M.Sc. CHEMISTRY

LOCF SYLLABUS - 2021

SCHOOLS OF EXCELLENCE

WITH CHOICE BASED CREDIT SYSTEM (CBCS)

DEPARTMENT OF CHEMISTRY
SCHOOL OF PHYSICAL SCIENCES
ST.JOSEPH'S COLLEGE (AUTONOMOUS)
Special Heritage Status Awarded by UGC
Accredited at A^{++} Grade (IV Cycle) by NAAC
College with Potential for Excellence by UGC
DBT-STAR & DST-FIST Sponsored College
Tiruchirappalli - 620 002, Tamil Nadu, India

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)
POSTGRADUATE COURSES

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to maintain and uphold the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from the academic year 2014 – 15, to meet and excel the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system enhances the optimal utilization of both human and infrastructural resources. It also enhances academic mobility and enriches employability. The School system preserves the identity, autonomy and uniqueness of every department and reinforces Student centric curriculum designing and skill imparting. These five schools adhere to achieve and accomplish the following objectives.

Optimal utilization of resources both human and material for the academic flexibility leading to excellence.

Students experience or enjoy their choice of courses and credits for their horizontal mobility.

The existing curricular structure as specified by TANSCHE and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice based credit system.

Human excellence in specialized areas

Thrust in internship and / or projects as a lead towards research and

The multi-discipline nature of the School System caters to the needs of stake-holders, especially the employers.

Credit system:

Weightage to a course is given in relation to the hours assigned for the course. Generally one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The credits and hours of each course of a programme is given in the table of Programme Pattern. However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For PG courses, a student must earn a minimum of 110 credits as mentioned in the programme pattern table. The total number of minimum courses offered by the Department is given in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)
LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

OBE is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities and assessments should all help the students achieve the specific outcomes

Outcome Based Education, as the name suggests depends on Outcomes and not Inputs. The outcomes in OBE are expected to be measurable. In fact each Educational Institute can state its own outcomes. The ultimate goal is to ensure that there is a correlation between education and employability

Outcome –Based Education (OBE): is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve, stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs):

PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Programme Educational Objectives (PEOs): The PEOs of a programme are the statements that describe the expected achievement of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after Graduation.

Some important terminologies repeatedly used in LOCF.

Core Courses (CC)

A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Specific Elective Courses (DSE)

Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

DSE: Four courses are offered, one course in each semester.

Note: To offer **one DSE**, a minimum of two courses of equal importance / weightage is a must.

One DSE Course in semester two is offered as interdisciplinary/common course among the departments in a School (Common Core Course) at the PG level.

Generic Elective Courses

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

Generic Elective courses are designed for the students of **other disciplines**. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

Two GE Courses are offered, one each in semesters II and III. The GE course offered in semester II is within the school level and the GE in semester III is Between Schools level

The Ability Enhancement Courses (AEC)

One Main discipline related Ability Enhancement Course for 3 credits is offered for a PG programme by the Department.

Skill Enhancement Courses (SECs)

These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme.

One SEC is offered in semester II as a compulsory course on Soft Skills, offered by the Department of Human Excellence, common to all the students of PG programme.

Self–paced Learning: It is a course for two credits. It is offered to promote the habit of independent/self learning of Students. Since it is a two credit course, syllabus is framed to complete within 45 hours. It is not taught in the regular working hours.

Comprehensive Examinations: A detailed syllabus consisting of five units to be chosen from the courses offered over the five semesters which are of immense importance and those portions which could not be accommodated in the regular syllabus.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL and etc.

Course Coding:

The following code system (10 alphanumeric characters) is adopted for Post Graduate courses:

21	PXX	N	XX	NN/NNX
Year of Revision	PG Department Code	Semester number.	Part Category	running number/with choice

N:- Numerals X :- Alphabet

Part Category

CC - Core Theory

CP- Core Practical

IS- Internship

SP- Self Paced Learning

CE- Comprehensive Examination

PW- Project Work & viva-voce

Electives Courses

ES – Department Specific Electives

EG- Generic Electives

EC - Additional core Courses for Extra Credits (If any)*

Ability Enhancement Courses

AE – Ability Enhancement Course

SE – Skill Enhancement Course – Soft skills

CW - SHEPHERD & Gender Studies (Outreach)

CIA AND SEMESTER EXAMINATION

Continuous Internal Assessment (CIA):

Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	100

MID-SEM & END-SEM TEST

Centralised – Conducted by the office of COE

1. Mid-Sem Test & End-Sem Test: (2 Hours each); will have Objective and Descriptive elements; with the existing question pattern PART-A; PART-B; PART-C and PART D.
2. One of the CIA Component II/III for UG & PG will be of 15 marks and compulsorily a online objective multiple choice question type.
3. The online CIA Component must be conducted by the Department / faculty concerned at a suitable computer centre.
4. The one marks of PART-A of Mid-Sem and End-Sem Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.

Duration of Examination must be rational; proportional to teaching hours 90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

WEIGHTAGE of K – LEVELS IN QUESTION PAPER

(Cognitive Level)	Lower Order Thinking			Higher Order Thinking			Total
K- LEVELS	K1	K2	K3	K4	K5	K6	%
SEMESTER EXAMINATIONS	15	20	35	30			**100**
MID / END Semester TESTS	12	20	35	33			**100**

QUESTION PATTERN FOR SEMESTER EXAMINATION	
SECTION	**MARKS**
SECTION–A (No choice ,One Mark) **THREE** questions from each unit **(**15x1 =15)	**15**
SECTION-B (No choice ,2-Marks) **TWO** questions from each unit (10x2 =20)	**20**
SECTION-C (Either/or type) (7- Marks) **ONE** question from each unit (5x7 =35)	**35**
SECTION-D (3 out of 5) (10 Marks) **ONE** question from each unit (3x10 =30)	**30**
Total	**100**

BLUE PRINT OF QUESTION PAPER FOR SEMESTER EXAMINATION							
DURATION: 3. 00 Hours.							**Max Mark : 100**
K- LEVELS / **SECTIONS**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION–A (One Mark, No choice) (15x1 =15)	15						**15**
SECTION-B (2-Marks, No choice) (10x2=20)		10					**20**
SECTION-C (7- Marks) (Either/or type) (5x7=35)			5				**35**
SECTION-D (10 Marks) (3 out of 5) (3x10=30) Courses having only **K4** levels				3			**30**
Courses having **K4** and **K5** levels **One K5 level question is compulsory**				2	1		
(Courses having **all the 6** cognitive levels **One K5 and K6 level questions can be compulsory**				1	1	1	
Total	**15**	**20**	**35**	**30**			**100**

QUESTION PATTERN FOR MID/END TEST		
SECTION		**MARKS**
SECTION–A (No choice, One Mark)	(7x1 =7)	**7**
SECTION-B (No choice , 2-Marks)	(6x2 =12)	**12**
SECTION-C (Either/or type) (7- Marks)	(3x7 =21)	**21**
SECTION-D (2 out of 3) (10 Marks)	(2x10=20)	**20**
	Total	**60**

BLUE PRINT OF QUESTION PAPER FOR MID/END TEST							
DURATION: 2. 00 Hours.							**Max Mark: 60.**
K- LEVELS / **SECTIONS**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION –A (One Mark, No choice) (7 x 1 = 7)	7						**07**
SECTION-B (2-Marks, No choice) (6 x 2 = 12)		6					**12**
SECTION-C (Either/or type) (7-Marks) (3 x 7 =21)			3				**21**
SECTION-D (2 out of 3) (10 Marks) (2x10=20) Courses having only **K4** levels				2			**20**
Courses having **K4** and **K5** levels **One K5 level question is compulsory**				1	1		
Courses having **all the 6** cognitive levels **One K6 level question is compulsory**					1	1	
Total Marks	**07**	**12**	**21**	**20**			**60**
Weightage for 100 %	**12**	**20**	**35**	**33**			**100**

Assessment pattern for two credit courses.

S. No.	Course Title	CIA	Semester Examination	Total Marks
1	Self Paced Learning Course	25 + 25 = 50	50 Marks MCQ (COE)	100
2	Comprehensive Examinations	25 +25 = 50	50 Marks (MCQ) (COE)	100
3	Internship	100	--	100
4	Field Visit	100	--	100
5	Ability Enhancement Course (AEC) for PG (3 credits)	50 (Three Components)	50 (COE) Specific Question Pattern	100
Assessment Pattern for Courses in Part - IV				
6	Value Education Courses and Environmental Studies	50	50 Marks (For 2.00 hours) (COE)	100
7	Skill Enhancement Courses(SECs)	50 marks (by Course in-charge) 50 Marks (by an External member from the Department)		100
8	SEC: SOFT SKILLS (For UG and PG)	100	(Fully Internal)	100

EVALUATION

GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) respectively. These two are calculated by the following formulae:

$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$	$WAM\,(Weighted\,Average\,Marks) = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$
Where, C_i is the Credit earned for the Course i G_i is the Grade Point obtained by the student for the Course i M_i is the marks obtained for the course i and n is the number of Courses **Passed** in that semester.	

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

CLASSIFICATION OF FINAL RESULTS:

i) The classification of final results shall be based on the CGPA, as indicated in Table-2.

ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99 and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii) A Pass in SHEPHERD will continue to be mandatory although the marks will not count for the calculation of the CGPA.

iv) Absence from an examination shall not be taken an attempt.

Table-1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	**10**	**O**
80 and above and below 90	**9**	A+
70 and above and below 80	**8**	**A**
60 and above and below 70	**7**	**B+**
50 and above and below 60	**6**	**B**
Below 50	**0**	**RA**

Table-2: Final Result

CGPA	Corresponding Grade	Classification of Final Result
9.00 and above	**O**	**Outstanding**
8.00 to 8.99	A+	Excellent
7.00 to 7.99	**A**	**Very Good**
6.00 to 6.99	**B+**	**Good**
5.0 0 to 5.99	**B**	**Above Average**
Below 5.00	**RA**	**Re-appearance**

Credit based weighted Mark System is adopted for the individual semesters and cumulative semesters in the column 'Marks secured' (for 100)

Declaration of Result

Mr./ MS. _____ has successfully completed the Post Graduate in _____ programme. The candidate's Cumulative Grade Point Average (CGPA) is _____ and the class secured is _____ by completing the minimum of 110 credits.

The candidate has also acquired _____ (if any) extra by attending MOOC courses.

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

The Programme Outcomes(POs)/Programme Specific Outcomes(PSOs) are the qualities that must be imbibed in the graduates by the time of completion of their programme. At the end of each programme the PO/PSO assessment in done from the CO attainment of all curriculum components. The POs/PSOs are framed based on the guidelines of LOCF. There are five POs UG programme and five POs for PG programme framed by the college. PSOs are framed by the departments and they are five in numbers.

For each Course, there are five Course Outcomes to be achieved at the end of the course. These Course outcomes are framed to achieve the POs/PSOs. All course outcomes shall have linkage to POs/PSOs in such a way that the strongest relation has the weight 3 and the weakest is 1. This relation is defined by using the following table.

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

Mean Scores of COs = $\frac{\text{Sum of values}}{\text{Total No.of POs \& PSOs}}$		**Mean Overall Score =** $\frac{\text{Sum of Mean Scores}}{\text{Total No.of COs}}$	
Result	**Mean Overall Score**	**< 1.2**	**# Low**
		≥ 1.2 and < 2.2	**# Medium**
		≥ 2.2	**# High**

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

The Programme Outcomes (POs)/Programme Specific Outcomes(PSOs) are the qualities that must be imbibed in the graduates by the time of completion of their programme. At the end of each programme the PO/PSO assessment in done from the CO attainment of all curriculum components. The POs/PSOs are framed based on the guidelines of LOCF. There are five POs UG programme and five POs for PG programme framed by the college. PSOs are framed by the departments and they are five in numbers.

For each Course, there are five Course Outcomes to be achieved at the end of the course. These Course outcomes are framed to achieve the POs/PSOs. All course outcomes shall have linkage to POs/PSOs in such a way that the strongest relation has the weight 3 and the weakest is 1. This relation is defined by using the following table.

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Result	**Mean Overall Score**	**< 1.2**	**# Low**
		≥ 1.2 and < 2.2	**# Medium**
		≥ 2.2	**# High**

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

Vision

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

Mission

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value-driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

Programme Educational Objectives (PEOs)

- Graduates will be able to accomplish professional standards in the global environment.
- Graduates will be able to uphold integrity and human values.
- Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

Programme Outcomes (POs)

1. Graduates will be able to apply assimilated knowledge to evolve tangible solution to emerging problems.
2. Graduates will be able to analyze and interpret data to create and design new knowledge.
3. Graduates will be able to engage in innovative and socially relevant research and effectively communicate the findings.
4. Graduates will become ethically committed professional and entrepreneurs upholding human values.
5. Graduates imbibed with ethical values and social concern will be able to understand and appreciate cultural diversity, social harmony and ensure sustainable environment.

Programme Specific Objectives (PSOs)

1. Graduates will be able to apply assimilated knowledge to evolve chemical alternatives to emerging environmental requisites.
2. Graduates will be able to analyze, interpret and create data for emerging scientific needs.
3. Graduates will be able to engage in innovative and socially relevant research with ethical concern.
4. Graduates will be able to lead, appreciate and exhibit compatibility with humane values for social harmony.
5. Graduates will be able to effectively communicate and apply modern tool knowledge to evolve financial rewarding projects.

M. Sc. CHEMISTRY					
PROGRAMME STRUCTURE					
Sem	**Specification**	**No. of Courses**	**No. of Hours**	**Credits**	**Total Credits**
I-IV	Core Courses : Theory	10	54	51	51
I-IV	Core Courses : Practicals	6	24	18	18
II	Self-paced learning	1	-	2	2
IV	Comprehensive Examination	1	-	2	2
IV	Project work & Viva Voce	1	6	5	5
I- IV	Discipline Specific Elective	4	20	16	16
I	Ability Enhancement Course	1	4	3	3
II	Skill Enhancement Course (Soft Skills)	1	4	3	3
III	Generic Elective IDC (WS)	1	4	3	3
IV	Generic Elective IDC (BS)	1	4	3	3
II-IV	Online courses (MOOC)	3	-	(6)	(6)
I-IV	Outreach Programme	1	-	4	4
I-IV	**Total**	**31**	**120**	**110(6)**	**110(6)**

M. Sc. CHEMISTRY							
PROGRAMME PATTERN							
Course Details					**Scheme of Exams**		
Sem	**Code**	**Course Title**	**Hrs**	**Cr**	**CIA**	**SE**	**Final**
I	21PCH1CC01	Inorganic Chemistry-I	6	6	100	100	100
	21PCH1CC02	Physical Chemistry-I	7	6	100	100	100
	21PCH1CP01	Inorganic Chemistry Practical-I	4	3	100	100	100
	21PCH1CP02	Physical Chemistry Practical-I	4	3	100	100	100
	21PCH1ES01A	**DSE-1:** Organic Chemistry I	5	4	100	100	100
	21PCH1ES01B	**DSE-1:** Stereochemistry					
	21PCH1AE01	**AEC :** Analytical Techniques	4	3	50	50	50
		Total	**30**	**25**			
II	21PCH2CC03	Inorganic Chemistry-II	4	4	100	100	100
	21PCH2CC04	Organic Chemistry-II	5	4	100	100	100
	21PCH2CP03	Inorganic Chemistry Practical-II	4	3	100	100	100
	21PCH2CP04	Physical Chemistry Practical-II	4	3	100	100	100
	21PCH2SP01	**Self-Paced Learning :** Selected Topics in Organic Chemistry	-	2	50	50	50
	21SPS2ES02A	**DSE-2:** Spectroscopy and Group Theory	5	4	100	100	100
	21PSS2SE01	**SEC:** Soft skills	4	3	100	-	100
	21PCH2EG01	**GE-1(WS):** Industrial Products	4	3	100	100	100
		Extra Credit Courses (MOOC)-1	-	(2)			
		Total	**30**	**26(2)**			
III	21PCH3CC05	Inorganic Chemistry- III	5	4	100	100	100
	21PCH3CC06	Organic Chemistry-III	6	6	100	100	100
	21PCH3CC07	Physical Chemistry - II	6	6	100	100	100
	21PCH3CP05	Organic Chemistry Practical- I	4	3	100	100	100
	21PCH3ES03A	**DSE-3:** Bioorganic Chemistry	5	4	100	100	100
	21PCH3ES03B	**DSE-3:** Pharmaceutical Chemistry					
	21PCH3EG02	**GE-2 (BS):** Health Science	4	3	100	100	100
		Extra Credit Courses (MOOC)-2		(2)			
		Total	**30**	**26 (2)**			
IV	21PCH4CC08	Inorganic Chemistry-IV	6	6	100	100	100
	21PCH4CC09	Organic Chemistry-IV	5	5	100	100	100
	21PCH4CC10	Physical Chemistry - III	4	4	100	100	100
	21PCH4CP06	Organic Chemistry Practical- II	4	3	100	100	100
	21PCH4ES04A	**DSE-4:** Selected Topics In Inorganic and Physical Chemistry- I	5	4	100	100	100
	21PCH4ES04B	**DSE- 4:** Selected Topics In Chemistry					
	21PCH4PW01	Project work and Viva-Voce	6	5	100	100	100
	21PCH4CE01	Comprehensive Examination	-	2	50	50	50
		Extra Credit Courses (MOOC)-3	-	(2)			
		Total	**30**	**29 (2)**			
I-IV	21PCW4OR01	Outreach Programme (SHEPHERD)		4			
		Total (Four Semesters)	**120**	**110 (6)**			

*The courses with a scheme of Exam 50 in CIA and SE will be converted to 100 for grading.

