DEPARTMENT OF CHEMISTRY

Curriculum and Syllabus for

BSc Chemistry Programme

Under Choice Based Credit System

(Outcome Based Education with Effect from 2022 Admissions)

St Berchmans College
Founded 1922
AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade
CHANGANASSERY, KERALA

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Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

ACKNOWLEDGEMENT

The basic aim of this curriculum is to give sound knowledge and understanding of chemistry at undergraduate level. The new syllabus will definitely make the study more relevant and interesting. It will equip students to contribute to academic and industrial fields. The interdisciplinary approach and new laboratory techniques adds flavour to the new curriculum.

Outcome Based Education (OBE) is a student-centric teaching and learning methodology in which the course delivery and assessment are planned to achieve the stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels. The introduction of Outcome Based Education will definitely help the students to self-assess the attributes they achieve during their undergraduate study.

I use this opportunity to thank all those who toiled a lot to draft the syllabus in OBE mode. Thanks to college authorities and curriculum revision committee for arranging various training programmes for the preparations to introduce OBE in the curriculum. Special thanks to external members of the Board of Studies comprising **Dr. Mahesh Hariharan** (Professor, Indian Institute of Science Education and Research (IISER),Thiruvananthapuram), **Dr. Suneesh C. V.** (Associate Professor, University of Kerala, Thiruvananthapuram), **Dr. G. Anilkumar**, (Professor, School of Chemical Sciences, Mahatma Gandhi University, Kottayam), **Dr. Jubi John** (Senior Scientist, National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram) and **Mr. Davis Louis** (Managing Director, Highrange Rubber & Coir Products (P) Ltd., Changanassery). Let me thank my beloved colleagues of the department for taking much pain and patience for drafting the UG syllabus as per OBE mode.

Dr. Tomlal Jose E
Chairman of Board of Studies

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REGULATIONS FOR UNDERGRADUATE PROGRAMMES (BA/BSc/BCom/BCA) UNDER CHOICE BASED CREDIT SYSTEM 2022 (SB - UG - CBCS - 2022)

1. SHORT TITLE

1.1 These Regulations shall be called St. Berchmans College (Autonomous) Regulations governing undergraduate programmes under Choice Based Credit System 2022.

1.2 These Regulations shall come into force with effect from the academic year 2022 - 23 admissions onwards with outcome based education.

2. SCOPE

2.1 The regulation provided herein shall apply to all regular undergraduate programmes, BA/BSc/BCom/BCA, conducted by St. Berchmans College (Autonomous) with effect from 2022 - 23 admissions onwards.

2.2 Medium of instruction is English, except in the case of language courses other than English unless otherwise stated therein.

3. DEFINITIONS

3.1 'University' means Mahatma Gandhi University, Kottayam, Kerala.

3.2 'College' means St. Berchmans College (Autonomous) Changanassery.

3.3 There shall be an Academic Committee nominated by the Principal to look after the matters relating to the SB – UG - CBCS.

3.4 'Academic Council' means the Committee consisting of members as provided under section 107 of the University Laws Bill 2021, Government of Kerala.

3.5 'Parent Department' means the Department, which offers a particular undergraduate programme.

3.6 'Department Council' means the body of all teachers of a Department in the College.

3.7 'Faculty Mentor' is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities of the undergraduate programme undertaken in the Department.

3.8 Outcome-Based Education (OBE) is a student-centric teaching and learning methodology in which the course delivery and assessment are planned to achieve stated objectives and outcomes.

3.9 'Programme Outcome (PO)s' are statements that describe what students are expected to know and be able to do by the time of graduation.

3.10 'Programme Specific Outcome (PSO)s' are statements that describe what the graduates of a specific programme should be able to do.

3.11 'Course Outcome (CO)s' describe what students should be able to do at the end of a course.

3.12 'Programme' means a three-year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.

3.13 'Duration of Programme' means the period of time required for the conduct of the programme. The duration of an undergraduate programme shall be six (6) semesters.

3.14 'Semester' means a term consisting of a minimum 90 working days, inclusive of tutorials, examination days and other academic activities within a period of six months.

3.15 'Course' means a portion of a subject to be taught and evaluated in a semester.

3.16 'Course Teacher' means the teacher who is engaging classes on the course.

3.17 'Core Course' means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

3.18 'Complementary Course' means a course, which would enrich the study of core courses.

3.19 'Common Course I' means a course that comes under the category of courses of English.

3.20 'Common Course II' means additional language, which can be opted by a student, from among the languages offered by the College.

3.21 The Common Course I and II is compulsory for all students undergoing Model I and Model II programmes.

3.22 'Open Course' means a course offered by the departments other than the parent department outside the field of specialization of the student, which can be opted by a student.

3.23 'Choice Based Core Course' means a course, that enables the students to familiarize the advanced areas of Core Course.

3.24 'Vocational Course' means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

3.25 'Frontier course' is a new area of study that introduces the students to an emerging field that is related to the core subject.

3.26 'Extra Credit Course' means a course opted by the students, in addition to the compulsory courses, in order to gain additional credit that would boost the performance level and additional skills.

3.27 Extra credit courses shall be completed by working outside the regular teaching hours.

3.28 There will be two categories of extra credit courses, mandatory and optional. If a candidate fails to complete the mandatory course, he/she shall complete the same within the tenure of the programme. The details of the extra credit courses are given below:

Name	Semesters	Type	Credit
Value Education	I to VI	Compulsory	3
Basic Life Support System and Disaster Management (BLS & DM)	I	Compulsory	1
Social Awareness Course (SAC)	I and II	Compulsory	2
Skill Development Courses (SDC)	II and III	Compulsory	2
Industry Familiarisation Course	IV	Compulsory	2
Finishing School	III and IV	Compulsory	1
Virtual Lab	V	Optional	1
Massive Open Online Courses	I to V	Optional	Variable
Interdisciplinary Research	I to V	Optional	3

3.29 'On the Job Training' means a job training course given to the students to acquaint them with various industrial skills.

3.30 'Project' means a regular project work with stated credits on which the student conducts a project under the supervision of a teacher in the parent department/any appropriate research centre in order to submit a dissertation on the project work as specified.

3.31 'Dissertation' means a minor thesis to be submitted at the end of a research work carried out by each student on a specific area.

3.32 'Plagiarism' is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

3.33 'Seminar' means a lecture expected to train the student in self-study, collection of relevant matter from books and internet resources, editing, document writing, typing and presentation.

3.34 'Improvement Examination' is an examination conducted to improve the performance of a student in the courses of a particular semester as per the examination manual.

3.35 'Supplementary Examination' is an examination conducted for students who fail in the courses of a particular semester as per the examination manual.

3.36 The minimum credits, required for completing an undergraduate programme is one hundred and twenty (120).

3.37 'Credit' (C) of a course is a measure of the weekly unit of work assigned for that course in a semester.

3.38 'Course Credit': One credit of the course is defined as a minimum of one (1) hour lecture/minimum of two (2) hours laboratory/field work per week for eighteen (18) weeks in a semester. The course will be considered as completed only by conducting the final examination.

3.39 'Grade' means a letter symbol (A, B, C etc.) which indicates the broad level of performance of a student in a course/semester/programme.

3.40 'Grade Point' (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

3.41 'Credit Point' (CP) of a course is the value obtained by multiplying the grade point (GP) by the credit (C) of the course.

3.42 'Semester Credit Point Average' (SCPA) of a semester is calculated by dividing total credit points obtained by the student in a semester by total credits of that semester and shall be rounded off to two decimal places.

3.43 'Cumulative Credit Point Average' (CCPA) is the value obtained by dividing the sum of credit points in all the courses obtained by the student for the entire programme by the total credits of the whole programme and shall be rounded off to two decimal places.

3.44 'Institution Average' is the value obtained by dividing the sum of the marks obtained by all students in a particular course by the number of students in the respective course.

3.45 'Grace Marks' means marks awarded to course/courses as per the choice of the student, in recognition of meritorious achievements of a student in NCC/NSS/sports/arts and cultural activities.

3.46 Rank certificate shall be issued to candidates who secure positons from one to three. Position certificate shall be issued on request from fourth position to tenth position. Candidates shall be ranked in the order of merit based on the CCPA scored by them. Grace marks awarded to students shall not be counted for fixing rank/position. The rank and position certificate shall be signed by the Principal and Controller of Examinations.

4. PROGRAMME STRUCTURE

4.1. The programme shall include core courses, vocational courses, frontier course, complementary courses, common courses, open course and choice based core courses. There shall be a project/dissertation to be undertaken by all students. The programme will also include assignments, seminars, practical, viva-voce, OJT, field visit, industry visit, field project etc., if they are specified in the curriculum.

Study tour/field visit/industrial visit/visit to research institutes/visit to historical places/cultural and heritage centres etc. shall be conducted during the fifth or sixth semester as part of the curriculum.

4.2. Total credits for a programme is one hundred and twenty (120). The credit distribution for various UG programmes is shown below.

Model I BA/BSc

i.	Programme duration	6 Semesters
ii.	Total credits required for successful completion of the programme	120
iii.	Minimum credits required from Core + Choice based core course + Project + Complementary courses	79
iv.	Minimum credits required from Common course I	22
v.	Minimum credits required from Common course II	16
vi.	Minimum credits required from Open course	3
vii.	Minimum attendance required	75%

Model II BA

i.	Programme duration	6 Semesters
ii.	Total credits required for successful completion of the programme	120
iii.	Minimum credits required from Core + Vocational courses + Choice based core course + Project + Complementary courses	93
iv.	Minimum credits required from Common course I	16
v.	Minimum credits required from Common course II	8
vi.	Minimum credits required from Open course	3
vii.	Minimum attendance required	75%

Model III BSc/BCA

i.	Programme duration	6 Semesters
ii.	Total credits required for successful completion of the programme	120
iii.	Minimum credits required from Core + Choice based core course + Project + Complementary courses	109
iv.	Minimum credits required from Common course I	8
v.	Minimum credits required from Open course	3
vi.	Minimum attendance required	75%

Model I BCom

i.	Programme duration	6 Semesters
ii.	Total credits required for successful completion of the programme	120
iii.	Minimum credits required from Core + Optional courses + Project	95
iv.	Minimum credits required from Common course I	14
v.	Minimum credits required from Common course II	8
vi.	Minimum credits required from Open course	3
vii.	Minimum attendance required	75%

4.3. **Project/Dissertation of courses other than BCA**

All students shall do a project/research work in the area of core course during the course of the programme. The project/ research work shall be done individually or as a group of maximum five (5) students. The projects/research work shall be identified during the fourth semester of the programme with the help of the supervising teacher. The report of the project/research work shall be submitted to the department during sixth semester and shall be produced before the examiners appointed by the College. The project report/dissertation shall be subject to evaluation followed by a viva-voce/defence in the sixth semester.

4.4. **Project/Dissertation of BCA**

Minor project

All students shall do a minor project in the fourth semester. The project shall be done individually or as a group of maximum five (5) students. The report of the project shall be submitted before the examiners appointed by the College. The project report shall be subject to evaluation followed by a viva-voce.

Major project

All students shall do a major project in the sixth semester. The project shall be done individually. The report of the project shall be submitted to the department during sixth semester and shall be produced before the examiners appointed by the College. The project report shall be subject to evaluation followed by a viva-voce.

4.5 In exceptional circumstances like natural calamities, epidemics, pandemics etc, viva/OJT may be conducted through online mode also. Head of the Department shall make the arrangement for conducting the viva/OJT examinations through online. The entire proceedings shall be recorded and the soft copy shall be submitted to the Controller of Examinations.

4.6 **Evaluations**

The evaluation of each course shall contain two parts.

i In-Semester Assessment (ISA)
ii End-Semester Assessment (ESA)

Both ISA and ESA shall be carried out using indirect grading. The ISA: ESA ratio shall be 1:4, for courses with or without practical. There shall be a maximum of eighty (80) marks for end-semester assessment and twenty (20) marks for in-semester assessment.

4.7 **In-semester assessment**

The components of the in-semester assessment and their marks are given below.

Common Courses and courses without practical

Component	**Marks**
Attendance	2
Exam 1 & Exam 2 *Marks shall be secured from two examinations based on modern tools	2½ + 2½
Exam 3 (written examination)	5
Quiz/Poster/Seminar/Field report/Group Discussion/Work Book/Assignment/Article Review/Viva (Any two from the above)	4 + 4
Total	**20**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Courses other than common courses with practical (except BCA & BSc Psychology)

Component	Marks
Attendance	2
Exam 1 & Exam 2 *Marks shall be secured from two examinations based on modern tools	2 + 2
Exam 3 (written examination)	3
Quiz/Poster/Seminar/Field report/Group Discussion/Work Book/Assignment/Article Review/Viva (Any two from the above)	3 + 3
Total	**15**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

The internal assessment of practical courses shall be conducted either annually or in each semester. The components for internal assessment are given below.

Internal assessment of practical courses evaluated in each semester

Component	Marks
Attendance	1
Lab Test	2
Record*	2
Total	**5**

*Marks awarded for Record shall be related to number of experiments/practicals recorded.

Marks for attendance

% of Attendance	Marks
Above 75	1

(Decimals shall be rounded off to the next higher whole number)

Internal assessment of practical courses evaluated annually

Component	Marks
Attendance	2
Lab involvement	3
Lab Test/Viva/Field report	3
Record*	2
Total	**10**

*Marks awarded for Record shall be related to number of experiments/practicals recorded.

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Assessment of practical courses of BCA programme

The internal assessment of practical courses shall be conducted in each semester. The ISA:ESA ratio shall be 1:4. There shall be a maximum of eighty (80) marks for end-semester evaluation and twenty (20) marks for in-semester assessment. The components for internal assessment are given below.

Component	Marks
Attendance	2
Viva	4
Record	4
Test (1×10=10) or (2×5=10)	10
Total	20

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Assessment of practical courses of BSc Psychology programme

The internal assessment of practical courses shall be conducted in each semester. The ISA: ESA ratio shall be 1:4. There shall be a maximum of eighty (80) marks for end-semester evaluation and twenty (20) marks for in-semester assessment. The components for internal assessment are given below.

Component	Marks
Attendance	2
Record	5
Viva	6
Test papers	7
Total	20

Marks for attendance

% of Attendance	Marks
Above 90	2
75-90	1

(Decimals shall be rounded off to the next higher whole number)

4.8 To ensure transparency of the evaluation process, the ISA mark awarded to the students in each course in a semester shall be published on the notice board according to the schedule in the academic calendar published by the College. There shall not be any chance for improvement of ISA. The course teacher and the faculty mentor shall maintain the academic record of each student registered for the course which shall be forwarded to the office of the Controller of Examinations through the Head of the Department and a copy shall be kept in the office of the Head of the Department for at least two years for verification.

4.9 A student who has not secured minimum marks in the in-semester assessment can redo the same before the end semester examination of the semester concerned.

4.10 **End-semester assessment**

The end-semester examination in theory and practical courses shall be conducted by the College.

4.11 The end-semester examinations shall be conducted at the end of each semester. There shall be one end-semester examination of three (3) hours duration in each lecture based course.

4.12 The question paper shall be strictly on the basis of model question paper set by Board of Studies.

4.13 A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Marks for each type of question can vary from programme to programme, but a general pattern may be followed by the Board of Studies.

4.14 End-semester Examination question paper pattern shall be as given below.

Core Courses and complementary courses in English of BA Programmes in English

Section	Total No. of Questions	No. of Questions to be Answered	Marks	Total Marks for the Section
A	13	10	5	50
B	4	2	15	30
			Maximum	**80**

Courses without practical except core courses of BA Programmes in English

Section	Total No. of Questions	No. of Questions to be Answered	Marks	Total Marks for the Section
A	12	10	2	20
B	9	6	5	30
C	4	2	15	30
			Maximum	**80**

Courses with practical

Section	Total No. of Questions	No. of Questions to be Answered	Marks	Total Marks for the Section
A	12	10	2	20
B	9	6	4	24
C	4	2	8	16
			Maximum	**60**

Courses in BSc Mathematics Programme

Section	Total No. of Questions	No. of Questions to be Answered	Mark for Each Question	Total Marks for the Section
A	12	10	1	10
B	At most 13	Questions with total marks 40 will be given. All questions can be answered.	3, 4, 5 or 6	30
C	Four question sets, one from each module. Each set consists of two questions out of which one is to be answered.	4	10	40
			Maximum	**80**

4.15 Photocopies of the valued answer scripts of the end semester examination shall be made available to the students for scrutiny as per the regulations in the examination manual.

4.16 Practical examination shall be conducted annually or in each semester. The duration and frequency of practical examination shall be decided by the respective Board of Studies.

4.17 Practical examination shall be conducted by the examiners appointed by the Controller of Examinations.

4.18 The marks for end-semester theory and practical examinations are given below

Course	Marks
Courses without practical	80
Course with practical	60
Practical (assessment in each semester)	20
Practical (odd and even semester combined)	40
Course with practical (BCA and BSc Psychology programmes)	80
Practical (BCA and BSc Psychology programmes)	80

4.19 The project report/dissertation shall be subject to in-semester assessment followed by end-semester evaluation at the end of the programme. In-semester assessment is to be done by the supervising teacher and end-semester assessment by an evaluation board consisting of an examiner appointed by the Controller of Examinations and the Head of the Department or his nominee. A viva-voce/defence related to the project work shall be conducted by the end-semester evaluation board and students have to attend the viva-voce/defence individually.

Components of Project Evaluation	**Marks**
In-semester Assessment	20
Dissertation	50
Viva-Voce	30
Total	**100**

4.20 If the student fails in project evaluation, he or she shall submit the project report/dissertation after modifying it on the basis of the recommendations of the examiners.

4.21 For all courses (theory and practical) an indirect grading system based on a ten (10) point scale according to the percentage of marks (ISA + ESA) is used to evaluate the performance of the student in that course. The percentage shall be rounded mathematically to the nearest whole number.

Percentage of Marks	**Grade**	**Performance**	**Grade Point**
95 and above	S	Outstanding	10
85 to below 95	A+	Excellent	9
75 to below 85	A	Very Good	8
65 to below 75	B+	Good	7
55 to below 65	B	Above Average	6
45 to below 55	C	Satisfactory	5
35 to below 45	D	Pass	4
Below 35	F	Failure	0

5 CREDIT POINT AND CREDIT POINT AVERAGE

5.1 **Credit Point**

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the credit and GP is the grade point

5.2 **Semester Credit Point Average**

Semester Credit Point Average (SCPA) is calculated using the formula

SCPA = TCP/TCS

where TCP is the total credit point of all the courses in the semester and TCS is the total credits in the semester

CPA shall be rounded off to two decimal places.

5.3 **Cumulative Credit Point Average**

Cumulative Credit Point Average (CCPA) is calculated using the formula

CCPA = TCP/TC

where TCP is the total credit point of all the courses in the whole programme and TC is the total credit in the whole programme

CPA shall be rounded off to two decimal places.

5.4 **Credit Point Average (CPA)** of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational Course, Core Course etc. are calculated using the formula

CPA = TCP/TC

where TCP is the Total Credit Point of a category of course and TC is the total credit of that category of course

Grades for the different courses, semesters, Semester Credit Point Average (SCPA) and grades for overall programme, Cumulative Credit Point Average (CCPA) are given based on the corresponding Credit Point Average (CPA) as shown below:

CPA	Grade	Performance
9.5 and above	S	Outstanding
8.5 to below 9.5	A+	Excellent
7.5 to below 8.5	A	Very Good
6.5 to below 7.5	B+	Good
5.5 to below 6.5	B	Above Average
4.5 to below 5.5	C	Satisfactory
4 to below 4.5	D	Pass
Below 4	F	Failure

5.5 A separate minimum of 30% marks each for in-semester and end-semester assessment (for both theory and practical) and aggregate minimum of 35% are required for a pass in a course.

5.6 For a pass in a programme, a separate minimum of grade 'D' is required for all the individual courses.

5.7 If a candidate secures F Grade for any one of the courses offered in a semester/programme, only F grade will be awarded for that semester/programme until the student improves this to D grade or above within the permitted period.

5.8 Candidate who secures D grade and above will be eligible for higher studies.

6 SUPPLEMENTARY/IMPROVEMENT EXAMINATION

6.1 There will be supplementary examinations and chance for improvement. Only one chance will be given for improving the marks of a course.

6.2 There shall not be any improvement examination for practical examinations and examinations of the final year.

7 ATTENDANCE

7.1 The minimum requirement of aggregate attendance during a semester for appearing the end semester examination shall be 75%. Condonation of shortage of attendance to a maximum of ten (10) days in a semester subject to a maximum of two times during the whole period of undergraduate programme may be granted by the College. This condonation shall not be counted for internal assessment.

7.2 Benefit of attendance may be granted to students representing the College, University, State or Nation in Sports, NCC, NSS or Cultural or any other officially sponsored activities such as College union/University union activities etc., on production of participation/attendance certificates, within one week from competent authorities, for the actual number of days participated, subject to a maximum of ten (10) days in a semester, on the specific recommendations of the Faculty Mentor and Head of the Department.

7.3 A student who does not satisfy the requirements of attendance shall not be permitted to appear for the end-semester examinations.

7.4 Those students who are not eligible even with condonation of shortage of attendance shall repeat the course along with the next batch after obtaining readmission.

8 BOARD OF STUDIES AND COURSES

8.1 The Board of Studies concerned shall design all the courses offered in the UG programme. The Board shall design and introduce new courses, modify or re-design existing courses and replace any existing courses with new/modified courses to facilitate better exposure and training for the students.

8.2 The syllabus of a programme shall contain vision, mission and Programme Outcomes of the College, Programme Specific Outcomes and Course Outcomes of the Department. It shall also contain course mapping table, programme articulation matrix and model question papers.

8.3 The syllabus of a course shall contain the title of the course, course outcomes, course mapping table, contact hours, the number of credits, and reference materials.

8.4 Each course shall have an alpha numeric code.

8.5 Every programme conducted under Credit Semester System shall be monitored by the Academic Council.

9 REGISTRATION

9.1 A student who registers his/her name for the external examination for a semester will be eligible for promotion to the next semester.

9.2 A student who has completed the entire curriculum requirement, but could not register for the semester examination can register notionally, for getting eligibility for promotion to the next semester.

9.3 A student may be permitted to complete the programme, on valid reasons, within a period of twelve (12) continuous semesters from the date of commencement of the first semester of the programme.

9.4 The minimum strength of students for open courses is 15 and the maximum is 75 per batch.

9.5 Each student shall register for the open courses in the prescribed registration form in consultation with the faculty mentor during fourth semester. Faculty mentor shall permit registration on the basis of the preferences of the student and availability of seats.

10 ADMISSION

10.1 The admission to all UG programmes shall be as per the rules and regulations of the College/University.

10.2 Candidates should have passed the Plus Two/equivalent examination with Chemistry as one of the optional subjects at Plus Two level for admission to BSc Chemistry programme.

10.3 Separate rank lists shall be drawn up for seats under reservation quota as per the existing rules.

10.4 There shall be an academic and examination calendar prepared by the College for the conduct of the programmes.

11 MARK CUM GRADE CARD

11.1 The College under its seal shall issue to the students, a Mark cum Grade Card on completion of each semester, which shall contain the following information.

a. Name of the Student
b. Register Number
c. Photo of the student
d. Degree
e. Programme
f. Date of Birth
g. Date of Eligibility
h. Semester and Name of the Examination
i. Month and Year of Examination
j. Stream
k. Course Code, Title and Credits of each course opted in the semester
l. Marks for ISA, ESA, Total Marks (ISA + ESA), Maximum Marks, Letter Grade, Grade Point (GP), Credit Point (CP) and Institution Average in each course opted in the semester
m. Total Credits, Marks Awarded, Credit Point, SCPA and Letter Grade in the semester
n. Result
o. Credits/Grade of Extra Credit Courses

11.2 The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The final Mark Cum Grade Card shall show the CCPA, the overall letter grade of a student for the entire programme and level of attainment of PO and PSO.

12 AWARD OF DEGREE

The successful completion of all courses other than extra credit courses with ‘D’ grade shall be the minimum requirement for the award of the degree.

13 MONITORING COMMITTEE

There shall be a Monitoring Committee constituted by the Principal to monitor the internal evaluation conducted by the College. The Course Teacher, Faculty Mentor, and the College Coordinator shall keep all the records of the continuous evaluation, for at least a period of two years, for verification.

14 GRIEVANCE REDRESSAL MECHANISM

14.1 In order to address the grievance of students regarding ISA, a two-level grievance redressal mechanism is envisaged.

14.2 A student can approach the upper level only if grievance is not addressed at the lower level.

14.3 Department level: The Principal shall form a Grievance Redress Committee in each Department comprising of course teacher and one senior teacher as members and the Head of the Department as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

14.4 College level: There shall be a College level Grievance Redress Committee comprising of Faculty Mentor, two senior teachers and two staff council members (one shall be an elected member) and the Principal as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

15 TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of three years from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

St Berchmans College

Founded 1922

AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

Changanassery, Kottayam, Kerala, India-686101

30-Jan-2021

CONSOLIDATED MARK CUM GRADE CARD

(Common for BA/BSc/BCom/BCA/BVoc Degree programmes)

Name of Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Stream :

Date of Birth :

Date of Eligibility for the Degree :

PHOTO

SEMESTER RESULTS

Semester	Marks Awarded	Maximum Marks	Credits	SCPA	Grade	Month and Year of Passing	Results
Semester I							
Semester II							
Semester III							
Semester IV							
Semester V							
Semester VI							
Total							

PROGRAMME PART RESULTS

Programme Part	Marks Awarded	Maximum Marks	Credit Points	Credits	CCPA	Grade
Common Course I:						
Common Course II :						
Core Course:						
Complementary Course :						
Complementary Course:						
Open Course						
Total						

FINAL RESULT

CUMULATIVE CREDIT POINT AVERAGE (CCPA) =	GRADE =	*Grace Mark Awarded

Entered by:

Verified by:

Controller of Examinations

Principal

Permanent Register Number (PRN):

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average (IA)	Result
			ESA		ISA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
SEMESTER I													
SEMESTER II													
SEMESTER III													

SEMESTER IV													
SEMESTER V													
SEMESTER VI													
	End of Statement												

DESCRIPTION OF THE EVALUATION PROCESS

Grade and Grade Point

The evaluation of each course comprises of In-Semester Assessment (ISA) and End-Semester Assessment (ESA) components in the ratio 1:4 for all Courses. Grades and Grade Points are given on a ten (10) point scale based on the percentage of Total Marks (ISA + ESA) as given in Table 1. Decimals are corrected to the nearest whole number.

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the Credit and GP is the Grade Point.

Credit Point Average (CPA) of a semester/programme is calculated using the formula

CPA = TCP ÷ TC

where TCP is the Total Credit Point and TC is the Total Credit.

CPA shall be rounded off to two decimal places.

Table 1

Percentage of Marks	Grade	Performance	Grade Point
95 and above	S	Outstanding	10
85 to below 95	A+	Excellent	9
75 to below 85	A	Very Good	8
65 to below 75	B+	Good	7
55 to below 65	B	Above Average	6
45 to below 55	C	Satisfactory	5
35 to below 45	D	Pass	4
Below 35	F	Failure	0

Semester Credit Point Average (SCPA) and Cumulative Credit Point Average (CCPA)

Grades for the different Semesters and overall Programme are given based on the corresponding CPA, as shown in Table 2.

Table 2

CPA	Grade	Performance
9.5 and above	S	Outstanding
8.5 to below 9.5	A+	Excellent
7.5 to below 8.5	A	Very Good
6.5 to below 7.5	B+	Good
5.5 to below 6.5	B	Above Average
4.5 to below 5.5	C	Satisfactory
4.0 to below 4.5	D	Pass
Below 4	F	Failure

For conversion of SCPA into percentage, multiply the secured SCPA by 10.

For conversion of CCPA into percentage multiply the secured CCPA by 10.

Note: A separate minimum of 30% marks is required for a pass for both In-Semester Assessment and End-Semester Assessment in each course. An aggregate minimum of 35% marks is required for a pass in each course. For a pass in a programme, a minimum CPA of 4 is required.

SHORT TERM COURSES

The main objective of the short term courses offered by the college is to supplement the students with various skills and technical know-how outside the structured academic curriculum, to produce quality citizens who are academically proficient, self-reliant and socially committed. The courses have compulsory components and optional components that equip the students to attain various programme objectives envisaged by the Vision and Mission statements of the college.

All Short-Term Courses (STCs) are coordinated by the Department of Short Term Courses, headed by a Director and is supervised by a Vice Principal nominated by the Principal. Each component of the STC is coordinated and managed by a Faculty Convener. The Advisory Board of the Department consists of the Vice-Principals, Director of the Short Term Courses and the various Conveners.

