bases of using chemical structures
- 4.Determine the properties of molecules using computational methods
- 5.Determine structures using computer assisted structure elucidations
- 6.Analyzed the chemistry related softwares and applied it to predict the physio-chemical properties of unknown compounds

UNIT I

Introduction To Chemo-Informatics: History and evolution of chemo-informatics, Use of chemo-informatics, Prospects of chemo-informatics, Molecular Modelling and Structure elucidation.

UNIT II

Representation of Molecules and Chemical Reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Mol. files and Sd. files, Libraries and toolkits, Different electronic effects, Reaction classification.

UNIT III

Searching Chemical Structures: Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.

UNIT IV

Applications: Prediction of Properties of Compounds; Linear Free Energy Relations;

UNIT V

Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modelling Toxicity; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra;

Software

Computer Assisted Structure elucidations; Computer Assisted Synthesis Design, Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Chemo-informatics in Drug Design.

SUGGESTED READINGS

1. Andrew R. Leach & Valerie, J. Gillet (2007). *An introduction to Chemoinformatics*. Springer: The Netherlands.
2. Gasteiger, J. & Engel, T. (2003). *Chemoinformatics: A text-book*. Wiley-VCH.
3. Gupta, S. P. (2011). *QSAR & Molecular Modeling*. New Delhi: Anamaya Pub.

Course Objectives

This course enables the students

- To understand the method of preparation of hair dyes, hair spray and shampoos
- To Describe the preparation and uses of lotions
- To Discuss the formulation methods of lipsticks and talcum powder
- To understand the preparation and uses of creams
- To explain the importance of essential oils in cosmetic industry
- To apply the knowledge to prepare the various forms of cosmetic products

Course Outcomes (CO's)

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

- 1.Demonstrate the preparation of hair dyes, hair spray and shampoos
- 2.Describe the preparation and uses of lotions
- 3.Discusse the formulation methods of lipsticks and talcum powder formulations
- 4.Reporte the preparation and uses of creams
- 5.Explaine the importance of essential oil in cosmetic industry.
6. Prepare the various forms of cosmetic products

Unit I

A general study including preparation and uses of the following: Hair dye, hair spray, Shampoo.

Unit II

Preparation and uses of suntan lotions, face powder, lipsticks, talcum powder, nail enamel,

Unit III

Preparation and uses of creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

Unit IV

Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil

Unit V

Essential oils and their importance in cosmetic industries with reference to eucalyptus rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

SUGGESTED READINGS

1. E. Stocchi. (1990).*Industrial Chemistry*. Vol –I. UK : Ellis Horwood Ltd.
2. P.C. Jain, M. Jain (2004).*Engineering Chemistry*. Delhi: Dhanpat Rai & Sons.
3. Sharma, B.K. & Gaur, H. (1996).*Industrial Chemistry*. Meerut : Goel Publishing House.

Course objectives

The course helps the student to

- Apply the applications of cheminformatics in drug design.
- Draw the chemical structure using chemdraw software.
- Molecular docking studies were carried using Autodock software.
- Predict ADME using swissadme software
- Learn Lipinski's rule of five using swissadme software.
- Predict drug likeness

Course outcome

The students know to perform the cheminformatics aspects in the drug designing process.

1. Applied the applications of cheminformatics in drug design.
2. Draw the chemical structure using chemdraw software.
3. Molecular docking studies were carried using Autodock software.
4. Prediction ADME using swissadme software
5. Learn the Lipinski's rule of five using swissadme software.
6. Prediction of drug likeness

Contents**Hands-on Exercises**

Application of Chemo-informatics in Drug Design.

1. Drawing structures using Mervin sketch software's.
2. Solubility of drug molecules using SWISS ADME software.
3. Determination of drug like properties using SWISS ADME software.
4. Determination of bioactivity of compounds using Molinspiration software.
5. Energy stabilisation of a drug structure using ARGUS software.
6. Demonstration of molecular docking.
7. Determination of chemical shifts in NMR spectra.

SUGGESTED READINGS

1. Andrew R. Leach & Valerie, J. Gillet. (2007). *An introduction to Chemoinformatics*. Springer: The Netherlands.
2. Gasteiger, J. & Engel, T. (2003). *Chemoinformatics: A text-book*. Wiley-VCH.
3. Gupta, S. P. (2011). *QSAR & Molecular Modeling*. New Delhi: Anamaya Pub.

Course Objective

This course enables the student to

- To understand the method of preparation of talcum powder, shampoo, hair remover, face cream.
- To explain the formulation methods of enamles and nail polish.
- To Discuss about the how to identify the better cosmetic products.
- To list out the number of ingredients to prepare the powder, shampoo, hair remover, face cream and enamels.
- To explain the preparation of nail polish remover.
- To apply the knowledge to study about various types of preparation techniques of cosmetics.

Course Outcome (CO)

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

- 1.Demonstrate the preparation of talcum powder, shampoo, hair remover, face cream
- 2.Explain the formulation methods of enamels and nail polish
- 3.Discuss about how to identify the better cosmetics products.
- 4.List out the number of ingredients to prepare the powder, shampoo, hair remover, face cream, enamels.
- 5.Explain the preparation of nail polish remover
- 6.Apply the knowledge to study about various types of preparation techniques of cosmetics.