GENERIC ELECTIVE -1: 2nd Semester Within school (WS)- Offered to students belong to other Departments in the School							
Course Details					Scheme of Exams		
School	Course Code	Course Title	Hrs	Cr	CIA	SE	Final
SBS	21PBI2EG01	Herbal Technology	4	3	100	100	100
	21PBT2EG01	Medical Biotechnology	4	3	100	100	100
	21PBO2EG01	Medicinal Botany	4	3	100	100	100
SCS	21PCA2EG01	Applied Statistics using R	4	3	100	100	100
	21PMA2EG01	Mathematical Foundations	4	3	100	100	100
	21PCS2EG01	Mobile Adhoc Networks (MANET)	4	3	100	100	100
SLAC	21PEN2EG01A	Indian Literature in Translation	4	3	100	100	100
	21PEN2EG01B	English Literature For Competitive Examinations					
SMS	21PCO2EG01	Supply Chain Management	4	3	100	100	100
	21PEC2EG01	Labour Economics	4	3	100	100	100
	21PHR2EG01	Organizational Behaviour	4	3	100	100	100
	21PCC2EG01	Stress Management	4	3	100	100	100
SPS	21PCH2EG01	Industrial Products	4	3	100	100	100
	21PPH2EG01A	Solar Energy and Utilization	4	3	100	100	100
	21PPH2EG01B	Renewable Energy Resources	4	3	100	100	100

GENERIC ELECTIVE -2: 3rd Semester Between schools (BS)- Offered to students in the Departments belong to other Schools (Except the school offering the course)							
Course Details					Scheme of Exams		
School	Course Code	Course Title	Hrs	Cr	CIA	SE	Final
SBS	21PBI3EG02	First Aid Management	4	3	100	100	100
	21PBT3EG02	Food Technology	4	3	100	100	100
	21PBO3EG02	Horticulture and Landscaping	4	3	100	100	100
SCS	21PCA3EG02	Web Design	4	3	100	100	100
	21PMA3EG02	Operations Research	4	3	100	100	100
	21PCS3EG02	Advances in Computer Science	4	3	100	100	100
	21PDS3EG02	Deep Learning	4	3	100	100	100
SLAC	21PEN3EG02	English for Effective Communication	4	3	100	100	100
SMS	21PCO3EG02	Basics of Taxation	4	3	100	100	100
	21PEC3EG02	Managerial Economics	4	3	100	100	100
	21PHR3EG02	Counselling and Guidance	4	3	100	100	100
	21PCC3EG02	Dynamics of Human Behaviour in Business	4	3	100	100	100
SPS	21PCH3EG02	Health Science	4	3	100	100	100
	21PPH3EG02A	Physics for Competitive Exam	4	3	100	100	100
	21PPH3EG02B	Nano Science	4	3	100	100	100

Semester	Course code	Title of the Course	Hours	Credits
I	21PCH1CC01	CORE-1: INORGANIC CHEMISTRY - I	6	6

CO. No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	identify the catalytic and magnetic properties of transition elements.	K1
CO-2	understand the structures of selected complexes.	K2
CO-3	apply the fundamental aspects of nuclear chemistry.	K3
CO-4	compare and contrast the properties of lanthanides and actinides.	K4
CO-5	interpret and elaborate various structure-property relations of transition metal complexes.	K5 & K6

Unit-I Transition Elements (18 Hours)

Transition elements - general characteristics - atomic, ionic radii - variation along the period and group - variable valency, colour, magnetic properties, non-stoichiometry, catalytic property, formation of alloys, complexing tendency - stabilization of unusual oxidation states.

Unit-II Inner Transition Elements (18 Hours)

Inner transition elements - position in the periodic table - electronic configuration, oxidation states, solubility, colour and spectra, magnetic properties - separation of lanthanides - lanthanide contraction: causes and consequences - gadolinium break, shift reagents - extraction of thorium and uranium- comparison of actinides and lanthanides.

Unit-III Selected Compounds of *d*-block and basics of Nuclear Chemistry (18 Hours)

Selected compounds of *d*-block elements: (Structure only)**:** chromium (II) acetate, manganese (III) acetate, manganese (III) oxalate, $[Re_2Cl_8]^{2-}$, $[Nb_6Cl_{12}]^{2+}$, $[Mo_6Br_8]^{4+}$, Prussian blue, Turnbull's blue, $[Ni(DMG)_2]$, [Zn(EDTA)].

Fundamentals of Nuclear Chemistry: Subatomic particles and their properties - nuclear binding energy - nuclear structure - liquid drop model and nuclear shell model - n/p ratio - nuclear forces - modes of radioactive decay - alpha, beta and gamma decay - orbital electron capture - nuclear isomerism - internal conversion.

Unit -IV Instrumental Techniques in Nuclear Chemistry (18 Hours)

Q-value of nuclear reaction, coloumbic barrier, nuclear cross section, threshold energy and excitation function - different types of nuclear reactions: fragmentation, nuclear fission, nuclear fusion and spallation - proportional counter, Geiger-Muller counter, scintillation counter and Cherankov counter-linear accelerators - cyclotron, synchrotron.

Unit - V Applications of Fission, Fusion and Trace Elements (18 Hours)

Characteristics of fission reactions - product distribution, theories of fission - fissile and fertile isotopes - nuclear fusion and stellar energy- nuclear wastes - nuclear reprocessing - radiation hazards and prevention - applications of isotopes - neutron activation analysis -

isotopic dilution analysis - uses of tracers in structural and mechanistic studies, agriculture, medicine and industry - radio carbon dating - hot atom chemistry - atomic power projects in India.

Books for Study

1. Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity*, 4th Edition, Harper Collins College Publishers, New York, 1993.
   Unit I and II *Chapter 14*
2. Lee J D, *Concise Inorganic Chemistry*, 5th Edition, ELBS, London, 1998.
   Unit I *Chapter 18* **Unit II** *Chapter 29 and 30*
3. Glasstone S, *Source Book on Atomic Energy*, Affiliated East West Press Pvt. Ltd. New Delhi, 1967.
   Unit III *Chapter 1 and 5* **Unit IV** *Chapter 6* **Unit V** *Chapter 13-18*

Books for Reference

1. Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3rd Edition, Inter Science Publishers, New York, 1972.
2. Shriver D, Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry*, 6th Edition, W H Freeman and Company, New York, 2014.
3. Housecroft C E and Sharpe A G, *Inorganic Chemistry*, 4th Edition, Pearson Education Limited, Essex, 2012.
4. Friedlander G, Macias E S, Kennedy J W and Miller J M, *Nuclear and Radiochemistry*, 3rd Edition, John Wiley and Sons Inc., London, 1981.
5. Arniker H J, *Essentials of Nuclear Chemistry*, New Age International Publishers, New Delhi, 2005.

Web Resources

Radioactivity | Nuclear Fission | Nuclear Reactions | Reactor System | Periodic Table Properties

Semester	Course code	Title of the Course	Hours	Credits
I	21PCH1CC01	CORE-1: INORGANIC CHEMISTRY - I	6	6

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	2	2	2	3	2	2	2	2	2.2
CO-2	3	2	2	2	2	3	2	2	2	2	2.2
CO-3	3	3	2	2	2	2	3	2	2	2	2.3
CO-4	3	2	2	2	2	2	3	2	2	2	2.2
CO-5	3	2	2	2	2	3	3	2	2	2	2.3
Mean overall Score											2.24 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCH1CC02	CORE-2: PHYSICAL CHEMISTRY-I	7	6

CO. No.	CO-Statements	Cognitive Levels (K level)
	On successful completion of this course, students will be able to	
CO-1	describe the concepts of classical mechanics.	K1
CO-2	understand the fundamentals of statistical thermodynamics.	K2
CO-3	apply mathematical relations in quantum chemistry.	K3
CO-4	correlate the Schrodinger equation with simple systems.	K4
CO-5	interpret and validate the concepts of statistical thermodynamics in various thermodynamic functions.	K5 & K6

Unit-I Classical Mechanics (21 Hours)

Conservation principles- conservation of linear momentum, angular momentum and energy- equations of motion - Newtonian, Lagrangian and Hamiltonian- failure of classical mechanics - black body radiation- photoelectric effect - heat capacity of substances- hydrogen atomic spectrum- wave particle dualism- de-Broglie equation- Compton effect - uncertainty principle and its applications - conversion of classical wave equation into Schrodinger wave equation.

Unit-II Mathematics for Quantum Chemistry (21 Hours)

Functions - definition- classification- linearly dependent and independent functions- odd and even functions- inner product- normalization- orthogonality- orthonormal functions- Kronecker delta -proper function - Eigen functions - need for normalization- review of vectors and vector spaces- operators - linear and non-linear operators- commutation relationship- Construction of operators-linear momentum- angular momentum and energy operators- commutation relation among angular momentum operators- Hermitian operators and their properties- anti Hermitian - postulates of quantum mechanics.

Unit-III Basic Quantum Chemistry (21 Hours)

Solution of the Schrodinger equation for exactly solvable problems - particle in 1D and 3D boxes - harmonic oscillator and rigid rotor- tunneling - one dimensional potential barrier and wells - solution of Schrodinger equation for hydrogen atom - radial and angular probability distributions - atomic orbital and electron spin - Pauli's exclusion principle.

Unit-IV Fundamentals of Statistical Thermodynamics (21 Hours)

Statistical method - microstates- macro states - permutations and combinations - combinatory rule - probability theorems - ensembles - phase space - thermodynamic probability - statistical equilibrium - Maxwell Boltzmann statistics - derivation of M.B. statistics - relationship between entropy and probability - heat capacity of solids - Einstein and Debye models - statistical meaning of third law of thermodynamics.

Unit-V Applications of Statistical Thermodynamics (21 Hours)

Partition functions - molar- translational- rotational and vibrational partition functions of diatomic and polyatomic molecules - separation of partition function according to forms of energy-partition function and vibrational energy - total partition function - electronic partition function-derivation of thermodynamic quantities E, S, A, H, G, K and C_p, C_v using partition function-Sackur-Tetrode equation - Bose - Einstein statistics - Fermi - Dirac statistics -

electronic heat capacity of gases - equipartition of energy - classical and quantum statistical theory of heat capacities - heat capacities for diatomic molecule - rotational heat capacity of hydrogen molecule - nuclear spin statistics - nuclear spin entropy- quantum statistics.

Books for Study

1. Prasad R K, *Quantum Chemistry*, 5th Edition, Wiley Eastern Ltd, New Delhi, 1992. **Unit I, II and III** *Chapters 1- 7*
2. Anderson J M, *Mathematics of Quantum Chemistry*, 1st Edition, W.A. Benjamine Inc., Massachusetts, 2005. **Unit II** *Chapter 1 and 2*
3. McQuarrie D A, *Quantum Chemistry*, 1st Indian Edition, Viva Books Private Ltd., New Delhi,2007. **Unit I, II and III** *Chapter: 1-6*
4. Kuriakose J C and Rajaram J C, *Thermodynamics*, Shoban Lal Co., Jalandar, 1996. **Unit IV and V** *Chapter 7 and 8*

Books for Reference

1. Levine I N, *Quantum Chemistry*, 6th Edition, Prentice Hall of India, Pvt. Ltd., 2009.
2. Atkins P and Ronald Friedman, *Molecular Quantum Mechanics*, 5th Edition, Oxford University Press, New York, 2011.
3. Gupta M C, *Statistical Thermodynamics*, 2nd Edition, New Age International Publishers, Chennai, 1998.
4. McQuarrie D A, *Statistical Thermodynamics*, Indian Edition, Viva Books Private Ltd., New Delhi, 2003.

Web Resources

Wave Duality | Postulates-Part-I | Particle in a Box | Statistical Thermodynamics | Microstates

Semester	Course code	Title of the Course	Hours	Credits
I	21PCH1CC02	CORE-2: PHYSICAL CHEMISTRY-I	7	6

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	1	3	3	2	2	1	2.2
CO-2	2	2	2	3	1	2	2	2	3	1	2.0
CO-3	3	2	2	2	2	3	2	2	2	2	2.2
CO-4	2	3	2	2	2	2	3	2	2	2	2.2
CO-5	3	3	3	2	2	3	3	3	2	2	2.6
Mean overall Score											2.24 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCH1CP01	Core Practical-1: INORGANIC CHEMISTRY PRACTICAL-I	4	3

CO No.	CO-Statement	Cognitive Level (K-Level)
	On completion of the course, the postgraduates will be able to	
CO-1	understand the basics of semimicro inorganic analysis.	K1
CO-2	explain the classification of metal cations into different groups.	K2
CO-3	examine a given inorganic mixture and find out the different groups of cations in it.	K3
CO-4	investigate the presence of trace metal ions using colorimetry.	K4
CO-5	assess and improve the water quality by eliminating the environmental pollutants.	K5 & K6

Unit-I Introduction to Inorganic Semimicro Analysis (5 Hours)

Introduction to the semi-micro method - apparatus and procedures - reaction vessels - reagent bottles - the dropper pipette - stirrers - spatula - generators for hydrogen sulphide - heating devices- centrifuge - evaporation - testing for gaseous products

Unit-II Classification of Cations into Groups (5 Hours)

Classification of cations into groups - analysis of group I - separation of copper and tin groups - analysis of groups IIA and IIB - analysis of group III - analysis of group IV - analysis of group V - analysis of group VI

Unit-III Systematic Semi-micro Analysis of Inorganic Mixtures Containing Two Common and Two Less Common (rare) Cations (30 Hours)

Systematic semi-micro analysis of any five inorganic mixtures.

Unit-IV Introduction to Colorimetric Analysis (5 Hours)

Basic principles of colorimetry - Lambert's law - Beer's law -Beer-Lambert law - applications of Beer's law - deviations from Beer's law - classification of methods of color measurement - the standard series method - photoelectric photometric method - spectrophotometric method.

Unit-V Experimental Colorimetric Determinations (15 Hours)

Some general remarks on colorimetric determinations - general procedure for colorimetric determinations - colorimetric estimation of iron as its thiocyanate complex - colorimetric estimation of copper by its reaction with ferrocyanide - colorimetric estimation of nickel as its dimethyl glyoxime complex.

Books for Study

1. *Inorganic Laboratory Manual*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirappalli-2. **Unit III** and **Unit-V**
2. Ramanujam V V, *Inorganic Semi Micro Qualitative Analysis*, 3rd Edition, National Publishing Company, Chennai, 1990.
   Unit-I *Chapter 1 and 2* **Unit-II** *Chapter 3 and 4*
3. Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5thEdition, Longman Scientific & Technical, Essex, England, 1989.
   Unit-IV *Chapter 17* **Unit-V** *Chapter 17*

Books for Reference

1. Svehla G, *Vogel's Qualtitative Inorganic Analysis*, 7th Edition, Longmann, London, 1996.
2. Metz C and Castellion M E, *Chemistry: Inorganic Qualitative Analysis in the Laboratory*, Academic Press, New York, 1980.
3. Skoog D A, West D M, Holler F J, and Crouch S R, *Fundamentals of Analytical Chemistry*, 9th Edition, Brooks/Cole Cengage Learning, Belmont, USA, 2014.

Web Resources

Colorimeter Gravimetry-Virtual Lab

Semester	**Course code**			**Title of the Course**				**Hours**		**Credits**
I	**21PCH1CP01**			**INORGANIC CHEMISTRY PRACTICAL-I**				**4**		**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO-1	2	2	3	2	2	2	2	3	2	2	**2.2**
CO-2	1	3	2	2	3	2	3	2	2	3	**2.3**
CO-3	3	2	3	2	1	3	2	3	2	1	**2.4**
CO-4	2	1	2	2	2	2	1	2	2	2	**2.0**
CO-5	2	2	2	2	1	2	2	2	2	1	**1.8**
Mean overall Score											**2.14 (Medium)**

SCHEME OF VALUATION

INTERNAL

CIA	**100 Marks**
Cumulative mark of regular practical classes	40 Marks
Record	10 Marks
Two CIA tests	50 Marks

For Each CIA Test ***100 marks***

Test	10 Marks
Results	90 Marks (60 Marks for Analysis & 30 Marks for colorimetry)

Scheme of valuation

Inorganic Analysis

15 marks for each radical

Only 10 marks for group identification

Colorimetry

<5% Error	30 Marks
10%	20 Marks
>10%	10 Marks

EXTERNAL

Total	**100 Marks**
Viva voce	10 Marks
Results	90 Marks (60 Marks for Analysis & 30 Marks for colorimetry)

Scheme of valuation

Inorganic Analysis

15 marks for each radical

Only 10 marks for group identification

Colorimetry

<5% Error	30 Marks
10%	20 Marks
>10%	10 Marks

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCH1CP02	Core Practical-2: PHYSICAL CHEMISTRY PRACTICAL- I	4	3

CO. No.	CO-Statement	Cognitive Level (K-Level)
	On successful completion of this course, students will be able to	
CO-1	learn concepts of kinetics of chemical reaction and adsorption isotherm.	K1
CO-2	understand the effect of ionic strength on the rate constant.	K2
CO-3	analyze the phase transformations.	K3
CO-4	experiment the concepts of surface catalysis and adsorption.	K4
CO-5	justify the concepts of phase rule in different component systems.	K5

Unit – I Principle Behind Experiments (8 Hours)

Kinetics of reaction between iodide and persulphate- iodination of acetone- hydrolysis of ester- phase diagram (simple and compound forming systems)- adsorption isotherm- heat of solution- polarimetry.

Unit -II Preparation of Solutions (4 Hours)

Preparation and standardization of HCl, NaOH, iodine, potassium persulphate, oxalic acid, sucrose.

Unit -III Cycle I (16 Hours)

Neutral salt effect - kinetics of reaction between iodide and persulphate - effect of ionic strength on rate constant.

1. Kinetics of iodination of acetone.
2. Kinetics of hydrolysis of ester - comparison of acid strengths.

Unit – IV Cycle II (16 Hours)

1. Phase diagram of naphthalene - *m*-dinitrobenzene system. (Simple eutectic system).
2. Freundlich's adsorption isotherm - adsorption of acetic acid by charcoal.
3. Phase diagram of two-component system forming a compound.

Unit -V Cycle II (16 Hours)

1. Determination of Arrhenius parameters - Hydrolysis of methyl acetate by acid
2. Heat of solution of oxalic acid by solubility.
3. Polarimetry - Inversion of Cane sugar.

Books for Study

1. *Lab Manual*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirappalli.
2. Venkateswaran V, Veeraswamy R and Kulandaivelu A R, *Basic Principles of Practical Chemistry*, 2nd Edition, Sultan Chand & sons, New Delhi, 1997.
3. Daniels, Mathews F, Howard J and John Warren W, *Experimental Physical Chemistry*, 7th Edition, Mc Graw Hill, New York, 1970.
4. Findlay A, *Practical Physical Chemistry*, 7th Edition, Longman, London, 1959.

Web Resources

Phase diagram of naphthalene - *m*-dinitrobenzene system.