In case of any grievances, students can approach the Grievance Redressal Cell of the STC which consists of the Vice-Principal in Charge, Director and the concerned Convener. If the student feels that the issue was not adequately addressed, he/she can approach the Grievance Redressal Cell of the college. The grading pattern for all courses except the MOOCs will be the same as in the UG regulations 2022. The courses offered by the department are given in the following table.

	Name	Semesters	Type	Credit
1	Value Education	I to VI	Compulsory	3
2	Basic Life Support System and Disaster Management (BLS & DM)	I	Compulsory	1
3	Social Awareness Course (SAC)	I and II	Compulsory	2
4	Skill Development Courses (SDC)	II and III	Compulsory	2
5	Industry Familiarisation Course	IV	Compulsory	2
6	Finishing School	III and IV	Compulsory	1
7	Virtual Lab	V	Optional	1
8	Massive Open Online Courses	I to V	Optional	Variable Credit
9	Inter disciplinary Research	I to V	Optional	3

REGULATIONS FOR SHORT TERM COURSES

VALUE EDUCATION

Value Education is a compulsory extra credit course with three (3) credits for all the students admitted to the undergraduate programmes.

Duration

The duration of the course shall be three academic years (six semesters). There shall be minimum 60 hours spread over three years with 20 hours every academic year.

Evaluation

The evaluation of each course shall contain two parts.

i. Continuous evaluation (every year)
ii. Final evaluation (every year)

There shall be a maximum of 50 marks comprising of forty (40) marks for final evaluation and ten (10) marks for continuous evaluation.

Continuous Evaluation

Component	Marks
Assignment	5
Attendance	5
Total	10

1. **Assignment**
   The students shall submit at least one assignment in every year. The marks for assignment is five (5).
2. **Attendance**
   The minimum requirement of aggregate attendance during a year for appearing the final examination shall be 75%.

Marks for attendance

Maximum of five (5) marks will be given for attendance as follows.

% of Attendance	Marks
90 and above	5
85-89	4
80-84	3
76-79	2
75	1

(Decimals shall be rounded off to the next higher whole number)

Final evaluation

Final evaluation shall be conducted by the course coordinator at the end of every year.

There shall be an annual written examination of one and a half hours (1½) duration with a maximum forty marks (40), every year.

The question paper shall be strictly on the basis of model question paper set by the Expert Committee.

A question paper consists of short answer type, short essay type and long essay type questions.

The total marks of the course (three years combined) shall be one hundred and fifty (150).

Award of certificate

A separate minimum 30% marks each for continuous evaluation and final evaluation and an aggregate minimum of 35% are required for a pass in the course.

If a student does not acquire minimum marks in first and second years, he/she can continue the course.

The student shall be eligible to get certificate only after completing the course with D Grade. On successful completion of the course, the grade awarded will be indicated in the Mark cum Grade Card.

The grading pattern will be the same as in UG Regulations 2022.

The course shall be completed during the tenure of the programme.

BASIC LIFE SUPPORT SYSTEM AND DISASTER MANAGEMENT (BLS & DM)

- The main objective of this course is to provide intensive training on Basic Life Support System and Disaster Management with the help of professional trainers and adequate numbers of mannequins and kits for imparting the training to students.
- This course is compulsory for all the undergraduate students of this college and has one (1) credit.
- The course on BLS & DM shall be conducted by a nodal centre created in the College.
- Each student shall undergo five (5) hours of hands-on training in BLS & DM organised by the Centre for BLS & DM.
- After the completion of the training, the skills acquired shall be evaluated using an offline/online test and grades shall be awarded.
- Nodal Centre for BLS & DM shall conduct an online test and publish the results.
- Students who could not complete the requirements of the BLS & DM training shall appear for the same along with the next batch.
- The grading of the course is as per the grading pattern in UG Regulations 2022.

SOCIAL AWARENESS COURSE (SAC)

- The aim of SAC is to make students aware of the problems that different societies and communities face on a day-to-day basis and to be conscious of the difficulties and hardships of society.
- This is a compulsory course with two (2) credits.
- Social Awareness Course shall be conducted by a nodal centre consisting of the convenor, other faculty members nominated by the Principal.
- The centre shall identify the areas where the students can serve the society through the course.
- During the first semester itself, the centre shall organise activities to sensitize the students about the significance and relevance of Social Awareness and publish a list of different areas where they can work as volunteers.
- The centre shall allot students to various areas based on their preference.
- Students shall carry out the voluntary work allotted to them after the regular class hours/weekends/holidays falling in the first and second semesters and the summer vacation following the second semester.
- Evaluation of the SAC activity shall be based on the hours of work put in by a student. A minimum of 50 hours of social work (corresponding to 50 marks) is required for the successful completion of the course. Every additional work beyond the minimum 50 hours shall fetch five (5) marks per hour. Maximum marks shall be 100.
- Students who donate blood during the first year shall be given 10 marks on production of the certificate from the medical officer. However, marks earned through blood donation shall not be counted for a pass in the course. Mark for blood donation shall be awarded only once during the SAC.
- Two credits shall be awarded to students who complete the requirements of SAC.
- The grading will be as per the grading pattern in the UG Regulations 2022.
- Students who could not complete the requirements of the SAC shall appear for the same with the next batch.
- The Director of Short-Term Courses and Convenor of SAC has the right to exclude students who are physically challenged from SAC, if requested.

SKILL DEVELOPMENT COURSES (SDC)

- This is a compulsory component of STC with two (2) credits.
- SDC's shall be completed within the first four semesters of the programme.
- Depending on the nature of the course, there will be a theory component and a skill development component.
- The credit will be awarded only if the student gets a D grade (35% marks) and above.
- A student can do a maximum of three skill Development Courses according to his/her choice, but pass in at least one course is compulsory.
- The Convenor of SDC will coordinate the course.
- The Head of the Department concerned in consultation with the faculty members may prepare a syllabus for the SDC, which will be approved by the Board of Studies concerned.

Evaluation of SDC

The evaluation the course shall be done internally and contain two parts.

i. Continuous evaluation
ii. Final evaluation

Both continuous evaluation and final evaluation shall be carried out using indirect grading. The marks for continuous evaluation is twenty (20) and that of the final evaluation is eighty (80).

Continuous evaluation

The components of the continuous evaluation and their marks are as below.

For all courses, without practical

There are two components for continuous evaluation, which include attendance and assignment. All the components of the continuous evaluation are mandatory.

Component	Marks
Attendance	5
Assignments	15
Total	**20**

Marks for attendance

Minimum 75% attendance is compulsory for attending the final examination.

% of Attendance	Marks
90 and above	5
85 - 89	4
80 – 84	3
76 – 79	2
75	1

(Decimals shall be rounded mathematically to the nearest whole number)

For all courses with practical

The components for continuous evaluation of courses with practical are given below.

Component	Marks
Attendance	5
Lab/skill work involvement	15
Total	**20**

Assignments

At least one assignment shall be submitted for the course.

Final evaluation

The final evaluation of theory and practical courses shall be conducted by the office of the Controller of Examinations. It can be in the form of 80 marks written examination or 80 marks project/practical examination or 80 marks written and project/practical examination combined, as decided by the Board of Studies concerned.

INDUSTRY FAMILIARIZATION COURSE

- It is a compulsory course with two (2) credits.
- Every UG student shall undergo a compulsory industry familiarization course for a minimum period of five days (25 hours) at a centre identified by the concerned department.
- Head of the Department and the Mentor of the class shall monitor the progress of the course.
- Industry familiarization course shall be carried out preferably during the summer vacation following the fourth semester or during the Christmas vacation falling in the fourth semester or holidays falling in the semester.
- At the end of the stipulated period, each student shall produce a course completion cum attendance certificate and an illustrated report of the training he/she has underwent, duly certified by the supervisor and Head of the institution where the industry familiarization course has been undertaken.
- On receipt of the course completion cum attendance certificate and the report, the Mentor shall prepare a list of students who have completed the course and a list of students who failed to complete the course. The Head of the department shall verify the lists and forward to the Convenor.
- Students who could not complete the requirements of the course shall appear for the same along with the next batch.
- Grade will be awarded as per the grading pattern in UG Regulations 2022.

FINISHING SCHOOL

- It is a compulsory course with one (1) credit.
- The course provides compulsory training for all under graduate students of this college.
- The training is to help students develop their soft skills and interview skills.
- The training shall impart soft skills comprising of language skills, personal presentation and grooming, table manners, resume preparation, group discussion techniques, and interview skills among the undergraduate students.
- This course shall be conducted during the third and fourth semesters for all the undergraduate students.
- There will be a total of 20 contact hours which shall be handled by a team of professional members/faculty. In addition, a one-day outbound training session by a team of professional trainers that touches on the aspects of creativity, problem solving and team building shall also be organized.
- The students shall be assessed on the basis of the components given below.

Component	Marks
Attendance	5
Aptitude Test	10
Assignments	10
Group discussion	10
Interview	15
Total	**50**

Marks for attendance

Maximum of five (5) marks will be given for attendance as follows.

% of Attendance	Marks
90 and above	5
85-89	4
80-84	3
76-79	2
75	1

(Decimals shall be rounded off to the next higher whole number)

Grades will be awarded as per grading pattern in UG Regulations 2022.

VIRTUAL LAB EXPERIMENTS

- This is an optional course with one (1) credit.
- The main aim of the Virtual Lab Experiments is to provide remote-access to simulation-based Labs in various disciplines of Sciences which enthuse students to conduct experiments by arousing their curiosity.
- The Convenor will coordinate the Virtual Lab component and he may use the services available in different virtual lab platforms after the approval of the advisory body.
- Students have to do at least 36 hours of experiments and they get a maximum of one credit for this.
- Convenor and the mentor of the student shall oversee the progress and assign grades as per the grading pattern in UG Regulations 2022 after the completion of the programme.

MASSIVE OPEN ONLINE COURSE (MOOC)

- MOOCs are an integral part of today's education.
- Those students who participate in MOOC courses conducted by the Government (SWAYAM) and other reputed agencies earn additional credits on production of course certificates.
- The students shall approach the Convener of the component to verify whether the agency is approved or not before registering for such courses and claiming credits.
- SB College Local Chapter of SWAYAM/NPTEL may be consulted for assistance.
- A student can take maximum of 5 courses during Semester I to Semester V of their UG programme.
- The selected course need not be in the same discipline of the study of the student.
- This is an optional course with variable credits for each course.
- Number of credits awarded to each course depends on the duration of the course.
- A course of 4 to 6 weeks or 18 hours fetch one (1) credit, 6 - 10 weeks; two (2) credits and more than 10 weeks, three (3) credits.
- In case of any dispute, students may approach the Grievance Redressal Cell of the STC.

INTERDISCIPLINARY RESEARCH

- To enhance the research aptitude of students, College offers a platform to conduct interdisciplinary research for its UG students with the help of the Centre of Interdisciplinary Research (CIDR).
- First year UG students interested in interdisciplinary research may approach the Convener of this component.
- He will find a supervisor from the home department and a co-supervisor from another discipline/department.
- Students will be given training in basic research methodology with the help of lectures/MOOCs/tutorials after which the student may select a research problem under the supervision of the supervisor and co-supervisor.
- Students are expected to finish their research before the beginning of the sixth semester.
- After that, they shall write their project report, communicate the research findings to UGC approved journals, and submit the report to the Convenor in the prescribed format, who will arrange the oral/poster presentation of the findings and evaluate the thesis with the help of a Board of Examiners approved by the Director of the STC and will be graded.
- On successful completion of all the procedures, students will be awarded three credits.
- The same project report may not be used as such for the final year project work of the student.
- This is an optional course with three (3) credits.

PROGRAMME OUTCOMES

PO1: Develop in-depth conceptual knowledge in the discipline for vertical growth and scholarly pursuits

PO2: Identify historical, theoretical, scientific, technological, economic philosophical, cultural, aesthetic and ethical bases of different disciplines and relate them effectively

PO3: Demonstrate problem solving skills, effective communication, interpersonal dynamics and resilience in global and local contexts

PO4: Transfer the knowledge of methods, skills, tools and systems of different disciplines for a sustainable and egalitarian world order

PO5: Generate need based innovative processes and products for personal and societal well-being

PROGRAMME SPECIFIC OUTCOMES

PSO1: Develop core competency in chemical sciences and allied subjects.

PSO2: Compare and correlate the characteristic properties of chemical compounds and materials by employing analytical and instrumentation techniques.

PSO3: Identify and apply the relevant chemical science concepts in academic, industrial, economic, environmental, and social contexts.

PSO4: Communicate the results of scientific work in oral, written, and electronic formats to both scientific and public audiences.

PSO5: Demonstrate hands-on experience in lab activities that will enable them to develop essential practical knowledge and skills to pursue a career in R & D, industry, teaching and entrepreneurship.

PROGRAMME STRUCTURE

Semester I

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course I	4	3	100
3	Common Course II	4	4	100
4	Core Course	2	2	75
5	Core Course Practical	2	Evaluation in Semester II	
6	Complementary Course: Mathematics	4	3	100
7	Complementary Course: Physics	2	2	75
8	Complementary Course Practical: Physics	2	Evaluation in Semester II	
	Total	**25**	**18**	**550**

Semester II

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course I	4	3	100
3	Common Course II	4	4	100
4	Core Course	2	2	75
5	Core Course Practical	2	2	50
6	Complementary Course: Mathematics	4	3	100
7	Complementary Course: Physics	2	2	75
8	Complementary Course Practical: Physics	2	2	50
	Total	**25**	**22**	**650**

Semester III

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
3	Common Course II	5	4	100
4	Core Course	3	3	75
5	Core Course Practical	2	Evaluation in Semester IV	
6	Complementary Course: Mathematics	5	4	100
7	Complementary Course: Physics	3	3	75
8	Complementary Course Practical: Physics	2	Evaluation in Semester IV	
	Total	**25**	**18**	**450**

Semester IV

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course II	5	4	100
3	Core Course	3	3	75
4	Core Course Practical	2	2	50
5	Complementary Course: Mathematics	5	4	100
6	Complementary Course: Physics	3	3	75
7	Complementary Course Practical: Physics	2	2	50
	Total	**25**	**22**	**550**

Semester V

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Core Course	3	3	75
2	Core Course	4	3	75
3	Core Course	3	3	75
4	Core Course	2	2	75
5	Open Course	3	3	100
6	Core Course Practical	3	Evaluation in Semester VI	
7	Core Course Practical	2		
8	Core Course Practical	3		
9	Core Course Practical	2		
	Total	**25**	**14**	**400**

Semester VI

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Core Course	3	3	75
2	Core Course	3	3	75
3	Core Course	3	3	75
4	Core Course	3	3	75
5	Choice Based Core Course	3	3	100
6	Core Course Practical	3	3	50
7	Core Course Practical	2	2	50
8	Core Course Practical	3	3	50
9	Core Course Practical	2	2	50
10	Project/Paper Review/Industry Visit Report	-	1	100
	Total	**25**	**26**	**700**
	Grand Total	**-**	**120**	**3300**

OUTLINE OF CORE COURSES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CBCH101	Introduction to Quantum Mechanics and Chemical Bonding	2	36	2	15	60	75
	Volumetric Analysis (P)	2	36	Evaluation in Semester II			
Semester II							
CBCH202	States of Matter and Symmetry	2	36	2	15	60	75
CBCH2P01	Volumetric Analysis (P)	2	36	2	10	40	50
Semester III							
CBCH303	Conceptual Organic Chemistry	3	54	3	15	60	75
	Qualitative Organic Analysis (P)	2	36	Evaluation in Semester IV			
Semester IV							
CBCH404	Organic Chemistry of Aromatics, Heterocycles, Ethers, Phenols and Carbonyls	3	54	3	15	60	75
CCH4P02	Qualitative Organic Analysis (P)	2	36	2	10	40	50
Semester V							
CBCH505	Chemistry of Main Group Elements	3	54	3	15	60	75
CBCH506	Introduction to Environmental Science and Scientific Writing	4	72	3	15	60	75
CBCH507	Organic Chemistry of Acids, Nitrogen Compounds and Biomolecules	3	54	3	15	60	75
CBCH508	Basic Physical Chemistry	2	36	2	15	60	75
	Physical Chemistry Experiments (P)	3	54	Evaluation in Semester VI			
	Techniques In Organic Chemistry (P)	2	36				
	Qualitative Inorganic Analysis (P)	3	54				
	Applied Chemistry Practical (P)	2	36				
Semester VI							
CBCH609	Inorganic Chemistry of *d* and *f* Block Elements	3	54	3	15	60	75
CBCH610	Advanced Organic Chemistry	3	54	3	15	60	75
CBCH611	Advanced Physical Chemistry	3	54	3	15	60	75
CBCH612	Electrochemistry, Ionic Equilibrium and Surface Chemistry	3	54	3	15	60	75
CBCH6P03	Physical Chemistry Experiments (P)	3	54	3	10	40	50

CBCH6P04	Techniques in Organic Chemistry (P)	2	36	2	10	40	50
CBCH6P05	Qualitative Inorganic Analysis (P)	3	54	3	10	40	50
CBCH6P06	Applied Chemistry Practical (P)	2	36	2	10	40	50
CBCH6PJ	Project/Paper Review/Industry Visit Report	-	-	1	25	75	100

CHOICE BASED CORE COURSES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
CBCH6E01	Materials Chemistry	3	54	3	20	80	100
CBCH6E02	Polymer Chemistry	3	54	3	20	80	100

OUTLINE OF THE COMPLEMENTARY COURSES IN MATHEMATICS FOR BSc CHEMISTRY PROGRAMME

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CDMC101	Mathematics for Chemistry - I	4	72	3	20	80	100
Semester II							
CDMC202	Mathematics for Chemistry - II	4	72	3	20	80	100
Semester III							
CDMC303	Mathematics for Chemistry - III	5	90	4	20	80	100
Semester IV							
CDMC404	Mathematics for Chemistry - IV	5	90	4	20	80	100

OUTLINE OF THE COMPLEMENTARY COURSES IN PHYSICS FOR BSc CHEMISTRY PROGRAMME

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CDPC101	Mechanics and Properties of Matter	2	36	2	15	60	75
	General Physics Practical (P)	2	36	Evaluation in Semester II			
Semester II							
CDPC202	Electric and Magnetic Phenomena, Thermodynamics and Error Analysis	2	36	2	15	60	75
CDPC2P01	General Physics Practical (P)	2	36	2	10	40	50
Semester III							
CDPC303	Quantum Mechanics, Spectroscopy, Nuclear Physics and Nuclear Medicine	3	54	3	15	60	75
	Optics and Electronics (P)	2	36	Evaluation in Semester IV			
Semester IV							
CDPC404	Physical Optics, Laser Physics and Superconductivity	3	54	3	15	60	75
CDPC4P02	Optics and Electronics (P)	2	36	2	10	40	50

OUTLINE OF COMMON COURSES IN ENGLISH FOR MODEL I BA/BSc PROGRAMMES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CCEN101	Reading Literature in English - I: Poetry and Drama	5	90	4	20	80	100
CCEN102	Writings on Contemporary Issues	4	72	3	20	80	100
Semester II							
CCEN203	Writing Skills	5	90	4	20	80	100
CCEN204	Reading Literature in English - II: Short Stories and Novel	4	72	3	20	80	100
Semester III							
CCEN305	Life and Literature	5	90	4	20	80	100
Semester IV							
CCEN406	English for Developing Job Skills	5	90	4	20	80	100

OUTLINE OF COMMON COURSES IN HINDI FOR MODEL I BA/BSc PROGRAMMES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CCHB101	Prose and One-Act Plays	4	72	4	20	80	100
Semester II							
CCHB202	Short Stories and Novel	4	72	4	20	80	100
Semester III							
CCHB303	Poetry, Grammar and Translation	5	90	4	20	80	100
Semester IV							
CCHB404	Drama and Long Poem	5	90	4	20	80	100

OUTLINE OF COMMON COURSES IN SYRIAC FOR MODEL I BA/BSc PROGRAMMES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CCSB101	Poetry, Grammar & History of Syriac Language & Literature	4	72	4	20	80	100
Semester II							
CCSB202	Hymnody, Grammar & History of Syriac Language and Literature	4	72	4	20	80	100
Semester III							
CCSB303	Prose, Grammar & History of Syrian Church in India	5	90	4	20	80	100
Semester IV							
CCSB404	Prose, Grammar & Syriac Heritage of Kerala	5	90	4	20	80	100

SKILL DEVOLOPMENT COURSES

Course Code	Course Title	Total Hours	Credit	CE	FE	Total
CCHSDC01	Instrumental Methods of Analysis for Biologists, Chemists and Physicists	36	2	20	80	100
CCHSDC02	Chemistry and Technology of Rubber and Plastics Processing	36	2	20	80	100

SEMESTER I

CBCH101: INTRODUCTION TO QUANTUM MECHANICS AND CHEMICAL BONDING

Credit: 2 **Total Hours: 36**

Course Outcomes

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

CO1: Evaluate critically the relevant theories related to atomic structure in detail.

CO2: Learn the basic notions of Quantum Mechanics and solve problems based on them.

CO3: Study the basic theory behind various types of chemical bonding.

CO4: Acquire knowledge on the periodic properties of elements in detail.

CO5: Perform electronic-structure calculations using computers.

Course Mapping Table

	Cognitive Level	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Analyze	2	-	2	-	-	2	2	2	2	-
CO2	Evaluate	2	-	-	1	1	2	2	1	2	-
CO3	Analyze	2	1	-	2	2	1	2	2	2	-
CO4	Evaluate	2	-	1	-	-	2	2	2	2	-
CO5	Analyze	2	-	1	1	-	2	2	2	2	-
	Average	**2**	**1**	**1.33**	**1.33**	**1.5**	**1.8**	**2**	**1.8**	**2**	**-**

Module 1: Basic Quantum Chemistry and Atomic Structure (18 Hours)

Bohr atom model in detail, explanation of spectrum of hydrogen and hydrogen like systems, limitations of Bohr Theory, Sommerfield's extension to Bohr Theory. Dual Nature of electron: evidences for particle and wave nature, photoelectric effect, matter waves, de Broglie's equation, Davisson and Germer experiment, Heisenberg's uncertainty principle, Compton Effect, Planck's Quantum theory of radiation. A brief history of quantum mechanics, postulates of quantum mechanics. Born interpretation of the wave function, normalization, orthogonality, orthonormalization. Operators in quantum mechanics: Hermitian operators, examples; Commuting and non-commuting operators. Time-independent Schrodinger's equation (justification required), time dependent Schrodinger's equation (justification not required). Particle in one dimensional box: detailed derivation; Extension to particle in 3D box. Qualitative treatment of harmonic oscillator, rigid rotor, Hydrogen atom, radial and angular probability distribution curves. Shapes of s, p, d and f orbitals. Quantum numbers - principal, azimuthal, magnetic, and spin quantum numbers, Discovery of spin: Stern-Gerlach experiment. Introduction to Computational Chemistry: Molecular mechanics, theory and applications.

Module 2: Chemical bonding **(9 Hours)**

Ionic bond: Nature and the factors influencing ionic bonds. Covalent and Co-ordinate bonds: Polarity in covalent bonds, polarization of ions, Fajans rules, percentage of ionic character, dipole moment and molecular structure. VSEPR theory, notion of hybridisation with examples (sp, sp2, sp3, sp3d and sp3d2), structure of H_2O, NH_3, XeF_2, XeF_4, SF_4, ClF_3, IF_7, I_3-, and SO_4^2. Valence bond theory (VB) and its applications and limitations, VB of hydrogen atom (derivation not expected). Molecular orbital theory (MOT), linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals. Applications of MO theory to homo- and hetero-diatomic molecules, bond order, bond strength and bond energy. Metallic Bonds: Free electron, valence bond and band theories (basic notions only, derivations not expected). Hydrogen Bonding: Types, consequences and significance. Lattice energy of ionic compounds: Born-Lande equation, Born-Haber cycle and its applications, solubility and stability of ionic compounds on the basis of lattice energy.

Module 3: Periodic Classification **(9 Hours)**

A brief history of periodic table, Modern periodic law. Long form of periodic table, periodicity in properties – covalent, Van der Waals, and ionic radii. Radii of cations and anions, isoelectronic ions. Ionization energy, successive ionization energies, periodic trends and factors affecting ionization energy. Periodic trends in Electron affinity and electronegativity; Pauling's, Mulliken's and Allred-Rochow's scales of electronegativity, Factors influencing electronegativity, Applications of electronegativity. Effective nuclear charge–screening effect, Slater's rules.

Textbooks

1. Atkins, P.W., and J. de Paula, Physical Chemistry, 11th Edition, Oxford University Press, 2018
2. Atkins, P.W., and R.S. Friedman, Molecular Quantum Mechanics, 5th Edition, Oxford, 2010
3. Prasad, R.K. Quantum Chemistry, Wiley Eastern Ltd., New Delhi, 2006.
4. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Vikas Publishing Co., Jalandhar, 2013
5. M. Chanda, Atomic Structure and Chemical Bonding, Tata Mc Graw Hill, 2007.
6. D.A. McQuarrie, J. D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd. 2004.
7. Ira N. Levine, Physical Chemistry, 6th $ 7th Edition, McGraw Hill, 2009 &2014

8. R. Gopal, Inorganic Chemistry for Undergraduates, Universities Press, India Pvt. Ltd., 2009.
9. P. L. Soni, Text book of Inorganic Chemistry, S. Chand and Sons, 2006

Reference

1. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4th Edition, Pearson Education, New York, 2006
2. D. F. Shriver, P. W. Atkins, Inorganic Chemistry, 3rdEdn., Oxford University Press, New Delhi, 2004.
3. F. A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 6th Edition, Wiley Interscience, 1999.
4. J. D. Lee, Concise Inorganic Chemistry, 5th Edition, Chapman & Hall, 2009

Course designed by: Dr. Cyril Augustine

SEMESTER II

CBCH202: STATES OF MATTER AND SYMMETRY

Credit: 2 **Total Hours: 36**

Course Outcomes

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

CO1: Understanding the structure, properties and defects in different types of solids.

CO2: Representation of crystal structure, lattice planes and calculation of interplanar spacing, draw the crystal structures of NaCl and CsCl.

CO3: Interpret the properties of ideal and real gases.

CO4: Describe and apply the principles and laws of kinetic theory of gases.

CO5: Explain the concept of symmetry: symmetry elements, operations, point groups, and symmetry operations of different molecules.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	2	-	1	-	-	2	-	1	-	-
CO2	Understand	2	-	-	-	-	1	-	-	-	-
CO3	Apply	1	1	1	-	-	1	-	1	-	-
CO4	Apply	2	1	1	-	-	1	-	1	-	-
CO5	Understand	1	-	1	-	-	1	-	-	-	-
	Average	**1.60**	**1.00**	**1.33**	**-**	**-**	**1.20**	**-**	**1.00**	**-**	**-**

Module 1: Solid State **(14 Hours)**

Types of solids- crystalline, amorphous, polycrystalline solids, nature of the solid state, External features of a crystal- faces, forms, edges, interfacial angles- their relationships, zone, and zone axis. Seven crystal systems and fourteen Bravais lattices; law of constancy of interfacial angles, Hauy's law of rational indices, Law of constancy of symmetry. Elementary ideas of crystal symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups. Weiss's indices, Miller indices- calculation of inter planar distance between different planes of simple, bcc and fcc system. X - ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Interpretation of XRD pattern of NaCl and KCl. Detailed study of simple cubic, bcc and fcc structures. Packing efficiency, density of unit cells. Voids (Td, Oh and cubic), radius ratio. Close packing of spheres - types and coordination numbers. Structure of common ionic compounds like NaCl, ZnS, CsCl, CaF_2, Na_2O, spinels and inverse spinels. Defects in crystals: Schottky, Frenkel, Metal excess, Metal deficiency, F-center.

Module 2: Liquid State and Gaseous State (18 Hours)

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. Temperature and pressure dependence on viscocity, 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. Principle of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor Z, and its variation with pressure for different gases. Causes of deviation from ideal. van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrich); Virial equation of state; van der Waals equation expressed in virial form and 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. Vapour pressure, surface tension and 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. liquid crystals: nematic, smetic and cholesteric - thermographic behaviour.

Module 3: Group Theory (4 Hours)

Group theory: molecular symmetry and symmetry groups - symmetry elements and operations. Symmetry planes, inversion centre, proper/improper axes and rotations. Molecular symmetry and optical isomerism, symmetry point groups, classification of molecular point groups. Point group examples (NH_3, N_2F_2, CFClBrI, N_2O_4, H_2O, Diborane).

Textbooks

1. B. R Puri, L. R Sharma, M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, Jalandhar, 2018.
2. K. L. Kapoor, Physical Chemistry, Vol. I, II, III & IV, Mac Millan (India) Ltd., 2000.