Contents**Preparations of cosmetics and perfumes**

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

SUGGESTED READINGS

1. E. Stocchi. (1990). *Industrial Chemistry*, Vol –I. UK: Ellis Horwood Ltd.
2. P.C. Jain, M. Jain (2004). *Engineering Chemistry*. Delhi: Dhanpat Rai & Sons.
3. Sharma, B.K. & Gaur, H. (1996). *Industrial Chemistry*. Meerut: Goel Publishing House.

Course Objectives

This course enables the student to

1. To remember the history of polymeric materials
2. To list out the various types of polymers
3. To understand the criteria for polymerization and the principle of kinetics of polymerisation
4. To apply the knowledge to understand the Molecular weight and structure property relationship
5. To differentiate the physical and volumetric properties of polymers
6. To discuss about the polymer solutions and polymer structure and its relationship with its properties

Course Outcomes (CO's)

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

1. State the history of polymeric materials
2. List out the various types of polymers
3. Explain the criteria for polymerization and the kinetics in polymerisation
4. Demonstrate the Molecular weight and structure property relationship
5. Differentiate the physical and volumetric properties of various polymers
6. Discuss the polymer solutions, its characterization and polymer structure relationship with its properties.

UNIT I**Introduction and History of Polymeric Materials:**

Introduction and classification including di-block, tri-block and amphiphilic polymers; Polymerisation reactions -Addition and condensation, Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

UNIT II**Kinetics of Polymerization:**

Mechanism and kinetics of step growth, radical chain growth, free radical addition polymerization, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

UNIT III

Structure of Polymers

Nature and structure of polymers-Structure Property relationships.

Determination of molecular weight of polymers (M_n , M_w , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its Significance. Poly-dispersity index.

UNIT IV

Polymer properties

Glass transition temperature (T_g) and determination of T_g , Free volume theory, WLF equation, Factors affecting glass transition temperature (T_g).

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

UNIT V

Polymeric Structure and Property Relationship

Structure of polymers - Linear, branched, cross linked, and network polymers, molecular weight (number average, weight average, viscosity average) and distribution of molecular weight, polydispersity index, crystallinity in polymer, melting temperature and glass transition temperature, Volumetric properties - molar volume, density, Van der Waals volume - Coefficient of linear thermal expansion and volumetric thermal expansion - Pressure volume temperature (PVT) relationship.

SUGGESTED READINGS

1. Seymour R.B., Charles E (2003). *Seymour's Polymer Chemistry: An Introduction*.
2. Marcel Dekker, Inc. G. Odian. (2004). *Principles of Polymerization*. John Wiley.
3. F.W. Billmeyer. (1972). *Text Book of Polymer Science*. John Wiley.
4. P. Ghosh. (2001). *Polymer Science & Technology*. Tata Mcgraw-Hill.
5. R.W. Lenz. (1968). *Organic Chemistry of Synthetic High Polymers*. John Wiley.

Course Objectives

The course enables the students to

- To remember the Synthesis and modification of inorganic solids.
- To describe about the technological importance of inorganic solids
- To understand the Synthesis and properties of nanomaterials
- To understand the knowledge for synthesis of engineering materials used for mechanical construction
- To analyse the Synthesis and properties of composite materials
- To understand the Synthesis and properties of speciality polymers

Course Outcomes (CO's)

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

- 1.State the Synthesis and modification of inorganic solids
- 2.Describe the technological importance of Inorganic Solids
- 3.Illustrate the Synthesis and properties of nanomaterials
- 4.Execute the Synthesis of engineering materials used for mechanical construction
- 5.Determine the properties of composite materials
- 6.Discuss the Synthesis and properties of speciality polymers

UNIT I**Synthesis and Modification of Inorganic Solids:**

Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods.

Inorganic solids of technological importance:

Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry–one-dimensional metals, molecular magnets, inorganic liquid crystals.

UNIT II**Nanomaterials:**

Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites.

UNIT III**Introduction toEngineering Materials for Mechanical Construction:**

Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminium and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.

UNIT IV

Composite Materials:

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.

UNIT V

Speciality Polymers:

Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.

SUGGESTED READINGS

1. Shriver & Atkins. (2014). *Inorganic Chemistry*, Oxford University Press.
2. Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong. (2011-2012). 5th Edition. Oxford University Press.
3. Adam, D.M. (1974) *Inorganic Solids: An introduction to concepts in solid-state structural chemistry*. John Wiley & Sons.
4. Poole, C.P. & Owens, F.J. (2003). *Introduction to Nanotechnology*. John Wiley & Sons.
5. Rodger, G.E. (2002). *Inorganic and Solid State Chemistry*. Cengage Learning India Edition.

Course Objectives

This course enables the students,

- To remember the preparation and properties of compounds with nitrogen containing functional groups.
- To understand the preparation and properties of diazonium salts and polynuclear hydrocarbons.
- To gain a knowledge in the preparation and properties of five and six membered heterocyclic compounds.
- To explain the preparation and properties of fused heterocyclic compounds.
- To understand the preparation and reactions of alkaloids
- To explain the classification, isolation and occurrence of terpenes.