Freundlich's adsorption isotherm

Semester	Course code	Title of the Course	Hours	Credits
I	21PCH1CP02	PHYSICAL CHEMISTRY PRACTICAL- I	4	3

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	2	2	2	3	2	2	2	2	2.2
CO-2	3	3	2	2	1	3	3	2	2	1	2.2
CO-3	3	3	3	3	2	3	3	3	3	2	2.8
CO-4	3	2	3	2	1	3	3	2	2	2	2.3
CO-5	2	3	3	2	2	2	3	3	2	2	2.4
									Mean overall Score		2.38

SCHEME OF VALUATION
INTERNAL

CIA **100 Marks**

Cumulative mark of Regular Practical Classes	50 Marks
Two CIA tests	50 Marks

For Each CIA Test ***100 marks***

Procedure	10 Marks
Record	10 Marks
Viva	10 Marks
Results	70 Marks
	Table-10marks
	Calculation-10 marks
	Graph - 10 marks
	Results-40 marks

Scheme of valuation

<2% Error	40 Marks
3%	30 Marks
4%	20 Marks
>4%	10 Marks

EXTERNAL

Total **100 Marks**

Procedure	10 Marks
Viva	10 Marks
Results/Analysis	80 Marks
	Table-10marks
	Calculation-10 marks
	Graph - 10 marks
	Results -50 marks

Scheme of valuation

<2% Error	50 Marks
3%	40 Marks
4%	30 Marks
>4%	20 Marks

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCH1ES01A	DSE-1: ORGANIC CHEMISTRY - I	5	4

CO No.	CO-Statements	Cognitive Levels (K - level)
	On successful completion of this course, students will be able to	
CO-1	understand the concepts of stereochemistry and write the configurational nomenclature.	K1
CO-2	examine the mechanisms of nucleophilic substitution reactions and describe nucleophilic substitution on aromatic rings.	K2
CO-3	compose multiple ways for addition-elimination reactions and predict the stereochemistry of elimination mechanisms.	K3
CO-4	assess the concept of aromaticity and classify the reactions on aromatic rings.	K4
CO-5	identify the types of intermediates and their role in identifying organic mechanisms.	K5

Unit -I Stereochemistry (15 Hours)

Configuration: Double bonds - cyclic systems - tetrahedral atoms with multiple stereogenic centres - other types of stereogenic centres - axial chirality - biphenyls, allenes, spiranes - assigning *R/S* - chirality and symmetry concept of atropisomerism - helicity and chirality - Topocity and prostereoisomerism - topocity of ligands and faces - enantiotopic ligands and faces - diastereotopic ligands and faces - configuration at prochiral centers.

Conformation: Mono and disubstituted three-, four-, five- and six- membered ring systems and their optical activity - conformations of decalin - Newmann projection of cyclohexane and decalins - chirality in molecules with non-carbons stereocenters (*N, S* and *P*).

Unit-II Nucleophilic Substitutions (15 Hours)

Mechanisms of nucleophilic substitution: Ionization mechanism: S_N1 and direct displacement mechanism: S_N2 - borderline mechanism - stereochemistry and mechanism - substitution in aryldiazonmium ions - structural and solvation effects on reactivity - nucleophilicity - solvation -leaving group ability - steric and strain effects - effect of conjugation on reactivity - neighbouring group participation (NGP) - substitution at vinylic and allylic carbons and reactivity - ambient nucleophiles and substrates - hydrolysis of esters - mechanisms - phase transfer catalysis (PTC) - crown ethers.

Nucleophilic substitutions on aromatic rings: S_NAr mechanism - S_N1 (Aromatic) mechanism with evidences - Benzyne mechanism - effect of substrate structure, leaving group, attacking nucleophile and solvent.

Unit - III Aromatic Substitution Reactions (15 Hours)

Aromaticity: Huckel's theory of aromaticity: Huckel Molecular Orbital (HMO) energies for conjugated planar ring systems of 3-9 carbon atoms - annulenes - cyclobutadiene - benzene - cyclooctatetraene - [10-18] and larger annulenes - aromaticity in charged rings - cations and anions - homoaroamticity - fused ring systems - polycyclic aromatic compounds - hydrocarbons incorporating exocyclic bonds - heteroaromatic systems.

Electrophilic substitution reactions: Active electrophiles - generalized mechanism - structure -reactivity relationships for substituted benzenes - mechanistic interpretation of the relationship -reactivity of polycyclic and heteroaromatic compounds - nitration - halogenation

- protonation and hydrogen exchange - alkylation and acylation - substitution by diazonium ions - substitution of groups other than hydrogen.

Unit-IV Addition and Elimination Reactions (15 Hours)

Addition reactions: Introduction - addition of HX to alkenes - acid catalyzed hydration and related reactions - addition of halogens - sulfenylation and selenylation - addition reaction involving epoxides - solvomercuration - argentation - hydroboration - reactions of organoboranes - enantioselective hydroboration - addition to alkynes and allenes.

Elimination reactions:E1, E2 and E1CB mechanisms-spectrum of E1, E2 and E1CB mechanisms, regioselectivity - stereochemistry of E2 reactions - dehydration of alcohols - dehalogenation - Chugav reaction - Hofmann exhaustive methylation - elimination and its regioselectivity - Cope elimination - Shappiro reaction - extrusion reactions.

Unit-V Reactive Intermediates (15 Hours)

Carbocations: Structure and stability - direct observation of carbocations - competing reactions - rearrangement of carbocations - non-classical carbocations.

Carbenes: Reactivity - generation - addition and insertion reactions - generation and reactions of ylides by carbenoid decomposition - rearrangement reactions: ring expansion of cycloalkanones - Wolff - aldehyde to alkyne elongation *via* carbine and carbenoid.

Nitrenes: Generation - rearrangements to electron deficient nitrogen.

Free radicals: Sources of radicals - addition reactions of radicals with substituted alkenes - cyclization - addition to C=N bonds - Tandem radical cyclizations and alkylations - fragmentation and rearrangements - intramolecular functionalization by radical reactions.

Books for Study

1. Carey F A, Sundberg R J, *Advanced Organic Chemistry, **Part A**: Structure and mechanism*s, 5th Edition, Springer (India) Pvt. Ltd. New Delhi, 2007.
   Unit I *Chapter 2* **Unit II** *Chapter 4*
   Unit III *Chapter 8 & 9* **Unit IV** *Chapter 5*
2. Carey F A, Sundberg R J, *Advanced Organic Chemistry, **Part B**: Structure and Mechanisms,* 5th Edition, Springer (India) Pvt. Ltd. New Delhi, 2007.
   Unit III *Chapter 11* **Unit IV** *Chapter 4* **Unit V** *Chapter 10*

Books for Reference

1. Eliel E L, *Stereochemistry of Carbon Compounds*, Tata-McGraw Hill Publishing Company, New Delhi, 1998.
2. Nasipuri D, *Stereochemistry of Carbon Compounds*, 2nd Edition, New-Age International Publishers, New Delhi, 1996.
3. Bruckner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010.
4. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, 2nd Edition, Oxford University Press, New York, 2012.
5. Gould E S, *Mechanism and Structure in Organic Chemistry*, Holt-Reinhart and Winston, New York, 1959.
6. Smith M B, and March J, *March's Advanced Organic Chemistry*, 6th Edition, John-Wiley and Sons, New York, 2007.

Web Resources

Stereochemistry

Substitution Reaction

Carbocations

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCH1ES01A	DSE -I: ORGANIC CHEMISTRY - I	5	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	2	3	2	3	3	2	2	3	2	2.4
CO-2	3	2	2	3	2	2	2	2	3	2	2.3
CO-3	2	2	2	3	1	3	1	2	2	3	2.1
CO-4	3	2	2	3	2	2	3	2	2	3	2.4
CO-5	3	2	2	2	2	1	2	3	3	2	2.2
	Mean Overall Score										2.28 (High)

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCH1ES01B	DSE-1: STEREOCHEMISTRY	5	4

CO No.	CO-Statement	Cognitive Level (K - level)
	On successful completion of this course, students will be able to	
CO-1	find the configuration of organic molecules.	K1
CO-2	infer the conformational analysis of cyclic and acyclic systems.	K2
CO-3	apply chiral auxiliaries in asymmetric synthesis and design diastereoselectivity in selective organic reactions.	K3
CO-4	assess the importance of protecting groups and categorize Chemo-, regio-, and stereoselectivity in selective organic synthesis.	K4 & K5
CO-5	design asymmetric synthesis using chiral auxiliaries	K6

Unit - I Configuration (15 Hours)

Configuration: Double bonds - cyclic systems - tetrahedral atoms - with multiple stereogenic centres - other types of stereogenic centres - axial chirality - biphenyls, allenes, spiranes - assigning *R/S* - chirality and symmetry concept of atropisomerism - helicity and chirality - topocity and prostereoisomerism - topocity of ligands and faces - enantiotopic ligands and faces - diastereotopic ligands and faces - configuration at prochiral centers.

Unit – II Resolution (15 Hours)

Absolute configuration - enantiomers - diastereomers - polarimeter - resolution - methods - chiral shift reagents and chiral solvating agents - separation of enantiomers - enzymatic resolution and disymmetrization - the anomeric effect in cyclic compounds.

Unit – III Conformational Analysis (15 Hours)

Conformational isomerism in ethane and n-butane - projection formula - Fischer, Newmann and Sawhorse - conformational isomerism in cycloalkanes - Baeyer's strain theory- mono and disubstituted three-, four-, five- and six- membered ring systems and their optical activity - conformations of decalin - chirality in molecules with non-carbons stereocenters (N, S and P).

Unit- IV Stereoselectivity (15 Hours)

Chemoselectivity: Chemo-, regio-, and stereoselectivity - reactivity of carbonyl groups towards nucleophiles - selectivity of hydrides in reduction - selectivity in oxidations - Protecting groups - hydroxyl, amino, carbonyl and carboxylic acid protecting groups

Regioselectivity: Regioselectivity in electrophilic and nucleophilic aromatic substitution, regioselectivity in elimination reactions, electrophilic attack on alkenes, regioselectivity in radical reactions, nucleophilic attack on allylic compounds, electrophilic attack on conjugated dienes and conjugate addition.

Unit - V Asymmetric Synthesis (15 Hours)

Chiral auxiliaries: Alkylation of chiral enolates - enantiomeric excess - optical purity - chiral reagents and chiral catalysis - asymmteric hydrogenation - asymmetric epoxidation - asymmteric dihydroxylation

Diastereoselectivity: Prochirality, Cram's rule and chelation effect, diastereoselectivity in aldol reaction, diastereoselective epoxidation

Books for Study

1. Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part A: Structure and mechanisms*, 5th Edition, Springer (India) Pvt Ltd. New Delhi, 2007.
   Unit I *Chapter 2* **Unit II** *Chapter 2*
2. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, 2nd Edition, Oxford University Press, New York, 2012.
   Unit III *Chapter 16* **Unit IV** *Chapter 23* **Unit V** *Chapter 41*
3. Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part B: Structure and Mechanisms*, 5th Edition, Springer (India) Pvt. Ltd, New Delhi, 2007.
   Unit IV *Chapter 3*

Books for Reference

1. Bruckner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010.
2. Gould E S, *Mechanism and Structure in Organic Chemistry*, Holt-Reinhart and Winston, New York, 1959.
3. Eliel E L, *Stereochemistry of Carbon Compounds*, Tata-McGraw Hill Publishing Company, New Delhi, 1998.
4. Nasipuri D, *Stereochemistry of Carbon Compounds*, 2nd Edition, New-Age International Publishers, New Delhi, 1996.

Web Resources

Conformation Analysis

Regioselectivity

Asymmetric Synthesis

Semester	**Course code**			**Title of the Course**					**Hours**	**Credits**
I	**21PCH1ES01B**			**DSE-1: STEREOCHEMISTRY**					**5**	**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO-1	3	2	3	2	2	3	1	2	2	2	2.2
CO-2	2	2	3	3	2	2	3	2	2	2	2.3
CO-3	3	1	2	3	2	1	2	2	3	3	2.2
CO-4	3	3	2	2	2	2	3	2	2	3	2.4
CO-5	3	2	2	3	2	2	1	3	2	2	2.2
Mean overall Score											**2.26 (High)**

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCH1AE01	AEC: ANALYTICAL TECHNIQUES	4	3

CO. No.	CO-Statements On successful completion of this course, students will be able to	Cognitive Levels (K-Level)
CO-1	know the different types of errors that could occur experimentally.	K1
CO-2	compare different spectrophotometric methods.	K2
CO-3	apply thermal methods to characterize minerals and polymers and differentiate the principles and applications of chromatography.	K3
CO-4	predict the presence of functional groups and structural information of molecules using UV-Vis spectra..	K4
CO-5	apply IR spectra to infer the structural features of organic molecules.	K5

Unit-I Spectrophotometric methods (12 Hours)

Spectrophotometric Methods - Colorimetry, Flame Photometry, Fluorimetry, Phosphorimetry, AAS. Colorimetry - fundamental laws - deviations from Beer's law - instrumentation and applications of spectrophotometry. Principle, instrumentation and applications of fluorimetry and phosphorimetry. Flame photometry and atomic absorption spectrophotometry - Theory, instrumentation, interferences and applications.

Unit-II Thermal methods and Chromatography (12 Hours)

Thermal Methods General Characteristics of thermo-analytical methods - Thermogravimetric analysis - Principle, instrumentation and applications - Factors affecting thermogram - Differential Thermal Analysis- DTA instrumentation and applications - Differential scanning calorimetry - Principle, instrumentation and applications

Chromatography: Principles of chromatography - retardation factor - plate theory - column efficiency - Classification of chromatographic techniques - Principle, instrumentation and applications of gas chromatography (GC), thin-layer chromatography (TLC) and high-performance liquid chromatography (HPLC)

Unit-III Optical Activity (12 Hours)

Absolute configuration - optical activity - specific rotation - polarimeter - enantiomeric excess -resolution - methods - chiral shift reagents and chiral solvating agents - separation of enantiomers - enzymatic resolution and desymmetrization - the anomeric effect in cyclic compounds

Unit-IV UV-Visible Spectroscopy (12 Hours)

Nature of electronic transitions - UV band structure - principles of absorption spectroscopy - instrumentation-presentation of spectra - solvents - chromophore -effect of conjugation - Woodward-Fieser rules for dienes, enones, and aromatic compounds - visible spectra - colour in compounds.

ORD and CD: Concept of circularly polarized light-cause of optical activity-atomic and conformational asymmetry-ORD and CD-octant rule, α-haloketone rule and their applications-Cotton effect and ORD curves-applications to determine the absolute configurations of monocyclic ketones and steroids.

Unit-V IR spectroscopy **(12 Hours)**

Absorption process - modes of stretching and bending - bond properties and absorption trends - vibrations -Hooke's law - FT-IR spectrometer - sample preparation - correlation charts and tables - analysis of a spectrum - characteristic absorption bands of: alkanes, alkenes, alkynes - conjugation effects, ring size effects for exo and endo double bonds - aromatic rings - substituted aromatic rings - alcohols and phenols - ethers - carbonyl compounds: factors influencing C=O stretching- conjugation, ring size, substituents, and hydrogen effects - amines - nitriles, isocyanates, and imines-nitro compounds-solving spectral problems.

Books for Study

1. Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5th Edition, Longman Scientific & Technical, Essex, England, 1989.
   Unit I *Chapters 17, 18, 20 and 21*
   Unit II Thermal studies - *Chapters 11 Chromatography - Chapters 8 and 9*
2. Carey F A, Sundberg R J, *Advanced Organic Chemistry, **Part A**: Structure and mechanisms*, 5th Edition, Springer (India) Pvt. Ltd. New Delhi, 2007.
   Unit III *Chapter 2*
3. Pavia D L, Lampman G M, Kriz G S and Vyvyan J R, *Introduction to Spectroscopy*, 5th Edition, Cengage Learning, Delhi, 2015.
   Unit IV & V *Chapter 2-10*

Books for Reference

1. Skoog D A, West D M, Holler F J, and Crouch S R, *Fundamentals of Analytical Chemistry*, 9th Edition, Brooks/Cole Cengage Learning, Belmont, CA 94002-3098, USA, 2014.
2. Silverstein R M and Bassler G C, *Spectrometric Identification of Organic Compounds*, 4th Edition, John- Wiley and Sons, New York, 1993.
3. Kemp W, *Organic Spectroscopy*, 3rd Edition, ELBS, London, 1987.

Web Resources

Analytical Chemistry | MIT-Online Course | Error Analysis

Semester	Course code	Title of the Course	Hours	Credits
I	21PCH1AE01	AEC: ANALYTICAL TECHNIQUES	4	3

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	3	2	2	3	1	2	2	2	2.2
CO-2	3	3	2	2	2	2	3	2	2	3	2.4
CO-3	2	2	3	3	2	2	3	2	2	2	2.3
CO-4	3	2	2	3	2	2	1	3	2	2	2.2
CO-5	3	1	2	3	2	1	2	2	3	3	2.2
Mean overall Score											2.26 (High)

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PCH2CC03**	**CORE-3: INORGANIC CHEMISTRY - II**	**4**	**4**

CO. No.	CO-Statement	Cognitive Level (K -Level)
	On successful completion of this course, students will be able to	
CO-1	understand the concept of ionic bonding.	**K1**
CO-2	summarize the concepts of acids and bases.	**K2**
CO-3	discuss the chemistry of halogens and noble gases.	**K2**
CO-4	apply the VSEPR theory to predict the structures.	**K3**
CO-5	summarize the nature of inorganic chains, rings, cages and clusters.	**K5**

Unit-I Ionic Bonding (12 Hours)

Effective nuclear charge - shielding - Slater's rule - Born - Lande equation - Born Haber cycle and its applications - radius ratio - polarization- Fajan's rule - results of polarization. electronegativity - determination - methods of estimating charges, electronegativity equalization - types of chemical forces - Van der Waals forces - hydrogen bonding - effects of chemical forces - melting and boiling points, solubility and hardness.