Reference

1. P. Atkins, J. de Paula, Atkin's Physical Chemistry, 11th Edn., Oxford University Press, 2018
2. I. N. Levine, Physical Chemistry, 6thEdn., Mc Graw Hill, 2009.
3. K. J. Laidler, J. H. Meiser, Physical Chemistry, 2nd Edn., 2002
4. G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd., 1997.

5. D. N. Bajpai, Advanced Physical Chemistry, S Chand & Company Pvt Ltd., 2013
6. M. Tinkham, Group theory and quantum mechanics, Dover Books on Chemistry, 2003.
7. C. N. Banwell, E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edn., Tata Mc Graw Hill, 2017

Course designed by: Dr. Sam John

SEMESTER III

CBCH303: CONCEPTUAL ORGANIC CHEMISTRY

Credit:3 **Total Hours: 54**

Course outcomes

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

CO1: Describe the basic concepts of organic chemistry.

CO2: Predict the stereochemistry and conformation of organic compounds.

CO3: Identify the natural sources of alkanes and recognize applications of alkanes and polyhalogen compounds.

CO4: Outline the importance and reactions of alkenes and alkynes.

CO5: Categorize different types of alcohols.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	2	-	1	-	-	1	-	2	-	-
CO2	Evaluate	2	2	1	-	-	2	-	1	1	-
CO3	Remember	2	1	1	-	-	1	1	1	1	1
CO4	Understand	1	2	2	-	-	1	1	2	2	1
CO5	Analyze	2	2	2	-	-	1	1	-	2	1
	Average	**1.8**	**1.75**	**1.6**	**-**	**-**	**1.2**	**1**	**1.5**	**1.5**	**1**

Module 1: Fundamentals of Organic Chemistry **(9 Hours)**

Concept of acidity and basicity - Arrhenius, Lowry-Bronsted and Lewis concepts, pKa, pKb. Curly arrow notations, Homolytic and heterolytic fission. Electrophiles and nucleophiles. Reaction intermediates- carbocations (classical and non-classical), carbanions, free radicals, carbenes (singlet and triplet), nitrenes- structure and stability. Electron displacement effects- Inductive effect- acidity and basicity of organic acids and bases, electromeric effect. Hyperconjugation- stability of carbocations and alkenes, mesomeric effect, the concept of resonance. The steric effect, steric inhibition of resonance, organic super bases and superacids, types of organic reactions- addition, substitution, elimination, pericyclic and rearrangements (basic idea only).

Module 2: Stereochemistry of Organic Compounds **(9 Hours)**

Introduction, Classification, Geometrical isomerism: cis – trans- and syn - anti isomerism E/Z notations with Cahn Ingold Prelog (CIP) rules. Optical isomerism- the concept of chirality, specific rotation, enantiomers, molecules with two or more chiral-centres, diastereoisomers, meso compound. Relative and absolute configuration: D/L and R/S designations- CIP rules.

Asymmetric synthesis: Asymmetric induction (basic idea only). Optical activity of systems without stereocentres- allenes and biphenyl. Fischer projection, Newman and Sawhorse projection formulae and their interconversions. Conformational analysis of alicyclic compounds: ethane and butane. Conformational analysis of cyclic compounds: cyclohexane and methylcyclohexane. Origin of ring strain in cyclic systems. Baeyer's strain theory.

Module 3: Alkanes and Haloalkanes (18 Hours)

Alkanes: Natural sources of alkanes, petroleum refining process, knocking and anti-knocking agents, octane number and cetane number, Fischer Tropsch and Bergius process. Preparation of alkanes - Catalytic hydrogenation of alkenes and alkynes, reduction of haloalkanes, Wurtz reaction, Corey- House method and Kolbe's electrolytic process. Reactions of alkanes: Free radical substitution reactions- halogenation, sulphonation and nitration reactions, oxidation, dehydrogenation, cracking and aromatisation of alkanes. Preparation of cycloalkanes: preparation using Freund method, Dieckmann's ring closure, Diels–Alder reaction and reduction of aromatic hydrocarbons. Reactions of cycloalkanes: Substitution and ring opening reactions- Photohalogenation, catalytic hydrogenation, catalytic halogenation, addition of hydrogen halides and oxidation reactions. Preparation of alkyl halides: from alcohols, halogenation of alkanes, addition of hydrogen halides to alkenes, Darzens process, Hunsdicker and Finkelstien reactions. Preparation of vinyl and allyl halides. Reactions of alkyl halides: Nucleophilic substitution reactions- S_N2 and $S_N1$mechanisms. Effect of solvent, substrate, nucleophile and nucleofuge on nucleophilic substitution reactions. Relative reactivity of alkyl halides vs. allyl and vinyl halides. Polyhalogen compounds: preparation and applications of chloroform, iodoform, and carbon tetrachloride, freons, BHC.

Module 4: Alkenes and Alkynes (12 Hours)

Alkenes: general methods of preparation- dehydrogenation, preparation by elimination, dehydrohalogenation and dehydration. Regioselectivity using Hoffmann and Saytzeff rules, cis and trans eliminations. E1, E2, E1CB, Saytzeff and Hofmann elimination. Elimination versus substitution. Reactions of alkenes: cis-addition (alkaline $KMnO_4$) and trans-addition (halogens), addition of hydrogen halides and water, Markonikov's rule, free radical additions-peroxide effect. Wagner – Meervin rearrangement, oxy mercuration - demercuration, hydroboration, ozonolysis. Syn hydroxylation, epoxidation and Simmons-Smith reaction (mechanism not needed). Dienes: stability of dienes (conjugated, isolated and cumulative dienes). General methods of preparation, mechanism of dehydrohalogenation. Reaction mechanism of 1,2 - and 1,4 – additions. Alkynes: Preparation from CaC_2, alkylation of terminal alkynes, conversion into higher alkynes by dehalogenation of tetra halides and

dehydrohalogenation of vicinal dihalides. Reactions: acidity of alkynes, reaction with Tollens reagent and Fehlings solution, formation of metal acetylides, mechanism of addition of water. Mechanism of addition of bromine, alkaline $KMnO_4$ and hydrogen halides, oxidation, ozonolysis and hydroboration/oxidation Reduction (cis and trans)

Module 5: Alcohols (6 Hours)

Aliphatic alcohols: Monohydric alcohols: Primary, secondary and tertiary alcohols- preparation of alcohols by hydroboration, oxidation ($KMnO_4$), reduction of aldehydes, ketones, carboxylic acids and esters, Grignard synthesis. Hydrogen bonding, Acidic nature, Reactions with reference to C-OH bond cleavage and O-H bond cleavage, iodoform test. Primary, secondary and tertiary alcohols- tests to distinguish them (Lucas test, Victor Meyer's Test & dichromate test). Conversion of primary to secondary, secondary to tertiary, primary to tertiary alcohols, ascending and descending in alcohol series. Dihydric alcohols - methods of formation, chemical reactions of vicinal glycols - oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol- pinacolone rearrangement. Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol. Alcoholic beverages- manufacture of ethanol, methylated and denatured alcohol.

Textbooks

1. K. S. Tewari, N. K. Vishnoi, A Textbook of Organic Chemistry, 4th Edn., Vikas Publishing House, 2017.
2. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, 3rd Edn., Vishal Publishing Company, 2017.
3. P. S. Kalsi, Stereochemistry: Conformation and Mechanism, 9th Edn. New Age International, New Delhi, 2019.
4. I. L. Finar, Organic Chemistry, Vols. 1 & 2, 5th Edn., Pearson Education, 2005

Reference

1. S. M. Mukherji, S. P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan, 1984.
2. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd Edn., Oxford University Press, 2012.
3. R. T. Morrison, R. N. Boyd, Organic Chemistry, 6th Edn., Prentice Hall, 2004.
4. P. Sykes, A Guide to Mechanism in Organic Chemistry, 6th Edn., Pearson Education, 2004.
5. P. S. Kalsi, Organic Reactions and Their Mechanisms, 8th Edn., New Age International, 2014

6. J. March, Advanced Organic Chemistry, 6th Edn., John Wiley & Sons, 2007
7. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, 2ndEdn., Ane Books India, 2013

Course designed by: Dr. Renchu Scaria

SEMESTER IV

CBCH404: ORGANIC CHEMISTRY OF AROMATICS, HETEROCYCLES, ETHERS, PHENOLS AND CARBONYLS

Credit: 3 **Total Hours: 54**

Course Outcomes

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

CO1: Apply the aromaticity rules to benzenoid, non-benzenoid, polycyclic organic compounds.

CO2: Outline the reaction mechanism of electrophilic and nucleophilic reaction mechanisms.

CO3: Predict the role of reagents in various organic transformation reactions.

CO4: Understand the chemistry in the synthetic applications of active methylene compounds.

CO5: Elucidate the structure of simple heterocyclics/natural compounds.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	2	2	1	1	-	2	1	1	-	-
CO2	Understand	1	1	1	-	-	1	1	1	-	-
CO3	Understand	1	1	1	-	-	2	1	-	-	-
CO4	Remember	2	1	1	-	-	2	1	-	-	-
CO5	Analyze	1	1	2	-	-	1	2	-	-	-
	Average	**1.4**	**1.2**	**1.2**	**1**	**-**	**1.6**	**1.2**	**1**	**-**	**-**

Module 1: Aromatic compounds and Aromaticity **(18 Hours)**

Concept of aromaticity: antiaromaticity and non-aromaticity. Huckel's rule: application to benzenoid; benzene, naphthalene and non-benzenoid compounds; cyclopropenyl cation, cyclopentadienyl anion and tropylium cation. Aromatic behaviour of five membered heterocyclics, azulene, fulvene, calicene. Aromaticity of polycyclic compounds: anthracene and chrysene. Introduction to homoaromatic behavior and nmr evidence for aromaticity. General mechanism of electrophilic substitution, mechanism of halogenation, nitration, Friedel-Craft's alkylation, and acylation. Applications Orientation of aromatic substitution: ortho, para and meta directing groups. Ring activating and deactivating groups with examples. Orientation of groups like -OH, amino, methoxy and halogens. Aromatic nucleophilic substitutions: The addition - elimination and the elimination - addition mechanisms of nucleophilic aromatic substitution reactions. Synthetic applications.

Module 2: Ethers and Phenols (9 Hours)

Ethers and epoxides: nomenclature and classification. Preparation by Williamson's synthesis and alkoxymercuration - demercuration methods. Mechanism of epoxidation reactions by mCPBA- chemoselectivity and diastereoselectivity. Preparation and reactions of thiols and thioethers. Crown ethers, Synthetic applications. Phenols: nomenclature, physical properties, hydrogen bonding. Preparation: preparation from diazonium salts and sulphonic acids. Frémy's salt, Teuber reaction, Kolbe's reaction and Riemer-Tiemann reaction. Dienone-phenol rearrangement. Structure and properties of catechol, resorcinol, pyrogallol and phloroglucinol.

Module 3: Carbonyl and Active Methylene Compounds (9 Hours)

Aldehydes and ketones: nomenclature and classification. Preparation of aldehydes and ketones- preparation from alcohols (PCC, PDC, Swern Oxidation). Reactivity of carbonyl groups, acidity of alpha hydrogen. Reactions: mechanism of enolization reactions, nucleophilic addition reactions with Grignard reagents. Mechanism of aldol, Perkin, Knoevenagel reactions and benzoin condensation, Claisen condensation. Wittig reaction, Cannizzaro, Beckmann, benzyl - benzilic acid rearrangement and Reformatsky reactions, Baeyer-Villiger oxidation. Synthetic applications. Mechanism of reductions with $NaBH_4$, $LiAlH_4$. Synthetic applications. Synthetic applications of diethyl malonate, cyanoacetic ester and ethyl acetoacetate.

Module 4: Heterocyclic Compounds and Natural Products (18 Hours)

Classification, structure, and aromaticity of five- membered and six-membered rings containing one heteroatom. Basicity of heterocyclic compounds in comparison with aliphatic and aromatic amines. Preparation and properties of five membered ring compounds: Pyrrole-Paal-Knorr synthesis, Indole-Fischer and Madelung synthesis, Furan-Paal-Knorr synthesis and Thiophene-Hinsberg synthesis. Reactions of five membered ring compounds: Protonation reactions, electrophilic substitution reactions at ring carbons-mechanism and regioselectivity of the reaction-nitration, sulfonation, halogenation acylation and alkylation reactions. Reactions of five membered ring compounds: Reactions with organometallic reagents, bases and nucleophilic reagents, cycloaddition reactions, oxidations and reduction reactions. Preparation and properties of six membered ring compounds: pyridine-Hantzsch synthesis, quinoline-Skraup synthesis and isoquinoline-Bischler-Napieralski reaction. Conversion of pyrrole to pyridine and indole to quinoline Reactions of six membered ring compounds: Addition reactions to nitrogen atom of the ring, electrophilic substitution reactions at ring carbons-mechanism and regioselectivity of the reaction-nitration, sulfonation and halogenation reactions. Reactions of six membered ring compounds: Nucleophilic substitution reactions-mechanism and regioselectivity of the reaction amination (Chichibabin reaction) and

hydroxylation reaction, oxidations, and reduction reactions. Preparation and applications of pyridine N-oxides. Alkaloids: Definition, classification, occurrence, extraction, general properties, and functions of alkaloids. Structural elucidation of coniine and nicotine. Terpenoids: Definition, classification, occurrence, isolation, and general properties of terpenoids. Isoprene and special isoprene rules. Structural elucidation citral and geraniol.

Textbooks

1. A. Bahl, B. S. Bahl, A Textbook of Organic chemistry, S. Chand and Company Ltd., New Delhi, 22nd Ed., 2016.
2. P. Sykes, A Guidebook to Mechanism in Organic Chemistry, Pearson Education, 2013.
3. R. T. Morrison and R. N. Boyd., Organic Chemistry, Prentice Hall of India Pvt. Ltd., New Delhi, 7th Ed., 2011.
4. K. S. Tewari and N. K. Vishnoi, A Text book of Organic Chemistry, Vikas Publishing House Pvt. Ltd., 3rd Ed., 2006.
5. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publications, New Delhi, 14th Ed., 2014.
6. V. K. Ahluwalia, Text book of organic chemistry Vol.-I & Vol.-II, Ane‘s Student edition, New Delhi, 2010.

Reference

1. V. K. Yadav, Steric and Stereo Electronic Effects in Organic Chemistry, Springer, 2016.
2. I. L. Finar, Organic Chemistry, Vol 1 and 2, Addison Wesley Longman Ltd, England, 6th Ed., 2009.
3. Helena Dodzuik, Introduction to supramolecular chemistry, Springer, New York, 2002.
4. Heterocyclic Chemistry- J. A. Joule, K. Mills, G. F. Smith, Blackwell publishing Ltd, 5th edition, 2010.

Course designed by: Dr Benny Thomas

SEMESTER V

CBCH505: CHEMISTRY OF MAIN GROUP ELEMENTS

Credit: 3 **Total Hours: 54**

Course Outcomes

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

CO1: Analyze general group trends of main group elements.

CO2: Differentiate different types of nuclear reactions and identify its applications in various fields.

CO3: Recall the chemistry of Noble gases.

CO4: Apply basic methods and techniques of analytical chemistry.

CO5: Differentiate various reactions in non-aqueous solvents.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Analyze	2	1	-	-	-	2	-	2	-	-
CO2	Understand	1	1	2	-	-	1	-	-	1	1
CO3	Remember	1	-	1	-	-	1	1	-	1	1
CO4	Apply	2	2	-	-	-	2	-	1	-	-
CO5	Understand	1	-	1	-	-	1	-	1	1	-
	Average	**1.4**	**1.33**	**1.33**	**-**	**-**	**1.4**	**1**	**1.33**	**1**	**1**

Module 1: Characteristic and Distinctive Properties of s, and p Block Elements (18 Hours)

Hydrogen: occurrence of hydrogen, isotopes of hydrogen, hydrides - ionic or salt like hydrides, molecular or covalent hydrides and metallic or interstitial hydrides. Heavy water: manufacture and properties. Chemistry of s - block elements: inert pair effect, relative stability of different oxidation states, diagonal relationship-diagonal relationship between beryllium and aluminium, diagonal relationship of lithium with magnesium, anomalous behaviour of first member of each group. Allotropy and catenation. Alkali metals: Li, Na, K, Rb and Cs - occurrence, comparative study of elements-trends in ionization potential, electropositive character, oxidation state, reducing character, and characteristic flame colouration, oxides, halides, hydroxides and carbonates. Exceptional property of lithium. Alkaline earth metals: Be, Mg, Ca, Sr and Ba - occurrence and comparative study of the elements-trends in ionization potential, electropositive character, oxidation state, and characteristic flame colouration, oxides, hydroxides, halides, sulphates and carbonates. Basic beryllium acetate and nitrate. Exceptional property of beryllium.

p-Block elements: comparative study of the p-block elements - groups 13 - 18 with special reference to electronic configuration, structure of elements and trends in atomic and ionic radii, ionization potential, electron affinity, electronegativity and oxidation states, inert pair effect. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses; borohydrides (diborane), carboranes, boron nitride, borazene, boric acid and borates, silanes, oxides and oxoacids of nitrogen, phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

Module 2: Nuclear Chemistry (12 Hours)

The nucleus: structure of the nucleus, subatomic particles, forces in the nucleus, mesons. Nuclear models-shell model, liquid drop model (basic idea). Stability of nucleus - n/p ratio, binding energy; radioactive elements. Mass defect: energy produced during common nuclear reactions. Radiochemistry: natural and induced radioactivity; radioactive decay α-decay, β-decay, γ-decay, neutron emission, positron emission, electron capture. Decay constant, half-life period, unit of radioactivity (Curie). Geiger-Nuttal rule, radioactive displacement law, radioactive series. Nuclear reactions: types of nuclear reactions - spallation, nuclear fission, and nuclear fusion reactions. Nuclear fission-theory of nuclear fission; chain reaction and critical mass. Nuclear reactors - fast breeder reactors, fuels used in nuclear reactors, separation of isotopes, moderators, coolants; nuclear fusion. Atom bomb, neutron bomb and hydrogen bomb (principles). Applications: energy tapping, radio carbon dating, neutron activation analysis, isotopic labelling studies, nuclear medicine.

Module 3: Noble Gases (6 Hours)

Occurrence and uses, rationalization of inertness of noble gases. Compounds of Noble gases - clathrates, preparation and properties of XeF_2, XeF_4, and XeF_6; nature of bonding in noble gas compounds (valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds – fluorides and oxy fluorides (VSEPR theory). Separation of noble gases and uses.

Module 4: Analytical Chemistry (15 Hours)

Evaluation of analytical data: sampling, evaluation of analytical data, significant figures. Errors, accuracy and precision, methods of their expression, normal law of distribution, determinate and indeterminate errors. Statistical test of data; F, Q, and t test, rejection of data, and confidence intervals. Solvent extraction: classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of

organic species from the aqueous and non-aqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition and ion exchange. Development of chromatograms: frontal, elution and displacement methods. Basic principles and applications of LC, GLC, GPC, TLC and HPLC.

Module 5: Non-aqueous Solvents (3 Hours)

Non-aqueous solvents: Types of solvents and their general characteristics. Reactions in liquid ammonia and liquid sulphur dioxide.

Textbooks

1. B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Vikas Publishing Co., Jalandhar, 2013
2. R. Gopal, Inorganic Chemistry for Undergraduates, Universities press, India Pvt. Ltd., 2009.
3. H. Kaur Chromatography, Published by Pragati Prakashan, 2021
4. P. L. Soni, Text Book of Inorganic Chemistry, S. Chand and Sons, 2007

Reference

1. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4th Edn. Pearson Education, 2006.
2. J. D. Lee, Concise Inorganic Chemistry, 5th Edn, Chapman & Hall, 2002
3. D. F. Shriver, P. W. Atkins, Inorganic Chemistry, 3rd Edn., Oxford University Press, New Delhi, 2004
4. F.A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 6th Edn., Wiley Interscience, 1999
5. R. Gopalan, Elements of Nuclear Chemistry, Vikas Publishing House, 1999
6. S. Glasstone, Sourcebook on Atomic Energy, 3rd Edn., Krieger Publishing Company, 1979.
7. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman.2019
8. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
9. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
10. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
11. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

12. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.2005

Course designed by: Mr. Subin Joseph

CBCH506: INTRODUCTION TO ENVIRONMENTAL SCIENCE AND SCIENTIFIC WRITING

Credit:3 **Total Hours: 72**

Course Outcomes

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

CO1: Develop an awareness to protect nature and apply control measures to prevent pollution.

CO2: Realize environmental issues.

CO3: Know the fundamentals of soil chemistry and toxicology.

CO4: Realize various energy sources and the need of its protection.

CO5: Prepare research papers and thesis.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Analyze	2	-	2	-	-	2	-	2	-	-
CO2	Apply	2	-	-	1	1	2	-	2	-	-
CO3	Understand	2	1	-	2	2	2	-	2	-	-
CO4	Analyze	2	-	1	-	-	2	-	2	-	-
CO5	Apply	2	-	1	1	-	2	-	2	-	-
	Average	**2**	**1**	**1.33**	**1.33**	**1.5**	**2**	**-**	**2**	**-**	**-**

Module 1: Environmental Issues **(18 Hours)**

Pollution: air pollution, water pollution, soil pollution, noise pollution – sources, effects and control measures. Solid waste management: types, causes, effects and control measures of urban and industrial solid wastes, biodegradable and non-degradable solid wastes. Global and local environmental issues: global warming and climate change; ozone depletion; greenhouse effect; acid rain; carbon trading; carbon credit; carbon sequestration; nuclear accidents and nuclear holocaust; sand mining; wetland deterioration; landscape changes; deforestation; soil erosion; flood and drought; desertification; overexploitation of resources. Threats to fresh water resources of Kerala with examples; tourism and its impact on environment. Wetlands in Kerala: Threats and remedies. Case studies: Kuttanad Wetland System. Disaster management: introduction to hazards; classification of hazards: natural and anthropogenic, disaster management- earthquakes; cyclone; tsunami; floods; landslides; droughts.

Module 2: Chemical Toxicology and Lithosphere **(18 Hours)**

Chemical Toxicology: definition, toxic chemicals in the environment, impact of toxic chemicals on enzymes. Biochemical effects of As, Cd, Pb, Hg, CO, NOx, O_3, CN-, pesticides and carcinogenic substances. Lithosphere: Weathering of rocks- physical, chemical and biological processes. Factors controlling the formation of soil; soil profile and classification of soil. Composition of soil: organic and inorganic components in soil. Micro- and macro-

nutrients, NPK in soil. Nitrogen Cycle. Acid base and ion exchange reactions in the soil. Classification of energy resources: primary and secondary, conventional and non-conventional, renewable and non-renewable. Geothermal energy, hydroelectric power, hydrogen energy, nuclear energy, solar energy, wind energy, tidal power. Use of alternate energy sources-Energy from Wastes, Biogas Plants, Biomass and Biofuels, Conservation of Energy.

Module 3: Environmental Analysis and Pollution Control (18 Hours)

Environmental Sampling: Spatial and temporal variability, Types of samples: water sampling-surface and groundwater sampling, soil sampling. Sample preparation techniques - extraction of organic analytes from liquid samples, Preservation techniques of the samples. Sampling and Analysis of Air Samples: CO, H_2S, SO_2, Solid Particulate Matter (SPM) and hydrocarbons in air sample. Air Pollution Control Devices, Control of CO, SOx, NOx, Particulate matter and Hydrocarbons. Sampling and Analysis of Water: Estimation of some physico-chemical parameters of water quality such as pH, salinity, conductivity, total solids, total dissolved solids, total suspended solids, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand and hardness. Basic principles involved in the analysis of faecal indicator bacteria–test for coliforms–fecal coliforms–E. coli. Sampling and Analysis of Soil: pH, cation exchange capacity, total nitrogen, phosphorous and potassium.

Module 4: Introduction to Research Methodology (18 Hours)

Research in Science: History of the search for knowledge: Deductive method, Syllogistic reasoning, inductive method; The role of theory; Research hypothesis; Research: Definition, Characteristics; Scientific Method: Deductive-inductive process by John Dewey; Purposes of research: Basic, Applied and Action Research; Types of Educational Research: Historical, Quantitative, Qualitative and Experimental Research. Preparation of a Research Paper: Title, Abstract, Key-words, Introduction, Review of literature, Methods, Results and Discussion, Conclusions, References. Preparation of Review Papers: Scheme and structure of a review paper; significance of review papers. Thesis Writing: Review of literature; Presentation of results- tables, and figures; References- citations pattern; Acknowledgements, Appendix; Thesis preparation- Standard models. Preparing for Seminars and Conferences: Preparation of Abstracts and full papers. Methods of Presentation: Oral and Poster. Literature Survey in Chemistry: Primary and secondary sources of literature; Literature databases: Chemical Abstracts Service, SciFinder and ScienceDirect, Web of Science; Introduction to prominent journals of chemistry.

Textbooks

1. A. K. De, Environmental Chemistry, New Age International, 7th Edn., 2007

2. Gopinath Chandradasan, Environmental Chemistry, Vishal Publishing Co. Jalandhar, 2017.
3. V. K. Ahluwalia, Environmental Chemistry, 2nd Edn., Ane Books Pvt. Ltd., New Delhi, 2013
5. B. B. Kebbekus, S. Mitra, Environmental Chemical Analysis, Chapman and Hall, 1998
6. Gurumani N, 754p, Research methodology for biological sciences. M.J.P. Publications, Chennai, 2006

References

1. G. W. van Loon, S. J. Duffy, Environmental Chemistry A Global Perspective, Oxford University Press, New York, 2008
2. N. Singh, A. K. Thakur, Climatic Change and Environmental Issues, The Energy and Resource Institute, New Delhi, 2016
3. R. P. Cote, P. G. Wells, Controlling Chemical Hazards: Fundamentals of the Management of Toxic Chemicals, Springer, 2012
4. G. M. Tyler, Living in the Environment: Principles, Connections, and Solutions, Thomson Brooks/Cole, 2005
5. R. B. Baird, Standard Methods for the Examination of Water and Wastewater, 23rd Edn., American Water Works Association, 2017
7. D. D. Mishra, S. S. Dara, A Textbook of Environmental Chemistry and Pollution Control, S. Chand Publishing, 1993
8. P. Singh, Environmental Pollution and Management, Chugh Publications, 1985
9. R. Gopalan, A. Anand, R. W. Sugumar, A Laboratory Manual for Environmental Chemistry, I.K. International Publishing House Pvt. Ltd., 2009
10. R. A. Malviya, Environmental Pollution and its Control Under International Law, Chugh Publications, 1987
11. Kothari C.R. (2008). Research Methodology: Methods and Techniques 2nd Edn. New Age International Publishers, New Delhi.

Course designed by: Dr Cyril Augustine

CBCH507: ORGANIC CHEMISTRY OF ACIDS, NITROGEN COMPOUNDS AND BIOMOLECULES

Credit: 3 **Total Hours: 54**

Course Outcomes

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

CO1: Nomenclate and classify aliphatic and aromatic carboxylic acids, amines, amino acids, nucleic acids, carbohydrates, enzymes and vitamins.

CO2: Describe the preparation, estimation, interconversion and applications of common nitrogen compounds, sulphonic acids, carboxylic acids and their derivatives, α-amino acids, peptides, fats, lipids and carbohydrates.

CO3: Examine the relationship between structure and reactivity of carboxylic acids, sulphonic acids, nitrogen compounds, α-amino acids, peptides, nucleic acids and carbohydrates.

CO4: Explain the structures of carbohydrates, proteins, enzymes, lipids, vitamins, steroids and nucleic acids, and understand their role in life related processes and other fields.

CO5: Predict the outcome and discuss mechanisms of organic and bioorganic reactions, using a basic understanding of the reactivity of functional groups.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	2	-	1	-	-	2	1	1	-	-
CO2	Understand	2	1	1	-	-	2	-	-	-	-
CO3	Analyze	2	1	2	-	-	1	1	1	1	-
CO4	Understand	1	1	1	-	-	1	1	1	1	-
CO5	Apply	1	-	-	-	-	1	-	1	-	-
	Average	**1.6**	**1**	**1.25**	**-**	**-**	**1.4**	**1**	**1**	**1**	**-**

Module 1: Carboxylic Acids, Sulphonic Acids and their Derivatives (18 Hours)

Nomenclature and classification of aliphatic and aromatic carboxylic acids. Acidity: effect of substituents on acidity of carboxylic acids (aliphatic acids, mono, di, tri-chloro acetic acids, Benzoic acid, o/m/p-nitro benzoic acids). Dicarboxylic Acid: Methods of formation, properties and uses of dicarboxylic acids, hydroxy acids and unsaturated acids like oxalic, malonic, adipic, phthalic, citric, lactic, malic, tartaric, citric, cinnamic, acrylic, maleic and fumaric acid. Reactions: Stereospecific addition to maleic and fumaric acids. HVZ reaction, Preparation of coumarin–Fries rearrangement (Mechanism expected). Action of heat on hydroxyl and saturated dicarboxylic acids. Carboxylic acid derivatives: Preparation and general reactions of acid chlorides, acid anhydrides, amides and esters. Acid and Alkaline hydrolysis of esters, trans-esterification (Mechanism expected). Claisen condensation, Dieckmann and Reformatsky reactions (Mechanism expected). Benzene sulphonic acids: preparation, reactions

and uses. Benzene sulphonyl chlorides: ortho and para toluene benzene sulphonyl chlorides - preparation and uses.