Course Outcomes (CO's)

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

- 1.List the preparation and properties of compounds with nitrogen containing functional groups.
- 2.Discuss the preparation and properties of diazonium salts and polynuclear hydrocarbons.
- 3.Sketch the preparation and properties of five and six membered heterocyclic compounds.
- 4.Explain the preparation and properties of fused heterocyclic compounds.
- 5.Discuss the preparation and reactions of alkaloids & terpenes.
- 6.Explain the classification, isolation and occurrence of terpenes

UNIT I**Nitrogen Containing Functional Groups**

Preparation and important reactions of nitro compounds, nitriles and isonitriles.

Amines: Preparation and properties: Effect of substituent and solvent on basicity; Gabriel phthalimide synthesis, Carbylamines reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

UNIT II

Diazonium Salts: Preparation and their synthetic applications.

Polynuclear Hydrocarbons

Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.

UNIT III

Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis),

UNIT IV

Fused Heterocyclic Compounds

Indole (Fischer indole synthesis and Madelung synthesis), Quinoline and isoquinoline, (Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner- Miller synthesis, Bischler- Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction)

UNIT V

Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action, Hoffmann's exhaustive methylation, Emde's modification; Structure elucidation and synthesis of Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Terpenes

Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral.

SUGGESTED READINGS

1. Morrison, R. T. & Boyd, R. N. (1992). *Organic Chemistry*. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. (2002). *Organic Chemistry*. Volume 1. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. (2002). *Organic Chemistry: Stereochemistry and the Chemistry of Natural Products*. Volume 2. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Acheson, R.M. (1976). *Introduction to the Chemistry of Heterocyclic compounds*. John Welly & Sons.
5. Graham Solomons, T.W. (2012). *Organic Chemistry*. John Wiley & Sons, Inc.
6. Kalsi, P. S. (2009). *Textbook of Organic Chemistry*. 1st Ed. New Age International (P) Ltd. Pub.
7. Clayden, J., Greeves, N., Warren, S. & Wothers, P. (2012). *Organic Chemistry*. Oxford University Press.
8. Singh, J.; Ali, S.M. & Singh, J. (2010). *Natural Product Chemistry*. Prajati Parakashan.

Course Objectives

This course enables the students,

- To remember the general principles of metallurgy
- To understand the properties of S-block elements
- To understand the structures of complexes formed by s-block elements
- To remember the chemistry of p-block elements
- To discuss the oxides, hydrides and oxoacids of p-block elements
- To explain the Preparation, properties, structure and uses of some types of inorganic compounds.

Course Outcomes (CO's)

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

- 1.State the basic principles and methods involved in the metallurgy
- 2.Explain the basic properties of s-block elements and their compounds
- 3.Interpret the complex formation tendency of s-block elements and their structure
- 4.List the basic properties of p-block elements and their compounds.
- 5.Discuss the oxides, hydrides and oxoacids of p-block elements
- 6.Explain the preparation, properties, structure and uses of borazine, silicates, silicones, Inter-halogen compounds, phosphonitrilic and clathrates.

UNIT I**General Principles of Metallurgy**

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 agent. 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.

UNIT II**Chemistry of S Block Elements:**

- (i) General characteristics: melting point, flame colour, reducing nature, diagonal relationships and anomalous behaviour of first member of each group.
- (ii) Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water.
- (iii) Common features such as ease of formation, thermal stability and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates.

UNIT III**Complexes of S-Block Elements:**

- (i) 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.
- (ii) Solutions of alkali metals in liquid ammonia and their properties.

UNIT IV

Chemistry of P Block Elements:

Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electro-negativity, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group.

Structure, bonding and properties: acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat of the following:

- Hydrides : hydrides of Group 13 (only diborane), Group 14, Group 15 (EH_3 where E = N, P, As, Sb, Bi), Group 16 and Group 17.
Oxides : oxides of phosphorus, sulphur and chlorine
Oxoacids : oxoacids of phosphorus and chlorine; peroxy acids of sulphur
Halides: halides of silicon and phosphorus

UNIT V

Preparation, Properties, Structure and Uses of The Following Compounds:

Borazine

Silicates, silicones,

Phosphonitrilic halides $\{(\text{PNCl}_2)_n \text{ where } n = 3 \text{ and } 4\}$

Interhalogen and pseudohalogen compounds

Clathrate compounds of noble gases, xenon fluorides (MO treatment of XeF_2).

SUGGESTED READINGS

1. Lee, J.D. (2008). *Concise Inorganic Chemistry (5th Edition)*. Pearson Education.
2. Lee, J.D. (2019). *Concise Inorganic Chemistry (4th Edition)*. Pearson Education
2. Douglas .B.E, Mc Daniel, D.H. & Alexander J.J. (1997). *Concepts and Models of Inorganic Chemistry. 3rdEd.* N.Y. : John Wiley Sons.
3. Madan, R. L. (2015). *Chemistry for Degree Students*, S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi.
4. Greenwood, N.N. & Earnshaw. (2005). *Chemistry of the Elements*, Butterworth- Heinemann.
5. Cotton, F.A. & Wilkinson, G. Carlos A. Murillo and Bochmann, (2007). *Advanced Inorganic Chemistry*. Wiley, VCH.
6. Miessler, G. L. & Donald, A. Tarr. (2011). *Inorganic Chemistry. 5thEd.* (adapted). Pearson,
7. Shriver, D.F., Atkins P.W & Langford, C.H. (2010). *Inorganic Chemistry. 5th Ed.* Oxford University Press.