Unit-II Covalent Bonding (12 Hours)

Octet rule - valence bond theory - resonance - conditions of resonance - formal charge - hybridization - molecular orbital theory - symmetry and overlap - molecular orbital in homonuclear diatomic molecules: O_2 , B_2 , N_2 and C_2 - MO treatment of hetero nuclear diatomic molecules: CO and HCl - VSEPR theory: methane, ammonia, water, PCl_3F_2 (Bent's rule), SF_4 , BrF_3, TeF_5^-, ICI_2^-, ICI_4^-, XeF_2 , XeF_4 , XeF_6 , XeO_3 , XeO_4 , XeO_2F_2 , $XeOF_4$, phosphorus trihalides, ammonia and NX_3 dipole moments, OF_2 and COF_2 - bond angle - s, p character relationship - energetics of hybridization.

Unit-III Acids and Bases (12 Hours)

Electrode potentials and electromotive forces - applications - acid-base concepts: Bronsted-Lowry, Lux-Flood, Usanovich, Lewis, solvent system and generalized acid base concepts - measures of acid-base strength - steric effect and solvation effects F-strain and B-strain - hard and soft acids and bases - acid base strength - hardness and softness - symbiosis - theoretical basis of hardness and softness, electronegativity and hardness and softness - types of solvents, types of reactions - autoionisation, neutralisation, precipitation, solvation, solvolysis and complex formation. Liq. NH_3, liq. SO_2, HF and H_2SO_4 as solvents - alkali metals in liq. NH_3.

Unit-IV Periodicity and the Chemistry of Halogens and Noble Gases (12 Hours)

Periodicity: The use of p-orbitals in pi-bonding - pπ-pπ bonding in phosphine complexes andπ bonding - comparison of pπ-dπnon-metals - the use of d orbitals by non-metals - experimental evidence of p oxides - experimental evidences for d-orbital contraction and participation Chemistry of halogens and noble gases: Interhalogen compounds - polyhalide ions - oxyacids of heavier halogens -structure and reactivity of noble gas fluorides.

Unit - V Inorganic Chains, Rings, Cages and Clusters (12 Hours)

Silicate minerals - ortho, pyro, and meta silicates - pyroxene, amphiboles - two-dimensional silicates - talc, mica and three dimensional aluminosilicates, feldspar, zeolites, ultramarine - silicones-preparation, properties and uses-polymeric sulphur nitride, phosphonitrilic compounds - trimers and tetramers - homocyclic inorganic ring systems - concept of multi-centered bond - structure of B_2H_6 , B_4H_{10} , $[B_{12}H_{12}]^{2-}$, B_6H_{10}, B_8H_{12}, $B_{10}H_{14}^-$ Wade's rules, *closo-*, *nido-*, *arachno-* boranes and carboranes - The "STYX" code.

Books for Study

1. Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity*, 4th Edition, Pearson Education, India, 2008.
   Unit I *Chapter 4* **Unit II** *Chapter 5* **Unit III** *Chapter 8*
   Unit IV *Chapter 10 & 12* **Unit V** *Chapter 11*

Books for Reference

1. Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3rd Edition, Inter Science Publishers, New York, 1972.
2. Shriver D, Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry*, 6th Edition, W H Freeman and Company, New York, 2014.
3. Housecroft C E and Sharpe A G, *Inorganic Chemistry*, 4th Edition, Pearson Education Limited, Essex, 2012.

Web Resources

Ionic Vs Covalent

Acid and Base

Metal Clusters

Semester	Course code			Title of the Course			Hours			Credits
II	21PCH2CC03			CORE-3: INORGANIC CHEMISTRY - II			4			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	1	3	2	2	2	1	2.1
CO-2	2	2	2	2	1	2	2	2	2	2	2.0
CO-3	2	2	2	2	1	2	2	2	2	2	2.0
CO-4	3	2	2	2	1	3	2	2	2	1	2.0
CO-5	2	3	2	2	2	2	3	2	2	2	2.2
Mean overall Score											2.0 (Medium)

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PCH2CC04**	**CORE-4: ORGANIC CHEMISTRY - II**	**5**	**4**

CO. No.	CO-Statements	Cognitive Levels (K -Level)
	On successful completion of this course, students will be able to	
CO-1	define the techniques of determining the mechanisms of reactions.	**K1**
CO-2	understand the synthetic applications of enolates.	**K2**
CO-3	utilize the synthetic applications carbon nucleophiles in synthesis.	**K3**
CO-4	categorize the reduction reactions and their mechanism.	**K4**
CO-5	determine and design the multiple ways for using oxidation reactions in synthesis.	**K5 & K6**

Unit - I Methods of Determining Reaction Mechanism (15 Hours)

Non-kinetic methods: Product analysis and its importance- intermediates and transition states - trapping, testing and detection of intermediates - cross-over experiments - isotopic labeling -stereochemical studies.

Kinetic methods: isotope effects-primary, secondary and solvent isotope effect-correlation analysis-linear free energy relationships - Hammett equation-significances of σ and ρ-applications of Hammett equation -Taft equation and its applications.

Catalysis: By acids and bases - Bronsted catalysis law - aciditiy functions-*p*H profile rates - Lewis acid catalysis - solvent effects: bulk solvent effects - specific solvent effects - acidity of hydrocarbons: *p*Ka values of weakly acidic hydrocarbons.

Unit - II Oxidations (15 Hours)

Oxidation of alcohols to aldehydes, ketones, and carboxylic acids -transition metal oxidants - addition of oxygen to C=C- transition metal oxidants - epoxides from alkenes and peroxide reagents-subsequent transformations of epoxides - allylic oxidations - transition metal oxidants - reactions of alkenes with singlet oxygen - oxidative cleavage of C=C-transition metal oxidants - oxidation of ketones and aldehydes by oxygen-and periodic compounds - oxidation with other reagents - selective oxidative cleavages at functional groups - cleavage of glycols-oxidative decarboxylations - oxidations at unfunctionalized carbon.

Unit - III Reductions (15 Hours)

C-C multiple bonds: Hydrogenation using heterogeneous and homogeneous catalysts - enantioselective hydrogenation - partial reduction of alkynes - hydrogen transfer from diimide.

Carbonyl groups: Group III hydride donor reagents - comparative reactivity of common hydride donors - stereoselectivity of hydride reduction - enantioselective reduction of carbonyl compounds-reduction of other functional groups - Group IV hydride donors - silicon hydrides - hydride transfer for carbon-reduction reactions involving hydrogen atom donors-dissolving metal reductions-addition of hydrogen - reductive removal of functional groups-reductive coupling of carbonyl compounds - reductive deoxygenation of carbonyl groups to methylene - reduction of carbonyl compounds to alkenes-reductive elimination and fragmentation.

Unit - IV Reactions of Enolates (15 Hours)

Generation of enolates - regioselective and stereoselective enolate formation-solvent effects on enolate structure and reactivity - alkylation of highly stabilized and ketone enolates -

alkylation of aldehydes, esters, acids, amides and nitriles-alkylation of dianions - intramoleular alkylation of enolates - enantioselectivity in alkylation reactions - enamines and imine anions - conjugate addition of enolates - conjugate addition with tandem alkylations - conjugate addition by enaolate equivalents - facial selectivity - addition of organometallic reagents and cyanide ions.

Unit - V Reactions of Carbon Nucleophiles (15 Hours)

Aldol addition and condensation reactions - regio and stereoselectivity in aldol reactions of aldehydes and ketones-aldol addition reactions of enaolates of ester and other carbonyl derivatives - Mukaiyama aldol condensation - facial selectivity - intramolecular aldol condensation - Robinson annulation - Mannich reaction - additions to *N*-acyl iminium ions - amine catalyzed condensation reactions - Claisen and Dieckmann reactions - Wittig reaction - reactions of alpha-trimethylsilylcarbanions with carbonyl compounds - Julia olefination-reactions involving sulfur ylides and related nucleophiles - nucleophilic addition - cyclization of alpha-haloesters.

Books for Study

1. Francis Carey A, Richard J. Sundberg, *Advanced Organic Chemistry, Part B: Structure and Mechanisms*, 5th Edition, Springer (India) Pvt Ltd., New Delhi, India, 2007.
   Unit-II *Chapter 12* **Unit-III** *Chapter 5* **Unit IV** *Chapters 1 & 2*
   Unit V *Chapter 2*
2. Michael Smith B and Jerry March, *March's Advanced Organic Chemistry*, 6th Edition, John-Wiley and Sons, New York, 2007. **Unit-I** Chapter *6*
3. Reinhard Bruckner, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010. **Unit V** *Chapter 5*

Books for References

1. Peter Sykes, *Guide Book to Mechanism in Organic Chemistry*, 6th Edition, ELBS with Longmann, 1997.
2. Jonathan Clayden, Nick Greeves, and Stuart Warren, *Organic Chemistry*, Oxford University Press, New York, 2012.
3. Stanley Pine H, *Organic Chemistry*, 5th Edition, Tata-Mcgraw Hill, New Delhi, 2006.

Web Resources

Reaction Mechanism | Oxidation Reactions | Enolate Reactions | Nucleophilic Addition

Semester	Course code			Title of the Course			Hours			Credits
II	21PCH2CC04			CORE-4: ORGANIC CHEMISTRY - II			5			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	2.2
CO-1	2	3	3	2	2	3	2	2	2	1	2.0
CO-2	2	2	2	2	1	2	2	2	2	2	2.2
CO-3	2	3	2	2	2	2	3	2	2	2	2.0
CO-4	2	2	2	2	1	2	2	2	2	2	2.0
CO-5	3	2	2	2	1	3	2	2	2	1	2.0
Mean overall Score											

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PCH2CP03**	**Core Practical 3: INORGANIC CHEMISTRY PRACTICAL-II**	**4**	**3**

CO No.	CO-Statements	Cognitive Levels (K-Level)
	On completion of the course, the graduates will be able to	
CO-1	discuss the basics of titrimetric analysis.	**K2**
CO-2	discuss the methods of preparation of complexes.	**K2**
CO-3	illustrate various methods of characterization of complexes.	**K3**
CO-4	identify the components of a binary inorganic mixture.	**K4**
CO-5	recommend a suitable thermal method for the quantification of metal cations.	**K5**

Unit-I Basic Principles of Titrimetric Analysis (5 Hours)

Titrimetric analysis - classifications of reactions in titrimetric analysis - Standard solutions - Equivalents, normality and oxidation numbers - Preparation of standard solutions - Primary and secondary standards - redox titrations - complexation titrations.

Unit-II Basic Principles of Gravimetric and Thermo Gravimetric Analyses (5 Hours)

Introduction to gravimetric analysis - precipitation methods - the colloidal state - supersaturation and precipitate formation - the purity of the precipitate: co-precipitation - of the precipitate: thermogravimetric method of analysis.

Unit-III Methods of preparation and characterization of complexes (5 Hours)

Preparatory methods of coordination complexes - characterization methods - conductance measurements - magnetic measurements - potentiometric measurements - polarimetry - UV-Visible spectra

Unit-IV Estimations of Metal Ions in a Binary Mixture (30 Hours)

a) Quantitative analysis of a mixture of iron (volumetry) and copper (gravimetry)
b) Quantitative analysis of a mixture of copper (volumetry) and nickel (gravimetry)
c) Quantitative analysis of a mixture of calcium (volumetry) and magnesium (gravimetry)
d) Quantitative analysis of a mixture of calcium and magnesium (both by volumetry)
e) Quantitative analysis of a mixture of iron (volumetry) and zinc (gravimetry)
f) Quantitative analysis of a mixture of copper (volumetric) and zinc (gravimetry)

Unit-V Preparation and Characterization of Selected Complexes (15 Hours)

a) Preparation and characterization of hexamminecobalt(III) chloride
b) Preparation of tetramminecopper(II) sulphate
c) Preparation of *tris*-(thiourea)copper(I) chloride
d) Preparation of potassium *tris*-(oxalato)chromate(III) trihydrate

Books for Study

1. *Inorganic Laboratory Manual*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirappalli-2
   Unit IV and Unit V
2. Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5thEdition, Longman Scientific & Technical, Essex, England, 1989.
   Unit I *Chapter 10* **Unit II** *Chapter 11*
3. Pass G and Sutcliffe H, *Practical Inorganic Chemistry*, 2nd Edition, Chapman and Hall, London, 1974.
   Unit III *Chapter 18, 20, 21 and 22* **Unit V** *Chapters 6 and 9*

Books for Reference

1. Skoog D A, West D M, Holler F J, and Crouch S R, *Fundamentals of Analytical Chemistry*, 9th Edition, Brooks/Cole Cengage Learning, Belmont, CA 94002-3098, USA, 2014

Web Resources

Coordination Chemistry

Gravimetric Analysis

Semester	Course Code	Title of the Course	Hours	Credits
II	21PCH2CP03	INORGANIC CHEMISTRY PRACTICAL-II	4	3

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	2	3	2	1	2	2	3	2	1	2.0
CO-2	3	2	2	2	3	3	2	2	2	3	2.3
CO-3	2	2	3	3	2	2	2	3	3	2	2.4
CO-4	3	2	2	1	2	3	2	2	1	2	2.0
CO-5	2	3	2	2	2	2	3	2	2	2	2.2
Mean overall Score											2.18 (Medium)

SCHEME OF VALUATION

INTERNAL

CIA **100 Marks**

Cumulative mark of Regular Practical Classes	40 Marks
Record	10 Marks
Two CIA tests	50 Marks

For Each CIA Test ***100 marks***

Test	10 Marks
Results	90 Marks (60 Marks for Estimations & 30 Marks for Preparation)

Scheme of valuation

Inorganic Estimations

Thirty Marks each for the volumetric and gravimetric estimations

Gravimetry		***Volumetry***	
<2% Error	30 Marks	<1% Error	30 Marks
3%	25 Marks	2%	25 Marks
4%	20 Marks	3%	20 Marks
>4%	15 Marks	4% and above	15 Marks

Preparation

Fifteen marks each for the crude and re-crystallized samples

EXTERNAL

Total **100 Marks**

Test	10 Marks
Results	90 Marks (60 Marks for Estimations & 30 Marks for Preparation)

Scheme of valuation

Inorganic Estimations

Thirty Marks each for the volumetric and gravimetric estimations

Gravimetry		***Volumetry***	
<2% Error	30 Marks	<1% Error	30 Marks
3%	25 Marks	2%	25 Marks
4%	20 Marks	3%	20 Marks
>4%	15 Marks	4% and above	15 Marks

Preparation

Fifteen marks each for the crude and re-crystallized samples

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PCH2CP04**	**Core Practical 4: PHYSICAL CHEMISTRY PRACTICAL- II**	**4**	**3**

CO. No.	CO-Statements	Cognitive Levels (K -Level)
	On successful completion of this course, students will be able to	
CO-1	describe the concept electrode potential.	**K1**
CO-2	understand the concept of salting out constant.	**K2**
CO-3	learn the concepts and measurement of equivalent conductance.	**K2**
CO-4	apply the concepts of potentiometric titrations.	**K3**
CO-5	experiment the concepts of conductometric titrations.	**K4**

Unit –I Principle Behind Experiments (8 Hours)

Standard electrode potential - dissociation constant -conductometric acid-base and precipitation titrations- saponification of ethyl acetate by conductivity- potentiometric acid-base, precipitation and redox titrations - effect of NaCl on solubility of benzoic acid- solubility of sparingly soluble salt- equivalent conductance of a strong electrolyte at infinite dilution.

Unit -II Preparation of Solutions (4 Hours)

Preparation and standardization of HCl, CH_3COOH, NaOH, KCl, KI, $AgNO_3$ and NaCl.

Unit - III Cycle I (16 Hours)

1. Conductometric acid-base titration - mixture of acids.
2. Conductometric precipitation titration - iodide and chloride mixture.
3. Determination of second-order rate constant for saponification of ethyl acetate by conductivity.

Unit - IV Cycle II (16 Hours)

1. Potentiometric acid-base titration - mixture of acids.
2. Potentiometric precipitation titration - iodide and chloride mixture.
3. Salting out constant - effect of NaCl on solubility of benzoic acid.
4. Determination of standard electrode potential of zinc and copper.

Unit - V Cycle III (16 Hours)

1. Potentiometric redox titration
2. Solubility of sparingly soluble salt by (i) Conductivty and (ii) Potentiometry
3. Determination of equivalent conductance of a strong electrolyte at infinite dilution.
4. Dissociation constant of weak acid by conductivity method.

Books for Study

1. *Lab Manual*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirappalli.
2. Venkateswaran V, Veeraswamy R and Kulandaivelu A R., *Basic Principles of Practical Chemistry*, 2nd Edition, Sultan Chand & sons, New Delhi, 1997.
3. Daniels, Mathews F, Howard J and John Warren W, *Experimental Physical Chemistry*, 7th Edition, Mc Graw Hill, New York, 1970.
4. Findlay A, *Practical Physical Chemistry*, 7th Edition, Longman, London, 1959.

Web Resources

Conductometric precipitation titration

Saponification of ethyl acetate by conductivity

Semester	Course code			Title of the Course				Hours		Credits
II	21PCH2CP04			Core Practical 4: PHYSICAL CHEMISTRY PRACTICAL- II				4		3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	1	3	3	2	2	1	2.2
CO-2	3	2	2	2	2	3	2	2	2	2	2.2
CO-3	3	3	3	3	2	3	3	3	3	2	2.8
CO-4	3	3	2	2	2	3	2	2	2	2	2.3
CO-5	3	2	3	2	1	3	3	2	2	3	2..4
Mean overall Score											2.38 (High)

SCHEME OF VALUATION

INTERNAL

CIA	**100 Marks**
Cumulative mark of Regular Practical Classes	50 Marks
Two CIA tests	50 Marks

For Each CIA Test	***100 marks***
Procedure	10 Marks
Record	10 Marks
Viva	10 Marks
Results	70 Marks
Table	10marks
Calculation	10 marks
Graph	10 marks
Results	40 marks

Scheme of valuation

<2% Error	40 Marks
3%	30 Marks
4%	20 Marks
>4%	10 Marks

EXTERNAL

Total	**100 Marks**
Procedure	10 Marks
Viva	10 Marks
Results	80 Marks
Table	10marks
Calculation	10 marks
Graph	10 marks
Results	50 marks

Scheme of valuation

<2% Error	50 Marks
3%	40 Marks
4%	30 Marks
>4%	20 Marks

Semester	Course code	Title of the Course	Hours	Credits
II	**21PCH2SP01**	**SELF PACED LEARNING: SELECTED TOPICS IN ORGANIC CHEMISTRY**	**-**	**2**

CO. No.	CO-Statements	Cognitive levels (K - level)
	On successful completion of the course, students will be able to	
CO-1	recall and understand the concepts of green chemistry.	**K1 & K2**
CO-2	analyze the types of errors in analyses.	**K3**
CO-3	comprehend the skeletal rearrangements in organic molecules.	**K4**
CO-4	analyze the mechanism of various photochemical reactions.	**K5**
CO-5	predict the hybridization of different molecules.	**K6**

Unit-I Error Analysis

Error Analysis - Significant figures - rounding off the values - accuracy and precision- errors - classification of errors - constant errors and proportional errors - determinate errors (systematic errors) and indeterminate (random and accidental) - minimization of errors: calibration of apparatus, analysis of standard samples, running a blank determination, and independent analysis.