Module 2: Nitrogen compounds (12 Hours)

Preparation of aliphatic and aromatic nitro compounds. Nitro-aci-tautomerism. Mulliken-Barker test for identifying nitroalkanes and nitroarenes. Reactions of aliphatic nitro compounds-reduction in acidic and neutral media, Nef carbonyl synthesis, Henry reaction, hydrolysis, reaction with nitrous acid. Comparison with alkyl nitrites. Reactions of aromatic nitro compounds- Reduction in acidic, neutral and alkaline medium, hydrogenation and substitution reaction in benzene ring. Preparation of aliphatic amines-general methods for the preparation of primary, secondary and tertiary amines-reductive amination, Hofmann hypobromite reaction, Schmidt reaction, Curtius rearrangement, Lossen rearrangement, Gabriel phthalimides synthesis. Separation of primary, secondary and tertiary amines with Hinsberg and Hofmann methods. Reactions of amines-with mineral acids, nitrous acid and carbonyl compounds (formation of enamines), carbylamine reaction, Liberman's nitrosamine reaction, Hoffmann's exhaustive methylation, and Hofmann elimination reaction. Preparation of aromatic diazonium compounds: structure and stability of benzene diazonium salts. Reactions: substitution, reduction and coupling reactions, Sandmeyer, Gatterman and Gomberg reactions. Applications: -conversion to benzene, phenol, chloro, bromo, iodo, fluoro, cyano and nitro benzenes and preparation of azo dyes. Preparation of diazomethane and diazoacetic ester: von Pechmann, McKay and Backer methods. Structure and synthetic applications of diazomethane and diazoacetic ester: methylation reactions, conversion of aldehydes to ketones, synthesis of nitrogen containing heterocycles, Arndt-Eisterdt synthesis and Wolf rearrangement.

Module 3: Amino Acids, Proteins and Nucleic Acids (6 Hours)

Amino acids – Classification – Structure of α-amino acids – Zwitter ion formation – Isoelectric point. Synthesis of α-Amino acids- phthalimide synthesis, reductive amination of α- ketoacids, Amination of α-halo acids, and Strecker synthesis. Peptides: Formation and geometry of peptide bond. Structure of peptides. Solution phase peptide synthesis (upto dipeptides). Primary, secondary and tertiary structure of proteins: α-helix and β-pleated sheets-– Denaturation of proteins. Nucleic acids: Components of nucleic acids, nucleosides and nucleotides. Structure of pentose sugar, adenine, guanine, cytosine, uracil and thymine. Watson and Crick model of DNA – Differences between DNA and RNA.

Module 4: Carbohydrates **(10 Hours)**

Classification and nomenclature of monosaccharides, Fischer, Haworth projections and chair conformations of glucose and fructose. Osazone test, Molisch's Test. Epimers with examples, Anomers and mutarotation in glucose (mechanism expected). Cyclic structure – pyranose and furanose forms – Haworth projection formula – chair conformations. (Mechanism expected). Determination of ring size of glucose and fructose Interconversions of aldoses and ketoses; Chain lengthening (Kiliani-Fischer synthesis) and shortening of aldoses- Ruff degradation (Mechanism expected). Disaccharides: reactions and structure of sucrose, inversion of cane sugar, lactose, and maltose. Polysaccharides: structure of starch (amylose and amylopectin) and cellulose. Iodine test-Industrial applications of starch and cellulose (structural elucidation not required). Cyclodextrins (uses and structure not required).

Module 5: Biologically Important Compounds **(8 Hours)**

Introduction to oils and fats; common fatty acids present in oils and fats, structure of omega-6, omega-3 fatty acids, alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Hydrogenation of fats and oils, saponification value, acid value, iodine number. Reversion and rancidity (Mechanism expected). Enzymes: Classification, mechanism of enzyme action, enzyme inhibition. Uses of common enzymes. Enzyme inhibitors. Steroids: structure and function of cholesterol. Diels's hydrocarbon. Elementary ideas of HDL, LDL. Vitamins: classification, uses and deficiency diseases. Structures of Vitamin A, C, D2 and D3.

Textbooks

1. A. Bahl, B. S. Bahl, Advanced Organic Chemistry, S. Chand Publishing, 2015.
2. S. S. Gupta, Organic Chemistry, Oxford University Press, 2017.
3. N. Tewari, Organic Chemistry, A Modern Approach, Volume-III, McGraw Hill Education, 2019.
4. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Golden Jubilee Year edition, Vishal Publishing Company, 2020.
5. S. M. Mukherji, S. P. Singh, Reaction Mechanism in Organic Chemistry, Revised Edition, Trinity Press, 2015.

Reference

1. F. A. Carey, R. M. Giuliano, Organic Chemistry, 10th Edition, 2016.
2. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee, Organic Chemistry, 7th Edition, Pearson Education India, 2010.

3. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd Edition, Oxford University Press, 2012.
4. I. L. Finar, Organic Chemistry, Vols. 1 and 2, 6th Edition, Pearson Education India, 2002.

Course designed by: Dr. Shijo K Cherian

CBCH508: BASIC PHYSICAL CHEMISTRY

Credit: 2 **Total Hours: 36**

Course Outcomes

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

CO1: Interpret the basic concepts and terminologies of thermodynamics and thermochemical principles.

CO2: State and apply the laws of thermodynamics in physical and chemical processes in ideal and real systems.

CO3: Determine the properties of real systems based on thermodynamic principles.

CO4: To categorize the various regions of electromagnetic radiation and energy modes of matter.

CO5: To interpret the interaction of MW and IR radiation with matter.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	1	1	1	-	-	1	1	1	-	-
CO2	Apply	2	1	1	-	-	2	2	1	1	-
CO3	Understand	2	1	-	-	-	1	1	1	-	-
CO4	Remember	2	1	-	-	-	2	1	1	-	-
CO5	Analyse	1	2	-	-	-	2	1	2	-	-
	Average	**1.4**	**1.2**	**1**	**-**	**-**	**1.6**	**1.2**	**1.2**	**1**	**-**

Module 1: Thermodynamics **(18 Hours)**

First law: concept of work, heat, internal energy, enthalpy, statement of first law. Heat capacity, relationship between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of ideal gases under isothermal and adiabatic conditions. Comparison of isothermal and adiabatic expansions. Joule-Thomson effect: inversion temperature, Joule-Thomson coefficient. Zeroth law of thermodynamics: statement. Absolute temperature scale.

Enthalpy of reactions, standard enthalpy of reaction, standard enthalpy of combustion, standard enthalpy of neutralisation, standard enthalpy of formation. Determination of enthalpies of reaction. Kirchhoff equations, (integrated Kirchhoff equation), flame temperature, explosion temperature, Applications of Hess's law and bond energy. Cyclic process, Carnot cycle, Carnot's theorem, efficiency of heat engine. Second law of thermodynamics, concept of entropy, entropy change for reversible and irreversible processes, entropy change accompanying changes of phase, entropy change of an ideal gas with change in pressure, volume and temperature, entropy change in isothermal, isobaric and isochoric process.

Gibbs and Helmholtz free energy, variation of free energy change with temperature and pressure, Maxwell relations (equations only), criteria for reversible and irreversible process,

Gibbs-Helmholtz equation. Partial molar properties, chemical potential, Gibbs-Duhem equation, chemical potential of a mixture of ideal gases in terms of partial pressure, molar concentration and mol fraction, Clausius - Clapeyron equation, applications. Third law of thermodynamics (statement only).

Module 2: Basic Spectroscopy (18 Hours)

Introduction: Electromagnetic spectrum, characterisation of radiation, regions of the spectrum, Quantisation of energy, types of molecular energies, absorption and emission, representation of spectra, Factors affecting width and intensity, signal - to - noise ratio, resolving power, Born-Oppenheimer approximation. Microwave (rotational) spectroscopy: classification of molecules, interaction of radiation with rotating molecule, Rigid diatomic molecules, selection rules, representation of rotational energy levels and spectrum, intensities of spectral lines, Determination of bond lengths of diatomic molecules, effect of isotopic substitution, Stark effect, basic instrumentation, applications. Infra - red spectroscopy: Vibrating diatomic molecule, potential energy curve, simple harmonic oscillator, zero point energy, force constant, Anharmonic oscillator, Morse curve, energy levels, selection rules, dissociation energies, fundamental frequencies, overtones, hot bands, Combination frequencies, Fermi resonance, skeletal vibrations, finger print region, group frequencies, Degrees of freedom for polyatomic molecules, normal vibrations, fundamental vibrations of water and carbon dioxide, applications. Raman spectroscopy: quantum theory of Raman effect, Rayleigh, Stokes and anti-Stokes lines, classical theory, molecular polarizability and polarizability ellipsoid, Pure rotational Raman spectra of linear molecules, wave numbers of spectral lines, vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion.

Textbooks

1. B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry, 48th Edn., Vishal Publishing Company, Jalandhar, 2020
2. K. L. Kapoor, Physical Chemistry, Vol. I, II, III & IV, Mac Millan (India) Ltd., 2000
3. N. Banwell, E.M. McCash, Fundamentals of Molecular Spectroscopy, 5thEdn., Tata McGraw Hill, 2017.
4. G. Aruldhas, Molecular Structure and Spectroscopy, Prentice Hall of India, 2008
5. P. S. Sindhu, Fundamentals of Molecular Spectroscopy, New Age International, 2011

Reference

1. P. Atkins, J. de Paula, Atkin's Physical Chemistry, 7th Edn., Oxford University Press, 2006
2. F. A. Alberty, R. J. Silby, Physical Chemistry, 3rd Edn., John Wiley & Sons, 2004

3. J. Rajaram, J. C. Kuriakose, Thermodynamics, Shoban Lal Nagin Chand & Co., 1986
4. G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd., 1997
5. D. N. Sathyanarayan, Handbook of Molecular Spectroscopy, IK International Publishing, 2015
6. H. S. Randhawa, Modern Molecular Spectroscopy, Macmillan India Ltd., 2009

Course designed by: Mr Aravind K

SEMESTER VI

CBCH609: INORGANIC CHEMISTRY OF d AND f BLOCK ELEMENTS

Credit: 3 **Total Hours: 54**

Course Outcomes

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

CO1: Discuss the chemistry and general group trends of transition metals, lanthanides and actinides.

CO2: Distinguish coordination complexes and identify the possible number of isomers of the compound.

CO3: Illustrate the various theories of bonding in coordination compounds.

CO4: Summarize the nature of bonding and applications of organometallic compounds with specific examples.

CO5: Demonstrate the chemistry behind metal clusters, Chevrel phases and Zintl ions with examples.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	2	1	2	1	-	1	2	1	1	-
CO2	Apply	2	1	1	1	-	1	1	1	-	-
CO3	Analyze	2	-	2	-	-	1	1	1	1	-
CO4	Evaluate	1	-	2	-	-	2	2	2	1	-
CO5	Remember	2	-	1	-	-	2	2	2	1	-
	Average	**1.80**	**1.00**	**1.60**	**1.00**	**-**	**1.40**	**1.60**	**1.40**	**1.00**	**-**

Module 1: d and f Block Elements **(18 Hours)**

Transition Metals: Electronic configurations, elements of first transition series, elements of second transition series, elements of third transition series. General characteristics of d-Block elements with special reference to variable oxidation states, colour, magnetic and catalytic properties, tendency to form complexes. Stability of various oxidation states and e.m.f.- Latimer and Pourbaix diagrams. Difference between first, second and third transition series. Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (extractive metallurgy not expected). Lanthanides and Actinides: Comparative study of lanthanide elements with respect to electronic configuration, oxidation states, atomic and ionic radii, colour, magnetic properties and complex formation. Lanthanide contraction-cause and consequences, Occurrence and principles of separation of lanthanides. General features and chemistry of actinides.

Comparative study of actinide elements with respect to electronic configuration, oxidation states, atomic and ionic radii, colour, complex formation. Actinide contraction, Trans-uranium elements, Genesis of elements and extension of periodic table, extraction of U-233 and Pu-239, processing of spent nuclear fuel-solvent extraction and ion exchange methods.

Module 2: Coordination Chemistry (18 Hours)

Werner's theory, electronic interpretation of co-ordination compounds. Types of ligands, nomenclature and isomerism in co-ordination compounds. Thermodynamic and kinetic stability of complexes, factors influencing stability. Application of coordination compounds in qualitative and quantitative analysis. VBT, CFT and MOT- merits and demerits. CFT – crystal field splitting in tetrahedral, square planar and octahedral complexes, factors affecting crystal field splitting - spectrochemical series. CFSE of complexes, consequences of crystal field splitting, Jahn-Teller Effect - tetragonal distortions from octahedral geometry. Spectral and magnetic properties of complexes. Origin of colour in coordination complexes, d-d transition, charge transfer transition (MLCT, LMCT). Reactivity of metal complexes: labile and inert complexes, ligand substitution reactions, substitution reactions of square planar complexes – trans effect.

Module 3: Organometallic Compounds (12 Hours)

Definition of organometallic compounds; classification based on the nature of metal-carbon bond; Classification of ligands in organometallic compounds, hapticity and 18-electron rule Metal carbonyls: Notion of pi-acceptor ligands; mononuclear and polynuclear carbonyls; bonding in metal carbonyls; Structures of important mononuclear and polynuclear carbonyls; IR Spectra of metal carbonyls and their significance. Ferrocene: Preparation, properties, bonding, and major reactions. Applications of organometallic compounds: Ziegler-Natta catalyst, Wilkinson catalyst and their significance.

Module 4: Inorganic Clusters (6 Hours)

Metal clusters, definition; carbonyl and halide clusters; low nuclearity carbonyl clusters (LNCC) and high nuclearity carbonyl clusters (HNCC). Electron counting schemes for HNCCs, Wades rules with Examples. Halide type clusters, structure and bonding in $[Re_2Cl_8]^2$. Introduction to Chevrel phases and Zintl ions with examples.

Textbooks

1. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Vikas Publishing Co., Jalandhar, 2020
2. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press, India Pvt. Ltd., 2009

3. P. L. Soni, Text Book of Inorganic Chemistry, S. Chand and Sons, 2013

Reference

1. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4th Edn., Pearson Education, 2006
2. J. D. Lee, Concise Inorganic Chemistry, 5th Edn., Chapman & Hall, 2008
3. D. F. Shriver, P. W. Atkins, Inorganic Chemistry, 7th Edn., Oxford University Press, New Delhi, 2018
4. F. A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 6th Edn., Wiley Interscience, 2009

Course designed by: Dr. Jinesh M. Kuthanapillil

CBCH610: ADVANCED ORGANIC CHEMISTRY

Credit:3 **Total Hours: 54**

Course outcomes

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

CO1: Interpret and predict the spectra of common organic compounds.

CO2: Describe the reactions behind the synthesis of organic polymers.

CO3: Identify the commonly used drugs, dyes and pigments and their mode of action.

CO4: Demonstrate the importance of pericyclic reactions in organic chemistry.

CO5: Illustrate the role of important reagents used in organic synthesis.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Analyze	2	2	-	-	-	2	-	2	-	-
CO2	Understand	2	1	2	-	-	1	-	-	1	1
CO3	Remember	1	-	2	-	-	1	1	-	1	1
CO4	Understand	2	-	-	-	-	2	-	1	-	-
CO5	Apply	2	1	-	-	-	2	-	1	1	-
	Average	**1.8**	**1.33**	**2**	**-**	**-**	**1.66**	**1**	**1.33**	**1**	**1**

Module 1: Applications of Spectroscopic Methods in Organic Chemistry (18 Hours)

UV-Visible Spectroscopy: Electromagnetic radiations, electronic transitions, λ_{max} and ε_{max}, Effect of conjugation, the concept of chromophore and auxochrome, bathochromic, hypsochromic, hyperchromic and hypochromic shifts. Woodward-Feiser rules for dienes and problems. Woodward-Feiser Rules for enones and problems. Infrared Spectroscopy: Infrared radiation and types of molecular vibrations, functional group and fingerprint region. Factors influencing vibrational frequencies-inductive effect, hydrogen bonding, conjugation, resonance and ring size, Important functional group regions in IR, IR spectra of alkanes, alkenes, alkynes, aromatic hydrocarbons, simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives. NMR Spectroscopy: Proton NMR- Chemical shift values and factors influencing it; shielding and deshielding effects. Anisotropic effects in alkene, alkyne, aldehydes and aromatics compounds. Spin-spin splitting. Interpretation of Proton-NMR spectra of simple compounds.

Module 2: Organic Polymers (9 Hours)

Introduction to polymers-classification of polymers, Glass transition temperature. Polymerization reactions: addition and condensation polymerization. Synthesis and applications of PVC, PMMA, LDPE, HDPE, PAN, polyurathenes, Synthesis and applications of polyesters, Nylon 6, Nylon 66, Nylon 610, bakelite, melamine, Natural rubbers, the structure of natural rubber, latex processing, Vulcanization- hot and cold, Synthetic rubbers

SBR, NBR, PB, polychloroprene and thiokol rubber, Biodegradable polymers, conducting polymers, plastic recycling

Module 3: Pharmaceutical Chemistry (5 Hours)

Introduction to drugs, classification, lock and key mechanism, Antipyretics and analgesics- mode of action, synthesis of paracetamol, aspirin and ibuprofen, Antibiotics- chloramphenicol and penicillins- structure, mode of action (Synthesis not expected), Psychotropic drugs- drug addiction, drug abuse, and recovery. (Synthesis not expected)

Module 4: Molecules of Colour (4 Hours)

Dyes: Important theories regarding colour and constitution of dyes, classification based on structure and application. Synthesis and applications of Methyl orange; Malachite green, Rosaniline, Phenolphthalein and Fluorescein, Synthesis of Indigotin, Alizarin. Edible dyes, Food colours with examples, Examples of natural and synthetic dyes.

Module 5: Pericyclic Reactions (12 Hours)

Pericyclic and photochemical reactions: definition and classification. Electrocyclic reactions: FMO approach, Examples of electrocyclic reactions (thermal and photochemical) that involve 4π and 6π electrons and corresponding cycloreversion reactions. Cycloaddition reactions: FMO approach, Diels Alder reaction, photochemical [2+2] reactions. Sigmatropic shifts and their orders, [1, 3] and [1, 5] hydrogen shifts, [3, 3] shifts reference to Claisen and Cope rearrangement.

Module 6: Special Reagents (6 Hours)

Applications of $NaBH_4$, diborane, Applications of CPBA, $Pb(OAc)_4$, osmium tetroxide, Uses of NBS, DDQ, TMS-Cl, Grignard reagents-synthetic applications, alkyl lithium compounds and Gilman reagent

Textbooks

1. Y. R. Sharma, Elementary Organic Spectroscopy, 5th Edition, S. Chand & Company Ltd., New Delhi, 2013
2. R. M. Silverstein, F.X. Webster, Spectrometric Identification of Organic Compounds, 8th Edn, John Wiley and Sons, New York, 2015
3. V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age International (P) Ltd., 2011
4. B. K. Sharma, Polymer Chemistry, Goel Publishing House, Meerut, 1989
5. A. Burger, Medicinal Chemistry -A Burger-Wiley Interscience, New York, Vol. I and II, 1990
6. O. Wilson, O. Giswold, F. George J. G., Text Book of Organic, Medicinal and Pharmaceutical Chemistry,9th Edn, Lippincott Company, Philadelphia, 1991

7. P. Y. Bruice, Organic Chemistry, 7thEdn., Pearson Prentice Hall, 2011
8. B. Mehta, M. Mehta, Organic Chemistry, PHI Learning Private Limited, 2015
9. C. Bhakta, Organic Chemistry, Bharathi Bhavan Publishers and Distributors, 2014
10. A. Fleming, Frontier Orbitals and Organic Chemical Reactions, Wiley, 1976
11. S. Sankararaman, Pericyclic Reactions-A Text Book, Wiley VCH, 2005

Reference

1. W. Kemp, Organic Spectroscopy, 3rd Edn., Macmillan, New York, 2008
2. P. S. Kalsi, Applications of Spectroscopic Techniques in Organic Chemistry, 7th Edition, New Age International (P) Ltd., New Delhi, 2016
3. G. Odian, Principles of Polymerization, 4th Edn., Wiley, 2004
4. F. W. Billmeyer Jr., Textbook of Polymer Science, John Wiley and Sons, New Delhi, 2007
5. M. G. Arora, M. Singh, M.S. Yadav, Polymer Chemistry, 2nd Revised Edn., Anmol Publications Private Ltd., New Delhi, 1989
6. M. P. Stevens, Polymer Chemistry: An Introduction, 3rd Edn, Oxford University Press, USA, 1998
7. A. O. Bentley, J.E. Driver, Lewis Malcolm Atherden - Bentley and Drivers' Text Book of Pharmaceutical Chemistry, 1969
8. G. Patrick, Medicinal Chemistry, 5th Edn., Garland Science, 2013
9. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, 2ndEdn., Ane Books India, 2013
10. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, 3rdEdn., Vishal Publishing Company, 2017
11. A. Bahl, B. S. Bahl, Advanced Organic Chemistry, 20 th Edn., S. Chand Publishers, 2002
12. R. O. C Norman, J. M. Coxon, Principles of Organic Synthesis. Second Indian reprint, 2012
13. G. Brahmachari, Organic Name Reactions, Narosa Publishing House New Delhi, 2007
14. K. S. Tewari, N. K. Vishnoi, Organic Chemistry, 3rdEdn., Vikas Publishing House, 2006

Course designed by: Dr. Renjith Thomas

CBCH611: ADVANCED PHYSICAL CHEMISTRY

Credit: 3 **Total Hours: 54**

Course Outcomes

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

CO1: Interpret the interaction of matter with UV/vis and radiofrequency radiations.

CO2: Categorize the chemical equilibrium existing in systems.

CO3: Interpret the phase diagrams of various systems and define the colligative properties of solutions.

CO4: Describe the factors affecting rate of chemical reactions.

CO5: Define the impact of photon absorption on matter.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	1	1	1	-	-	1	1	1	-	-
CO2	Understand	2	1	-	-	-	1	1	1	-	-
CO3	Apply	2	1	1	-	-	2	2	1	1	-
CO4	Remember	2	1	-	-	-	2	1	1	-	-
CO5	Understand	1	1	-	-	-	1	1	1	-	-
	Average	**1.4**	**1**	**1**	**-**	**-**	**1.4**	**1.2**	**1**	**1**	**-**

Module 1: Advanced Spectroscopy **(12 Hours)**

Electronic spectroscopy: types of electronic transitions, representation of electronic spectrum, Born – Oppenheimer approximation and basic idea about vibrational *coarse structure* and rotational *fine structure*, Franck-Condon principle, dissociation and pre dissociation, photoelectron spectroscopy, chemical analysis by electronic spectroscopy. Nuclear Magnetic Resonance (NMR) spectroscopy: magnetic properties of nuclei, spin, magnetic moment, interaction of spin and magnetic field, Larmor precession, resonance condition, chemical shift, low resolution spectra, different scales, spin-spin coupling and high resolution spectra, chemical exchange, interpretation of PMR spectra of simple organic molecules like acetaldehyde, ethyl alcohol, benzene and aniline. Electron Spin Resonance (ESR) spectroscopy: principle, hyperfine structure, ESR of simple radicals like methyl, ethyl etc.

Module 2: Chemical Equilibrium **(6 Hours)**

Standard free energy change, Standard free energy of formation of compounds, law of mass action, equilibrium constant, derivation of law of chemical equilibrium, derivation of relations between K_p, K_c and K_x, pressure dependence of equilibrium constants, derivation of van't Hoff equation. Pressure dependence of equilibrium constants, Le Chatlier's principle.

Module 3: Phase Equilibria and Solutions (18 Hours)

Concept of phases, components and degrees of freedom, Gibbs Phase Rule, One component systems: water and sulphur systems. Two component systems: solid - liquid equilibrium - naphthalene- biphenyl system, Thermal analysis, cooling curve, freezing mixtures, Simple eutectic - Lead - silver system, Formation of compounds with congruent melting point and incongruent melting point - general phase diagrams, Solid - gas equilibrium - salt hydrate, Nernst distribution law - derivation and applications. Solutions: Raoult's law, ideal and non - ideal solutions, positive and negative deviations, fractional distillation, distillation of immiscible liquids, solubility of partially miscible systems – UCST, LCST, Henry's laws and its applications. Colligative Properties: 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 and (iv) osmotic pressure and amount of solute. Applications in calculating molar masses of normal dissociated and associated solutes in solution, van't Hoff factor.

Module 4: Kinetics and Photochemistry (18 Hours)

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions for zero, first, second and third order reactions, experimental methods of the determination of rate laws, half-life time for first order and second order reactions, determination of order of reactions. Effect of temperature on reaction rates, effect of catalyst, Arrhenius equation; activation energy. Photochemistry: Characteristics of electromagnetic radiation, Fluorescence and phosphorescence - Jablonski diagram, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, examples of low and high quantum yields, photosensitised reactions, quenching. bioluminescence, chemiluminescence.

Textbooks

1. N. Banwell, E.M. McCash, Fundamentals of Molecular Spectroscopy, 5th Edn., Tata McGraw Hill, 2017
2. G. Aruldhas, Molecular Structure and Spectroscopy, Prentice Hall of India, 2019
3. P. S. Sindhu, Fundamentals of Molecular Spectroscopy, New Age International, 2019
4. V. K. Ahluwalia, R. K. Parashar, Organic Reaction Mechanisms, 4th Ed Alpha Science International, 2011.
5. B. R Puri, L. R Sharma, M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, Jalandhar, 2021

Reference

1. K. L. Kapoor, Physical Chemistry, Vol. I, II, III & IV, Mac Millan (India) Ltd., 2019

2. R. S. Drago, Physical Methods in Chemistry, Saunders College, 1992
3. D. N. Sathyanarayan, Handbook of Molecular Spectroscopy, IK International Publishing, 2020
4. H. S. Randhawa, Modern Molecular Spectroscopy, Macmillan India Ltd., 2009
5. Atta-ur-Rahman, Nuclear Magnetic Resonance: Basic Principles, Springer, 2012
6. P. Atkins, J. de Paula, Atkin's Physical Chemistry, 7th Edn., Oxford University Press, 2006
7. F. A. Alberty, R. J. Silby, Physical Chemistry, 3rd Edn., John Wiley & Sons, 2004
8. P. Atkins, J. de Paula, Atkin's Physical Chemistry, 11th Edn., Oxford University Press, 2018
9. I. N. Levine, Physical Chemistry, 6thEdn., Mc Graw Hill, 2009
10. J. Laidler, J. H.Meiser, Physical Chemistry, 2nd Edn., 1995
11. Mc Quarrie, J. D. Simon, Physical Chemistry – A molecular Approach, Viva Books Pvt. Ltd, 2011
12. G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd., 199

Course designed by: Dr Tomlal Jose E

CBCH612: ELECTROCHEMISTRY, IONIC EQUILIBRIUM AND SURFACE CHEMISTRY

Credit:3 **Total Hours: 54**

Course Outcomes

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

CO1: Describe and apply the principles and laws of electrochemistry.

CO2: Distinguish between different types of cells.

CO3: Explain the concept of acids and bases, their strengths and interpret acid-base titrations.

CO4: Interpret the properties of different types of electrolytes and their applications.

CO5: Illustrate adsorption phenomena, catalysis and different types of dispersions and adsorption isotherms.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	2	-	1	-	-	2	-	1	-	-
CO2	Understand	2	-	-	-	-	1	-	-	-	-
CO3	Apply	1	1	1	-	-	1	-	1	-	-
CO4	Apply	2	1	1	-	-	1	-	1	-	-
CO5	Understand	1	-	1	-	-	1	-	-	-	-
	Average	**1.60**	**1.00**	**1.33**	**-**	**-**	**1.20**	**-**	**1.00**	**-**	**-**

Module 1: Electrical Conductance and EMF **(24 Hours)**

Conductance: Faraday's laws of electrolysis, measurement of conductance, cell constant, specific conductance and molar conductance. Variation of specific and equivalent conductance with dilution for strong and weak electrolytes. Kohlrausch's law of independent migration of ions, ion conductance and ionic mobility. Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes. Ostwald's dilution law. Debye-Huckel model (physical idea only). Application of conductance measurement (determination of solubility product and ionic product of water). Conductometric titrations. Determination of transport number by Hittorf's method, moving boundary method.