20CHU512A	POLYMER CHEMISTRY– PRACTICAL	Semester-V
Instruction Hours/week:L:0 T:0 P:4	Marks: Internal:40 External: 60 Total:100	4H 2C
		End Semester Exam: 3 hrs

Course Objectives

This course enables the students,

- To experience the preparation of different types of polymers by various methods
- To understand the purification process of polymers
- To explain the characterisation of polymers by chemical methods.
- To prepare isophthaloyl chloride
- To determine hydroxyl number of a polymer using colorimetric method
- To analyse the polymers using instrumental method

Course outcome (CO's)

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

- 1.Prepare different types of polymers by various methods
- 2.Execute the purification technique for few polymers
- 3.Determine the properties of polymers by chemical and instrumental methods.
- 4.Prepare isophthaloyl chloride
- 5.Determine hydroxyl number of a polymer using colorimetric method
- 6.Analyse the polymers using instrumental method

Contents

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
 - a. Purification of monomer
 - b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutyronitrile (AIBN)
2. Preparation of nylon 66/6
 1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
 - a. Preparation of IPC
 - b. Purification of IPC
 - c. Interfacial polymerization
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Micro-scale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
 - (a) Polyacrylamide-aq.NaNO₂ solution
 - (b) (Poly vinyl propylidene (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of —head-to-head— monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).

4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis
*at least 7 experiments to be carried out.

SUGGESTED READINGS

1. Malcohm P. Stevens (1999). *Polymer Chemistry: An Introduction*. 3rd Ed. Oxford University Press.
2. Harry R. Allcock, Frederick W. Lampe and James E. Mark, (2003). *Contemporary Polymer Chemistry*. 3rd ed. Prentice-Hall
3. Fred W. Billmeyer, (1984). *Textbook of Polymer Science*. 3rd ed. Wiley-Interscience
4. Joel R. Fried, (2003). *Polymer Science and Technology*. 2nd ed. Prentice-Hall.
5. Petr Munk & Tejraj M. Aminabhavi, (2002). *Introduction to Macromolecular Science*. 2nd ed. John Wiley & Sons
6. L. H. Sperling, (2005). *Introduction to Physical Polymer Science*. 4th ed. John Wiley & Sons.
7. Malcolm P. Stevens, (2005). *Polymer Chemistry: An Introduction*. 3rd ed. Oxford University Press.
8. Charles E. Carraher, (2013). *Seymour/ Carraher's Polymer Chemistry*. 9th ed. Jr.

Course objectives

The course helps the student to

- Explain the ion exchange method
- Explain the cation exchange method
- coprecipitation methods of novel inorganic solids
- Discuss the method for the preparation of nanoparticles
- Nano particle preparation using green method
- Prepare the hydrogel by coprecipitation method

Course outcome

The students have demonstrated

- 1.The cation exchange method
- 2.The ion exchange method
- 3.coprecipitation methods of novel inorganic solids
- 4.The method for the preparation of nanoparticles
- 5.Nano particle preparation using green method
- 6.Preparation of the hydrogel by coprecipitation method

Contents

Preparation of nano particles, co-precipitation method

1. Determination of cation exchange method
2. Determination of total difference of solids.
3. Synthesis of hydro-gel by co-precipitation method.
4. Synthesis of metal nanoparticles.
5. Interpretation of FTIR, NMR and UV-Vis data of given material.
6. Analysis of XRD pattern of few selected crystals like NaNO_3 , CaCl_2 , etc.; Indexing of a given powder diffraction pattern of a cubic crystalline system.
7. Estimation of particle size from the BET, SEM techniques.

SUGGESTED READING

1. Fahlman, B.D. (2004). *Materials Chemistry*, Springer.

**20CHU513 NITROGEN CONTAINING FUNCTIONAL GROUPS,
HETEROCYCLIC CHEMISTRY AND NATURAL PRODUCTS - PRACTICAL****4H 2C****Instruction Hours/week:L: 0 T:0 P:4****Marks: Internal:40****External: 60 Total:100****End semester exam: 3 hrs****Course Objectives**

This course enables the students,

- To understand the presence of nitro, amine and amide groups
- To understand the procedures the qualitative analysis of nitrogen containing functional groups.
- To Identify the functional groups like phenols , carbonyl compounds and esters
- To disinguish the various functional groups among the organic compounds
- To observe the characteristic changes of various types of organic compounds
- To apply this knowledge to identify the unknown or new organic compounds.

Course Outcomes (CO's)

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

1. Identify the functional group tests for nitrogen containing organic compounds
2. Understand the qualitative analysis procedure for nitrogen containing functional group compounds.
3. Experiment the tests to Identify the functional groups like alcohols, carboxylic acids, phenols, carbonyl compounds and esters
4. Disinguish the various functional groups among the organic compounds
5. Observe the characteristic changes of various types of organic compounds
6. Apply this knowledge to identify the unknown or new organic compounds.

Contents

1. Functional group test of nitro, amine and amide groups.
2. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, carbonyl compounds and esters)
3. Identification of the nitrogen containing functional groups by spectroscopic method

SUGGESTED READINGS

1. Mann, F.G. & Saunders, B.C. (2009). *Practical Organic Chemistry*. Pearson Education
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. (2012). *Practical Organic Chemistry*. 5th Ed. Pearson.
3. Ahluwalia, V.K. & Aggarwal, R. (2000). *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*. University Press
4. Ahluwalia, V.K. & Dhingra, S. (2000). *Comprehensive Practical Organic Chemistry: Qualitative Analysis*. University Press.