Average, range, median, average deviation, relative average deviation and standard deviation, variance, coefficient of variation - the normal error curve - testing of significance: *F*-test, *t*-test and *Q*-test - confidence limit - method of least squares.

Unit-II Structure and Properties

Hybridization - Electronegativity - dipole moments - polarity of solvents - hydrogen bonding - Bonds weaker than Hydrogen Bonding - Addition Compounds - Acids and Bases - HSAB Theory. Electronic Effects - inductive, resonance and hyperconjucative effects and their influence - rules of resonance - tautomerism - steric effects.

Unit-III Rearrangements Involving Intermediates

Classifications - mechanisms and applications of the following rearrangements: Wagner-Meerwein in tandem and cascade rearrangements - Tiffeneau-Demjanov ring expansion - Pinacol-Pinacolone - semi-pinacolone - Baeyer-Villiger, Favorskii, Fries, Beckmann, Hoffmann, Curtius, Lossen, Schmidt, Neber, Stevens, Bamford-Stevens reaction- Von Richter, Sommelet-Hauser and Smiles rearrangements - di-*pi* methane and its related rearrangements.

Unit-IV Photochemical reactions

Photochemistry - Fundamental concepts - Jablonskii diagram - photosensitization - photo chemistry of carbonyl compounds: - - photocycloaddition: - photochemistry of alkenes - photochemical rearrangements: - photolysis of diazo compounds - photo substitution reactions: - photochemistry of dienes and aromatic compounds

Unit-V Green Chemistry

The twelve principles, atom economy for addition, elimination, substitution reactions ant its calculation, green starting materials, green reagents, green catalysts, green solvents and green reactions.

Books for Study

1. Smith M B, and March J, *March's Advanced Organic Chemistry*, 6th Edition, John-Wiley and Sons, New York, 2007.
   Unit I Chapter 1-3
2. Bruchner R, Advanced *Organic Chemistry Reaction Mechanisms - Reactions, Stereochemistry and Synthesis*, 6th Edition, Springer-Verlag, Berlin, Heidelberg, 2010.
   Unit II *Chapter 11*
3. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, Oxford University Press, New York, 2012.
   Unit III *Chapter 36*
4. Morrison R T and Boyd R T, *Organic Chemistry*, 7th Edition, Allyn and Bacon Ltd., New York, 2011.
   Unit III *Chapter 36*
5. Anastas P T, *Text Book on Green Chemistry*, Oxford University Press, UK, 2006.
   Unit V *Chapters 1-5*

Book for References

1. Gould E S, *Mechanism and Structure in Organic Chemistry*, Holt-Reinhart and Winston, New York, 1959.
2. Smith M B, and March J, *March's Advanced Organic Chemistry*, 6th Edition, John-Wiley and Sons, New York, 2007.

Semester	Course code	Title of the Course	Hours	Credits
II	21PCH2SP01	SELF-PACED LEARNING: SELECTED TOPICS IN ORGANIC CHEMISTRY	-	2

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	1	3	2	3	2	1	2.2
CO-2	3	3	2	2	1	3	2	3	2	2	2.3
CO-3	2	2	2	2	2	2	2	2	2	2	2.0
CO-4	3	2	3	2	1	3	2	2	2	1	2.1
CO-5	3	3	3	2	2	3	3	2	2	2	2.5
Mean overall Score											2.22 (High)

Semester	Course code	Title of the Course	Hours	Credits
II	**21SPS2ES02A**	**DSE -2: INTERDISCIPLINARY CORE:SPECTROSCOPY AND GROUP THEORY**	**5**	**4**

CO. No.	CO-Statements	Cognitive levels (K - level)
	On successful completion of the course, students will be able to	
CO-1	describe the concept of rotational and vibrational spectroscopy	**K1**
CO-2	learn the concepts of Raman, NMR, ESR, electronic and Mossbauer spectroscopy	**K2**
CO-3	apply the concept of group theory in constructing character table	**K3**
CO-4	correlate the concept of group theory	**K4**
CO-5	predict the structures of simple compounds	**K5**

Unit-I Rotational and Vibrational Spectroscopy (15 Hours)

Basic aspects of spectroscopy - characterization of electromagnetic radiation - quantization of energy- microwave spectroscopy - rotation of molecules and selection rules - diatomic molecules - rigid and non-rigid rotator - rotational constant and centrifugal distortion - techniques and instrumentation - vibrational spectroscopy - diatomic molecules, harmonic and anharmonic oscillators - zero point energy - force constant - fundamental absorption and overtones (hot bands, Fermi resonance) - polyatomic molecules - techniques and instrumentation of FT-IR.

Unit-II Raman, NMR, and Mossbauer Spectroscopy (15 Hours)

Raman spectroscopy - Raman and Rayleigh scattering - quantum and classical theories of Raman effect - Stokes and anti-stokes lines - pure rotational Raman spectra - vibrational Raman spectra - mutual exclusion rule - polarized and depolarized Raman lines - techniques and instrumentation- NMR - hydrogen nuclei - chemical shift and spin-spin splitting - coupling constant - splitting with and without chemical exchange - interaction between spin and magnetic field - gyro magnetic ratio - instrumentation of NMR - FT NMR- applications of 2D NMR techniques like COSY, NOESY - applications of ^{13}C NMR spectroscopy - Mossbauer spectroscopy - principles of Mossbauer spectroscopy- Doppler shift - recoil energy- isomer shift- quadrupole splitting - applications to various compounds.

Unit-III ESR Spectroscopy and Electronic Spectroscopy (15 Hours)

ESR - principle - position of ESR absorptions - g value - hyperfine splitting - zero field splitting - ESR spectrum of free radicals and copper salicylaldehyde complexes - electronic spectra - Electronic spectra of diatomic molecules - Born-Oppenheimer approximation - vibrational coarse structure - Franck-Condon principle - dissociation energy and dissociation products - rotational fine structure of electronic vibration - vibration transition - Fortrat diagram- electronic angular momentum in diatomic molecules - spectrum of molecular hydrogen - molecular photoelectron spectroscopy - UV photoelectron spectroscopy and X-ray photoelectron spectroscopy.

Unit-IV Rudiments of Group Theory (15 Hours)

Principles of group theory - symmetry elements - symmetry operations - properties of group - abelian, non - abelian and cyclic groups - multiplication tables - classes - subgroups -

molecular point groups - Schoenflies symbols - optical activity and dipole moment on the basic of point groups matrices for symmetry operations - reducible and irreducible representations - statement of great orthogonality theorem - construction of character table - explanation of a character table.

Unit-V Applications of Group Theory (15 Hours)

Applications of group theory - standard reduction formula relating reducible and irreducible representations - hybridization schemes for atoms in molecules of different geometry - AB_4 tetrahedral, AB_3 triangular planar and AB (linear)- symmetries of vibrational modes in non-linear molecules (H_2O, NH_3 and BF_3) - integration method - selection rules in spectroscopy - IR & Raman active - vibration modes -mutual exclusion rule - symmetry in crystals - Hermann - Mauguin symbols - space groups of crystals -translational elements of symmetry - comparison of crystal symmetry with molecular symmetry.

Books for Study

1. Banwell C N, *Molecular Spectroscopy*, 2nd Edition, TATA McGraw Hill Co., New Delhi, 2010.
   Unit I -III *Chapter 2,3,4,5,& 6*
2. Raman K V, *Group Theory and its Applications to Chemistry*, Tata Mc Graw-Hill Publishing Company, New Delhi, 1990.
   Unit IV *Chapter 1,2,3 & 4* **Unit V** *Chapter 5,6,7 & 8*

Book for References

1. Drago R S, *Physical Methods in Inorganic Chemistry*, East West Press Ltd, New Delhi, 1971.
2. Chang R, *Basic Principles of Spectroscopy*, Englewood Cliffs, New Jersey, 1978.
3. Straughan B P and Walker S, *Spectroscopy*, Volume 1,2,3, Chapman and Hall, A Halstet Press Book, John Wiley & Sons Ins., New York, London, 1975.
4. Barrow G M, *Introduction to Molecular Spectroscopy*, Tata McGraw - Hill, New Delhi, 1993.
5. Chatwal G R and Anand S K, *Spectroscopy*, Himalaya Publishing House, Mumbai, 2009.
6. Albert Cotton F, Chemical applications of Group Theory, 3rd Edition, Wiley India (P) Ltd., New Delhi, 2010.

Web Resources

Principles of Organic Chemistry

NPTEL-Online Course

Semester	Course code	Title of the Course	Hours	Credits
II	21SPS2ES02A	DSE -2: INTERDISCIPLINARY CORE:SPECTROSCOPY AND GROUP THEORY	5	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	1	3	2	3	2	1	2.2
CO-2	3	3	2	2	1	3	2	3	2	2	2.3
CO-3	3	3	3	2	2	3	3	2	2	2	2.5
CO-4	3	2	3	2	1	3	2	2	2	1	2.1
CO-5	2	2	2	2	2	2	2	2	2	2	2.0
Mean overall Score											2.22 (High)

Semester	Course Code	Title of the Course	Hours	Credits
II	21PSS2SE01	SEC: SOFT SKILLS	4	3

Programme Specific Outcomes (PSOs)
After the successful completion of the course, students will learn:

- the dynamics of effective and professional communication skills and put them into daily use
- to write a Professional resume using creative methods of online platforms
- the dynamics of interview skills and GD preparations and presentations in public platforms and present the best of themselves as job seekers
- to understand, analyze and express their personality styles and personal effectiveness in various environments
- to learn and update themselves with the required knowledge in Numerical ability and Test of Reasoning for competitive examinations

Course outcomes (COS)
Upon completion of this course, students will:

- be exposed and trained in various nuances of Soft Skills in a Professional manner responding to the requirements of national and international market
- be able to synthesize the knowledge and practical skills learnt to be personal effective in any managerial positions
- be equipped to construct plans and strategies to work for better human society
- be able to illustrate the problems at work and home and design solutions and maintain a balance of work and home
- be able to connect on a continuum and maintain growth and sustainability and creativity in employment that increases in productivity, profit for individuals and the society.

Module 1: Effective Communication & Professional communication

Effective communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication. JOHARI Window as a tool of effective communication.

Professional Communication: The Art of Listening, The passage, Kinesthetic, Production of Speech, Speech writing , Organization of Speech, Modes of delivery, Conversation Techniques, Good manners and Etiquettes, Different kinds of Etiquettes, Politeness markers.

Module II. Resume Writing & Interview Skills

Resume Writing: Meaning and Purpose. Resume Formats. Types of s Resume. Functional and Mixed Resume**,** Steps in preparation of Resume, Model resumes for an IT professional Chronological, Types of interviews, Creative resumes using online platforms

Interview Skills: Common interview questions, Dos and Don'ts for an interview, Attitude, Emotions, Measurement, Body Language, Facial expressions, Different types of interviews, Telephonic interviews, Behavioral interviews and Mock interviews (Centralized).

Module III: Group Discussion & Team Building

Group Discussion: Group Discussion Basics, GD as the first criterion for selecting software testers, Essentials of GD, Factors that matter in GD, GD parameters for evaluation, Points for GD Topics, GD Topics for Practice, Tips for GD participation. Video shooting of GD presentation & Evaluation (Centralized)

Team Building: Characteristics of a team, Guidelines for effective team membership, Pedagogy of team building, Team building skills. Team Vs Group - synergy, Types of synergy, Synergy relates to leadership ,Stages of Team Formation, Broken Square-Exercise, Leadership, Leadership styles, Conflict styles, Conflict management strategies & Exercises

Module IV: Personal Effectiveness

Personal Effectiveness: Self Discovery: Personality, Characteristics of personality, kinds of self, Personality inventory table, measuring personality, intelligence and Exercises

Self Esteem: Types -High & Low self esteem, Ways of proving self esteem, Hypersensitive to criticism, activities. Goal setting: Goal setting process, Decision making process & Exercises.

Stress Management: Identifying stress, Symptoms of stress, Responding to Stress, Sources of stress, Coping with stress and Managing stress.

Module V: Numerical Ability

Average, Percentage, Profit and Loss**,** Problems of ages, Simple Interest, Compound Interest, , Area, Volume and Surface Area, Illustration, Time and Work, Pipes and Cisterns, Time and Distance**,** Problems on Trains**,** Illustrations, Boats and Streams, Calendars and Clocks.

Module VI: Test of Reasoning

Verbal Reasoning: Number series, letter series, coding and decoding, logical sequence of words, Assertion and Reasoning, Data Sufficiency, Analogy, Kinds of relationships.

Non-Verbal Reasoning: Completion of Series**,** Classification, analogical, Pattern comparison, Deduction of figures out of series, Mirror Reflection Pattern, Hidden figures, Rotation pattern, Pattern completion and comparison, Sense of direction, Blood relations.

Text cum Exercise book

Melchias G, Balaiah John, John Love Joy (Eds), 2018. Winners in the Making: A primer on soft skills. SJC, Trichy.

References

* Aggarwal, R.S. *Quantitative Aptitude, S.Chand & Sons*
*.Aggarwal, R.S. (2010). *A Modern Approach to Verbal and Non Verbal Reasoning*. S.Chand & CO,Revised Edition.
* Covey, Stephen. (2004). *7 Habits of Highly effective people,* Free Press.

* Egan, Gerard. (1994). *The Skilled Helper* (5th Ed). Pacific Grove, Brooks/Cole.
* Khera ,Shiv (2003). *You Can Win.* Macmillan Books , Revised Edition.

Other Text Books

* Murphy, Raymond. (1998). *Essential English Grammar*. 2nd ed., Cambridge University Press.

* Prasad, L. M. (*2000). Organizational Behaviour, S.Chand & Sons.*

* Sankaran, K., & Kumar, M. *Group Discussion and Public Speaking* . M.I. Pub, Agra, 5th ed., Adams Media.

* Schuller, Robert. (2010) . *Positive Attitudes*. Jaico Books.

* Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.

** Yate, Martin. (2005). H*iring the Best: A Manager's Guide to Effective Interviewing and Recruiting**

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PCH2EG01**	**GENERIC ELECTIVE-1(WS): INDUSTRIAL PRODUCTS**	**4**	**3**

CO. No.	CO-Statement	Cognitive Level (K -Level)
	On successful completion of this course, students will be able to	
CO-1	describe manufacturing processes of cement and glass.	**K1**
CO-2	understand the importance of plastic and fibres.	**K2**
CO-3	explain the composition and applications of fertilizers.	**K3**
CO-4	illustrate the preparation and uses of cosmetics.	**K4**
CO-5	classify dyes, pigments and paints.	**K5**

Unit-I Cement and Glass (12 Hours)

Cement - Composition, different methods of manufacturing and uses -Portland cement - Composition, different methods of manufacturing (Wet and Dry process), uses - Setting of cement, Glass- - Composition, Types, different methods of manufacturing - Melting, Blowing, Pressing, Annealing and finishing- chemical and physical properties of glass.

Unit-II Pigments, Dyes and Paints (12 Hours)

Pigments - Classification, Manufacture and uses. Dyes - Classification, preparation, dyeing processes. Paints - Composition, Types, Manufacture and testing of Paints.

Unit-III Fibers, Plastics and Rubber (12 Hours)

Fibres - definition-difference between Natural and synthetic fibres-properties of synthetic fibres-Artificial silk, rayon, nylon and Terylene Plastics - composition, Classification, manufacture, properties and uses recycling of plastics Rubber: types of rubber-synthetic rubber- natural rubber - Vulcanizations of Rubber- properties and uses of rubber.

Unit-IV Fertilizers and Fuels (12 hours)

Fertilizers -Types of Fertilizers: Organic and Inorganic fertilizers, Preparation and uses, Fuels - Energy resources - Industrial gases, Water gas, Producer gas, Oil gas, natural gas, coal gas, Gobar gas, Indane gas, Petroleum products and coal products.

Unit-V Cosmetics (12 hours)

Shampoo- composition and its preparation, lipstick -preparation, Face cream and face powder -composition and their preparation. Hair dyes - chemical and herbal dyes. Perfumes and Deodorants.

Books for Study

1. Charkarabarthy B N, *Industrial Chemistry*, Oxford and IBH Publishing. Co. 1st Edition. New Delhi, 2002. **Unit I -III** *Chapter:2,3,4,5,& 6*
2. Sharma B K, *Industrial Chemistry*, Goel Publishing House, 1st Edition, New Delhi, 2011. **Unit IV -IV** *Chapter:2,3,4,5,& 6*

Books for Reference

1. Othmer K, *Encyclopedia of Chemical Technology*, John Wiley and Sons,USA, 1999.

Web Resources

Cosmetics

Cosmetics and Additives

Semester	Course Code	Title of the Course	Hours	Credits
II	21PCH2EG01	GENERIC ELECTIVE- 1(WS): INDUSTRIAL PRODUCTS	4	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	2	1	1	2	3	2	2	2	2.0
CO-2	1	2	3	3	2	2	3	1	2	3	2.2
CO-3	2	3	2	2	1	3	2	2	2	2	2.1
CO-4	2	3	2	3	2	2	3	2	2	2	2.3
CO-5	2	3	2	2	3	2	2	3	3	2	2.4
Mean overall Score											2.20 (High)

Semester	Course code	Title of the Course	Hours	Credits
III	**21PCH3CC05**	**CORE-5: INORGANIC CHEMISTRY- III**	**5**	**4**

CO No	CO-Statement	Cognitive level (K Level)
	On successful completion of this course, students will be able to	
CO-1	understand the stability of the complexes.	**K1**
CO-2	know the organometallic complexes and draw their structures.	**K2**
CO-3	analyze the electronic spectra of the complexes.	**K4**
CO-4	predict mechanisms of reactions of complexes.	**K5**
CO-5	predict the structure of the complexes utilizing spectral techniques.	**K5**

Unit-I Theories of Coordination Chemistry (15 Hours)

Crystal field theory - splitting pattern of octahedral, tetrahedral, square planar, trigonal bipyramidal and square pyramidal complexes - magnetic properties, CFSE, high spin-low spin cross over - limitations - structural and thermodynamic effects of inner orbital splitting, Jahn-Teller effect (static, dynamic, elongation and flattening) - ligand field theory - evidences for M-L overlap, spin-orbit coupling constant and Racha parameters - MO theory of octahedral complexes (sigma and pi bonding), tetrahedral and square planar complexes.