Electrochemical Cells: types of electrochemical cells and examples, cell reactions, emf and change in free energy, ΔH and ΔS and equilibrium constant of cell reactions from emf measurements. Thermodynamic derivation of Nernst equation. Standard cells, half cells/electrodes, different types of electrodes (with examples). Standard electrode potential (IUPAC convention) and principles of its determination. Determination of pH values using hydrogen, quinone-hydroquinone and glass electrodes. Potentiometric titrations: acid-base and redox. Rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Concentration cells: electrode concentration cell and

electrolyte concentration cells. Types of electrolyte concentration cells – with transference and without transference, liquid junction potential. Over voltage, oxygen over voltage, factors affecting over voltage. Polarography, half wave potential, Ilkovic equation and application in quantitative analysis (elementary ideas only).

Module 2: Ionic Equilibrium (18 Hours)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization. Theories of acids and bases: Lewis concept, Lux-Flood definition, Usanovich definition, hard and soft acids and bases. Effect of solvents on the strength of acids and bases, levelling effect. Ionization of weak acids and bases. Dissociation constant, dissociation constants of polybasic acids, relative strengths of weak acids and bases. Ionic product of water, pH and pOH. Common ion effect, buffer solutions, buffer capacity, buffer range, buffer action, pH of buffer solutions, applications of buffers in analytical chemistry and biochemical processes in the human body. Salt hydrolysis: calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Solubility product, relation between solubility product and molar solubility of sparingly soluble salts, applications of solubility product principle. Theory of acid - base indicators, action of phenolphthalein and methyl orange, titration curves of strong acid against strong base and weak acid with strong base, mathematical treatment of acid base titrations.

Module 3: Surface Chemistry and Catalysis (12 Hours)

Surface Chemistry: adsorption and surface phenomena, physisorption and chemisorption of gases, adsorption isobar, isostere and isotherms. Freundlich adsorption isotherm, derivation of Gibbs and Langmuir isotherm, BET equation (derivation not required) and its use in surface area determination, nature of adsorbed state, adsorption and heterogeneous catalysis, surface film. Colloids: electrical double layer and colloid stability, electrokinetic phenomena, soaps and detergents, micelle formation and critical micelle concentration. Catalysis: types of catalyst, specificity and selectivity, mechanisms of catalysed reactions at solid surfaces. Autocatalysis, enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Textbooks

1. B. R Puri, L. R Sharma, M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, Jalandhar, 2010
2. Gurdeep Raj, Surface Chemistry, Goel Publishing House, 2006

Reference

1. K. L. Kapoor, Physical Chemistry, Vol. I, II, III & IV, Mac Millan (India) Ltd., 2000

2. P. Atkins, J. de Paula, Atkin's Physical Chemistry, 7th Edn., Oxford University Press, 2006
3. F. A. Alberty, R. J. Silby, Physical Chemistry, 3rd Edn., John Wiley & Sons, 2004
4. A. W. Adamson, A. P Gast, Physical Chemistry of Surfaces, 6th Edn., Wiley, 1997

Course designed by: Dr. Bejoy Francis

PRACTICAL

SEMESTER I AND II

CBCH2P01: VOLUMETRIC ANALYSIS

Credit: 2 **Total Hours: 72**

Course Outcomes

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

CO1: Practice basic laboratory safety measures.

CO2: Calibrate laboratory glassware's for quantitative analysis.

CO3: Learn the common concentration terms and prepare standard solutions.

CO4: Estimate the amount of substance present in a solution using volumetric methods.

CO5: Report and summarize the results obtained from different experiments.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	-	-	2	-	2	-	-	2	-	-
CO2	Understand	-	-	2	-	2	-	-	-	1	-
CO3	Analyse	-	-	-	-	2	2	-	-	1	-
CO4	Analyse	-	-	-	-	3	2	-	-	1	-
CO5	Analyse	-	-	-	2	-	-	-	2	-	-
	Average	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**1**	**-**	**2**

Laboratory Safety

Introduction to lab safety

Basic lab techniques- calibration of volumetric apparatus

Volumetric experiments

Concentration terms and preparation of standard solution of oxalic acid, sodium carbonate, Mohr's salt and potassium dichromate.

Standardization of secondary standards

Acidimetry and alkalimetry

Estimation of HCl, HNO_3, H_2SO_4, NaOH, KOH, Na_2CO_3 and $NaHCO_3$ in a mixture and NaOH and Na_2CO_3 in a mixture

Permanganometry

Estimation of oxalic acid, $FeSO_4$, Mohr's salt, Estimation of calcium (compulsory)

Iodometry and Iodimetry

Estimation of copper, estimation of arsenious oxide.

Dichrometry

Estimation of ferrous ion using internal and external indicator

Estimation of ferric ion using internal and external indicator

Complexometry

Estimation of Zn, Mg using EDTA

(At least four experiments from acidimetry, three experiments from permanganometry, one experiments from dichrometry/iodometry/iodimetry and two from complexometry.)

Reference

1. A. O. Thomas, Practical Chemistry, 7th Edn., Scientific Book Centre, Kannur, 1999
2. D. A. Skoog, D. M. West, F. James Holler, S. R. Crouch, Fundamentals of Analytical Chemistry, 8th Edn., Brooks/Cole, 2004
3. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, Vogel's Textbook of Quantitative Chemical Analysis 6thEdn., Prentice Hall, 2000
4. G. D. Christian, Analytical Chemistry, 6thEdn., John Wiley and Sons, 2003
5. R. A. Day, A. L. Underwood, Quantitative Analysis,6thEdn., Prentice Hall, 1991

Course designed by: Dr. Renjith Thomas

SEMESTER III AND IV

CBCH4P02: QUALITATIVE ORGANIC ANALYSIS

Credit: 2 **Total Hours: 72**

Course Outcomes

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

CO1: Learn the characteristic tests of common organic functional groups.

CO2: Qualitatively analyze a given simple or multifunctional organic compound using micro/semi-micro analytical techniques.

CO3: Prepare solid derivatives to confirm the compounds.

CO4: Determine the physical properties of organic compounds.

CO5: Report and summarize the results obtained from different experiments.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	-	-	2	-	2	2	-	2	-	-
CO2	Analyse	-	-		-	3	2	-	2	-	-
CO3	Analyse	-	-	-	-	3	2	-	2	2	-
CO4	Analyse	-	-	-	-	2	2	-	2	1	-
CO5	Analyse	-	-	-	2	-	-	-	2	-	-
	Average	**-**	**-**	**2**	**2**	**2.5**	**2**	**-**	**2**	**1.5**	**-**

Qualitative microanalysis of simple organic compounds

Introduction to microanalysis and lab setting.

Test for elements like N, S and halogens.

Test for saturation, unsaturation and aromaticity.

Study of the reactions of the following functional groups: alcohol, aldehyde, ketone, carboxylic acid, 1,2-dicarboxylic acid, ester, primary, secondary and tertiary amines

Systematic analysis of the following organic compounds containing one functional group and characterization with a derivative- alcohol, aldehyde, ketone, carboxylic acid, salicylic acid, nitro-benzoic acid, chloro benzoic acid, salicylaldehyde, cinnamic acid, nitrophenols, nitroanilines, dicarboxylic acid (aliphatic and aromatic), ester, primary and secondary amines halogen in nucleus and side chain, carbohydrates, diamides (urea and thiourea), amides, anilides, nitro compounds, dinitro compounds, primary, secondary and tertiary amines, polynuclear hydrocarbons.

Preparation of derivatives

Determination of melting and boiling points of organic compounds

(Minimum seven organic compounds to be analysed followed by the preparation of their solid derivatives.)

Reference

1. A. O. Thomas, Practical Chemistry, 7th Edn., Scientific Book Centre, Kannur, 1999
2. Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith, Austin R. Tatchell Vogel's Textbook of Practical Organic Chemistry, 5thEdn., Longman Scientific & Technical, 1989
3. F. G. Mann, B. C. Saunders, Practical Organic Chemistry, 4thEdn., Pearson Education, 2009
4. V. K. Ahluwalia, S. Dhingra, Comprehensive Practical Organic Chemistry: Qualitative Analysis, Universities Press, 2000

Course designed by: Dr. Renjith Thomas

SEMESTER V AND VI

CBCH6P03: PHYSICAL CHEMISTRY EXPERIMENTS

Credit: 3 **Total Hours: 108**

Course Outcomes

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

CO1: Design and perform a physical chemistry experiment in the lab using scientific methods.

CO2: Demonstrate the applications of experiments based on thermodynamics, phase. equilibrium, viscosity and kinetics for cementing the theoretical knowledge.

CO3: Conduct experiments based on, electrochemistry and colorimetry and analyse data using spread sheets.

CO4: Perform basic computational chemistry experiments.

CO5: Report and summarize the results obtained from different experiments.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Analyse	-	-	1	-	2	2	-	-	-	-
CO2	Analyse	-	-	2	-	3	2	-	-	-	-
CO3	Analyse	-	-	-	-	3	2	-	-	-	-
CO4	Analyse	-	-	-	-	1	1	-	2	2	-
CO5	Analyse	-	-	-	2	-	-	-	-	-	-
	Average	**-**	**-**	**1.5**	**2**	**2.25**	**1.75**	**-**	**2**	**2**	**-**

Set 1

Critical solution temperature (CST) of phenol water system, estimation of unknown concentration of KCl and NaCl using CST.

Determination of heat of neutralization of strong acid and strong base, weak acid and strong base, heat of solution of KNO_3

Determination of the transition temperature of salts like sodium thiosulphate and sodium acetate.

Determination of molecular weight by Rast's Method (using naphthalene, camphor or biphenyl as solvent and acetanilide, p-dichlorobenzene as solute).

Kinetics of simple reactions (acid hydrolysis of methyl acetate)-determination of rate constant

Viscometry for determination of unknown concentration of sugar solution.

Set 2

Potentiometric titration – Fe^{2+} vs. $Cr_2O_7^{2-}$, I^- vs. MnO^{4-}

Conductometric titrations of strong acid- strong base, weak acid-strong base.

Determination of equivalence point of potentiometric and conductometric titrations using a spreadsheet.

Determination of partition coefficient between water and CCl_4 with iodine as solute.

Colorimetric estimation of Fe/Cu/Ni

Computational chemistry experiments- optimization of geometry and electronic structure analysis of simple organic compounds using licenced or open-source software (8 molecules)

(Minimum 10 different experiments, 5 from each SET)

Reference

1. A. O. Thomas, Practical Chemistry, 7th Edn., Scientific Book Centre, Kannur, 1999
2. W. G. Palmer, Experimental Physical Chemistry, Cambridge University Press, 2009
3. J. B. Yadav, Advanced Practical Physical Chemistry, 29thEdn., Krishna Prakashan Media Pvt. Ltd., 2010
4. R. C. Das, B. Behera, Experiments in Physical Chemistry, Tata McGraw-Hill, 1983
5. K. K. Sharma, An Introduction of Practical Chemistry, Vikas Publishing House, New Delhi, 2003

Course designed by: Dr. Renjith Thomas

CBCH6P04: TECHNIQUES IN ORGANIC CHEMISTRY

Credit: 2 **Total Hours: 72**

Course Outcomes

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

CO1: Identify and separate organic compounds/mixtures using chromatography.

CO2: Design and perform organic synthesis in the lab.

CO3: Propose a suitable mechanism for the reactions and calculate the yield**.**

CO4: Draw the structure and mechanism of organic reactions using software.

CO5: Report and summarize the results obtained from different experiments.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Analyse	-	-	2	-	2	2	-	2	-	-
CO2	Apply	-	-	2	-	3	2	-	2	2	-
CO3	Understand	2	-	-	-	2	2	-	2	2	-
CO4	Apply	-	-		-	3	1	-	2	2	-
CO5	Understand	-	-	-	2	-	-	-	2	-	-
	Average	**2**	**-**	**2**	**2**	**2.5**	**1.75**	**-**	**2**	**2**	**-**

Chromatography

TLC of o-nitrophenol, p-nitrophenol and mixture of ortho and para nitrophenol

Column chromatography- purification of p-nitrophenol and metadinitrobenzene

Synthetic organic Chemistry

Benzoylation of aniline, phenol and peta-naphthol

Esterification of benzoic acid

Sidechain oxidation of benzyl chloride and benzyl alcohol

Iodoform from acetone and ethylmethyl ketone

Nitration of naphthalene, acetanilide and nitrobenzene

Preparation of hippuric acid from glycine

Preparation of anthracene-maleic acid adduct

Preparation of tetrahydrocarbazole by Fischer Indolisation

Preparation of Umbelliferrone

Chemical structure drawing

Chemical structure drawing using Chemsketch or other freewares

Representation of mechanism of two reactions using Chemsketch

(Any two experiments from chromatography, five experiments from synthetic organic chemistry and 5 molecules/reactions from chemical structure drawing)

Reference

1. A. O. Thomas, Practical Chemistry, 7th Edn., Scientific Book Centre, Kannur, 1999
2. Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith, Austin R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, Longman Scientific and Technical, 1989
3. F. G. Mann, B. C. Saunders, Practical Organic Chemistry, 4thEdn., Pearson Education, 2009
4. V. K. Ahluwalia, S. Dhingra, Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis, Universities Press, 2004

Course designed by: Dr. Renjith Thomas

CBCH6P05: QUALITATIVE INORGANIC ANALYSIS

Credit: 3 **Total Hours: 108**

Course Outcomes

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

CO1: Learn the characteristic tests of common cations and anions.

CO2: Eliminate interfering anions.

CO3: Qualitatively analyze salt mixture with interfering anions.

CO4: Perform spot tests of cations.

CO5: Report and summarize the results obtained from different experiments.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Analyse	2	-	-	-	2	2	-	2	-	-
CO2	Apply	2	-	-	-	3	2	-	2	2	-
CO3	Analyse	2	-	2	-	3	2	-	2	2	-
CO4	Analyse	1	-	1	-	1	1	-	1	2	-
CO5	Understand	-	-	-	2	-	-	-	2	-	-
	Average	**1.75**	**-**	**2**	**2**	**2.25**	**1.75**	**-**	**1.8**	**2**	**-**

Study of reactions of cations and anions

Study of reactions of the following cations

Ag+, Hg^{2+}, Pb^{2+}, Cu^{2+}, Bi^{2+}, Cd^{2+}, As^{3+}, Sn^{2+}, Sb^{3+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+} , Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, Li^{+}, Na^{+}, K^{+}, NH_4^{+}

Study of reactions of the following anions

CO_3^{2-}, S^{2-}, SO_4^{2-}, NO_3^{-}, F^{-}, Cl^{-}, Br^{-}, BO_2^{-} $C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, CH_3COO^{-}, PO_4^{3-}, AsO_3^{3-}, AsO_4^{3-} and CrO_4^{2-}

Elimination of interfering anions

Spot tests for cations

Qualitative analysis of binary salt mixtures

Systematic qualitative analysis of mixtures containing two cations and two anions from the following with one interfering radical.

Identification and confirmation tests (with chemistry) and spot tests are expected.

(At least seven salt mixtures with interfering anions.)

Reference

1. A. O. Thomas, Practical Chemistry, 7th Edn., Scientific Book Centre, Kannur, 1999.
2. G. Svehla, Vogel's Qualitative Inorganic Analysis, 7th Edn., Pearson Education, New Delhi, 2006.

3. V. V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3rdEdn., The National Publishing Company, Chennai, 1974.

Course designed by: Dr. Renjith Thomas

CBH6P06: APPLIED CHEMISTRY PRACTICALS

Credit: 2 **Total Hours: 72**

Course Outcomes

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

CO1: Use Gravimetric methods for quantitative analysis.

CO2: Design the synthesis of coordination compounds.

CO3: Apply the scientific knowledge to check the quality of rubber latex, environment parameters and identify food adulterants.

CO4: Report and summarize the results obtained from different experiments.

CO5: Develop scientific writing skills.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Analyse	2	-	2	-	3	2	-	2	-	-
CO2	Apply	2	-	2	-	3	2	-	2	2	-
CO3	Apply	1	2	-	-	1	1	-	2	2	1
CO4	Apply	-	-		2		-	-	2	2	-
CO5	Create	-	-	-	3	-	-	-	2	-	-
	Average	**1.66**	**2**	**2**	**2.5**	**2.33**	**1.66**	**-**	**2**	**2**	**1**

Set 1: Gravimetry

Estimation of sulphate as barium sulphate

Estimation of barium as barium sulphate

Estimation of Fe as Fe_2O_3

Estimation of nickel as dimethyl glyoxime complex

Estimation of copper as CuCNS

Set 2: Preparation of coordination compounds

Preparation of tetrammine copper (II) sulphate.

Preparation of Tris thiourea copper(II) sulphate

Set 3: Applied Analysis

Determination of DRC of rubber latex and

Determination of hardness of water

Determination of pH of water and alkalinity of water

Determination of saponification value of oils

Tests for common food adulterants

Set 4: Scientific writing

Research paper review

Designing a poster for presentation

(At least three experiments from Set 1, one from Set 2 and two from Sets 3 and 4)

Reference

1. A. O. Thomas, Practical Chemistry, 7th Edn., Scientific Book Centre, Kannur, 1999
2. A. I. Vogel, A Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, 3rdEdn., Longman, 1971
3. G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney, Vogel's Text Book of Quantitative Chemical Analysis, 5thEdn., Longman Scientific and Technical, 1989

Course designed by: Dr. Renjith Thomas

CBCH6PJ: PROJECT/PAPER REVIEW/INDUSTRY VISIT REPORT

Credit: 1

Course outcome

After finishing the course project, students are expected to:

CO1: Design a research project in chemistry or allied subjects.

CO2: Perform the feasibility analysis and do a literature review.

CO3: Design a suitable methodology and execute the required experiments.

CO4: Analyse data and synthesize research findings.

CO5: Report research findings in written and verbal forms.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Create	2	-	2	2	2	2	2	2	2	-
CO2	Analyse	2	2	2	2	2	2	2	2	2	2
CO3	Apply	2	2	2	2	2	2	-	2	2	2
CO4	Analyse	2	2	2	2	2	2	-	2	2	2
CO5	Create	-	-	2	3	-	-	2	2	-	2
	Average	**2**	**2**	**2**	**2.2**	**2**	**2**	**2**	**2**	**2**	**2**

The students shall submit a dissertation of the project work. The evaluation of the dissertations is given below.

Component	Marks
Review of literature	10
Methodology and content	25
Language and syntax	15
Total	**50**

Tentative chapters of the project report are

Chapter-1 Introduction

Chapter-2 Literature Survey

Chapter-3 Materials and Methods

Chapter-4 Results and Discussions

Chapter-5 Conclusions

References

Course designed by: Dr. Renjith Thomas

CHOICE BASED CORE COURSES

CBCH6E01: MATERIALS CHEMISTRY

Credit: 3 **Total Hours: 54**

Course Outcomes

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

CO1: Distinguish various types of inorganic polymers and their properties.

CO2: Judge the structural and functional roles of metal ions in metalloproteins.

CO3: Recall various aspects of metallurgy and categorize various refractories and ceramic materials.

CO4: Suggest methods of synthesizing and methods of characterisation of nano materials.

CO5: Interpret the various analytical tools in chemistry.

Course Mapping Table

	Cognitive Level	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Understand	2	-		2	-	2		-	-	-
CO2	Evaluate	1	1	1	-	1	1	1	1	-	-
CO3	Remember	2	1	-	1	1	2	1	2	-	-
CO4	Apply	2	1	1	-	-	2	2	2	-	-
CO5	Understand	2	1	2	1	1	2	2	-	-	-
	Average	**1.8**	**1**	**1.33**	**1.33**	**1**	**1.8**	**1.5**	**1.67**	**-**	**-**

Module 1: Inorganic Polymers and Bio-inorganic Chemistry (18 Hours)

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes, phosphazenes, Bioinorganic chemistry: Elements of life – essential, major, trace and ultra-trace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na^+, K^+, Mg^{2+}, Ca^{2+}, $Fe^{3+/2+}$, $Cu^{2+/+}$, and Zn^{2+}). Metal ion transport across biological membrane Na^+ ion pump, ionophores. Biological functions of haemoglobin and myoglobin, cytochromes and ferredoxins, carbonate bicarbonate buffering system and carbonic anhydrase. Biological nitrogen fixation. Photosynthesis: Photosystem - I and Photosystem - II. Toxic metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only).

Module 2: Metallurgy and Chemistry of Materials (18 Hours)

Metallurgy: occurrence of metals based on standard electrode potential, methods of concentration of ores, reduction to free metal, electrometallurgy, hydrometallurgy. Refining of metals, electrolytic, ion exchange, zone refining, vapour phase refining and oxidative refining. Thermodynamics of the oxidation of metals to metal oxides - Ellingham diagrams. Nanomaterials – classification, synthesis – chemical precipitation, mechanic-chemical method, micro emulsion method, reduction technique, chemical vapour deposition and solgel method (brief study). Fullerenes and carbon nanotubes (elementary idea only). Refractory materials:

carbides, nitrides, borides. Graphite and graphite oxide, intercalation compounds of alkali metals, carbon monofluoride, intercalation compounds of graphite with metal halides, glass, silicates, zeolites, ultramarines and ceramics.

Module 3: Characterization Techniques of Materials (18 Hours)

Electron spectroscopies: X-ray photoelectron spectroscopy (XPS), ESCA and Auger electron spectroscopy (AES) -Basic principles, Electron microscopy: Scanning electron microscopy (SEM)and Energy dispersive spectroscopy (EDS) in electron microscopes; Transmission electron microscopy (TEM)- Basic principles, Scanning Probe Microscopies: Scanning tunneling microscope (STM) and atomic force microscope (AFM) – Basic principles. Thermal analysis: Thermo gravimetric analysis (TGA), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC), Dynamic mechanical analysis (DMA) and Thermomechanical analysis (TMA) – Basic principles, Flame atomic absorption and emission spectrometry: basic principle, instrumentation (choice of source, monochromator, detector, choice of flame and burner designs). Techniques of atomization, sample introduction, analysis and application (basic idea only). Electro analytical methods: classification of electroanalytical methods, basic principle of pH metric titrations. Techniques used for the determination of equivalence point.

Textbooks

1. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4thEdn. Pearson Education, 2006
2. J. D. Lee, Concise Inorganic Chemistry, 5thEdn., Chapman & Hall, 2002
3. A. Cottrel, An Introduction to Metallurgy, 2nd Edn., Universities Press, 1975
4. T. Pradeep, Nano; The Essentials, Mc Graw-Hill Education, New Delhi, 2006
5. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Vikas Publishing Co., Jalandhar, 2013
6. G. R. Chatwal, S.K. Anand, Instrumental Methods Of Chemical Analysis, Himalaya Publishing House, 2011.
7. S. K. Anand, G.R. Chatwal, Instrumental Methods Of Chemical Analysis, Himalaya Publishing House, 2014

Reference

1. D. F. Shriver, P. W. Atkins, Inorganic Chemistry, 3rd Edn., Oxford University Press, New Delhi, 2004
2. F. A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 1st - 6thEdns., Wiley Interscience, 1962, 1966, 1972, 1980, 1988, 1999

3. V. S. Muraleedharan, A. Subramania, Nanosciece and Nanotechnology, Ane Books Pvt. Ltd., New Delhi, 2009
2. G. D Christian, Analytical Chemistry, 6thEdn. New York, John Wiley, 2004
3. S. M. Khopkar, Basic Concepts of Analytical Chemistry, New Age, International Publisher, 2009
4. P. A. Salunke, M. R. Usman, A Text Book of Instrumental Methods of Analysis, S. Vikas and Company, 2018
5. C.R. Brundle, C.A. Evans, S. Wilson, Encyclopedia of Materials Characterization, Butterworth-Heineman, 1992.
6. Y. Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia), 2008.
7. S. Zhang, Lin Li, A. Kumar, Materials Characterisation Techniques, CRC press, 2008.
8. D.A. Skoog, F.J. Holler, S. R. Crouch, Instrumental Analysis, Cengage Learning, 2007.
9. J.C. Vickerman, I. Gilmore, Surface Analysis: The Principal Techniques, 2nd ed., John Wiley & Sons, Inc.2009.
10. W. W. Wendlandt, Thermal Methods of Analysis, John Wiley, 1974.

Course designed by: Mr. Subin Joseph

CBCH6E02: POLYMER CHEMISTRY

Credit: 3 **Total Hours: 54**

Course Outcomes

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

CO1: Describe the characteristics and classification of polymers.

CO2: Recognise structure – property relationship of polymers.

CO3: Explain the polymerisation mechanisms.

CO4: Illustrate the polymer preparation and processing techniques.

CO5: Explain the properties of commercial and specialty polymers.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	2	-	-	-	-	2	1	-	-	-
CO2	Understand	1	1	-	-	-	1	-	-	-	-
CO3	Understand	2	1	-	-	-	2	-	-	-	-
CO4	Understand	1	-	-	-	-	2	-	-	-	-
CO5	Understand	2	2	-	-	-	2	-	-	-	-
	Average	**1.60**	**1.33**	**-**	**-**	**-**	**1.80**	**1**	**-**	**-**	**-**

Module 1: Introduction **(9 Hours)**

Brief history of macromolecular science. General characteristics of polymers in comparison with common organic compounds. Monomers, homopolymers and copolymers. Classification based on origin (natural, semi synthetic and synthetic), synthesis (addition and condensation), structure (linear, branched chain and cross linked) and ultimate form and use (elastomers, fibres, thermoplastics and thermosetting polymers).

Module 2: Molecular Weight, Glass Transition Temperature and Crystallisation Behaviour of Polymers **(12 Hours)**

Molecular weight of polymers**,** molecular weight distribution and its significance. Polydispersity index and its significance, molecular weights and degree of polymerisation.

Determination of molecular weight of polymers by end group analysis, viscometry, light scattering and osmotic pressure methods. Glass Transition Temperature (T_g): Definition, factors influencing glass transition temperature (T_g). T_g and molecular weight, T_g and melting point, importance of T_g. Crystallization and crystallinity: Determination of crystalline melting point and degree of crystallinity, morphology of crystalline polymers, factors affecting crystalline melting point.

Module 3: Mechanism of Polymerisation (6 Hours)

Chain and step growth polymerisations, free radical, ionic (both cationic and anionic) polymerisations, ring-opening polymerization with mechanism. Zeigler-Natta polymerization and its advantages.

Module 4: Polymerisation Techniques and Processing (9 Hours)

Polymerisation Techniques: Bulk, solution, suspension, emulsion, melt condensation and interfacial polycondensation polymerisations, Polymer Processing: Compression moulding, injection moulding, blow moulding, extrusion moulding, thermoforming, die casting, film casting, rotational moulding, calendaring and spinning.

Module 5: Commercial and Speciality Polymers (18 Hours)

Preparation, structure, properties and uses of polyethylene (LDPE and HDPE), polypropylene. Preparation, structure, properties and uses of polystyrene, PVC, PVP, teflon, PAN, PMMA, terylene, Kevlar, polyurethanes, polycarbonates, polybutadiene, SBR, nitrile rubber, neoprene, butyl rubber and silicone rubber, phenol-formaldehyde resin and urea-formaldehyde resin. Structure and properties of high temperature and fire-resistant polymers. Conducting polymers – preparation, structure and applications of polyacetylene, polyaniline, poly(*p*-phenylene sulphide), polypyrrole, polythiophene.

Textbooks

1. V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age International (P) Ltd., 2011
2. B.K. Sharma, Polymer Chemistry, Goel Publishing House, Meerut, 1989

Reference

1. G. Odian, Principles of Polymerization, 4th Edn., Wiley, 2004
2. F. W. Billmeyer Jr., Textbook of Polymer Science, John Wiley and Sons, New Delhi, 2007
3. R. Bahadur, N.V. Sastry, Principles of Polymer Science, Narosa, New Delhi, 2003
4. M.G. Arora, M. Singh, M.S. Yadav, Polymer Chemistry, 2nd Revised Edn., Anmol Publications Private Ltd., New Delhi, 1989
5. M. P. Stevens, Polymer Chemistry: An Introduction, 3rd Edn, Oxford University Press, USA, 1998
6. F. Mohammad, Specialty Polymers: Materials and Applications, I. K. International Pvt Ltd, 2007
7. R. Bahadur, N. V. Sastry, Principles of Polymer Science, Narosa, New Delhi, 2003

8. R. W. Lenz. Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967
9. R. W. Dyson, Specialty Polymers, Chapman and Hall, New York, 1998

Course designed by Dr. Bejoy Francis

COMPLEMENTARY COURSES IN MATHEMATICS FOR BSc CHEMISTRY PROGRAMME

SEMESTER I

CDMC101: MATHEMATICS FOR CHEMISTRY – I

Credit: 3 **Total Hours: 72**

Course Outcomes

CO1: Explain Geometry using Algebraic Equations

CO2: Apply differential calculus in multidimensional systems

CO3: Illustrate the concepts of partial derivatives

CO4: Apply Integral Calculus in real life situations

CO5: Familiarize with multiple integrals.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	2	-	-	1	-	2	1	2	-	-
CO2	Apply	1	-	1	1	-	1	-	1	1	-
CO3	Apply	2	-	-	-	-	2	1	2	-	-
CO4	Apply	2	-	1	1	-	2	1	2	1	-
CO5	Apply	2	-	1	1	-	1	-	2	-	-
	Average	**1.8**	**-**	**1**	**1**	**-**	**1.6**	**1**	**1.8**	**-**	**-**

Module 1: Curves and Surfaces **(18 Hours)**

Conic Sections and Quadratic equations, classification of Conic Sections by its eccentricity, Quadratic equations and rotations, Parameterization, Polar coordinates, Polar equations for Conic sections, Cylinders and Quadric Surfaces

Text book 1 Sections: 9.1 – 9.4, 9.6, 9.8, 10.6

Module 2: Essentials of Calculus **(18 Hours)**

The process of differentiation, Differentiation by rule- product rule, quotient rule Chain rule and inverse rule, Implicit functions, logarithmic differentiation, Successive differentiation, The indefinite integral, The definite integral, The integral Calculus, The method of substitution, Integration by parts.