20CHU514

INORGANIC CHEMISTRY III:**Metallurgy and S-Block and P-block elements - PRACTICAL****4H 2C****Instruction Hours/week:L: 0 T:0 P:4****Marks: Internal:40****External: 60 Total:100****End Semester Exam: 3 hrs****Course Objectives**

This course enables the students,

- To understand iodometric method for the metal ions estimation
- To apply the principles of complexometric titrations using EDTA for estimation metal ions
- To carry out the preparations of inorganic metal complexes.
- To know about the importance of indicator
- To observe the difficulties to estimate different metals by using EDTA method.
- To apply this knowledge to identify and estimate the metal atoms in various solutions

Course Outcomes (CO's)

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

1. Carryout the estimation of metal ions by iodometric and complexometric titration methods.
2. Demonstrate the preparation of s and p-block metal complexes.
3. Prepare the inorganic metal complexes
4. Know about the importance of indicator
5. Observe the difficulties to estimate different metals by using EDTA method.
6. Apply this knowledge to identify and estimate the metal atoms in various solutions

Contents**(A) Iodo / Iodimetric Titrations**

- (i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodometrically).
- (ii) Estimation of Potassium dichromate using sodium thiosulphate solution iodimetrically

(B) Complexometric titrations using disodium salt of EDTA

- (i) Estimation of Mg^{2+} , Zn^{2+}
- (ii) Estimation of Ca^{2+} by substitution method

(C) Inorganic preparations

- (i) Cuprous Chloride, Cu_2Cl_2
- (ii) Manganese (III) phosphate, $MnPO_4 \cdot H_2O$
- (iii) Aluminium potassium sulphate $KAl(SO_4)_2 \cdot 12H_2O$ (Potash alum) or Chrome alum.

SUGGESTED READINGS

1. Vogel, A.I. (1978). A Textbook of Quantitative Inorganic Analysis, ELBS.
2. Marr, G. and Rockett, R.W. (1972). Practical Inorganic Chemistry, Van Nostrand Reinhold.
3. Deepak Pant, P. (2010). Inorganic Chemistry Practical, Book Rix.

Course Objectives

This course enables the students,

- 1.To understand the interdisciplinary nature of analytical chemistry
- 2.To describe the various methods involved in the analysis of soil
- 3.To explain the various methods involved in the analysis of water
- 4.To discuss the basic concepts of chromatographic techniques
- 5.To understand the various methods involved in the analysis of food products
- 6.To apply the various methods involved in the analysis of cosmetics

Course Outcomes (CO's)

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

- 1.Discuss the interdisciplinary nature of analytical chemistry
- 2.Discriminate various methods involved in the analysis of soil
- 3.Execute the various methods involved in the analysis of water
- 4.Discuss the basic concepts of chromatographic technique
- 5.Explain the various methods involved in the analysis of food products
- 6.Demonstrate the various methods involved in the analysis of cosmetics

UNIT I

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

UNIT II

Analysis of Soil: Composition of soil, Concept of pH and pH measurement, Complexo-metric titrations, Chelation, Chelating agents, use of indicators

- a. Determination of pH of soil samples.

UNIT III

Analysis of Water and air: Definition of pure water, sources responsible for contaminating water-water sampling methods, water purification methods.

- a. Determination of dissolved oxygen (DO) of a water sample.
- b. Analysis of air quality in surrounding atmosphere, Determination of CO₂ and N₂ in the atmospheric air

UNIT IV

Analysis of Food Products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

- a. Identification of adulterants in some common food items like coffee powder, as afoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

- b. Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

- a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).

b. Basic principles and analysis of simple molecules using HPLC and LCMS

UNIT V

Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of Cosmetics: Major and minor constituents and their function

- a. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexo-metric titration.

SUGGESTED READING

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. (1988). *Instrumental Methods of Analysis* (7th Edition). Belmont, California, USA: Wadsworth Publishing Co. Ltd.
2. Skoog, D.A. Holler F.J. & Nieman, T.A. (1998). *Principles of Instrumental Analysis*, Cengage Learning India Ed.
3. Skoog, D.A.; West, D.M. & Holler, F.J. (1992). *Fundamentals of Analytical Chemistry* 6thEd.Fort Worth: Saunders College Publishing.
4. Harris, D. C. (2006). *Quantitative Chemical Analysis*. W. H. Freeman and Company Ltd., Dean, J. A. (1992). *Analytical Chemistry Notebook*. McGraw Hill.
5. Day, R. A. & Underwood, A. L. (1991). *Quantitative Analysis*. Prentice Hall of India.
6. Freifelder, D. (1982). *Physical Biochemistry* (2nd Edition).N.Y. USA: W. H. Freeman and Co.
7. Cooper, T.G. (1977). *The Tools of Biochemistry*. N.Y. USA: John Wiley and Sons.
8. Robinson, J.W. (1995). *Undergraduate Instrumental Analysis* (5th Edition).New Delhi: Marcel Dekker Inc.,

Course Objectives

This course enables the students,

- To understand the synthesis and manufacture of many natural and synthetic fertilizers
- To explain about the classification, toxicity and action of pesticides
- To discuss the classification, physical and chemical properties of insecticides.
- To understand the synthesis and manufacture of organochlorines and organophosphorous compounds
- To apply the knowledge about the synthesis and manufacture of quinine pesticides
- To describe the herbicides and weedicides.