Unit-II Basics of Organometallics (15 Hours)

Hapticity- 16 and 18 electron rules - applications and limitations - carbonyls- bonding - terminal, doubly, triply bridged carbonyls - structure of carbonyls - CO stretching frequencies of carbonyls and mixed carbonyls - carbonyl hydrides - nitrosyls-terminal, bridging and bent - *pi* complexes with olefins - ferrocene and benzenoid metal complexes - non-benzenoid aromatics as ligands and carbene complexes - fluxional molecules.

Unit-III Reaction Kinetics in Coordination Chemistry (15 Hours)

Inert and labile complexes - Stepwise, overall stability constants -Chelate effect-mechanisms of substitutions in octahedral complexes-dissociative (*D*), associative (*A*), and interchange (*I*) mechanisms - Aquation (acid hydrolysis) and anation - conjugate base mechanism of base hydrolysis - Substitution reactions in square planar complexes - Trans effect-theories and applications - electron transfer reactions - inner and outer sphere mechanisms- excited state outer sphere electron transfer - mixed valence complexes.

Unit-IV Physical Methods in Coordination Chemistry-I (15 Hours)

Types of magnetic behaviour - magnetic susceptibility measurements - Gouy's method-orbital contribution-spin-orbit coupling and its effects on magnetic properties - Temperature independent paramagnetism (TIP) - spin-crossover phenomena - electronic spectra of complexes-band width and intensity-Sugano-Tanabe and Orgel Diagrams - charge transfer spectra - infrared spectra of Coordination complexes-characteristic frequencies-mode of coordination and interpretation of IR spectra of complexes containing CO, SO_2, carboxylate, ester, amine, amide, DMSO ligands.

Unit-V Physical Methods in Coordination Chemistry-II (15 Hours)

NMR - Applications of NMR to inorganic compounds - NMR of metal hydrides (^{1}H NMR), metal carbonyls(^{13}C NMR), ^{19}F and ^{31}P NMR -Applications of NQR spectroscopy to the study of complexes-ESR-zero- field splitting - Krammer's degeneracy - pattern for number of lines of complexes having d^1-d^9 systems -bis(salicylaldimine) Cu(II), Mn(II) complexes - Mossbauer spectroscopy - quadrupole interactions - magnetic interactions - $FeSO_4$,$FeCl_3$,ferro-and ferricyanides, nitroprusside, FeC_2O_4, $Fe_3(CO)_{12}$.

Books for Study

1. Huheey J E, Keiter E A Keiter R L, and Medhi O K, *Inorganic Chemistry - Principles of Structure and Reactivity*, 4th Edition, Harper Collins College Publishers, New York, 1993.
   Unit I *Chapter 14* **Unit II** *Chapter 18,6*
   Unit III *Chapter 16,17* **Unit IV** *Chapter 15 Appendix-G*
2. Drago R S, *Physical Methods in Inorganic Chemistry*, Affiliated East-West Press Private Limited , New Delhi, 1965 (Reprint).
   Unit I *Chapter-3* **Unit IV** *Chapter-6,7& Appendix-A*
   Unit V *Chapter-8, 9, 10, 11*

Books for Reference

1. Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3rd Edition, Interscience Publishers, New York, 1972.
2. Purcell K F and Kotz J C, *Inorganic Chemistry*, WB Saunders Company, Philadelphia, 1977.
3. Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry,* 6th Edition, W H Freeman and Company, New York, 2014.
4. Miessler G L, Fischer P J and Tarr D A, *Inorganic Chemistry*, 5thEdition, Pearson Education, Inc., New York, 2014.
5. Housecroft C E and Sharpe A G, *Inorganic Chemistry* 4thEdition, Pearson Education Limited, Essex, 2012.
6. Lee JD, *Concise Inorganic Chemistry*, 6thEdition, ELBS, London, 1998.
7. Lewis J and Wilkins RG, *Modern Coordination Chemistry*, Interscience Publishers, Inc., New York, 1960.
8. Basalo F and Pearson RG, *Mechanisms of Inorganic Reactions*, John- Wiley and Sons Inc., New York, 1960.
9. Crabtree RH, *The Organometallic Chemistry of the Transition Metals*, 6thEdition, John-Wiley and Sons Inc., New York, 2014.
10. Kazuo Nakamota, *Infrared and Raman Spectra of Inorganic and Coordination Compounds*, Part A and B, 6thEdition, John-Wiley and Sons, Inc. NewYork, 2009.

Web resources

Fluxionality in Organic Chemistry

Magnetic Resonance

Crystal field Theory

Semester	Course code	Title of the Course	Hours	Credits
III	21PCH3CC05	CORE-5: INORGANIC CHEMISTRY- III	5	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	2	3	2	1	2	2	3	2	1	2.0
CO-2	3	2	2	2	3	3	2	2	2	3	2.3
CO-3	2	2	3	3	2	2	2	3	3	2	2.4
CO-4	2	3	2	2	2	3	2	2	2	2	2.2
CO-5	3	2	2	1	2	2	3	2	1	2	2.0
Mean overall Score											2.18 (Medium)

Semester	Course Code	Title of the Course	Hours	Credits
III	**21PCH3CC06**	**CORE-6: ORGANIC CHEMISTRY-III**	**6**	**6**

CO. No.	CO-Statements	Cognitive levels (K-Level)
	On successful completion of the course, students will be able to	
CO-1	acquire the knowledge and applications of ^{1}H NMR.	**K1**
CO-2	comprehend the basics of pericyclic reaction.	**K2**
CO-3	learn the principles, techniques and applications of ^{13}C NMR and ESR.	**K3**
CO-4	deduce the instrumentation, ionization techniques in mass spectrometry.	**K4**
CO-5	recognize the mechanisms of rearrangements.	**K5**

Unit -I ^{1}HNMR Spectroscopy (18 Hours)

^{1}H NMR: Nuclear spin states - mechanism of absorption - chemical shift and shielding - NMR spectrometer continuous wave and FT instrument - chemical equivalence - integrals and integration - chemical environment and chemical shift - local diamagnetic shielding: electronegativity and hybridization effects - acidic exchangeable protons - deuterium exchange and peak broadening-tautomerism - protons on N: amines and amides-magnetic anisotropy -spin-spin splitting (n+1) rule - coupling constants - symbols - spectra of diastereotopic systems - measuring coupling constants - spin system notation: A_2, AB, AX, AB_2, AX_2, A_2B_2, A_2X_2 spin systems -heteronuclear coupling: ^{1}H-^{19}F and ^{1}H-^{31}P - PMR absorptions by hydrocarbons and functional groups-Chemical shift reagents-chiral resolving agents - problem solving.

Unit -II ^{13}CNMR and ESR Spectroscopy (18 Hours)

^{13}C NMR: ^{13}C nucleus-chemical shifts - correlation charts - proton coupled and decoupled ^{13}C spectra - nuclear overhauser effect - off resonance decoupling - DEPT experiments.

Two dimensional spectroscopic methods: COSY, HETCOR and NOESY experiments - Magnetic resonance imaging - problem solving.

ESR spectroscopy - basic principle - predicting number of ESR lines for simple organic free radicals such as methyl, ethyl, phenyl and naphthalene radicals.

Unit - III Mass Spectrometry (18 Hours)

Basic principles - instrumentation - sampling techniques - ionization methods: EI, CI, desorption ionization techniques (SIMS, FAB, and MALDI), ESI - Mass analysis: magnetic, double focusing, quadrupole and ToF mass analysers - detection and quantization - determination of molecular weight - molecular ion peak - base and meta stable peaks - calculation of molecular formula - fragmentation and structural analysis - fundamental fragmentation processes -Stevenson's rule - α-cleavage-inductive cleavage - two bond cleavage - *retro* Diels-Alder cleavage - McLafferty rearrangements -fragmentation of hydrocarbons - alcohols, phenols, thiols - ethers and sulfides - carbonyl compounds - amines - and nitrogen compounds - halides.

Combined applications of UV-Visible, IR, NMR and Mass spectral techniques for the structural elucidation of organic molecules.

Unit- IV Pericyclic Reactions **(18 Hours)**

Characteristics and types of pericyclic reactions

Cycloaddition reactions: stereochemistry of Diels-Alder reactions - substituent effects on reactivity, regioselectivity and stereochemistry -catalysis by Lewis acid - synthetic applications - enantioselectivity-synthetic applications - diastereoselective using chiral auxiliaries - 1,3-dipolar additions - relative reactivity - regioselectivity - stereoselectivity - transition structures - applications - [2+2] cycloaddition reactions of ketenes and alkenes.

Electrocyclic reactions: overview - orbital basis for stereospecificity - FMO and MO correlation diagram methods - thermal and photochemical reactions - Woodward-Hoffman rules - electrocylic reactions of charged species - electrocyclization of heteroatomic trienes - rules for electrocyclic reactions.

Unit-V Sigmatropic rearrangements **(18 Hours)**

Types shifts of hydrogen and alkyl groups - [3,3]sigmatropic rearrangement - oxidation of tertiary allylic alcohols - Cope, oxy-cope, anionic cope rearrangements - Claisen rearrangements-ortho ester Claisen, Ireland-Claisen, Ester enolate Claisen and Claisen rearrangement of N,N-dialkylketene - [2,3]-sigmatropic rearrangements - allylic sulfoxides, selenoxides and amine oxides-allylic sulfonium and ammonium ylides - thermal and photochemical - [1,n] H sigmatropic shifts.

Books for Study

1. Pavia D L, Lampman G M, Kriz G S and Vyvyan J R, *Introduction to Spectroscopy*, 5th Edition, Cengage Learning, Delhi, 2015.
2. **Unit I & II** *Chapter 5-9* **Unit III** *Chapter 3-4*
3. Carey F A, and SundbergR J, *Advanced Organic Chemistry, Part A: Structure and mechanisms*, 5th Edition, Springer (India) Pvt Ltd., New Delhi, 2007.
   Unit IV *Chapter 10* **Unit V** *Chapter 10*
4. Carey F A, and Sundberg R J, *Advanced Organic Chemistry, Part B: Structure and Mechanisms*, 5th Edition, Springer (India) Pvt Ltd., New Delhi, 2007.
   Unit IV *Chapter 6* **Unit V** *Chapter 6*
5. Bruchner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010. **Unit V** *Chapter 12*

Books for Reference

1. Silverstein R M and Bassler G C, *Spectrometric Identification of Organic Compounds*, 4th Edition, John- Wiley and Sons, New York, 1993.
2. Kemp W, *Organic Spectroscopy*, 3rd Edition, ELBS, London, 1987.
3. Fleming I, *Spectroscopic Methods in Organic Chemistry*, 4th Edition, Tata-McGraw Hill Publishing Company, New Delhi, 1988.
4. Smith M B, and March J, *March's Advanced Organic Chemistry*, 6th Edition, John-Wiley and Sons, New York, 2007.
5. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, Oxford University Press, New York, 2012.
6. Bruchner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010.

Web Resources

Electromagnetic Spectrum

ESR - Instrumentation

Mass Spectroscopy

Semester	Course code			Title of the Course				Hours		Credits
III	21PCH3CC06			CORE-6: ORGANIC CHEMISTRY-III				6		6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	2	1	2	2	3	2	3	1	2.1
CO-2	1	2	3	3	2	2	3	1	2	3	2.2
CO-3	2	3	2	2	1	3	2	2	1	2	2.0
CO-4	2	3	2	3	2	2	3	2	1	1	2.1
CO-5	2	3	1	2	3	2	2	3	3	2	2.3
Mean overall Score											2.14 (Medium)

Semester	Course Code	Title of the Course	Hours	Credits
III	**21PCH3CC07**	**CORE-07: PHYSICAL CHEMISTRY II**	**6**	**6**

CO. No.	CO-Statements	Cognitive Levels (K Level)
	On successful completion of this course, students will be able to	
CO-1	memorize and retain the basics of various concepts of kinetics, solution kinetics catalysis and electrodics.	**K1**
CO-2	understand the underlying principles of kinetics and electrodics.	**K2**
CO-3	apply the underlying concepts in day to day inventions and application.	**K3**
CO-4	analyze the intricacies of electrical double layer and evaluate its implications in real life.	**K4 & K5**
CO-5	create new electrochemical cells and newer electrodes for application.	**K6**

Unit- I Theories of Reaction Rate (18 Hours)

Theories of reaction rates and reaction mechanism - Arrhenius equation - potential energy surfaces and reaction coordinates - collision theory - ARRT(thermodynamic treatment only) - application of ARRT to unimolecular, bimolecular and termolecular reactions - kinetic isotope effect- isokinetic relation and temperature - theories of unimolecular reactions - Lindemann and Rice-Ramsperger-Kassel - principle of microscopic reversibility and detailed balancing.

Unit-II Application of ARRT to Solution Kinetics and Catalysis (18 Hours)

Application of ARRT to solution kinetics - factors affecting reaction rate in solution- internal pressure - solvent dielectric constant - ionic strength - reactions - Van't Hoff equation and volume of activation - catalysis- characteristics of a catalyst -factors affecting catalytic reactions - types of catalysis - homogeneous catalysis - acid - base catalysis - Van't Hoff and Arrhenius intermediates -mechanism - protolytic and prototropic catalysis laws - acidity functions -Hammett-Zucker hypothesis - catalysis in biological systems- Michaelis-Menten equation - Lineweaver-Burk and Eadie-Hofstee plots - influence of substrate concentration- *p*H- and temperature on rate - influence of substituent's on reaction rates - Hammett and Taft equations - linear free energy relations.

Unit-III Surface Chemistry and Heterogeneous Catalysis (18 Hours)

Surface phenomenon - physical and chemical adsorption - adsorption and free energy relations at interface - Langmuir adsorption isotherm - Gibbs adsorption isotherm - BET isotherm - measurement of surface area - heterogeneous catalysis - mechanism - Langmuir Hinshelwood mechanism - Langmuir-Rideal bimolecular mechanism - role of surface in catalysis.

Unit-IV Debye-Huckel Theory and its Applications (18 Hours)

Debye Huckel theory - radius of ionic atmosphere - calculations of thickness of ionic atmosphere - evidences of ionic atmosphere - asymmetry effect -electrophoretic effect - Debye Falkenhagen effect - Wien effect - Debye-Huckel Onsager equation - modification and

verification of the equation - Debye-Huckel limiting law - modification and verification - finite ion size model - Huckel-Bronsted equation - calculation of activity coefficient - determination of ion size parameter - solubility - solubility product of sparingly soluble salt - common ion effect - neutral salt effect and solubility - determination of solubility and solubility product.

Unit-V Electrode Kinetics **(18 Hours)**

Theories of electrical double layer - electric double layer at the electrode -electrolyte interface - Helmholtz model of double layer - law of electrical neutrality - Gouy - Chapman diffused charged model - desorption theory of double layer - Stern's model, triple-layer theory- electro capillary phenomenon - electrocapillary curves for solutions containing anions, cations and molecular substances - electrocapillary maximum - Lipmann equations and potential - experimental measurement and its calculation - capillary electrometer and contact angle method - electro kinetic phenomena - classification electro-osmosis and electrophoresis - streaming potential and sedimentation potential - kinetics of electrode process - equilibrium and non-equilibrium process - concentration and activation polarization - theory of electrochemical over potential - derivation and verification of the equations - Butler-Volmer equation - Tafel equation.

Books for Study

1. Laidler K J, *Chemical Kinetics*, 3rd Edition, New Delhi TATA McGraw Hill Co. 1984.
Unit I and II *Chapters 2 and 3*
2. Kuriacose J C and Rajaram J, *Kinetics and Mechanism of Chemical Transformation*, Macmillan & Co, Delhi, 1993. **Unit I -III** *Chapters 5 -10*
3. Glasstone S, *An Introduction to Electrochemistry*, New Delhi, East West Press Pvt. Ltd, 1956. **Unit IV and V** *Chapter 3,4,15 and 16*

Books for Reference

1. Castellan G W, *Physical Chemistry*, 4th Edition, Narosa, New Delhi, 2004.
2. Kapoor K L, *A Textbook of Physical Chemistry*, Vol. 3 Macmillan, India Ltd, 2013.
3. Huges G, *Radation Chemistry*, Oxford series, 1973.
4. Antorpov L, *Theoretical Electrochemistry*, 2nd Edition, Mir Publishers, Moscow, 1977.
5. Bockris J O'M and Reddy A K N, *Modern Electrochemistry*, Vol. 1 & 2, 2nd Edition, Plenum Press, New York, 1998.

Web Resources

Electrical Double Layer	Gibbs Adsorption Isotherm

Semester	Course code	Title of the Course	Hours	Credits
III	21PCH3CC07	CORE- 07: PHYSICAL CHEMISTRY II	6	6

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	1	3	1	1	3	2	2	3	3	1	2
CO-2	2	3	2	3	2	1	2	3	1	3	2.2
CO-3	1	3	1	3	2	2	3	2	1	2	2
CO-4	2	1	3	3	2	2	3	2	2	3	2.3
CO-5	2	3	2	3	2	2	3	2	3	3	2.5
Mean overall Score											2.2 (High)

Semester	Course Code	Title of the Course	Hours	Credits
III	**21PCH3CP05**	**ORGANIC CHEMISTRY PRACTICAL-I**	**4**	**3**

CO. No.	CO-Statement	Cognitive Levels (K -Level)
On successful completion of this course, students will be able to		
CO-1	choose appropriate solvent for the separation of organic binary mixtures.	**K1**
CO-2	infer the functional group of the compounds based on characteristic reactions.	**K2**
CO-3	apply the skills of micro level analysis to identify the nature of organic compounds	**K3**
CO-4	categorize the micro level analysis to identify the functional groups of organic compounds	**K4**
CO-5	confirm the functional group by preparing a solid derivative	**K5**

Unit-I Micro Qualitative Analysis of an organic binary mixture (12 Hours)
Pilot separation -Ether separation, Bicarbonate separation, Alkali separation and Acid separation, Bulk separation, Preliminary tests- Colour and appearance - solubility tests - acidic/basic/neutral nature - tests for aliphatic and aromatic compounds - tests for saturation/unsaturation.