Text book 2 Sections 4.2, 4.6-4.9, 5.2-5.4, 6.3, 6.4

Module 3: Functions of Several Variables **(18 Hours)**

Concepts, Graphical Representation, Partial Differentiation, Stationary Points, The Total differential, Some Differential properties, Exact Differentials.

Text Book 2 Sections 9.1-9.7

Module 4: Multiple Integrals **(18 Hours)**

Line integrals, Multiple integral, The Double integral, Change of variables, over general regions, Double integrals in polar form, Triple integrals in rectangular coordinates. Spherical, Polar coordinates

Text Book 2 Sections: 9.8 - 9.11, 10.2

Textbooks

1. Thomas and Finney, *Calculus And Analytic Geometry*, Ninth Edition, Pearson, 2002
2. Erich Steiner, *The Chemistry Maths Book*, Second Edition, Oxford University Press, 2008.

Reference

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Eighth Edition, Wiley, 2007.
2. K F Riley and M P Hobson, *Essential Mathematical Methods for the Physical Sciences*, Cambridge University Press, 2011.
3. George B. Thomas, Jr, *Thomas' Calculus* Twelfth Edition, Pearson, 2009.

Course designed by: Jinu Mary Jameson

SEMESTER II

CDMC202: MATHEMATICS FOR CHEMISTRY – II

Credit: 3 **Total Hours: 72**

Course Outcomes

CO1: Explain basic concepts and nature of solutions of Ordinary Differential Equations

CO2: Solve first order ODE, Linear ODE of second and higher order and evaluate numerical solutions of first order ODE.

CO3: Demonstrate Vector Differentiation

CO4: Familiarize Vector and Scalar Operators

CO5: Demonstrate various functions using power series**.**

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	1	-	-	-	-	1	1	-	1	-
CO2	Apply	2	-	-	-	-	1	1	1	1	-
CO3	Apply	2	-	-	-	-	2	2	1	1	-
CO4	Apply	2	-	-	-	-	2	1	2	1	-
CO5	Analyze	2	-	-	-	-	1	2	1	-	-
	Average	**1.8**	**-**	**-**	**-**	**-**	**1.4**	**1.4**	**1.25**	**1**	**-**

Module 1: Ordinary Differential Equation I **(20 Hours)**

Exact Differential Equation, Linear Equations, Solutions by Substitutions, Equations of first order and not of first degree, First order equations of higher degree solvable for p, Equations solvable for y , Equations solvable for x, Equations of first degree in x and y, Lagrange's and Clairaut's Equations.

Text Book 1 Sections 2.1-2.4; 3.1- 3.5

Module 2: Ordinary Differential Equation II **(20 Hours)**

Concepts, Homogenous linear equations, The general solution, the particular solutions, The particle in a one-dimensional box, Inhomogenous linear equations- Method of undetermined coefficients, Forced oscillations, Errors, Numerical Methods of First order differential equations.

Text book 2 Sections 12.1-12.4, 12.6, 12.8-12.10, 20.1-20.2, 20.9

Module 3: Vector Calculus **(16 Hours)**

Concepts, Vector Algebra, components of vectors, Scalar differentiation of a vector, the scalar (dot) product, The vector(cross) product, scalar and vector fields, the gradient of a scalar field, divergence and curl of a vector field, Vector spaces.

Text Book 2 Sections 16.1-16.11

Module 4: Special Functions **(16 Hours)**

The power series method, The Frobenius method, The Legendre equation, The Hermite equation, the Laguerre equation, Bessels functions

Text book 2 Sections 13.1-13.7

Textbooks

1. A H Siddiqi, P Manchanda, Differential *Equations with applications*, First Edition, Macmillan India Ltd, 2006.
2. Erich Steiner, *The Chemistry Maths Book*, Second Edition, Oxford University Press, 2008.

Reference

1. R. K. Ghosh, K. C. Maity, *An Introduction to Differential Equations*, New Central Books, 2010.
2. K F Riley And M P Hobson, *Essential Mathematical Methods for the Physical Sciences*, Cambridge University Press, 2011.
3. Shepley L. Ross, *Differential Equations,* Wiley India, 2007.
4. George B. Thomas, Jr, *Thomas' Calculus,* Twelfth Edition, Pearson, 2016

Course designed by: Jinu Mary Jameson

SEMESTER III

CDMC303: MATHEMATICS FOR CHEMISTRY – III

Credit: 4 **Total Hours: 90**

Course Outcomes

CO1: Explain basic concepts and nature of solutions of Partial Differential Equations

CO2: Solve linear PDE of first order

CO3: Calculate Fourier series and Fourier integral.

CO4: Solve the linear system of equations using Linear Algebra techniques and apply Cayley Hamilton Theorem

CO5: Explain the techniques of Probability and Statistics.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	2	-	-	-	-	2	1	1	-	-
CO2	Apply	1	-	-	-	-	1	-	1	-	-
CO3	Apply	2	-	-	-	-	2	2	2	1	-
CO4	Analyze	2	-	-	-	-	2	1	2	1	-
CO5	Apply	1	-	-	-	-	1	-	1	-	-
	Average	**1.6**	**-**	**-**	**-**	**-**	**1.6**	**1.33**	**1.4**	**1**	**-**

Module 1: Partial Differential Equations **(25 Hours)**

Introduction to partial differential equations, Important partial differential equations – wave equation, Laplace's equation, Poisson's equation, Schrodingers equation, General form of a solution, General and particular solutions, First order equations, inhomogenous equations and problems, Second order Equations, Inhomogenous equations and problems

Text book1 Sections: 10.1, 10.2, 10.3

Module 2: Fourier Series **(21 Hours)**

The Dirichlet condition, The fourier coefficients, Symmetric Considerations, Discontinuous functions, Non periodic functions, Integration and Differentiation.

Text Book 1 Sections 4.1-4.5

Module 3: Matrices **(20 Hours)**

Rank of a matrix, Row canonical form, Normal form, Elementary matrices, System of linear equations, Solutions by matrix method, Crammer's Rule, Characteristic equation of a matrix, Characteristic roots and vectors, Cayley Hamilton Theorem (Statement only) and Simple Applications.

Text Book 2 Chapter 5,10,19,23

Module 4: Introduction to Probability and Statistics (24 Hours)

Data Representation, Arithmetic Mean, Median, Mode, Standard Deviation, and Variance, Mean absolute deviation, Skewness and Kurtosis, random experiment, Frequency and probability, Probability distribution, Combinations of probability, Exclusive events, Independent events, binomial distribution, Permutations and Combinations, Stirling approximation for large numbers,

Text book 3 Sections 21.1-21.7

Textbooks

1. K F Riley and M P Hobson, *Essential Mathematical Methods For Physical Sciences*, Cambridge University Press, 2011.
2. Frank Ayres Jr, *Matrices,* Shaum's Outline Series, Tata McGraw-Hill Third Edition, 1974.
3. Erich Steiner, *The Chemistry Maths Book*, Second Edition, Oxford University Press, 2008.

Reference

1. S P Gupta, *Statistical Methods*, Sultan Chand & Sons, New Delhi
2. S C Gupta and V K Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi
3. Erwin Kreyszig, *Advanced Engineering Mathematics*, 8th Edition, Wiley,2007.
4. David W. Lewis: *Matrix Theory*, Allied, 1991
5. Ian Sneddon: *Elements of Partial Differential Equations*, McGraw-Hill Book Company, 2004.

Course designed by: Treesa Maria Kuriakose

SEMESTER IV

CDMC404: MATHEMATICS FOR CHEMISTRY – IV

Credit: 4 **Total Hours: 90**

Course Outcomes

CO1: Apply various methods of numerical analysis.

CO2: Acquire a fundamental knowledge for solving interpolation

CO3: Apply numerical techniques of differentiation and integration

CO4: Familiarise the fundamental concepts of group structures

CO5: Apply the concepts of groups in different chemical applications

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	1	-	-	-	-	1	-	1	-	-
CO2	Apply	1	-	-	-	-	1	-	1	-	-
CO3	Apply	1	-	-	-	-	1	-	1	-	-
CO4	Understand	2	-	-	-	-	2	-	-	-	-
CO5	Apply	2	-	1	-	-	2	1	-	1	-
	Average	**1.4**	**-**	**1**	**-**	**-**	**1.4**	**1**	**1**	**1**	**-**

Module 1: Numerical Methods I **(20 Hours)**

Solutions of Numerical, Algebraic and Transcendental equations-The Bisection Method, Iteration Method, Regula Falsi method, Newton-Raphson method

Text Book 1 Sections 3.1-3.4

Module 2: Numerical Methods II **(25 Hours)**

Finite differences, Interpolation for equal intervals, Gregory- Newton Interpolation formulas, Numerical differentiation, Newton's Difference formulas for finding derivatives, Numerical integration, Trapezoidal rule, Romberg's Method, Simpson's One Third Rule.

Text Book 1 Sections 5.1-5.3, 6.1-6.3, 9.1-9.3; 9.7-9.13

Module 3: Symmetry and Groups **(23 Hours)**

A bridge from geometry to arithmetic, Classifying symmetry operations, Full analysis of symmetry of the water molecule: Introduction to notation, Products of covering operations: multiplication tables, what is a group? Definition of a group, Subgroups, Examples of groups. Sections 2.1 – 2.5, 3.1-3.3 of Text book 2

Module 4: Point Groups **(22 Hours)**

Introduction, Axes of rotation:C_n, Mirror planes:σ, Stereographic projection diagrams, Inversion: *I*, Rotatory reflections or improper rotations, S_n.

Text book 2 Sections 4.1-4.6

Textbooks

1. P Kandasamy, K Thilagavathy, K Gunavathi, *Numerical Methods*, S Chand 1997.
2. Arthur M Lesk, *Introduction to Symmetry and Group Theory for Chemists*, Kluwer Academic Publishers, 2004

Reference

1. F Albert Cotton, *Chemical Applications of Group Theory*, Cambridge, 2003
2. John B Fraleigh, *A First Course in Abstract Algebra*, *Seventh Edition*, Pearson Education, 2007.
3. Srimanta Pal, Numerical *Methods*, Oxford University Press, 2009.
4. S.S. Sastry, *Introductory Methods of Numerical Analysis*, 4th Edition (Prentice Hall, 2005.

Course designed by: Treesa Maria Kuriakose

COMPLEMENTARY COURSES IN PHYSICS FOR BSc CHEMISTRY PROGRAMME

SEMESTER I

CDPC101: MECHANICS AND PROPERTIES OF MATTER

Credit: 2 **Total Hours: 36**

Course Outcomes

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

CO1: Describe rotational motion, moment of inertia of rigid bodies and **apply** the ideas to relevant problems

CO2: Describe the differential equation for SHM and **apply** it to find the energy of an oscillating system

CO3: Describe elasticity and **apply** it to bending and twisting of a bar or rod

CO4: Describe laboratory methods of finding the modulus of elasticity

CO5: Describe fluid flow and **apply** Bernoulli's equation to fluids

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	-	3	2	-	-	2	-	2	-	-
CO2	Apply	-	3	-	-	-	2	-	2	-	-
CO3	Apply	-	3	2	-	-	2	-	2	-	-
CO4	Understand	-	3	-	-	-	2	-	1	-	-
CO5	Apply	-	3	3	-	-	2	-	2	-	-
	Average	**-**	**3**	**2.3**	**-**	**-**	**2**	**-**	**1.8**	**-**	**-**

Module 1: Rotational Dynamics of Rigid Bodies and Oscillations (18 Hours)

Angular displacement; angular velocity; angular momentum, torque- conservation of angular momentum- angular acceleration, rotational kinetic energy, Moment of inertia- parallel and perpendicular axes theorems, Calculation of moment of inertia of rod, ring, disc, cylinder and sphere, Flywheel- moment of inertia and experimental set up, Simple harmonic motion, Differential equation- expression for displacement, velocity and acceleration- graphical representation, Energy of a particle executing simple harmonic motion, Differential equation and solutions of forced and damped oscillators

Module 2: Elastic Properties of Materials and Hydrodynamics (18 Hours)

Young's modulus- bulk modulus-rigidity modulus, Uniform and non-uniform, Bending moment-flexural rigidity, Bending- cantilever method, Twisting couple- torsional rigidity, Rigidity modulus using static and dynamic methods, Streamline flow, Viscosity, Bernoulli's theorem, Torricelli's theorem, Venturi tube, The siphon

Textbook

1. H.S.Hans and S.P.Puri, Mechanics, Tata McGraw-Hill
2. Brijlal and N. Subrahmanyam, Properties of Matter, S. Chand and Co.
3. M.D. Raisinghania, Fluid dynamics: with complete hydrodynamics and boundary layer theory, S. Chand, 12/e

Reference

1. Elements of properties of matter – D S Mathur, S. Chand (2010)
2. Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Course designed by: Dr. Loji K Thomas

CDPC202: ELECTRIC AND MAGNETIC PHENOMENA, THERMODYNAMICS AND ERROR ANALYSIS

Credit: 2 **Total Hours: 36**

Course Outcomes

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

CO1: Describe the electric and magnetic properties of materials

CO2: **Classify** and **compare** different magnetic materials

CO3: **Describe** thermodynamic systems, processes and laws

CO4: Describe the principles of thermodynamics and **apply** them in different physical situations

CO5: **Evaluate** errors and uncertainties in experimental measurements

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	3	-	-	-	-	3	-	-	-	-
CO2	Understand	3	3	-	-	-	3	-	-	-	-
CO3	Remember	3	-	-	-	-	3	-	-	-	-
CO4	Apply	3	-	2	-	-	3	-	3	-	-
CO5	Evaluate	3	-	-	-	-	3	-	3	-	-
	Average	**3**	**3**	**2**	**-**	**-**	**3**	**-**	**3**	**-**	**-**

Module 1: Dielectric and Magnetic Properties of Solids (12 Hours)

Review of Basic Equations, Dielectric Constant, Dipole Moment and Polarizability, Clausius-Mossotti Relation and Ferroelectricity, Classification of Magnetic Materials, Langevin's theory and paramagnetism, Curie-Weiss law and Curie temperature, Antiferromagnetism and Ferrimagnetism, Magnetisation and Magnetic Domain Structure

Module: 2 Thermodynamics (12 Hours)

Thermodynamic systems, Thermodynamic equilibrium, Thermodynamic processes – isothermal process and adiabatic process, Work done in isothermal process and adiabatic process, Zeroth law of thermodynamics, First law of thermodynamics, The Carnot engine – Carnot cycle, work done in a cycle and efficiency, Refrigerator – coefficient of performance, Concept of entropy, Second and third law of thermodynamics

Module 3: Error Analysis (12 Hours)

Basic ideas of uncertainties and measurements, Dominant errors, random errors and systematic errors, Significant figures, Absolute, relative and percentage errors, Standard deviation, Estimating and reporting errors - best estimate, Error bars and graphical representation - checking relationships with a graph, Propagation of errors – sum and differences, products and quotients, powers, multiplying by constants, Independent uncertainties in sum and product,

Least count of instruments

Textbooks

1. Elementary Solid-State Physics: Ali Omar (Pearson)
2. Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)
3. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, John R. Taylor - Univ. Science Books

Reference

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta
2. Solid State Physics, P.K. Palanisamy, Scitech publications
3. Solid State Physics, R.K Puri & V.K. Babber, S. Chand
4. Modern Physics- R. Murugeshan (S. Chand and Co.)
5. Introduction of Electrodynamics- D.J. Griffiths (PHI Pvt. Ltd)
6. Modern Physics- G. Aruldas and P. Rajagopal (PHI Pub)
7. Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)

Course designed by: Benny Joseph

CDPC303: QUANTUM MECHANICS, SPECTROSCOPY, NUCLEAR PHYSICS AND NUCLEAR MEDICINE

Credit: 3 **Total Hours: 54**

Course Outcomes

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

C01: **Explain** the basics of Quantum mechanics and apply them to **solve** relevant problems, different atom models and its application in spectroscopy

C02: **Explain** the basics of rotational and vibrational spectroscopy, theory and applications of Raman spectroscopy.

C03: **Describe** various properties of atomic nuclei and nuclear forces

C04: **Describe** radioactivity, laws governing radioactivity, nuclear fission and fusion and its applications

C05: **Explain** Biological Effects of radiation and its application in Nuclear medicine

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	3	2	3	1	-	3	2	-	-	-
CO2	Apply	2	3	2	1	1	1	1	2	-	1
CO3	Understand	2	2	1	1	-	2	2	1	1	-
CO4	Understand	2	2	1	1	-	2	2	1	1	1
CO5	Understand	3	2	1	2	-	1	3	-	2	-
	Average	**2.4**	**2.2**	**1.6**	**1.2**	**0.2**	**1.8**	**2**	**0.8**	**0.8**	0.4

Module 1: Elementary Quantum theory **(23 Hours)**

Failure of classical mechanics and need for quantum mechanics-stability of atom, blackbody radiation associated laws, Planck's explanation, Photoelectric effect, Compton effect, de Broglie hypothesis, matter wave- Davisson-Germer experiment, uncertainty principle (derivation not expected) - description of a wave, wave packet, Operators in quantum mechanics,wave function-properties, Formulation of Schrodinger equation time independent and time dependent Solution of Schrodinger equation, Particle in 1D box, 3D box-derivation of wave function, energy, brief discussion on applications in quantum dots.

Atom models- Thomson’s model-Rutherford’s nuclear atom model, Bohr atom model-Somerfeld’s relativistic atom model, Vector atom model- Fine structure of Hydrogen atom, Rotational and vibrational spectra of rigid diatomic molecules, Raman effect-classical explanation, Raman spectrometer, usage in materials science.

Module 2: Atomic Nucleus and Radioactivity **(12 Hours)**

Nuclear constituents, Different nuclear types, Properties of nuclei- size, mass, charge, density

Binding energy- packing fraction Nuclear Stability Spin - Magnetic dipole moment, Electric quadrupole moment Properties of nuclear forces Radioactivity Radiations - law of radioactive decay Half-life, Mean life, Radioactivity units, Radioactive series Radioactive dating- carbon dating Artificial radioactivity

Nuclear Fission and Fusion (9 Hours)

Nuclear fission, Energy release in fission reactions, Liquid drop model of fission chain reaction, Nuclear reactor, power and breeder reactor- atom bomb, nuclear fusion, Energy production in stars, Thermonuclear reactions in sun- p-p chain - C-N cycle

Module 3: Biological Effects of radiation and Physics of Medicine (10 Hours)

Ionizing Radiation and nonIonizing Radiation, Factors affecting biological activity of radiations, Dose, Dose Rate and dose distribution, Damage to Critical Tissues, Human exposure to radiation, Nuclear medicine: Projection imaging, Physics of medicine-X-ray radiography, Gamma Camera, Imaging with internal radiation, Computed Tomography, Magnetic resonance imaging (MRI), Radiation therapy using e beam, neutrons,

Textbooks

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Nuclear Physics, Principles and Applications-John Lilley, Wiely 2006

Reference

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Modern Physics- R. Murugeshan (S. Chand and Co.)
4. Quantum Physics- S. Gasiorowicz (John Wiley & Sons)

Course designed by: Dr Sinu Mathew

CDPC404: PHYSICAL OPTICS, LASER PHYSICS AND SUPERCONDUCTIVITY

Credit: 3 **Total Hours: 54**

Course Outcomes

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

CO1: **Explain** superposition principle, interference and diffraction of electromagnetic radiation and **apply** interference to thin films, diffraction to optical phenomena occurring in glass

CO2: **Explain** superposition principle and recognize the various light interference processes

CO3: **Explain** the concepts, features, technical terms, different methods, techniques, materials and types of polarization of light and **apply** the concepts and rules to solve numerical problems

CO4: **Discuss** the basic concept, working and applications of LASER

CO5: **Discuss** the basic properties of Superconductors, BCS theory and applications of Superconductors

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	2	1	2	1	-	2	2	2	-	1
CO2	Apply	2	1	2	1	-	2	1	2	-	1
CO3	Apply	2	-	-	1	-	2	-	2	-	-
CO4	Understand	2	2	1	-	-	2	2	1	1	-
CO5	Understand	2	2	1	-	-	2	2	1	1	-
	Average	**2**	**1.5**	**1.5**	**1**	**-**	**2**	**1.75**	**1.6**	**1**	**1**

Module 1: Interference and Diffraction **(18 Hours)**

Interference of light-Principle of superposition, Coherent sources- Young's double slit experiment, Newton's rings theory Newton's rings- experimental details, applications, Interference in thin films-Reflected light, Diffraction basic ideas, Fresnel and Fraunhofer diffraction-Theory of plane transmission grating, Resolving power- Dispersive power of microscope

Module 2: Polarization **(18 Hours)**

Introduction- polarized and unpolarized light- plane of vibration –plane of polarization, polarization by reflection- Brewster's law-polarization by refraction through pile of plates – law of Malus, Polarization by scattering, polarization by selective absorption, Uni-axial and biaxial crystals – double refraction- principal plane- polarization by double refraction, polaroid-Elliptically and circularly polarized light, Quarter wave plate – Half wave plate

Module 3: Laser Physics and Superconductivity (18 Hours)

Interaction of electromagnetic radiation with matter, Stimulated absorption, spontaneous emission, stimulated emission. Principle of laser-population inversion, Einstein's Coefficients, - Types of lasers- Ruby laser -Neodymiun YAG laser- He-Ne laser- Properties of laser beams- Application of laser beams

Superconducting phenomenon- Occurrence, BCS theory (qualitative) , Meissner Effect- Type I and Type II superconductors, Josephson effects, High temperature superconductors- Applications of Superconductivity

Textbooks

1. A text book of optics- N. Subrahmanyam, Brijlal and M.N. Avadhanulu S Chand & Co Ltd
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Reference

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
2. Optics- A. Ghatak (Tata McGraw-Hill)

Course designed by: Mr. Justin John

PRACTICAL

SEMESTER I & II

CDPC2P01: GENERAL PHYSICS PRACTICAL

Credit: 2 **Total Hours: 72**

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

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	1	-	-	2	3	-	-	1	2	-
CO2	Understand	1	-	-	2	3	-	-	1	2	-
CO3	Apply	1	-	-	2	3	-	-	1	2	-
CO4	Analysis	1	-	-	2	3	-	-	1	2	-
CO5	Evaluate	1	-	-	2	3	-	-	1	2	-
Average		**1**	**-**	**-**	**2**	**3**	**-**	**-**	**1**	2	-

1. Vernier Calipers -- Volume of cylinder (solid and hollow), sphere.
2. Screw gauge – Radius of wire, volume of sphere and glass piece
3. Beam balance - Mass of a solid (sensibility method)
4. Spectrometer – Angle of the Prism
5. Hare’s Apparatus, U Tube – density of liquids
6. Coefficient of viscosity of the liquid – Constant Pressure head method
7. Coefficient of viscosity Variable Pressure head method
8. Surface Tension – Capillary rise method
9. Determination of Young’s Modulus- Cantilever (Scale and Telescope)
10. Fly wheel – Moment of Inertia
11. Torsion pendulum -Rigidity modulus
12. Determination of moment of inertia of rotationally symmetric body (solid sphere
13. OR cylinder OR disc) from their period of oscillation on a torsion axle
14. Spring constant - Hooke’s law - oscillation
15. Resistivity of the material of the wire- Ohm’s law and verification by multimeter

16. Poisson's ratio of rubber
17. Symmetric Compound pendulum – Acceleration due to gravity
18. Temperature dependence of capacitance- polymer and ceramic capacitors.
19. Potentiometer – standardization
20. Static Torsion - Rigidity modulus
21. Deflection and Vibration Magnetometer-m & Bh
22. Field along the axis of circular coil- determination of Bh
23. Searle's Vibration Magnetometer - magnetic moment
24. Resistance of a galvanometer and its figure of merit
25. Determination of Young's Modulus- Cantilever (Pin & Microscope)
26. Determination of Youngs Modulus – Non-Uniform bending (Scale & Telescope)
27. Asymmetric Compound Pendulum- Determination of moment of inertia and
28. Acceleration due to gravity (g)
29. Symmetric Compound Pendulum - Determination of Radius of gyration and moment of inertia
30. Torsion pendulum (Equal mass method) - Rigidity modulus and Moment of Inertia
31. Conversion of Galvanometer into voltmeter
32. Carey Foster's Bridge -Measurement of resistivity
33. Tangent Galvanometer – Ammeter calibration
34. Potentiometer-Calibration of low range ammeter
35. Potentiometer – Resistance of a wire

SEMESTER III & IV

CDPC4P02: OPTICS AND ELECTRONICS

Credit: 2 **Total Hours: 72**

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

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	1	-	-	2	3	-	-	1	2	-
CO2	Understand	1	-	-	2	3	-	-	1	2	-
CO3	Apply	1	-	-	2	3	-	-	1	2	-
CO4	Analysis	1	-	-	2	3	-	-	1	2	-
CO5	Evaluate	1	-	-	2	3	-	-	1	2	-
	Average	**1**	**-**	**-**	**2**	**3**	**-**	**-**	**1**	2	-

1. Spectrometer – Dispersive power of prism
2. Spectrometer – Grating - wavelengths
3. Newton’s rings -Wave length
4. Construction of full wave rectifier (center-tap) with and without filter – Ripple factor
5. Construction of regulated power supply using Zener diode- line and load regulation
6. Spectrometer - Refractive Index of material of prism.
7. Diode characteristics- ac and dc resistance
8. Characteristics of Zener diode
9. Construction of half wave rectifier with and without filter – Ripple factor
10. Laser- Transmission OR Reflection Grating- Determination of wavelength
11. Liquid lens – optical constants of a lens
12. Laser diffraction- width of single slit OR thickness of wire
13. Refractive index of liquid- Liquid Lens
14. Air wedge-thickness of wire
15. Gates – AND, OR, NOT- verification of truth tables

COMMON COURSES IN ENGLISH FOR MODEL I BA/BSc PROGRAMMES

SEMESTER I

CCEN101: READING LITERATURE IN ENGLISH - I: POETRY AND DRAMA

Credit: 4 **Total Hours: 90**

Course Outcomes

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

CO1: Explain the themes and ideas in the prescribed poems

CO2: Analyse the prescribed poems as social, cultural, and political documents

CO3: Describe the themes, plots, and characters in the prescribed One Act Plays.

CO4: Demonstrate the ability to relate literature with contemporary realities.

CO5: Stage short scenes from plays and recite poems.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	-	-	-	2	-	2	1	2	-	-
CO2	Apply	-	-	1	1	-	2	2	2	-	-
CO3	Understand	-	-	-	1	-	1	1	2	2	1
CO4	Analyze	-	-	-	1	-	1	1	2	1	1
CO5	Create	-	-	-	1	-	1	-	2	1	1
	Average	**-**	**-**	**1**	**1.2**	**-**	**1.4**	**1.25**	**2**	**1.33**	**1**

Module 1: Literature and Life **(18 Hours)**

1. William Shakespeare: Sonnet 1 - “From fairest creatures we desire increase”
2. John Donne: “Death Be Not Proud”
3. William Wordsworth: “The World is Too Much with Us”
4. Robert Frost: “The Road Not Taken”

Module 2: Literature and Love **(18 Hours)**

1. John Keats: “The Day is gone, and all its sweets are gone”
2. Elizabeth Barrett Browning: “How Do I Love Thee?”
3. Christina Rossetti: “I Loved You First…”
4. E E Cummings: “somewhere i have never travelled, gladly beyond”

Module 3: Literature and Social Issues **(18 Hours)**

1. Maya Angelou: “Still I Rise”
2. S Joseph: “My Sister’s Bible”
3. Kamala Das: “An Introduction”
4. Audre Lorde: “A Litany for Survival”

Module 4: Selections from Shakespeare **(18 Hours)**

1. *As You Like It* Act II Scene VII: "All the world's a stage."
2. *Julius Cesar* Act III, Scene II "Friends, Romans, Countrymen…"
3. *The Merchant of Venice* Act II Scene I "To bait fish withal…"
4. *Macbeth* Act V Scene V "She should have died hereafter…"

Module 5: One-Act Plays **(18 Hours)**

1. Gordon Daviot: "Remember Caesar"
2. Serafin Quintero, Joaquin Quintero: "A Sunny Morning"

Course designed by: Fr Jose Jacob

CCEN102: WRITINGS ON CONTEMPORARY ISSUES

Credit: 3 **Total Hours: 72**

Course Outcomes

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

CO1: Demonstrate their awareness of the secularism and diversity of India

CO2: Respond to contemporary environmental issues.