Course Outcomes (CO's)

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

1. Recognize the synthesis and manufacture of many natural and synthetic fertilizers
2. Explain the classification, toxicity and action of pesticides
3. Discuss the classification, physical and chemical properties of insecticides.
4. Discuss the synthesis and manufacture of organochlorines and organophosphorous compounds
5. Demonstrate the synthesis and manufacture of quinine pesticides
6. Describe the herbicides and weedicides.

Unit I

General introduction to pesticides (natural and synthetic) and **weedicides**, benefits and adverse effects. **Pesticide classification on use, chemical nature, formulation, toxicity and action.**

Unit II

Changing concepts of pesticides, structure activity relationship.

Insecticides: Classification and Study of following insecticides with respect to structure, chemical name, Physical properties, chemical properties, Mode of action, uses and toxicity.

Organo phosphates: Acephate, Dimethoate, Chlorpyrifos.

Organochlorines: Endosulfan,

Carbamate: Cartap hydrochloride, Methomyl, Carbamate.

Amides and similar functions: Rynaxypyr, Phthalic dicarboxamide,

Unit III

Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,), **Dimethyl phthalate, Ethylene oxide, Copper Sulphate.**

Unit IV

Synthesis and technical manufacture and uses of Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl)

Unit V

Synthesis and technical manufacture and uses of Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Herbicides and weedicides: Selective and non-selective, 2, 4-D and 2, 4, 5-t (structure and function)

SUGGESTED READING

1. Cremllyn, R. (1978). *Pesticides. Preparation and Modes of Action*. New York: John Wiley & Sons.

Course objectives

The course enables the students have

- To interpret the interdisciplinary nature of analytical chemistry
- To explain the various methods involved in the analysis of soil ,
- To estimate the BOD and COD level of water
- To analysis food products by using spectrometric method
- To determine the pH values of soil, shampoo, soap and aerated drinks
- To distinguish the glucose and fructose by using paper chromatography
- To study about the concepts of flame photometry and applid it to identify the metal atoms present in various types of aerated drinks

Course outcome

The course enables the students have to

1. Interpret the interdisciplinary nature of analytical chemistry
- 2.Explain the various methods involved in the analysis of soil ,
- 3.Estimate the BOD and COD level of water
- 4.Analysis of food products by using spectrometric method
- 5.Determine the pH values of soil, shampoo, soap and aerated drinks
- 6.Distinguish the glucose and fructose by using paper chromatography
- 7.Understand the concepts of flame photometry and identify the metal atoms present in various types of aerated drinks

Contents**Experiments (Any seven)**

1. Separation and identification of the monosaccharides present in the given mixture (glucose &fructose) by paper chromatography. Reporting the R_f values.
2. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC
3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.
5. Determination of pH of soil.
6. Determination of Total soluble salt in a soil.
7. Structural characterization of compounds by infrared spectroscopy.
8. Determination of chemical oxygen demand (COD).
9. Determination of Biological oxygen demand (BOD).
10. To study the use of phenolphthalein in traps cases.
11. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

SUGGESTED READING

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. (1988). *Instrumental Methods of Analysis*. 7th Ed. Belmont, California, USA: Wadsworth Publishing Co. Ltd.
2. Skoog, D.A. Holler F.J. & Nieman, T.A.(1998). *Principles of Instrumental Analysis*, Cengage Learning India Ed.

3. Skoog, D.A.; West, D.M. & Holler, F.J.(1992).*Fundamentals of Analytical Chemistry* 6th Ed. Fort Worth :Saunders College Publishing.
4. Harris, D. C. (2006). *Quantitative Chemical Analysis*. W. H. Freeman and Company Ltd.,
5. Dean, J. A. (1992). *Analytical Chemistry Notebook*. McGraw Hill.
6. Day, R. A. & Underwood, A. L. (1991). *Quantitative Analysis*. Prentice Hall of India.
7. Freifelder, D. (1982).*Physical Biochemistry*.2nd Ed. N.Y. USA: W.H. Freeman and Co.
8. Cooper, T.G. (1977).*The Tools of Biochemistry*.16.N.Y. USA: John Wiley and Sons.
9. Robinson, J.W.(1995). *Undergraduate Instrumental Analysis*.5th Ed. New Delhi:Marcel Dekker Inc.,

20CHU611B PESTICIDE INSECTICIDE AND HERBICIDE CHEMISTRY**CHEMISTRY-PRACTICAL****3H 1C****Instruction Hours/week: L:0 T:0 P:3****Marks: Internal: 40 External: 60 Total:100****End Semester Exam: 3 hrs****Course Objectives**

This course enables the student,

- To determine the acidity in given sample of pesticide formulation
- To estimate the alkalinity in given sample of pesticide formulation.
- To synthesis of simple organophosphates
- To understand the preparation techniques of phosphonates and thiophosphates.
- To identify the pesticide compositions in fruits and vegetables.
- To interpret the pesticide compounds from UV, IR, PMR and Mass data.