Unit-II Tests for Characteristic elements in organic compounds (12 Hours)
Preparation of sodium fusion extract -chemistry of converting organic N/S/halogens into inorganic ion in sodium fusion extract - tests for Nitrogen - tests for sulphur - tests for halogens such as chlorine, bromine and iodine - need for blank test.

Unit-III Analysis of Functional groups-1 (12 Hours)
Tests for carbonyl functional groups - mono- & dicarboxylic acids, esters, aldehydes and ketones, phenol, sulphanilic acid, alcohol and hydrocarbon

Unit-III Analysis of Functional groups-1 Primary and secondary amines, amide, diamide, anilide, and nitro compounds

Unit-V: Preparation of Derivatives (12 Hours)
Confirmation of the functional groups by preparation of solid derivatives/characteristic colour reactions for the functional groups - scientific reporting

Books for Reference

1. Ganapragasm N S and Ramamurthy C, *Organic Chemistry Lab Manual*, 2nd Edition, Vishwanathan S Printers and Publishers (P) Ltd., Chennai, 2015.
2. Furniss B S, Hannaford A J, Smith P W G, and Tatchell A R, *Vogel's Textbook of Practical Organic Chemistry*, 5th Edition, Pearson publication.

3. Venkateswaran V, Veeraswamy R, Kulandaivelu A R, *Basic Principles of Practical Chemistry*, 2nd Edition, Sultan Chand and Sons, New Delhi, 1997.
4. *Organic Chemistry Lab Manual for Micro Qualitative Analysis*, Department of Chemistry, St. Joseph's College, Tiruchirappalli-620 002. (Private circulation).

Web Resource


Organic Analysis-I


Organic Analysis-II


Separation of mixtures

Scheme of valuation

Organic Chemistry Practical-I **Organic Analysis + TLC Preparation**

INTERNAL

CIA	**100 Marks**
Cumulative mark of Regular Practical Classes	40 Marks
Record	10 Marks
Two CIA tests	50 Marks

For Each CIA Test	***100 marks***
Solvent for separation	10 Marks
Viva/Test	10 Marks
Results	80 Marks (40 marks for each compound)
Organic Analysis	
Solubility	5 Marks
Saturation/unsaturation	5 Marks
Aromatic/Aliphatic	5 Marks
Elements	10 marks
Functional Group	10 Marks
Derivative	5 marks

EXTERNAL

Total	**100 Marks**
Solvent for separation	10 Marks
Test	10 Marks
Results	80 Marks (40 marks for each compound)
Organic Analysis	
Solubility	5 Marks
Saturation/unsaturation	5 Marks
Aromatic/Aliphatic	5 Marks
Elements	10 marks
Functional Group	10 Marks
Derivative	5 marks

Semester	Course code	Title of the Course	Hours	Credits
III	21PCH3CP05	ORGANIC CHEMISTRY PRACTICAL- I	4	3

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	1	2	3	1	2	3	2	3	3	2.2
CO-2	3	2	1	3	2	3	1	3	3	3	2.4
CO-3	2	3	2	3	2	2	3	2	2	2	2.3
CO-4	3	2	3	3	2	2	3	1	2	3	2.4
CO-5	1	3	2	2	3	2	2	3	3	1	2.2
Mean overall Score											2.3 (High)

Semester	Course Code	Title of the Course	Hours	Credits
III	**21PCH3ES03A**	**DSE-3: BIOORGANIC CHEMISTRY**	**5**	**4**

CO. No.	CO – Statements	Cognitive Levels (K Level)
	On successful completion of course, students will be able to	
CO-1	understand the reactivity of heterocycles.	**K1**
CO-2	outline the structure and functions of DNA and RNA.	**K2**
CO-3	apply the separation concepts on aminoacids.	**K3**
CO-4	identify the mechanism of preparation and reactions of heterocycles.	**K4**
CO-5	compare the organic reaction mechanism with enzyme mechanism.	**K5**

Unit-I Heterocycles 1 **(15 Hours)**

Hantzsch pyridine synthesis - electrophilic aromatic substitution in pyridine and activated pyridine - nucleophilic substitution in pyridine - pyridone in nucleophilic substitutions - pyridine as catalyst and reagent - pyrones - structures of triazoles, and tetrazole and their tautomers - quinoline and isoquinoline - electrophilic and nucleophilic substitution reactions.

Unit-II Heterocycles 2 **(15 Hours)**

Preparation of imidazole- only the structures, numbering and naming of diazins (pyrazine, pyrimidine and pyrazine), azines (oxazine and azepine)-electrophilic aromatic substitution reactions in five membered heterocycles - pyrrole, furan, thiophene and indole - electrophilic addition in furan - lithiation in furan and thiophene - five membered heterocycles in Diels-Alder reactions.

Unit-III Nucleic Acids **(15 Hours)**

Structures and names of nucleosides and nucleotides - ATP - carrier of chemical energy - phosphoryl transfer reaction-mechanisms for phosphoryl transfer reactions - structures of dinucleotides - NAD^+, $NADP^+$, NADH, NADPH and GTP - Nucleic acids - DNA and RNA - primary and double helical structures - base pair - replication - transcription - ribosomal RNA - transfer RNA - translation -base sequencing of DNA - DNA fingerprinting - AZT drug in HIV treatment.

Unit-IV Carbohydrates and Amino Acids **(15 Hours)**

Carbohydrates: The reactions of monosaccharides in basic solutions - oxidation and reduction reactions of monosaccharides - the Wohl degradation - measuring the blood glucose level in diabetes - anomeric effect in glucose.

Amino acids: Separation of amino acids - electrophoresis - TLC - Ion exchange chromatography - Synthesis of amino acids - HVZ reaction - *N*-Phthalimidomalonic ester synthesis - Resolution of racemic mixtures of amino acids - Peptide bonds and disulfide bonds.

Unit-V Enzyme Catalysis and Lipids **(15 Hours)**

Enzyme Catalysis: Types of enzymes - names - Active site - molecular recognition - lock and key model - mechanism of carboxypeptidase A.

Lipids: Fatty acids - omega fatty acids - waxes - fats and oils - PUFA - phospholipids -- prostaglandins - biosynthesis of prostaglandins, thromboxanes, and prostacyclins.

Books for Study

1. Clayden J, Greeves N and Warren S, *Organic Chemistry*, 2nd Edition, Oxford University Press, New York, 2012.
   Unit I *Chapter* 29
   Unit II *Chapter* 8
2. Bruice P Y, *Organic Chemistry*, 4th Edition, Pearson Education, New Delhi, 2012.
   Unit III *Chapter* 27
   Unit IV *Chapter* 22
   Unit V *Chapter* 24

Books for Reference

1. Rodwell D, Bender D and Botham K, *Harper's Illustrated Biochemistry*, 31st Edition, McGraw Hill Professional, New York, 2018.
2. Stryer L, Berg J M, Tymoczko J L and Gatto G, *Biochemistry*, 9th Edition, W. H. Freeman and Company, New York, 2019.

Web Resources

Nucleic Acids

Carbohydrates

Semester	Course code			Title of the Course			Hours			Credits	
III	21PCH3ES03A			DSE-3: BIOORGANIC CHEMISTRY			5			4	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	3	2	2	2	3	3	3	2	2.5
CO-2	2	2	2	2	2	3	2	2	2	2	2.1
CO-3	3	3	3	2	2	3	3	3	2	2	2.6
CO-4	3	2	3	3	2	2	3	2	3	2	2.5
CO-5	2	2	2	3	2	2	3	2	2	2	2.2
Mean overall Score											2.38 (High)

Semester	Course Code	Title of the Course	Hours	Credits
III	21PCH3ES03B	DSE-3 : PHARMACEUTICALCHEMISTRY	5	4

CO. No.	CO – Statements	Cognitive Levels (K Level)
	On successful completion of course, students will be able to	
CO-1	recall the chemistry of bioregulatory drugs.	K1
CO-2	understand the therapeutic uses of drugs containing heterocycles.	K2
CO-3	identify the common diseases and their treatments employed.	K3
CO-4	classify drugs based on their biological, chemical characteristics.	K4
CO-5	apply the concept of chemical reactions in designing the drugs.	K6

Unit-I: Introduction to Chemistry of Drugs (15 Hours)

Drugs - definition- sources- study of drugs -classification (biological, chemical, commercial and utility)-nomenclature of drugs- biotransformation-drug design - factors affecting the stability of drugs- encapsulation - drug delivery systems and sustained release of drugs.

Unit-II: Drugs Containing Heterocycles (15 Hours)

Structures and their therapeutic uses of drugs containing pyridine: nikethamide, isoniazid, mepyramine and niacin-thiazole: niridazole, thiabendazole and sulfathiazole - imidazole: azomycin, metronidazole and clotrimazole - indole: seratonine, reserpine, ergotamine and indomethacin- quinoline: chinofon, chloroquine and primaquine.

Unit-III: Common Diseases and their Treatment (15 hours)

Insect borne diseases - Treatment using drugs - Air borne diseases-Treatment using drugs - water borne diseases- Treatment using drugs-Digestive disorders - treatment- diseases of respiratory system- treatment-diseases of nervous system - treatment - other common diseases- treatment.

Unit-IV: Name Reactions in Drug Synthesis (15 hours)

Mechanism and uses of Beckmann rearrangement- Fries rearrangement- Schmidt reaction-MPV reduction- Clemmensen Reduction-Birch Reduction-Darzen's reaction-Reiley Reaction-Mannich reaction-Michael reaction.

Unit-V: Bioregulatory Drugs (15 hours)

Cardiovascular drugs - Cardiac glycosides - anti arrhythmic drugs -antihypertensive agents - antianginal agents. Diabetes and Hypoglycaemic drugs - two types of diabetes - Diabetes insipidus and diabetes mellitus -Control of diabetes - Insulin -Hypoglycaemic agents. Anticonvulsants -Cancer and antineoplastic drugs - Common causes - antimetabolites.

Books for Study

1. Clayden J, Greeves N and Warren S, *Organic Chemistry*, 2nd Edition, Oxford University Press, New York, 2012.

Unit I *Chapter* 29 **Unit II** *Chapter* 8

2. Gosh J, *Text Book of Pharmaceutical Chemistry*, 3rd Edition, S. Chand & Chand Publications,

New Delhi, 1997.

Unit I *Chapter 2* **Unit III** *Chapter 6* **Unit V** *Chapter 10*

3. George M and Joseph L, *Text Book of Pharmaceutical Chemistry*, Viva Books, New Delhi, 2009. **Unit II** *Chapter 3*

Books for Reference

1. Srivastava, S K, *A Complete Text Book of Medical Pharmacology*, Volume I, 2nd Edition, Avichal Publishing Company, Kolkatta, 2012.
2. Srivastava, S K, *A Complete Text Book of Medical Pharmacology*, Volume II, 2nd Edition, Avichal Publishing Company, Kolkatta, 2012.
3. Deb A C, *Fundamentals of Biochemistry*, New Central Book Agency, Calcutta, 1994.
4. Satake M and Mido Y, *Chemistry for Health Science*, Discovery Publishing House, New Delhi, 2003.
5. Kar A, *Medicinal Chemistry*, Wiley Easterns Limited, New Delhi, 1993.

Web Resources

Medicinal Chemistry Common Diseases Base Catalyzed Reaction

Semester	Course code	Title of the Course	Hours	Credits
III	21PCH3ES03B	DSE-3 : PHARMACEUTICAL CHEMISTRY	5	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	2	3	3	2	3	2	2.5
CO-2	3	3	3	2	2	3	3	2	3	2	2.6
CO-3	3	3	2	2	2	3	3	2	2	2	2.4
CO-4	3	3	3	3	2	3	2	2	3	2	2.6
CO-5	2	2	2	2	2	2	2	2	3	2	2.1
Mean overall Score											2.44 (High)

Semester	Course code	Title of the Course	Hours	Credits
III	**21PCH3EG02**	**GENERIC ELECTIVE - 2 (BS): HEALTH SCIENCE**	**4**	**3**

CO. No.	CO-Statements	Cognitive Level (K -Level)
	On successful completion of course, students will be able to	
CO-1	describe the chemistry of respiration and learn the function of body fluids.	**K1**
CO-2	understand the function of drugs and their mode of action.	**K2**
CO-3	identify basic nutrients involved in maintenance of good health.	**K3**
CO-4	classify common infectious and nutrient deficient diseases.	**K4**
CO-5	explain and discuss the process of digestion.	**K5 & K6**

Unit-I Health **(12 Hours)**

Health - mental health and physical health - food pyramid - types of malnutrition - causes and remedies - macro and micronutrients - carbohydrates - classification and their biological functions, proteins-classification and their biological functions, vitamins - classification and their biological functions - dietary elements (Na, K, Ca, P, Mg, S, Fe, Zn, Se, Mo)

Unit-II Drugs **(12 Hours)**

Drugs - classification of drugs - drugs acting on CNS - general anaesthetics, hypnotics & sedatives, narcotics, antipyretics, antirheumatics, analgesics, anticonvulsants and antitussives - chemotherapeutic drugs - antibiotics, antiseptics and disinfectants - cardiovascular agents - anti cancer drugs - adverse effects of drugs

Unit-III Body Fluids **(12 Hours)**

composition of blood- blood volume, blood groups, functions of blood, blood pressure, anaemia, blood sugar - respiration - oxygen and carbon dioxide transport in blood - haemoglobin -myoglobin - composition of urine - electrolyte balance - Na/K pump

Unit IV Enzymes and Hormones **(12 Hours)**

Enzymes - types and their roles in biochemical reactions - hormones - types and functions - digestion in mouth, stomach, intestine and pancreas

Unit-V Common and Vitamin Deficiency Diseases **(12 Hours)**

Jaundice, cancer, kidney stone - typhoid, dengue, ulcer, goiter, diabetes, rickets, scurvy, beriberi, pellagra, night blindness, Covid-19 - causes - symptoms - diagnosis - vaccines/treatment

Books for Study

1. Ramani A V, *Food Chemistry*, MJP Publishers, Chennai, 2009.
   Unit I *Chapter 1, 2, 3 and 5* **Unit III** *Chapter 1*
   Unit IV *Chapter 1*
2. Ghosh, J A, *Text book of Pharmaceutical Chemistry*, S. Chand and Co. Ltd, 1999.
   Unit II *Chapter 1* **Unit V** *Chapter 1*

Books for Reference

1. Ashutosh Kar, *Medicinal Chemistry*, Wiley Easterns Limited, New Delhi, 1993.
2. Deb A C, *Fundamentals of Biochemistry*, New Central Book Agency, Calcutta, 1994.
3. Parul R. Sheth, *Chemicals of Life*, National Institute of Science Communication (CSIR), 2000.
4. Satake M and Mido Y, *Chemistry for Health Science*, Discovery Publishing, House, New Delhi, 2003.

Semester	Course code	Title of the Course	Hours	Credits
III	21PCH3EG02	GENERIC ELECTIVE - 2 (BS): HEALTH SCIENCE	4	3

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	3	2	2	3	2	3	2	2	2.4
CO-2	2	2	3	2	2	2	2	3	2	2	2.2
CO-3	3	2	3	2	2	3	2	3	2	2	2.4
CO-4	2	2	3	2	2	2	2	3	2	2	2.2
CO-5	3	2	3	2	2	3	2	3	2	2	2.4
										Mean overall Score	2.32 (High)

Semester	Course code	Title of the Course	Hours	Credits
IV	**21PCH4CC08**	**CORE-08: INORGANIC CHEMISTRY - IV**	**6**	**6**

CO No	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	recall the types of inorganic crystals and their characteristics.	**K1**
CO-2	understand various crystal defects.	**K2**
CO-3	apply concepts of photochemistry in the reactions of organometallic complexes.	**K3**
CO-4	examine metal ion binding biomolecules and explain their functions.	**K4 & K5**
CO-5	design metal complexes for anti-cancer activity.	**K6**

Unit-I Solid State -I **(18 Hours)**

Unit cell - types of cubic unit cells - three dimension close packed structures - radius ratio rule - indexing of crystal planes (miller indices) crystal structures of sodium chloride, cesium chloride, zinc blende, wurtzite, fluorite, antifluorite, nickel arsenide and rutile - normal and inverse spinels - applications of crystal field theory to predict the structure of spinels - thermodynamics of ionic crystal formation - lattice energy, Madelung constant, solubility, ion size and HSAB - X-ray diffraction - Bragg's law, rotating crystal method and powder method

Unit-II Solid State - II **(18 Hours)**

Defects in solids - stoichiometric defects - Schottky defect, Frenkel defect - non-stoichiometric defects - metal deficiency defect, metal excess defect - theories of bonding in metals - free electron theory, valence bond theory, band theory - semiconductors (*p*-type and *n*-type) - diodes, photovoltaic effect and light emitting diodes - super conductivity - low temperature super conducting alloys, theory of super conductivity, high temperature super conductors

Unit-III Inorganic Photochemistry **(18 Hours)**

Laws of photochemistry - photophysical processes - Jablonski diagram - fluorescence - phosphorescence - Kasha's rule - Stoke's shift - types of electronic transitions in transition metal complexes - photochemistry of Cr(III) complexes - photosubstitution - photoaquation - Adamson's rules - photorearrangement - photoredox reactions - photochemistry of organometallic compounds.

Unit IV Bioinorganic Chemistry-I **(18 Hours)**

Structure and function of chlorophyll - photo system-I and photo system-II - light reactions and dark reactions - Mn Catalyzed oxidation of H_2O to O_2 in chlorophyll - role of Mg^{2+} ion-structure and function of haemoglobin - cooperative effect in haemoglobin - role of globin - structure and function of myoglobin - structure and function of cytochrome C.