CO3: Describe the various human rights issues in the world.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	-	-	-	1	-	2	1	2	2	2
CO2	Apply	-	-	1	1	-	2	1	2	2	2
CO3	Understand	-	-	1	1	-	2	1	2	2	2
	Average	**-**	**-**	**1**	**1**	**-**	**2**	**1**	**2**	**2**	**2**

Module 1: Understanding India (18 Hours)

1. The Preamble to the Constitution of India
2. Rabindranath Tagore: "Where the mind is without fear" (*Gitanjali* Song 35)
3. Shashi Tharoor: "The Invention of India" (from *The Elephant, the Tiger & the Cellphone*: *Reflections on India, the Emerging 21st-century Power*)

Module 2: Environment (18 Hours)

1. Chief Seattle: "The end of living and the beginning of survival"
2. Rachel Carson: "The Obligation to Endure" (from *Silent Spring*)
3. Gerard Manley Hopkins: "Binsey Poplars"

Module 3: Issues Concerning Children, Women and the Elderly (18 Hours)

1. KailashSatyarthi: "Let Us Globalise Compassion and Set Our Children Free" (Nobel Lecture)
2. Anita Desai: "A Devoted Son"
3. Simon de Beauvoir: "The Coming of Age" (from Douglas Hunt, ed. *The Dolphin Reader*. Houghton Mifflin, 1990, pp. 829-35)

Module 4: Human Rights (18 Hours)

1. Martin Luther King: "I Have a Dream"
2. WamanNimbalkar: "Caste" (from *An Anthology of Dalit Literature: Poems*, edited by Eleanor Zelliot and Mulk Raj Anand, Gyan Pub. House, 1992, pp. 123)
3. Kalpana Jain: "Stigma, Shame and Silence" (from *Positive Lives: The Story of Ashok and Others with HIV*. Penguin, 2002)

Course designed by: Nithin Varghese

SEMESTER II

CCEN203: WRITING SKILLS

Credit: 4 **Total Hours: 90**

Course Outcomes

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

CO1: Write short paragraphs observing the structural format.

CO2: Write letters and E-mails effectively.

CO3: Write a summary, précis or note based on given passages.

CO4: Write coherent essays of different types using appropriate cohesive devices.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	-	-	-	2	-	2	-	2	1	1
CO2	Apply	-	-	-	2	-	2	-	2	1	1
CO3	Apply	-	-	-	2	-	2	-	2	1	1
CO4	Apply	-	-	-	2	-	2	-	2	1	1
	Average	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**2**	**1**	**1**

Module 1: Paragraph Writing **(18 Hours)**

1. Writing Process: Pre-Writing, Structure and Revision
2. Practising Paragraph Writing

Module 2: Informal and Formal Communication **(18 Hours)**

1. Informal Letters
2. Formal Letters
3. Business Letters
4. Writing E-mails

Module 3: Summary and Precis Writing **(18 Hours)**

1. Practising Summary writing
2. Practising Precis writing

Module 4: Note-Making **(18 Hours)**

1. Note-Making
2. Mind Mapping
3. Practising Note-Making

Module 5: Essay Writing **(18 Hours)**

1. Descriptive Essays
2. Narrative Essays

3. Cause-and-Effect Essays
4. Argumentative Essays

Course designed by: Dr Benny Mathew

CCEN204: READING LITERATURE IN ENGLISH - II: SHORT STORIES AND NOVEL

Credit: 3 **Total Hours: 72**

Course Outcomes

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

CO1: Demonstrate in writing their understanding of American and British short stories from different eras

CO2: Illustrate in writing their familiarity with short stories from non-Anglophone cultures from different eras

CO3: Identify the subtext and context of literary texts such as allegorical stories and novels

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	-	-	-	1	-	1	-	2	1	1
CO2	Understand	-	-	-	1	-	1	-	2	1	1
CO3	Understand	-	-	-	1	-	1	-	2	1	1
	Average	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**2**	**1**	**1**

Module 1: British and American Short Stories **(18 Hours)**

1. W Somerset Maugham: “The Verger”
2. Oscar Wilde: “The Nightingale and the Rose”
3. O Henry: “A Retrieved Reformation”

Module 2: Stories from Non-Anglophone Cultures **(18 Hours)**

1. Guy De Maupassant: “The Necklace”
2. Gabriel Garcia Marquez: “The Handsomest Drowned Man in the World”
3. Mulk Raj Anand: “The Barber’s Trade Union”

Module 3 & 4: Novel **(36 Hours)**

1. George Orwell: *Animal Farm*

Course designed by: Dr Vimal Mohan John

SEMESTER III

CCEN305: LIFE AND LITERATURE

Credit: 4 **Total Hours: 90**

Course Outcomes

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

CO1: Analyse the significance of a pro-nature approach to life.

CO2: Critically respond to the nurturing attitudes to life through the reading of select texts

CO3: Respond critically to the diversity of the Indian state

CO4: Respond critically to the contemporary issues faced by independent India.

CO5: Present examples of inspiring models of human life from *their* experience.

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Analyse	-	-	-	-	-	2	1	2	2	2
CO2	Apply	-	-	-	1	-	2	1	2	2	2
CO3	Apply	-	-	-	1	-	2	1	2	2	2
CO4	Apply	-	-	-	2	-	2	1	2	2	2
CO5	Apply	-	-	-	2	-	2	-	2	2	2
	Average	**-**	**-**	**-**	**1.5**	**-**	**2**	**1**	**2**	**2**	**2**

Module 1: Nature **(18 Hours)**

1. Sanchari Pal: "The Inspiring Story of How Sikkim Became India's Cleanest State"
2. Sarah Joseph: "Hagar: A Story of a Woman and Water" (from *Gift in Green* [chapter 2])

Module 2: Nurture **(18 Hours)**

1. Bertrand Russel: "An Ideal Individual"
2. M K Gandhi: "Childhood" (from *An Autobiography or The Story of my Experiments with Truth)*
3. R. N. Roy: "Martin Luther King: A Peaceful Warrior"

Module 3: Culture **(18 Hours)**

1. Jawaharlal Nehru: "The Variety and Unity of India" (from *The Discovery of India*)
2. Mahasweta Devi: "Kunti and Nishadin"

Module 4: Governance **(18 Hours)**

1. RamachandraGuha: "A 50-50 Democracy" (Excerpts from "Epilogue" I and II, *India after Gandhi: The History of World's Largest Democracy.* Picador India, 2017, pp. 751-756)

2. Arundhati Roy: “Public Power in the Age of Empire” (Address at the annual meeting of the American Sociological Association on August 16, 2004)

Module 5: Life Narratives (18 Hours)

1. Helen Keller: “Three days to see”
2. Jessie Owens: “My Greatest Olympic Prize”
3. J K Rowling: “The Fringe Benefit of Failure, and the Importance of Imagination”

Course designed by: Rev. Dr Teddy C Anthappai

SEMESTER IV

CCEN406: ENGLISH FOR DEVELOPING JOB SKILLS

Credit: 4 **Total Hours: 90**

Course Outcomes

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

CO1: Draft an effective job application and CV

CO2: Attend an interview with confidence and with clarity of purpose.

CO3: Articulate oneself in Group Discussions observing the etiquettes in language and manners

CO4: Summarize in words the key ideas from unknown passages, charts and graphs.

CO5: Apply their knowledge of English grammar in appropriate contexts

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	-	-	-	2	-	2	-	2	2	2
CO2	Apply	-	-	-	2	-	2	-	2	2	2
CO3	Apply	-	-	-	2	-	2	-	2	2	2
CO4	Apply	-	-	-	2	-	2	-	2	2	2
CO5	Apply	-	-	-	3	-	2	1	1	1	1
	Average	**-**	**-**	**-**	**2.2**	**-**	**2**	**1**	**1.8**	**1.8**	**1.8**

Module 1: Job Applications and CV **(18 Hours)**

1. Writing cover letter and application letter
2. Writing CV, Resume, Biodata

Module 2: Interview **(18 Hours)**

1. Interview language skills
2. Preparing for interview
3. Practising Interview

Module 3: Group Discussion **(18 Hours)**

1. Group Discussion: importance, GD etiquette, GD language
2. Doing GD

Module 4: English for Competitive Exams: Reading Comprehension **(18 Hours)**

1. Comprehending passages
2. Paraphrasing charts, graphs and answering questions

Module 5: English for Competitive Exams: Remedial Grammar **(18 Hours)**

1. Articles
2. Tenses: Past, Present and Future - Major uses

3. Subject-Verb agreement
4. Preposition
5. Reported Speech
6. Passive

Course designed by: Dr Raju Sebastian

COMMON COURSES IN MALAYALAM FOR MODEL I BA/BSc PROGRAMMES

SEMESTER I

CCMB101: ചെറുകഥാസാഹിത്യം

Credit: 4 **Total Hours: 72**

Course Outcomes

CO1: ചെറുകഥാസാഹിത്യത്തിന്റെ പ്രത്യേകതയും ഭാവുകത്വപരമായ പരിണാമവും മനസിലാക്കുന്നു.

CO2: ചെറുകഥയുടെ ആഖ്യാനശാസ്ത്രവും സൗന്ദര്യശാസ്ത്രവും കണ്ടെത്തുന്നു.

CO3: പ്രമേയസ്വീകരണത്തിലും ആഖ്യാനത്തിലും കഥാപാത്രനിർമിതിയിലും സംഭവിക്കുന്ന മാറ്റങ്ങളും നടത്തുന്ന പരീക്ഷണങ്ങളും മാതൃകകളിലൂടെ വിശകലനം ചെയ്യുന്നു

CO4: ഓരോ കാലഘട്ടത്തിന്റെയും ചരിത്ര-സാമൂഹികപശ്ചാത്തലത്തോട് ചെറുകഥാസാഹിത്യം എങ്ങനെ പ്രതികരിച്ചുവെന്ന് തിരിച്ചറിയുന്നു

CO5: മലയാളിയുടെ ജീവിതബോധത്തെയും മൂല്യസങ്കല്പങ്ങളെയും രൂപപ്പെടുത്തുന്നതിൽ ചെറുകഥകൾ വഹിച്ച പങ്കിനെ വിമർശനാത്മകമായി വിലയിരുത്തുന്നു.

മൊഡ്യൂൾ ഒന്ന്: ചെറുകഥ: ആരംഭഘട്ടം - നവോത്ഥാനഘട്ടം (18 മണിക്കൂർ)

1.1. ചെറുകഥയുടെ സവിശേഷതകൾ, ആദ്യകാലചെറുകഥകൾ

1.2. നവോത്ഥാന കഥകൾ: സാമൂഹികത – ദേശീയത

1.3. പുരോഗമനസാഹിത്യം, റിയലിസം

1.4. വിശദപഠനം: വെള്ളപ്പൊക്കത്തിൽ - തകഴി ശിവശങ്കരപ്പിള്ള

1.5. വിശദപഠനം: ശബ്ദിക്കുന്ന കലപ്പ - പൊൻകുന്നം വർക്കി

1.6. വിശദപഠനം: ഒരു മനുഷ്യൻ - വൈക്കം മുഹമ്മദ് ബഷീർ

1.7. വിശദപഠനം: മോതിരം - കാരൂർ നീലകണ്ഠപ്പിള്ള

മൊഡ്യൂൾ രണ്ട്: വ്യക്തികേന്ദ്രീകൃത കഥകൾ - കാല്പനികത (18 മണിക്കൂർ)

2.1. ആഖ്യാനത്തിലെ പുതുസങ്കല്പനങ്ങൾ

2.2. പ്രണയം, രതി, കുടുംബം - പുനർവായനകൾ

2.3. രാഷ്ട്രീയ-പ്രത്യയശാസ്ത്ര പ്രതിസന്ധികൾ

2.4. വിശദപഠനം: മഖൻസിങ്ങിന്റെ മരണം –ടി പത്മനാഭൻ

2.5. വിശദപഠനം: നിന്റെ ഓർമയ്ക്ക് – എം ടി വാസുദേവൻ നായർ

2.6. വിശദപഠനം: തുക്കുമരങ്ങൾ ഞങ്ങൾക്ക് – എം സുകുമാരൻ

2.7. വിശദപഠനം: കോലാട് - മാധവിക്കുട്ടി

മൊഡ്യൂൾ മൂന്ന്: ആധുനികഘട്ടം (18 മണിക്കൂർ)

3.1. ആധുനികതയുടെ ഭാവുകത്വം – പ്രത്യേകതകൾ, ദർശനാഭിമുഖ്യങ്ങൾ

3.2. കഥാപാത്രം, ഭാഷ, ആഖ്യാനം എന്നിവയിലെ പരീക്ഷണങ്ങൾ

3.3. രാഷ്ട്രീയാധുനികത, നഗരവത്കരണം – അപമാനവികത; ആധുനികതയുടെ അപചയം

3.4. വിശദപഠനം: മുടിത്തെയ്യമുറയുമ്പോൾ - സാറാ ജോസഫ്

3.5. വിശദപഠനം: ഫോട്ടോ – എം മുകുന്ദൻ

3.6. വിശദപഠനം: കടൽത്തീരത്ത് – ഒ വി വിജയൻ

3.7. വിശദപഠനം: ഹിഗ്വിറ്റ - എൻ എസ് മാധവൻ

മൊഡ്യൂൾ നാല്: ആധുനികാനന്തരഘട്ടം (18 മണിക്കൂർ)

4.1. ആഗോളവത്കരണവും കമ്പോളവത്കരണവും ,മാധ്യമസംസ്കാരം, ഉപഭോഗസംസ്കാരം

4.2. കീഴാള-പാരിസ്ഥിതിക പ്രത്യയശാസ്ത്രങ്ങളുടെ സാന്നിധ്യം

4.3. ലിംഗരാഷ്ട്രീയം, സ്ത്രീപക്ഷരചനകൾ; സൈബർ ഭാവന

4.4. വിശദപഠനം: ഭാരതമാതാവ് - വി പി ശിവകുമാർ

4.5. ഘടികാരങ്ങൾ നിലയ്ക്കുന്ന സമയം - സുഭാഷ് ചന്ദ്രൻ

4.6. ബിരിയാണി - സന്തോഷ് ഏച്ചിക്കാനം

4.7. മോസ്ഥിതനായങ്ങുവസിപ്പൂ മലപോലെ – എസ് ഹരീഷ്

Reference

1. എം അച്യുതൻ, ചെറുകഥ ഇന്നലെ ഇന്ന്, എസ് പി സി എസ്, കോട്ടയം.
2. വി രാജകൃഷ്ണൻ, ചെറുകഥയുടെ ഛന്ദസ്സ്, ഡി സി ബുക്ക്സ്, കോട്ടയം.
3. കെ എസ് രവികുമാർ, ചെറുകഥ വാക്കും വഴിയും, കറന്റ് ബുക്ക്സ്, തൃശ്ശൂർ.
4. ജി മധുസൂദനൻ (എഡി), ഹരിതനിരൂപണം മലയാളത്തിൽ, കറന്റ് ബുക്ക്സ്, തൃശ്ശൂർ.
5. കെ പി അപ്പൻ, ചെറുകഥ: ആഖ്യാനവും അനുഭവസത്തയും, ഡി സി ബുക്ക്സ്, കോട്ടയം
6. പി കെ രാജശേഖരൻ, ഏകാന്തനഗരങ്ങൾ, ഡി സി ബുക്ക്സ്, കോട്ടയം

Course designed by: ഡോ സണ്ണി സെബാസ്റ്റ്യൻ

SEMESTER II

CCMB202: കവിതാസാഹിത്യം

Credit: 4 **Total Hours: 72**

Course Outcomes

CO1: കവിതാസാഹിത്യത്തിന്റെ പ്രത്യേകതയും ഭാവുകത്വപരമായ പരിണാമവും മനസിലാക്കുന്നു.

CO2: സാമൂഹികാവബോധവും പാരിസ്ഥിതികാവബോധവും എപ്രകാരമാണ് സന്ധിചെയ്യപോകുന്നതെന്ന് കണ്ടെത്തുന്നു.

CO3: പ്രണയം, സ്നേഹം തുടങ്ങിയ വികാരങ്ങളുടെ സൂക്ഷ്മാവസ്ഥകളെ എപ്രകാരം കവിത അടയാളപ്പെടുത്തുന്നു എന്ന് തിരിച്ചറിയുന്നു.

CO4: ഓരോ കാലഘട്ടത്തിന്റെയും ചരിത്ര-സാമൂഹികപശ്ചാത്തലത്തോടും നവോത്ഥാന ആധുനിക മാറ്റങ്ങളോടും കൃതികൾ എങ്ങനെ പ്രതികരിക്കുന്നു എന്ന് വിലയിരുത്തുന്നു.

CO5: മലയാളിയുടെ ജീവിതബോധത്തെയും മൂല്യസങ്കല്പങ്ങളെയും രൂപപ്പെടുത്തുന്നതിൽ കൃതികൾ വഹിച്ച പങ്കിനെയും കീഴാളസാഹിത്യ ഇടപെടലുകളെയും വിമർശനാത്മകമായി വിലയിരുത്തുന്നു.

മൊഡ്യൂൾ ഒന്ന്: പരിസ്ഥിതി (18 മണിക്കൂർ)

1.1. പാരിസ്ഥിതികാവബോധം

1.2. ആധുനികതയും ആഗോളവത്കരണവും പ്രകൃതിയും

1.3. സൂക്ഷ്മജീവികളും സൂക്ഷ്മലോകവും കവിതയിൽ

1.4. വിശദപഠനം: കുറ്റിപ്പുറം പാലം- ഇടശ്ശേരി ഗോവിന്ദൻ നായർ

1.5. വിശദപഠനം: ശാർങ്ഗകപ്പക്ഷികൾ - ഒ എൻ വി കുറുപ്പ്

1.6. വിശദപഠനം: കൊച്ചിയിലെ വൃക്ഷങ്ങൾ - കെ ജി ശങ്കരപ്പിള്ള

1.7. വിശദപഠനം: കാറ്റേ കടലേ – പി പി രാമചന്ദ്രൻ

മൊഡ്യൂൾ രണ്ട്: പ്രണയം (18 മണിക്കൂർ)

2.1. പ്രണയസങ്കല്പങ്ങൾ

2.2. കാളിദാസന്റെയും ആശാന്റെയും പ്രണയസങ്കല്പം

2.3. ആത്മീയതയും പ്രണയവും

2.4. വിശദപഠനം: ലീല - കുമാരനാശാൻ(സർഗം 3, ആദ്യ 15 ശ്ലോകങ്ങൾ)

2.5. വിശദപഠനം: ആത്മരഹസ്യം - ചങ്ങമ്പുഴ

2.6. വിശദപഠനം: സഫലമീയാത്ര - എൻ എൻ കക്കാട്

2.7. വിശദപഠനം: കറുത്തനട്ടുച്ച - കുരീപ്പുഴ ശ്രീകുമാർ

മൊഡ്യൂൾ മൂന്ന്: പാർശ്വം (18 മണിക്കൂർ)

3.1. മുഖ്യവും പാർശ്വവും -പാർശ്വവത്കൃതർ

3.2. ദളിത് കാവ്യദർശനം

3.3. ഫെമിനിസം, എക്കോഫെമിനിസം

3.4. വിശദപഠനം: മാണിക്കംപെണ്ണ് (എന്ത് ശ്രുത്തി ഏത് ശ്രുത്തി) – മറിയാമ്മച്ചേടത്തി

3.5. വിശദപഠനം: കാക്ക - വൈലോപ്പിള്ളി ശ്രീധരമേനോൻ

3.6. വിശദപഠനം: കുറുപ്പിനെ വാഴ്ത്തുന്നവരോട് -എം ബി മനോജ്

3.7. വിശദപഠനം: കൈക്കലത്തുണികൾ - വിജില ചിറപ്പാട്

മൊഡ്യൂൾ നാല്: പ്രതിരോധം (18 മണിക്കൂർ)

4.1. മാനവികത, നവോത്ഥാനം, കൊളോണിയലിസം, ആഗോളവത്കരണം

4.2. ലിംഗം, ഭാഷ, സംസ്കാരം, സ്വത്വം -പ്രതിരോധങ്ങൾ, ബഹുസ്വരത

4.3. ഭരണകൂടവും പ്രതിരോധവും, അടിയന്തരാവസ്ഥ

4.4. വിശദപഠനം: കുറത്തി – കടമ്മനിട്ട രാമകൃഷ്ണൻ

4.5. വിശദപഠനം: മനുഷ്യന്റെ കൈകൾ - ബാലചന്ദ്രൻ ചുള്ളിക്കാട്

4.6. വിശദപഠനം: സത്യവാങ്മൂലം - സച്ചിദാനന്ദൻ

4.7. വിശദപഠനം: മലയാളകവിതയ്ക്ക് ഒരു കത്ത് – എസ് ജോസഫ്

Reference

1. കെ സച്ചിദാനന്ദൻ, മലയാള കവിതാപഠനങ്ങൾ, മാതൃഭൂമി, കോഴിക്കോട്.
2. ഡോ എം ലീലാവതി, മലയാളകവിതാസാഹിത്യചരിത്രം, കേരള സാഹിത്യ അക്കാദമി, തൃശ്ശൂർ.
3. ഡോ സി ആർ പ്രസാദ്, ആധുനികാനന്തര മലയാളകവിത, റെയിൻബോ.
4. എൻ അജയകുമാർ, ആധുനികത മലയാളകവിതയിൽ, എസ് പി സി എസ്, കോട്ടയം

Course designed by: ഡോ സണ്ണി സെബാസ്റ്റ്യൻ

SEMESTER III

CCMB303: ദൃശ്യകലാസാഹിത്യം

Credit:4 **Total Hours: 90**

Course Outcomes

CO1: കഥകളി, നാടകം, സിനിമ എന്നീ കലാരൂപങ്ങളെയും അവയുടെ സാഹിത്യപാഠങ്ങളെയും ചേർത്തുവെച്ച് നിരൂപിക്കുന്നു.

CO2: കേരളത്തിലെ ദൃശ്യകലാസംസ്കാരത്തിന്റെ സമ്പന്നതയും വൈവിധ്യവും മനസിലാക്കുന്നു

CO3: കേരളത്തിന്റെ സാംസ്കാരികജീവിതത്തെ ഈ ദൃശ്യകലകളും അവയുടെ സാഹിത്യവും എങ്ങനെ സ്വാധീനിക്കുന്നുവെന്ന് തിരിച്ചറിയുന്നു

CO4: ദൃശ്യകലകളുടെ ചരിത്രത്തെക്കുറിച്ച് ധാരണ നേടുന്നു

CO5: നാടകരചന, തിരക്കഥാരചന തുടങ്ങി കലകളുടെ ക്രിയാത്മകാവിഷ്കാരത്തിന് ആവശ്യമായ അറിവ് നേടുന്നു.

മൊഡ്യൂൾ ഒന്ന്: ഭാരതീയ നാടകപാരമ്പര്യം (18 മണിക്കൂർ)

1.1. നാടകലക്ഷണം, സംസ്കൃത നാടകകാരൻമാർ

1.2. കാളിദാസന്റെ കാവ്യലോകം

1.3. അഭിജ്ഞാനശാകുന്തളവും മഹാഭാരതത്തിലെ ശാകുന്തളോപാഖ്യാനവും

1.4. അഭിജ്ഞാനശാകുന്തളം – കഥാപാത്രങ്ങൾ

1.5. അഭിജ്ഞാനശാകുന്തളം – കാവ്യകൽപനകൾ, ദർശനതലം

1.6. വിശദപഠനം: മലയാളശാകുന്തളം (മൂന്ന്, നാല് അങ്കങ്ങൾ) – എ ആർ രാജരാജവർമ്മ

മൊഡ്യൂൾ രണ്ട്: യവനനാടകപാരമ്പര്യം (18 മണിക്കൂർ)

2.1. യവനനാടകപാരമ്പര്യം - സോഫൊക്ലീസ്, യൂറിപ്പിഡിസ്, ഈസ്കിലസ്

2.2. ട്രാജഡി – അരിസ്റ്റോട്ടിലിന്റെ നിർവചനം, ട്രാജഡിയുടെ ഘടകങ്ങൾ- പ്രയോജനം

2.3. വിശദപഠനം: മീഡിയ – യൂറിപ്പിഡിസ്

2.4. മീഡിയ – കഥാപാത്രങ്ങൾ

2.5. മീഡിയ – ജീവിതദർശനം

2.6. മീഡിയ – ഇതിവൃത്തസവിശേഷത

മൊഡ്യൂൾ മൂന്ന്: മലയാള നാടകപാരമ്പര്യം (18 മണിക്കൂർ)

3.1. പ്രധാന നാടകകാരന്മാർ, കൃതികൾ

3.2. സി എൻ ശ്രീകണ്ഠൻ നായർ - രാമായണനാടകത്രയം

3.3. വിശദപഠനം: ലങ്കാലക്ഷ്മി (സി എൻ ശ്രീകണ്ഠൻ നായർ)

3.4. ലങ്കാലക്ഷ്മി – ഇതിവൃത്തസവിശേഷത

3.5. ലങ്കാലക്ഷ്മി – കഥാപാത്രങ്ങൾ

3.6. ലങ്കാലക്ഷ്മി – ജീവിതദർശനം

മൊഡ്യൂൾ നാല്: ആട്ടക്കഥ (18 മണിക്കൂർ)

4.1. കഥകളിയും ആട്ടക്കഥയും – ഉത്ഭവവികാസങ്ങൾ

4.2. ആട്ടക്കഥാസാഹിത്യത്തിന്റെ സവിശേഷത

4.3. ഉണ്ണായി വാര്യരുടെ കവിവ്യക്തിത്വം – നളചരിതത്തിന്റെ അനന്യത

4.4. വിശദപഠനം: നളചരിതം ആട്ടക്കഥ രണ്ടാം ദിവസം (ആദ്യത്തെ അഞ്ചു രംഗങ്ങൾ)

4.5. നളചരിതം – കഥാപാത്രങ്ങൾ

4.6. നളചരിതം – കാവ്യകല്പനകൾ

4.7. നളചരിതം – ജീവിതദർശനം

മൊഡ്യൂൾ അഞ്ച്: ചലച്ചിത്രപാരമ്പര്യം (18 മണിക്കൂർ)

5.1. ചലച്ചിത്രകലയുടെ ഉദയവികാസങ്ങൾ

5.2. മലയാളസിനിമയുടെ വികാസപരിണാമങ്ങൾ, പ്രധാന ചലച്ചിത്രകാരന്മാർ, ചലച്ചിത്രങ്ങൾ

5.3. മലയാളത്തിലെ പുതുതലമുറസിനിമ – സവിശേഷതകൾ

5.4. വിശദപഠനം : ട്രാഫിക്(തിരക്കഥ)- ബോബി, സഞ്ജയ്

5.5. ട്രാഫിക് – ആഖ്യാന സവിശേഷത

5.6. ട്രാഫിക് – സമീപന സവിശേഷതകൾ

Reference

1. ആട്ടക്കഥാസാഹിത്യം – അയ്മനം കൃഷ്ണക്കൈമൾ
2. മലയാളനാടകവേദിയുടെ കഥ - മടവൂർ ഭാസി
3. മലയാളനാടകസാഹിത്യചരിത്രം – ജി ശങ്കരപിള്ള
4. മലയാളസിനിമയുടെ കഥ – വിജയകൃഷ്ണൻ

5. ന്യൂ ജനറേഷൻ സിനിമ – ജോസ് കെ മാനുവൽ

Course designed by: ശ്രീ അജീഷ് തോമസ്

SEMESTER IV

CCMB404: ഗദ്യസാഹിത്യം

Credit: 4 **Total Hours: 90**

Course Outcomes:

CO1: വ്യത്യസ്ത ഗദ്യവ്യവഹാരങ്ങളെ തിരിച്ചറിയുന്നു

CO2: വിജ്ഞാനാന്വേഷണത്തിന്റെയും വൈജ്ഞാനികാവിഷ്കാരങ്ങളുടെയും മാതൃകകളെ മനസ്സിലാക്കി അന്തർവൈജ്ഞാനിക ധാരണകൾ സ്വായത്തമാക്കുന്നു