Course Outcomes (CO's)

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

- 1.Evaluate acidity in given sample of pesticide formulation
- 2.Estimate the alkalinity in given sample of pesticide formulation
- 3.Carryout the synthesis of simple organophosphates
- 4.Prepare the phosphonates and thiophosphates
- 5.Identify the pesticide composition in fruits and vegetables.
- 6.Interpret the pesticide compounds using spectral data.

Contents

1. To calculate acidity/alkalinity in given sample of pesticide formulations.
2. Preparation of simple organophosphates, phosphonates and thiophosphates
3. Identification of pesticides in fruits and vegetables.
4. Identification of pesticides on the basis of given UV, IR, PMR and Mass data

Suggested Reading

1. Cremlyn, R. (1978). *Pesticides. Preparation and Modes of Action*. New York: John Wiley & Sons.

Course Objectives

This course enables the students,

1. To remember the theoretical principles in qualitative Analysis to identify the cations and anions
2. To understand the classification of organometallic compounds based on bond type
3. To analyse few important metal complexes of commercial importance
4. To understand the catalytic property of organometallic compounds.
5. To distinguish the ferrocene and benzene compounds
6. To analyse the Metal ions present in biological systems

Course Outcomes (CO's)

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

1. State the theoretical principles in qualitative analysis to identify the cations and anions.
2. Discriminate the types of organometallic compounds based on bond type.
3. Discuss the commercial importance of important metal complexes.
4. Describe the catalytic property of organometallic compounds.
5. Distinguish the ferrocene structure, properties from benzene.
6. Explain the importance of metal ions present in biological systems.

UNIT I**Theoretical Principles in Qualitative Analysis (H₂S Scheme)**

Basic principles involved in analysis of cations and anions. Solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

UNIT II**Organometallic Compounds**

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT.

UNIT III**Metal Carbonyls and Metal Alkyls**

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds.

UNIT IV

Reaction in Aromatic Benzene

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

EAN rule as applied to carbonyls, preparation, properties and structure of polynuclear carbonyls, VB and MO diagram of CO can be referred for synergic effect to IR frequencies.

UNIT V

Application of Organometallic Compounds

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxy peptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine, Cisplatin as an anti-cancer drug. Iron and its application in bio-systems, Haemoglobin, Myoglobin; Storage and transfer of iron.

Application in catalysis process-Wilkinson's catalyst, Ziegler-Natta catalyst

SUGGESTED READINGS

1. Cotton, F.A., Wilkinson, G., & Gaus, P.L. (1993). *Basic Inorganic Chemistry*. 3rd Ed. Wiley India.
2. Huheey, J. E., Keiter, E.A. & Keiter, R.L. (2006). *Inorganic Chemistry: Principles of Structure and Reactivity*. 4th Ed. Harper Collins. Pearson.
3. Sharpe, A.G. (2005). *Inorganic Chemistry*, 4th Indian Reprint. Pearson Education.
4. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. (1994). *Concepts and Models in Inorganic Chemistry* (3rd Edition). NY: John Wiley and Sons.
5. Greenwood, N.N. & Earnshaw, A. (1997). *Chemistry of the Elements* (2nd Edition), Elsevier, (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
6. Lee, J.D. (2008). *Concise Inorganic Chemistry* (5th Edition). John Wiley and sons.
7. Powell, P. (1988). *Principles of Organometallic Chemistry*, Chapman and Hall.
8. Shriver, D.D., Atkins, P. and Langford, C.H. (1994). *Inorganic Chemistry* (2nd Edition). Oxford University Press.
9. Miessler, G. L. & Tarr, Donald A. (2010). *Inorganic Chemistry* (4th Edition). Pearson.
10. Crabtree, Robert H. (2000). *The Organometallic Chemistry of the Transition Metals*. NY: John Wiley New York.
11. Spessard, Gary O., & Miessler, Gary L. (1996). *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall.

Course Objectives

This course enables the students,

- To remember the kinetic molecular model of a gas and about the molecular velocities
- To understand about the behaviour of real gases
- To understand the structure of the liquid state and its properties like surface tension and viscosity.
- To analyse the solid state, symmetries present and different types of crystals.
- To remember the theory of ionic equilibria, ionisation of electrolytes and salt hydrolysis.
- To prepare the buffer solutions for acid-base titrations.

Course Outcomes (CO's)

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

- 1.State the postulates of kinetic theory of gases, kinetic molecular model of gases and about the molecular velocities
- 2.Explain, why real gases deviate from ideal gases, Vander Waals equation of state and about critical constants.
- 3.Correlate the structure of the liquid state and its properties.
- 4.Distinguish the solid state, symmetries present and different types of crystals.
- 5.Explain the theory of ionic equilibria, ionisation of electrolytes and salt hydrolysis.
- 6.Formulate the buffer solutions and the choice of indicators to acid-base titrations.

UNIT I

Gaseous State: Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η ; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equi-partition of energy, degrees of freedom and molecular basis of heat capacities.

UNIT II

Behaviour of Real Gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature. Isotherms of real gases and their comparison with Van der Waals isotherms, continuity of states, critical state, relation between critical constants and Van der Waals constants, law of corresponding states.

Liquid state: Qualitative treatment of the structure of the liquid state; physical properties of liquids, vapour pressure, surface tension coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

UNIT III

Solid State: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.