CO3: രചനയുമായി ബന്ധപ്പെട്ട പ്രശ്നങ്ങൾ പരിഹരിച്ച് ഭാഷാപ്രയോഗത്തിന്റെ സാധ്യതകളെ മനസ്സിലാക്കി മികച്ച ആശയപ്രകാശനശേഷി നേടുന്നു

CO4: വിവർത്തനത്തിന്റെ പ്രാഥമികപാഠങ്ങൾ മനസ്സിലാക്കി വിവർത്തനത്തിൽ ഏർപ്പെടുവാനുള്ള ശേഷി ആർജിക്കുന്നു

CO5: നോവലെന്ന സാഹിത്യരൂപത്തെ മനസ്സിലാക്കി ആസ്വാദനശേഷി കൈവരിക്കുന്നു

മൊഡ്യൂൾ ഒന്ന്: ഗദ്യസാഹിത്യമാതൃകകൾ (18 മണിക്കൂർ)

1.1. ഗദ്യസാഹിത്യം, ഗദ്യസാഹിത്യരൂപങ്ങൾ

1.2. മിത്തും ചരിത്രവും

1.3. വിശദപഠനം: പരശുരാമനെ തേടി – എം ആർ രാഘവ വാര്യർ, രാജൻ ഗുരുക്കൾ

1.4. സഞ്ചാരസാഹിത്യം

1.5. വിശദപഠനം: ഓ സോളേമിയ - രവീന്ദ്രൻ

1.6. ജീവചരിത്രം, ആത്മകഥ

1.7. വിശദപഠനം: മിതാവാദി സി കൃഷ്ണൻ - എം കെ സാനു

മൊഡ്യൂൾ രണ്ട്: നിരൂപണ മാതൃകകൾ (18 മണിക്കൂർ)

2.1. സാഹിത്യനിരൂപണം, സാഹിത്യനിരൂപണം മലയാളത്തിൽ

2.2. മലയാളനിരൂപകർ: സാമാന്യപരിചയം

2.3. വിശദപഠനം: ജീവിതമെന്ന ചതുരംഗം - കെ പി അപ്പൻ

2.4. കവിതാനിരൂപണം

2.5. വിശദപഠനം: കൂടിയൊഴിക്കൽ - പ്രൊഫ എം എൻ വിജയൻ

2.6. സിനിമാനിരൂപണം, സിനിമാനിരൂപകർ: സാമാന്യപരിചയം

2.7. വിശദപഠനം: അരവിന്ദന്റെ എസ്കപ്പാൻ - ഒ കെ ജോണി

മൊഡ്യൂൾ മൂന്ന്: വിവിധ വിജ്ഞാനമേഖലാപഠനങ്ങൾ (18 മണിക്കൂർ)

3.1. ഇതര വിജ്ഞാനമേഖലകളും ഗദ്യസാഹിത്യവും, അന്തർവൈജ്ഞാനിക നിരൂപണം

3.2. മാധ്യമനിരൂപണം

3.3. വിശദപഠനം: ടെലിവിഷൻ യുദ്ധങ്ങൾ - ഷാജി ജേക്കബ്

3.4. ഭാഷാ-സംസ്കാരപഠനം

3.5. വിശദപഠനം: ഭാഷയും അധിനിവേശവും - പ്രദീപൻ പാമ്പിരിക്കുന്ന്

3.6. സമൂഹം, ദേശം, രാഷ്ട്രം

3.7. വിശദപഠനം: ആൾക്കൂട്ടങ്ങൾ പിരിഞ്ഞുപോകുമ്പോൾ - ടി ടി ശ്രീകുമാർ

മൊഡ്യൂൾ നാല്: നോവൽ പരിചയം (18 മണിക്കൂർ)

4.1. നോവൽ എന്ന സാഹിത്യരൂപം

4.2. നോവൽ പ്രസ്ഥാനത്തിന്റെ ഉദയം, പശ്ചാത്തലം

4.3. നോവൽപ്രസ്ഥാനം മലയാളത്തിൽ - സാമാന്യപരിചയം

4.4. എം മുകുന്ദൻ

4.5. വിശദപഠനം: ഒരു ദളിത് യുവതിയുടെ കദനകഥ - എം മുകുന്ദൻ

മൊഡ്യൂൾ അഞ്ച്: രചനാപരിശീലനം (18 മണിക്കൂർ)

5.1. ഉപന്യാസരചനാതത്വങ്ങൾ

5.2. ആശയവിപുലനം

5.3. പദശുദ്ധി

5.4. പദഘടന

5.5. വാക്യരചന

5.6. വാക്യദോഷങ്ങൾ

5.7. തർജ്ജമ

Reference

1. എം എൻ കാരശ്ശേരി, തെളിമലയാളം, ഡി സി ബുക്ക്സ്, 2017.
2. ഡോ കെ എം ജോർജ്(എഡി), ആധുനിക മലയാളസാഹിത്യചരിത്രം പ്രസ്ഥാനങ്ങളിലൂടെ, ഡി സി ബുക്ക്സ്, 2011.

Course designed by: ഡോ റെസ്സി മറിയം മാത്യു

COMMON COURSES IN HINDI FOR MODEL I BA/BSc PROGRAMMES

SEMESTER I

CCHB101: PROSE AND ONE-ACT PLAYS

Credit: 4 **Total Hours: 72**

Course Outcomes

At the end of the course, students shall be able to:

CO1: Appreciate Hindi literature.

CO2: Analyse the different aspects of prose.

CO3: Analyse the main trends and aspects of theatre.

Module 1: Prose **(18 Hours)**

1. Dr Kishori Lal Vyas: "Aayiye, hum Vriksh Devta ki Aaradhana Kare"
2. Vijay Kumar Sandesh: "Himachadit Uthung Shikhar aur Dhuli Hariyai"

Module 2: Prose **(18 Hours)**

1. Usha Bala: "Kaphan Chor ka Beta"
2. A P J Abdul Kalam: "Jab Mei Fail Hua"

Module 3: One-Act Plays **(18 Hours)**

1. Mamta Kaliya: "Jaan se Pyare"
2. Vinod Rastogi: "Bahu Ki Vidaa"

Module 4: One-Act Plays **(18 Hours)**

1. G J Harijeeth: "Sati"
2. Surendra Varma: "Hari Ghas Par Ghante Bhar"

Textbook

1. *Sahitya Darpan*, Rajpal & Sons, New Delhi, 2021

Course designed by: Dr Roy Joseph

SEMESTER II

CCHB202: SHORT STORIES AND NOVEL

Credit: 4 **Total Hours: 72**

Course outcomes

At the end of the course, students shall be able to:

CO1: Critically analyse literary texts.

CO2: Analyse the different aspects and styles of short stories.

CO3: Develop an understanding of how novel can be used to communicate ideas.

Module 1: Short Stories **(18 Hours)**

1. Premchand: "Idgaah"
2. Gyanaranjan: "Amrood ka Ped"
3. Swayam Prakash: "Jangal ka Daah"

Module 2: Short Stories **(18 Hours)**

1. Usha Priyamvada: "Chutti ka Din"
2. Kailas Banvasi: "Bazar Mein Ramdhan"
3. Kumar Ambuj: "Maa Rasoyi Mein Rahati Hai"

Module 3 & 4: Novel **(36 Hours)**

1. Ravindra Kaliya: *A, B, C, D*

Textbooks

1. *Katha Sansar,* Vani Prakashan, New Delhi, 2017
2. Ravindra Kaliya: *A, B, C, D,* Vani Prakashan, New Delhi, 2016

Course designed by: Dr Roy Joseph

SEMESTER III

CCHB303: POETRY, GRAMMAR AND TRANSLATION

Credit: 4 **Total Hours: 90**

Course Outcomes

At the end of the course, students shall be able to:

CO1: Appreciate ancient, medieval and modern Hindi poetry

CO2: Develop grammatical proficiency in Hindi

CO3: Develop proficiency by the usage of correct grammar in the translation process.

Module 1: Poetry - 1 **(18 Hours)**

1. Kabirdas: “Doha” (4)
2. Tulsidas: “Pada” (2)
3. Mahadevi Varma: “Veh Muskurate bhool nahi”
4. Dhoomil: “Khevali”

Module 2: Poetry - 2 **(18 Hours)**

1. Sarveshwar Dayal Saksena: “Cheenane Aaye Hai Veh”
2. Gyanendrapati: “Azadi Urph Gulami”
3. Arun Kamal: “Sabooth”
4. Kumal ViKal: “Dilli Darvaza”

Module 3: Poetry - 3 **(18 Hours)**

1. Vinod Kumar Shukla: “Jangal ke Ujaad Mei”
2. Rajesh Joshy: “Beesvim Sadi ke Anthim Dinom ka ek Aaschary”
3. Ekanth Srivastva: “Tande Paani ki Machine”
4. Kumar Ambuj: “Ache Aadmi”

Module 4: Grammar **(18 Hours)**

1. Shabdha vichar, Sagya, Ling, Vachan, Karak, Sarvanam, Visheshan, Kriya

Module 5: Translation **(18 Hours)**

1. Anuvad – (Hindi to English) – Practical Module

Textbooks

1. *Kavyakusum,* Aman Prakashan, Kanpur, 2018
2. *Samanya Hindi Vyakaran Thatha Rachana*, Vani Prakashan, New Delhi, 2018

Course designed by: Dr Roy Joseph

SEMESTER IV

CCHB404: DRAMA AND LONG POEM

Credit: 4 **Total Hours: 90**

Course Outcomes

At the end of the course, students shall be able to:

CO1: Understand and appreciate Hindi theatre

CO2: Critically appreciate epic poetry.

Module 1 & 2 Drama **(36 Hours)**

1. Mohan Rakesh: “Ashad ka ek Din”

Module 3: Long Poem - 1 **(18 Hours)**

1. Nilesh Raghuvanshi: “Dhaaba”
2. Agnisekhar: “Javahar Tunnel”

Module 4: Long Poem - 2 **(18 Hours)**

1. Umashankar Chaudhari: “Shahjehan ki Neend”

Module 5: Long Poem - 3 **(18 Hours)**

1. Nirmala Putul: “Ithni door math byahana baba”

Textbooks

1. Ashad ka ek Din, Rajpal & Sons, New Delhi, 2019
2. *Paanch Lambi Kavithayem*, Vani Prakashan, New Delhi, 2018

Course designed by: Dr Roy Joseph

COMMON COURSES IN SYRIAC FOR MODEL I BA/BSc PROGRAMMES

SEMESTER I

CCSB101: POETRY, GRAMMAR & HISTORY OF SYRIAC LANGUAGE & LITERATURE

Credit: 4 **Total Hours: 72**

Course Outcomes

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

CO1: Learn and write the different scripts.

CO2: Describe and compare the works of early Syriac writers.

CO3: Write and construct small Syriac sentences.

CO4: Recite poetry.

Module 1: History of Syriac Language and Literature (9 Hours)

1. Origin and development of Syriac language
2. Development of vowel system Greek and Dot systems
3. Different scripts- Estrangala, East Syriac and West Syriac
4. Early literature (from 1st to 4th centuries)
5. The Golden Age (from 5th to 9th centuries)
6. Age of declension (from 9th to 13th centuries)
7. Dormant period and Renascence (from 14th to 21st centuries)
8. Themes and purposes of Syriac poetry

Module 2: Early Syriac Writings (9 Hours)

1. Peshitta
2. Diatessaron
3. Demonstrations
4. Act of Thomas
5. Odes of Solomon

Module 3: Grammar (36 Hours)

1. Noun and Pronoun
2. Pronominal Suffixes (first and third group only)
3. Numerals
4. Conjugation of Verbs- Perfect tense
5. Orthographical Specialties

6. Case Letters
7. Adverb and Adjective

Module 4: Poetry **(18 Hours)**

1. Song of Repentance
2. Farewell
3. The Custody of Senses
4. On Fasting

Reference

1. Mar Aprem Theologian & Poet – Mar Aprem
2. The Odes of Solomon – GieVleugels& Martin Webber
3. The New Syriac Primer – George Anton Kiraz
4. Collection of Syriac Gems – Fr. Thomas William CMI
5. Suriayani Bhasha Praveshika – Fr. Abraham Konatt
6. A Brief Outline of Syriac Literature – Sebastian Brock
7. Scattered Pearls - Patriarch Ignatius Aphrem I Barsoum
8. The Syriac Language and Literature - Fr Romeo Thomas TOCD
9. Aramaic Grammar Vol I and II - Fr Thomas Arayathinal
10. The Harp Vol XXXII 2017

SEMESTER II

CCSB202: HYMNODY, GRAMMAR & HISTORY OF SYRIAC LANGUAGE AND LITERATURE

Credit: 4 **Total Hours: 72**

Course Outcomes

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

CO1: Write and construct small sentences

CO2: Recite poetry

CO3: Describe and compare the works

CO4: Analyze the texts

Module 1: Life and Works of Early Syriac Writers (6 Hours)

1. Ephrem
2. Aphrat
3. Bardeisan

Module 2: Life and Works of East and West Syriac Writers (12 Hours)

1. Narsai
2. Ishoyab III
3. Abdisho of Soba
4. Mar Jacob o Serugh
5. Balai
6. Bar Hebraeus

Module 3: Grammar (18 Hours)

1. Plural pronominal suffixes
2. Prepositions (first and second groups)
3. Conjugation (Future tense)
4. States of noun

Module 4: Poetry (36 Hours)

1. Pride and humility
2. Stray Gems
3. There should be no weeping about the dead
4. The good shepherd

Reference

1. The History of Syriac Literature and Sciences – Patriarch Aphrem Barsoum
2. Syriac Chaldaic Grammar – Fr. Gabriel of St. Joseph T.O.C.D.
3. A Brief Outline of Syriac Literature – Sebastian Brock
4. Collection of Syriac Gems – Fr. Thomas William CMI
5. Robinson's Paradigms and Exercises in Syriac Grammar – J.F. Coakley
6. The New Syriac Primer – George Anton Kiraz
7. Suriayani Bhasha Praveshika – Fr. Abraham Konatt
8. The Syriac Language and Literature - Fr Romeo Thomas TOCD
9. Aramaic Grammar Vol I and II - Fr Thomas Arayathinal
10. The Harp Vol XXXII 2017

SEMESTER III

CCSB303: PROSE, GRAMMAR & HISTORY OF SYRIAN CHURCH IN INDIA

Credit: 4 **Total Hours: 90**

Course Outcomes

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

CO1: Construct and apply the phrases and usages

CO2: Categorize the secular literature

CO3: Translate and analyzing the text

CO4: Compare and describe the Syriac traditions

Module 1: History of Syrian Church in India **(9 Hours)**

1. Syriac church in Pre- Portuguese period
2. Diampor synod
3. Koonan cross oath and its after effects
4. Latin rule over Syrian community

Module 2: Syriac Scholars of Modern Era **(9 Hours)**

1. Assemani
2. Paul Bedjan
3. Sebastian Brock

Module 3: Grammar **(36 Hours)**

1. P Conjugation of verbs- passive voice (perfect)
2. Present participle
3. Conjunction- interjection
4. Parsing of words

Module 4: Prose Texts **(36 Hours)**

1. Sermon on the mount
2. Old and new law
3. On charity, prayer and fasting
4. Parables about kingdom of heaven

Reference

1. The History of Alexander the Great – E. A. W. Budge
2. Bar Hebraeus : A Bio-Bibliography – Hidemi Takahashi
3. A Brief Outline of Syriac Literature – Sebastian Brock
4. The History of Syriac Literature and Sciences –Patriarch AphremBarsoum
5. The Syriac New Testament
6. SuriayaniBhasha Praveshika – Fr. Abraham Konatt
7. The Syriac Language and Literature - Fr Romeo Thomas TOCD
8. Aramaic Grammar Vol I and II - Fr Thomas Arayathinal
9. The Harp Vol XXXII 2017

SEMESTER IV

CCSB404: PROSE, GRAMMAR & SYRIAC HERITAGE OF KERALA

Credit: 4 **Total Hours: 90**

Course Outcomes

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

CO1: Write and construct the small sentences.

CO2: Categorize the secular literature.

CO3: Translate and analyzing the text.

CO4: Compare and describe the Syriac traditions.

Module 1: Syrian Churches in India **(9 Hours)**

1. Syro Malabar Church
2. Syrian Orthodox and Orthodox Syrian Churches
3. Malabar Independent Syrian Church
4. Malankara Marthoma Syrian Church
5. Malankara Catholic Church
6. Church of the East

Module 2: Great Malpans of Kerala **(9 Hours)**

1. Kuriakose Elias Chavara
2. Kalapurackal Anthrayos Malpan
3. Placidachan
4. Malpan John Bosco Thottakkara(Guru Yohend)
5. Mar Joseph Kariyattil
6. Paremakkal Thoma Kathanar and Varthamanapusthakam
7. Konatt Mathen Malpan
8. Kaniyamparambil Kurian Arch Corepiscopa

Module 3: Grammar ܩܠܝܢܝܩ **(36 Hours)**

1. Conjugation of verbs – passive voice future
2. Passive participle
3. Phrases and usages
4. Parsing of words

Module 4: Prose **(36 Hours)**

1. Divine protection
2. Bread of life
3. New commandment
4. True vine

Reference

1. A History of Christianity in Asia – Samuel Hugh Moffett
2. East of the Euphrates – T. V. Philip
3. Dimensions of Eastern Christianity – E. R. Hambye S. J.
4. Christianity in India - Xavier Koodapuzha
5. History of Syrian Christians – Dr. Romeo Thomas
6. The Syriac New Testament
7. The Syriac Language and Literature - Fr Romeo Thomas TOCD
8. Aramaic Grammar Vol I and II - Fr Thomas Arayathinal
9. The Harp Vol XXXII 2017

SKILL DEVELOPMENT COURSES

CCHSDC01: INSTRUMENTAL METHODS OF ANALYSIS FOR BIOLOGISTS, CHEMISTS AND PHYSICISTS

Credit: 2 **Total Hours: 36**

Course Outcomes

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

CO1: Describe the fundamentals concepts and basic principles of various analytical techniques

CO2: Familiarize the basics of various spectroscopic techniques such as UV-Visible, NMR, FT-IR and mass spectroscopies.

CO3: Determine suitable chromatographic technique for separation and purification of compounds.

CO4: Characterize and interpret different molecules using analytical methods.

CO5: Develop skills in procedures and instrumental methods applied in different analytical techniques.

Module 1: UV-Visible Spectroscopy

Electromagnetic spectrum, Electronic transitions in molecules, Absorptions, Chromophores, Auxochromes; Instrumentation, UV-Visible Spectral pattern, Finding absorption maxima, Measurement of absorbance and its applications.

Module 2: Infrared Spectroscopy

Vibrations in molecules, Functional Groups and Characteristic Vibrations, Representation of IR spectra; Instrumentation, Applications: Recording and Interpretation of IR spectra.

Module 3: NMR Spectroscopy

Different types of nuclei in nature, classification by spin quantum number; Larmor precession of bosons and fermions; Nuclei in molecules, characterization of molecules by NMR spectroscopy, NMR spectrum, interpretation, and applications in science.

Module 4: Mass Spectrometry

General Principles, Mass Spectral Patterns, Interpretation with examples, Applications.

Module 5: Chromatography

Basic principles of paper, thin layer and column chromatography. Gas Chromatography, HPLC. Applications, Experiments in paper, thin layer and column chromatography at the laboratory.

Module 6: Atomic Absorption Spectrometry

Basic principles and applications. Detection copper, chromium and iron in natural samples using AAS.

Module 7: Electrochemical Analyzer

Basic theory and applications. One or two experiments to familiarize the machine.

Module 8: Elementary Analytical Techniques

Theory and applications of pH meter, Salinometer, Conductivity Meter, Potentiometry, Turbidimetry and Flame Photometer. Experiments.

Reference

1. D. A. Skoog, F. J. Holler, S. R. Crouch, Principles of Instrumental Analysis, 6th Edn., Thomson Brooks/Cole, 2007
2. H. H. Willard, L. L. Merritt, J. A. Dean, Instrumental Methods of Analysis, 5th Edn., Van Nostrand, 1974.
3. G. D. Christian, Analytical Chemistry, John Wiley & Sons, 6th Edn, 2004
4. D. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, Fundamentals of Analytical Chemistry, 8th Edn., Thomson Brooks/Cole, 2007
5. G H Jeffery, J Bassett, J Mendham, R C Denney, Longman, Vogel's Text Book of Quantitative Chemical Analysis, 1989

CCHSDC02: CHEMISTRY AND TECHNOLOGY OF RUBBER AND PLASTICS PROCESSING

Credit: 2 **Total Hours: 36**

Course Outcomes

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

CO1: Learn the classification, composition, synthesis and application of different polymers.

CO2: Familiarize various polymer processing techniques.

CO3: Describe the manufacture, properties and applications of natural and synthetic rubber.

CO4: Understand the structure, importance and properties of plastics.

CO5: Identify different methods of recycling and waste disposal options for plastics and rubber.

THEORY

Module 1: Polymers

Importance, basic concept of polymers and its classification, monomers and polymers, homo and hetero polymers, Polymerization techniques, free radical polymerization, addition polymerization chain polymerization, step polymerization, coordination polymerization, ionic, ring opening, atom transfer radical (ATRP), co polymers, block polymers.

Module 2: Rubbers

Isoprene, chloroprene, various types of rubber, its application and manufacture. Natural rubber, Nitrile rubber, SBR (styrene butadiene rubber), chlorobutyl rubber, butyl rubber, neoprene rubber etc. Properties and advantages. Latex, latex compounding.

Module 3: Plastics

Different types of plastics, thermosets and thermoplastics, applications and manufacture. Elastomers, fibres etc. Manufacture of commercially important plastics like PP, PE, LDPE, PVC, Polystyrene. Resins, importance and synthesis. Epoxy, phenol formaldehyde and urea formaldehyde etc. Properties of thermosets and thermoplastics.

Module 4: Processing of Rubber

Mastication of rubber. Compounding of rubber, additives to be added during compounding, its applications and importance. Activators, accelerators, crosslinking agent, fillers (different types). Two roll mill, compression moulding-application and principle.

Module 5: Processing of Plastics

Different types of methods, its principle and advantages over other methods. Internal mixer, pultrusion, extrusion, injection moulding technique, compression moulding, die casting, resin transfer moulding, calendaring, rotational casting.

Module 6: Recycling of Rubber and Plastics

Different methods of recycling and waste disposal options.

PRACTICALS

1. Systematic analysis of polymers, NR, nitrile rubber, SBR, butyl rubber, PVC, polystyrene.
2. Synthesis of polymers. Glyptal resin, phenol formaldehyde resin, urea formaldehyde resin.
3. Determination of DRC (dry rubber content) and TSC (total solid content) in latex. Volatile fatty acid (VFA) content in latex.
4. Mixing of Rubber and Plastics, Compression moulding, latex compounding and product development.

Reference

1. V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age International, 2011
2. F. W. Billmeyer Jr., Text book of Polymer Science, 3rd Edn., John Wiley & Sons, 1984
3. G. Odian, Principles of Polymerization, 4th Edn., John-Interscience, 2004
4. K. Matyjaszewski, T. P. Davis, Handbook of Radical Polymerization, Wiley-Interscience, 2002
5. M. Chanda and S.K. Roy, Plastic Technology Hand Book, Marcel Dekker, 1986
6. J. R. Fried, Polymer Science and Technology, 2nd Edn., Prentice Hall, 2003
7. J. A. Brydson, Plastic Materials, Butterworths-Hieneman, 1999
8. Anil K. Bhowmick, Malcom M Hall, Henry A Benarey, Eds., Rubber Products Manufacturing Technology, Marcel Dekker, 1994
9. V. Shah, Handbook of Plastic Testing Technology, 2nd Edn, John Wiley & Sons, 1998
10. R. P. Brown, Physical Testing of Rubber, 3rd Edn, Springer, 1996
11. R. Brown, Handbook of Polymer Testing, Rapra Technology, 2002
12. J. Mitchell, Applied Polymer Analysis and Characterization, Hanser, 1992

FIELDWORK OR INDUSTRY AND LAB VISIT

- Industry visit to get the basic knowledge on the functioning of different types of rubber and plastic processing machines.
- Orientation training on rubber based industry.

Programme Articulation Table

Course Code	Course Title	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
Core Courses: Chemistry											
CBCH101	Introduction to Quantum Mechanics and Chemical Bonding	2	1	1.33	1.33	1.5	1.8	2	1.8	2	-
CBCH202	States of Matter and Symmetry	1.60	1.00	1.33	-	-	1.20	-	1.00	-	-
CBCH2P01	Volumetric Analysis	-	-	-	2	2	-	2	1	-	2
CBCH303	Conceptual Organic Chemistry	1.8	1.75	1.6	-	-	1.2	1	1.5	1.5	1
CBCH404	Organic Chemistry of Aromatics, Heterocycles, Ethers, Phenols and Carbonyls	1.4	1.2	1.2	1	-	1.6	1.2	1	-	-
CBCH4P02	Qualitative Organic Analysis	-	-	2	2	2.5	2	-	2	1.5	-
CBCH505	Chemistry of Main Group Elements	1.4	1.33	1.33	-	-	1.4	1	1.33	1	1
CBCH506	Introduction to Environmental Science and Scientific Writing	2	1	1.33	1.33	1.5	2	-	2	-	-
CBCH507	Organic Chemistry of Acids, Nitrogen Compounds and Biomolecules	1.6	1	1.25	-	-	1.4	1	1	1	-
CBCH508	Basic Physical Chemistry	1.4	1.2	1	-	-	1.6	1.2	1.2	1	-
CBCH609	Inorganic Chemistry of d and f Block Elements	1.80	1.00	1.60	1.00	-	1.40	1.60	1.40	1.00	-
CBCH610	Advanced Organic Chemistry	1.8	1.33	2	-	-	1.66	1	1.33	1	1
CBCH611	Advanced Physical Chemistry	1.4	1	1	-	-	1.4	1.2	1	1	-
CBCH612	Electrochemistry, Ionic Equilibrium and Surface Chemistry	1.60	1.00	1.33	-	-	1.20	-	1.00	-	-
CBCH6P03	Physical Chemistry Experiments	-	-	1.5	2	2.25	1.75	-	2	2	-
CBCH6P04	Techniques In Organic Chemistry	2	-	2	2	2.5	1.75	-	2	2	-
CBCH6P05	Qualitative Inorganic Analysis	1.75	-	2	2	2.25	1.75	-	1.8	2	-
CBCH6P06	Applied Chemistry Practicals	1.66	2	2	2.5	2.33	1.66	-	2	2	1
CBCH6PJ	Project/Paper Review/Industry Visit Report	2	2	2	2.2	2	2	2	2	2	2
Choice Based Core Courses											
CBCH6E01	Materials Chemistry	1.8	1	1.33	1.33	1	1.8	1.5	1.67	-	-
CBCH6E02	Polymer Chemistry	1.60	1.33	-	-	-	1.80	1	-	-	-

Course Code	Course Title	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
Complementary Course: Mathematics											
CDMC101	Mathematics for Chemistry - I	1.8	-	1	1	-	1.6	1	1.8	-	-
CDMC202	Mathematics for Chemistry - II	1.8	-	-	-	-	1.4	1.4	1.25	1	-
CDMC303	Mathematics for Chemistry - III	1.6	-	-	-	-	1.6	1.33	1.4	1	-
CDMC404	Mathematics for Chemistry - IV	1.4	-	1	-	-	1.4	1	1	1	-
Complementary Course: Physics											
CDPC101	Mechanics and Properties of Matter	-	3	2.3	-	-	2	-	1.8	-	-
CDPC202	Electric and Magnetic Phenomena, Thermodynamics and Error Analysis	3	3	2	-	-	3	-	3	-	-
CDPC303	Quantum Mechanics, Spectroscopy, Nuclear Physics and Nuclear Medicine	2.4	2.2	1.6	1.2	0.2	1.8	2	0.8	0.8	0.4
CDPC404	Physical Optics, Laser Physics and Superconductivity	2	1.5	1.5	1	-	2	1.75	1.6	1	1
Common Course: English											
CCEN101	Reading Literature in English - I: Poetry and Drama	-	-	1	1.2	-	1.4	1.25	2	1.33	1
CCEN102	Writings on Contemporary Issues	-	-	1	1	-	2	1	2	2	2
CCEN203	Writing Skills	-	-	-	2	-	2	-	2	1	1
CCEN204	Reading Literature in English - II: Short Stories and Novel	-	-	-	1	-	1	-	2	1	1
CCEN305	Life and Literature	-	-	-	1.5	-	2	1	2	2	2
CCEN406	English for Developing Job Skills	-	-	-	2.2	-	2	1	1.8	1.8	1.8

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