UNIT IV

Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; Ostwald dilution law, dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

UNIT V

Electro-Chemistry: Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid– base indicators; selection of indicators and their limitations.

SUGGESTED READINGS

1. Atkins, P. W. & Paula, J. de Atkin's. (2006). *Physical Chemistry*. Oxford University Press.
2. Ball D. W. (2007). *Physical Chemistry*. India: Thomson Press.
3. Madan, R. L. (2015). *Chemistry for Degree Students*, S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi.
4. Castellan, G. W. (2004). *Physical Chemistry (4th Edition)*. Narosa.
5. Mortimer, R. G. (2009). *Physical Chemistry (3rd Edition)*. NOIDA, UP: Elsevier.

Course Objectives

This course enables the students,

- To understand how to identify the anions and the cations in a mixture by qualitative semi-micro analysis
- To identify the interfering anion
- To remember the principles behind the spot tests
- To observe the characteristics of various metal ions
- To classify the characteristics of various anions
- To apply the principles of chromatography for ion separations

Course Outcomes (CO's)

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

1. Identify the anions and the cations in a mixture by qualitative semi micro analysis.
2. Eliminate the interfering anion.
3. Carry out the spot tests.
4. Observe the characteristics of various metal ions
5. Classify the characteristic of various anions.
6. Separate metal ion using chromatographic technique.

Contents

Qualitative semi-micro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

CO_3^{2-} , NO_2^- , S^{2-} , SO_3^{2-} , $\text{S}_2\text{O}_3^{2-}$, CH_3COO^- , F^- , Cl^- , Br^- , I^- , NO_3^- , BO_3^{3-} , $\text{C}_2\text{O}_4^{2-}$, PO_4^{3-} , NH_4^+ , K^+ , Pb^{2+} , Cu^{2+} , Cd^{2+} , Bi^{3+} , Sn^{2+} , Sb^{3+} , Fe^{3+} , Al^{3+} , Cr^{3+} , Zn^{2+} , Mn^{2+} , Co^{2+} , Ni^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , Mg^{2+}

Mixtures should preferably contain one interfering anion, **or** insoluble component (BaSO_4 , SrSO_4 , PbSO_4 , CaF_2 or Al_2O_3) **or** combination of anions e.g. CO_3^{2-} and SO_3^{2-} , NO_2^- and NO_3^- , Cl^- and Br^- , Br^- and I^- , NO_3^- and Br^- , NO_3^- and I^-

Spot tests should be done whenever possible.

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

- i. Ni (II) and Co (II)
- ii. Cu (II) and Cd(II)

SUGGESTED READING

1. Svehla, G. (1996) *Vogel's Qualitative Inorganic Analysis*, Longman, New York.

20CHU613

**PHYSICAL CHEMISTRY IV: STATES OF MATTER
AND IONIC EQUILIBRIUM-PRACTICAL**

4H 2C

Instruction Hours/week:L: 0 T:0 P:4

Marks: Internal:40

External: 60 Total:100

End Semester Exam: 3 hrs

Course Objectives

This course enables the students,

1. To determine the surface tension of a liquid.
2. To determine the viscosity of a liquid.
3. To distinguish the surface tension of different concentration of detergent solutions.
4. To prepare a buffer solution and to measure its pH.
5. To understand the concepts of diffraction methods
6. To analyze the pH of a solution during the course of a titration.

Course Outcomes (CO's)

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

1. Check the surface tension of a liquid.
2. Determine the viscosity of a liquid.
3. Distinguish the surface tension of different concentration of detergent solutions.
4. Determine the pH of a buffer solution.
5. Understand the concepts of diffraction methods.
6. Test the pH of a solution during the course of a titration.

Contents**1. Surface tension measurements**

- a. Determination of the surface tension of a liquid.
- b. Study the variation of surface tension with different concentration of detergent solutions.

2. Viscosity measurement.

- a. Determination of co-efficient of viscosity of an unknown aqueous solution.
- b. Study the variation of co-efficient of viscosity with different concentration of Poly Vinyl Alcohol (PVA) and determine molar of PVA.
- b. Study the variation of viscosity with different concentration of sugar solutions.

3. Solid State:

- a. Indexing of a given powder diffraction pattern of a cubic crystalline system.

4. pH metry:

- a. Study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures.
- b. Preparation of buffer solutions of different pH values (i). Sodium acetate-acetic acid (ii).Ammonium chloride-ammonium hydroxide
- c. pH metric titration of (i) strong acid with strong base, (ii) weak acid with strong base.
- d. Determination of dissociation constant of a weak acid.

SUGGESTED READINGS

1. Khosla, B. D., Garg, V. C. & Gulati, A.(2011).*Senior Practical Physical Chemistry*. New Delhi: R. Chand &Co.
2. Garland, C. W., Nibler, J. W. & Shoemaker, D. P. (2003). *Experiments in Physical Chemistry*.8th Ed. New York: McGraw-Hill.
3. Halpern, A. M. & McBane, G. C. (2003).*Experimental Physical Chemistry*.3rd Ed. New York: W. H. Freeman & Co.

20CHU691**PROJECT WORK****Semester-VI****8H 6C****Instruction Hours/week: L:0 T:0 P:8****Marks: Internal: 40 External: 60 Total:100**