Unit-V Bioinorganic Chemistry-II **(18 Hours)**

Structure and function of blue copper proteins - structure and function of vitamin B_{12} - *in vitro* and *in vivo* nitrogen fixation - Fe-S proteins - ionophores - ion transport mechanism in

cell membrane -Na-K pump - role of metal ions in DNA replication, transcription, translation - *cis*-platin and its mode of action in the treatment of cancer

Books for Study

1. Miessler G L, Fischer P J and Tarr D A, *Inorganic Chemistry*, 5th Edition, Pearson Education, New York, 2014.
   Unit I *Chapter 7* **Unit II** *Chapter 7*
2. Lee J D, *Concise Inorganic Chemistry*, 5th Edition, Blackwell Science Ltd, Oxford, London, 1996. **Unit II** *Chapter 3*
3. Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity,* 4th Edition, Harper Collins College Publishers, New York, 1993.
   Unit II *Chapter 4* **Unit IV & V** *Chapter 20*
4. Rohatgi-Mukherjee K K, *Fundamentals of Photochemistry,* New Age International Publishers, New Delhi, 2006. **Unit III** *Chapter 4*

Books for References

1. Keer H V, *Principles of Solid State,* Wiley Eastern Ltd, New Delhi, 1993.
2. Bertini I, Gray H B, Lippard S J and Valentine J S, *Bioinorganic Chemistry*, University Science Books, California, 1994.
3. Azaroff, *Introduction to Solids,* Tata McGraw Hill Publishing Co., New Delhi, 1994.
4. Evans R C, *Crystal Chemistry*, Cambridge University Press, London, 1964.
5. Addison W E, *Structural Principles of Inorganic Compounds,* Longman, London, 1961.
6. West A R, *Solid State Chemistry and its Applications,* 2nd Edition, John-Wiley and Sons Ltd, New York, 2014.
7. Wheatly P J, *The Determination of Molecular Structure,* Oxford University Press, London, 1959.
8. Purcell K F and Kotz J C, *Inorganic Chemistry*, W B Saunders Company, Philadelphia, 1977.

Web resources

X-ray Diffraction | Crystal Structure | Semiconductor | Cytochromes | Organometallic Compounds

Semester	Course code	Title of the Course	Hours	Credits
IV	21PCH4CC08	CORE08: INORGANIC CHEMISTRY - IV	6	6

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	2	2	2	3	2	2	2	2	2.2
CO-2	1	2	2	3	2	1	2	2	3	2	2.0
CO-3	2	2	3	2	2	2	2	3	2	2	2.2
CO-4	2	2	2	2	3	2	2	2	2	3	2.2
CO-5	2	2	2	3	2	2	2	2	3	2	2.2
Mean overall Score											2.16 (Medium)

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PCH4CC09	CORE-09: ORGANIC CHEMISTRY-IV	5	5

CO. No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	name the synthesis and application of organometallic reagents.	K1
CO-2	overview of modern name reactions.	K2
CO-3	get familiarized with the selectivity in reactions and control them.	K3
CO-4	analyze and explain the methods of synthesizing target molecules.	K4 & K5
CO-5	understand and design the methods of asymmetric synthesis.	K6

Unit-I Retro-synthetic analysis (15 Hours)

Synthons and synthetic equivalents - types of synthons: donor and acceptor synthons - umpolung reactions - typical examples. Functional Group Interconversion (FGI), Functional Group Addition (FGA) - monofunctional disconnection: alcohol disconnection - alkene disconnection - ketone disconnection - acid and their derivatives disconnection - alkane disconnection - amine disconnection - bifunctional 1,2-, 1,3-, 1,4-, 1,5-, and 1,6-disconnections.

Multistep Synthesis:

Illustrative synthesis of Juvabion from 4-methoxyacetophenone and from 4-methoxy-benzaldehyde

Unit - II Selectivity in Organic Synthesis (15 Hours)

Chemoselectivity:

Chemo-, region-, and stereoselectivity - reactivity of carbonyl groups towards nucleophiles - selectivity of hydrides in reduction - selectivity in oxidations - Protecting groups - hydroxyl, amino, carbonyl and carboxylic acid protecting groups

Regioselectivity: Regioselectivity in electrophilic and nucleophilic aromatic substitution, regioselectivity in elimination reactions, electrophilic attack on alkenes, regioselectivity in radical reactions, nucleophilic attack on allylic compounds, electrophilic attack on conjugated dienes and conjugate addition.

Unit - III Asymmetric Synthesis (15 Hours)

Chiral auxiliaries - alkylation of chiral enolates - enantiomeric excess-optical purity - chiral reagents and chiral catalysis - asymmteric hydrogenation - asymmetric epoxidation - asymmteric dihydroxylation

Diastereoselectivity: prochirality, Cram's rule and chelation effect, diastereoselectivity in aldol reaction, diastereoselective epoxidation.

Unit - IV Organometallic Reagents (15 Hours)

Preparation of organometallics: oxidative insertion, deprotonation of alkyne, ortholithiation of functionalized benzene rings, halogen metal exchange, transmetallation - preparation and properties and synthetic applications of organolithium, organomagnesium, organocopper reagents and intermediates - synthesis, features and reactions of organosilicon compounds - reactions involving organopalladium intermediates - Heck reaction - cross coupling reactions - Suzuki coupling, Stille coupling, Fukuyama coupling - Negishi coupling, Kumada coupling-Sonogashira reaction-carbonylation reactions - olefin metathesis reactions.

Unit - V Name Reactions **(15 Hours)**

Chan-Lam coupling, Hiyama coupling - Corey-Fuchs Reaction, Baylis-Hillman reaction - Biginelli reaction - Mukaiyama aldol reaction - Prins reaction, Mitsunobu reaction - Weinreb ketone synthesis Henry reaction - Hosomi-Sakurai reaction - Norrish Type I and II reactions - Paterno-Buchi and its regioselectivity - Barton reaction - Hofmann - Loeffler-Freytag reaction.

Books for Study

1. Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part A: Structure and mechanisms*, 5th Ed., Springer (India) Pvt Ltd. New Delhi, India, 2007.
   Unit I Chapter
2. Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part B: Structure and Mechanisms*, 5th Ed., Springer (India) Pvt Ltd. New Delhi, India, 2007.
   Unit I *Chapter 13* **Unit II** *Chapter 3* **Unit IV** *Chapter 7-9*
3. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, Oxford University Press, New York, 2012.
   Unit I *Chapter 28* **Unit II** *Chapter 23* **Unit III** *Chapter 41*
   Unit IV *Chapter 40* **Unit V** *Chapter 48*

Books for Reference

1. Warren S, *Designing Organic synthesis: The Disconnection Approach*, Wiley, New Delhi, 1984.
2. Bruchner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010.
3. Richard O. Norman.C, Coxon J M, *Principles of Organic Synthesis*, 3rd Ed., CRC Press, Boca Raton, Florida, USA, 1993 .

Web Resources

Retrosynthesis Chemoselective Asymmetric synthesis

Semester	Course code	Title of the Course	Hours	Credits
IV	21PCH4CC09	Core 09: ORGANIC CHEMISTRY-IV	5	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	3	2	2	2	3	2	2	3	2.4
CO-2	2	3	1	2	3	2	2	3	3	2	2.3
CO-3	3	2	2	2	1	3	2	2	1	2	2.0
CO-4	3	2	2	2	1	2	3	2	3	1	2.1
CO-5	2	3	2	3	2	2	3	2	1	3	2.3
Mean overall Score											2.22 (High)

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PCH4CC10	CORE-10: PHYSICAL CHEMISTRY-III	4	4

CO. No.	CO-Statements On successful completion of this course, students will be able to	Cognitive Levels (K-Level)
CO-1	recall and understand the concept of sensors and apply to real life examples	K1 & K2
CO-2	imbibe and apply the concepts of polarography and cyclic voltametry	K3
CO-3	examine the applications of quantum chemistry	K4
CO-4	interpret the concepts of molecular orbital theory to evaluate few organic molecular systems	K5
CO-5	elaborate the concepts and instrumentation of amperometry and electrogravimetry	K6

Unit-I Electrochemical and Biosensors (12 Hours)

Basic sensor technology - sensor systems - sensor characteristics - system characteristics - instrument selection - data acquisition and readout introduction - FET & MOSFET - chemical sensor - biosensors - ion exchange membrane electrodes - electrolytic sensors - electrochemical sensors.

Unit-II Electroanalytical Techniques - I (12 Hours)

Polarography - experimental setup - advantages of dropping mercury electrode - supporting electrolyte - polarographic peak maxima - types of peak maxima - polarographic peak maxima suppressor - residual current - migration current - diffusion current - polarogram - half wave potential - Ilkovic equation (derivation is not required) - outline of applications (Polarogram of Zn^{2+} and Cd^{2+}) - cyclic voltametry, principle, experimental set up - cyclic voltammogram of Fe^{2+} in H_2SO_4 - anodic peak current - cathodic peak current - electrochemically reversible couple - cathodic peak potential - anodic peak potential - electrochemically irreversible couple - outline of applications.

Unit-III Electro Analytical Techniques II (12 Hours)

Amperometry - principle of amperometric titration - different types of current voltage curves - amperometric titration between Pb^{2+} vs $K_2Cr_2O_7$, Pb^{2+} vs SO_4^{2-}, SO_4^{2-} vs Pb^{2+} Ni^{2+} vs DMG- Electrogravimetry - principle - experimental set up - physical characteristics of metal deposits - separation of Cu & Ni - Coulometry - principle, experimental set up - controlled potential coulometric analysis and application - experimental set up for constant current coulometry - coulometric - titration of Fe(II) with Cerium(III).

Unit-IV Applications of Quantum Chemistry I (12 Hours)

Approximation methods - need for approximation - perturbation theory - time independent perturbation - first order and second order perturbation theory - application of perturbation theory to particle in one dimensional box - anharmonic oscillator and helium atom - principle of variation and its proof - trial function and secular determinant- variation methods and its applications to hydrogen and helium atoms - particle in one dimensional box.

Unit-V Applications of Quantum Chemistry II (12 Hours)

The Born - Oppenheimer approximation- VB theory of hydrogen molecule and MO theory of hydrogen molecular ion (H_2^+) - coulomb integral- exchange integral and overlap integral- detailed calculation of energy and overlaps- construction of sp, sp^2 and sp^3 hybrid orbitals- Huckel molecular orbital theory - principles and applications to ethylene, butadiene, benzene, cyclobutadiene, trimethylamine, bicyclobutadiene and allyl systems- Hartee - Fock method- self consistent field method and Roothan equations.

Books for Study

1. Willard, Merit, Dean and Settle, *Instrumental Methods of Analysis,* 7th Edition, CBS Publication New Delhi, 2004. **Unit II** *Chapter XVI*
   Unit III *Chapter XVII & XV*
2. Kaur, H. *Instrumental Methods of Chemical Analysis,* Revised 4th Edition, Pragati Prakashan Educational Publishers, 2010.
   Unit II*Chapter 37* **Unit-III** *Chapter 3, 36 & 40*
3. Anatharaman R, *Fundamentals of Quantum Chemistry*, McMillan, New Delhi, 2001.
   Unit IV and V *Chapter 5 - 7*
4. Prasad R K, *Quantum Chemistry*, Revised 4th Edition, New age international (P) Ltd., New Delhi, 2008. **Unit IV and V** *Chapter 5&6*
5. *Department Study Material*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirapalli. **Unit I**

Books for Reference

1. Vogel A I, *Text book of Quantitative Inorganic Analysis*, ELBS, 1978.
2. McQuarrie D A, *Quantum Chemistry*, 2nd Indian Edition, Viva Books Private Ltd., 2008.
3. Levine I N, *Quantum Chemistry*, 6th Edition, PHI Learning Private Limited, 2009.
4. Noel M and Vasu K I, *Cyclic Voltammetry and the Frontiers of Electrochemistry*, Oxford and IBH, 1990.
5. Kissinger P T and Heinman, *Laboratory Techniques in Electroanalytical Chemistry*, Editors, Marcel, Dekker, Inc., New York, 1984.
6. Puri Sharma and Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 47th Edition, 2017.

Web resources

Polarography	Cyclic voltammetry-I	Cyclic voltammetry-II	Coulometry

Semester	Course code			Title of the Course			Hours			Credits
IV	21PCH4CC10			CORE-10: PHYSICAL CHEMISTRY-III			4			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	2	3	2	2	2	1	2.2
CO-2	2	2	2	2	2	2	2	2	2	1	1.9
CO-3	3	2	2	2	2	3	2	2	2	1	2.1
CO-4	2	3	2	2	2	2	3	2	2	2	2.2
CO-5	2	2	2	2	2	2	2	2	2	1	1.9
Mean overall Score											2.06 (Medium)

Semester	Course Code	Title of the Course	Hours	Credits
IV	**21PCH4CP06**	**ORGANIC CHEMISTRY PRACTICAL- II**	**4**	**3**

CO. No.	CO-Statements On successful completion of this course, students will be able to	Cognitive Levels (K -Level)
CO-1	describe the principles of quantitative analysis in organic chemistry	**K1**
CO-2	understand the procedure for estimation of organic compounds	**K2**
CO-3	analyze the amount of oils, proteins and dyes	**K3**
CO-4	estimate the phenol, Aniline and Glucose	**K5**
CO-5	prepare organic compounds *via* single and double stage method	**K6**

Unit- I Quantitative Analysis Organic Compounds (12 Hours)

1. Determination of saponification value of edible oil.
2. Estimation of iodine value of oil.
3. Estimation of phenol
4. Estimation of aniline.

Unit- II Quantitative Analysis Organic Compounds (12 Hours)

1. Estimation of ketone.
2. Estimation of glucose.
3. Estimation of ascorbic acid.

Unit - III Preparation of Organic Compounds (Single-Stage) (12 Hours)

1. Preparation of acetanilide from aniline
2. Preparation of *p*-nitroaniline from acetanilide
3. Preparation of *p*-bromoaniline from acetanilide
4. Preparation of methyl nitrobenzoate from methyl benzoate

Unit - IV Preparation of Organic Compounds (Two-stage) (12 Hours)

1. Preparation of orange-II dye
2. Preparation of *p*-nitroaniline
3. Preparation of methyl orange dye
4. Preparation of *p*-bromoaniline

Unit - V Preparation of Organic Compounds (Two-stage) (12 Hours)

1. Preparation of 1,3,5-tribromobenzene
2. Preparation of acetyl salicyclic acid (aspirin)
3. Preparation of methyl red

Book of References

1. Ganapragasm N S and Ramamurthy C, *Organic Chemistry Lab Manual*, 2nd Edition, Vishwanathan S Printers and Publishers (P) Ltd., Chennai, 2015.
2. Furniss B S, Hannaford A J, Smith P W G, and Tatchell A R, *Vogel's Textbook of Practical Organic Chemistry*, 5th Edition, Pearson publication.
3. Venkateswaran V, Veeraswamy R, Kulandaivelu A R, *Basic Principles of Practical Chemistry*, 2nd Edition, Sultan Chand and Sons, New Delhi, 1997.

4. *Organic Chemistry Lab Manual for Micro Qualitative Analysis*, Department of Chemistry, St. Joseph's College, Tiruchirappalli-620 002, (Private circulation).

Web Resources

Estimation of Phenol

Preparation of Orange II Dye

Scheme of Valuation

Organic Chemistry Practical-II **Estimation and preparation**

INTERNAL

CIA **100 Marks**

Cumulative mark of Regular Practical Classes	40 Marks
Record	10 Marks
Two CIA tests	50 Marks

For Each CIA Test ***100 marks***

Procedure	10 Marks
Test/Viva	10 Marks
Results	80 Marks (60 marks for estimation and 20 marks for preparation)

Organic Estimations

<1% Error	60 Marks
2%	50 Marks
3%	40 Marks
4%	30 Marks
>4%	20 marks

Preparation

10 marks each for the crude and recrystallized samples

EXTERNAL

Total **100 Marks**

Procedure	10 Marks
Test	10 Marks
Results	80 Marks (60 marks for estimation and 20 marks for preparation)

Organic Estimations

<1% Error	60 Marks
2%	50 Marks
3%	40 Marks
4%	30 Marks
>4%	20 marks

Preparation

10 marks each for the crude and recrystallized samples

Semester	Course code	Title of the Course	Hours	Credits
IV	21PCH4CP06	ORGANIC CHEMISTRY PRACTICAL- II	4	3

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	1	2	3	3	2	3	2	3	3	2.4
CO-2	1	2	3	3	2	3	3	3	3	3	2.6
CO-3	2	3	2	3	2	2	3	2	2	2	2.3
CO-4	3	2	3	3	2	2	3	1	2	3	2.4
CO-5	2	3	2	2	3	2	2	3	3	1	2.3
Mean overall Score											2.4 (High)

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PCH4ES04A	DSE-4: SELECTED TOPICS IN INORGANIC AND PHYSICAL CHEMISTRY- I	5	4

CO. No.	CO-Statements	Cognitive Levels (K -Level)
	On successful completion of this course, students will be able to	
CO-1	know the different types of organometallic reactions	K1
CO-2	discuss the role of organometallic complexes in catalytic processes	K2
CO-3	illustrate the industrial importance of compounds of main group elements	K3
CO-4	Identify the importance of partial molar properties	K4
CO-5	explain the concepts of fugacity and activity	K5 & K6

Unit-I Types of organometallic reactions (15 Hours)

Oxidative addition - addition of H-H, C-H, C-C, X-X and R-X bonds. Reductive elimination - cis-elimination, C-H elimination and dinuclear reductive eliminations. Insertion and deinsertion - 1, 1-insertion (carbonyl insertion or alkyl migration), 1,2-insertion (beta-elimination), insertion into M–H, M–C bonds. Nucleophilic addition to the ligand - addition to CO, carbene and pi-ligands. Metathesis reactions.

Unit-II Homogeneous catalysis by transition metal complexes (15 Hours)

Key steps in homogeneous catalysis - catalyst activation, substrate coordination, oxidative addition, reductive elimination, nucleophilic attack on substrate and product dissociation. The hydroformylation reaction - Co and Rh catalyzed hydroformylation reactions. The Wacker-Smidt synthesis of acetaldehyde, Hydrogenation of alkenes, carbonylation of methanol, Pd catalyzed C-C bond forming reactions, Reduction of Carbon Monoxide (Fischer-Tropsch Synthesis), oligomerization and polymerization reactions.

Unit-III Chemistry of the main group elements (15 Hours)

Allotropy, synthesis, structure and bonding, industrial importance of the compounds of the *s* and *p* block elements.

Unit-IV Chemical Thermodynamics I (15 Hours)

Partial molar properties - molarity and mole fraction - partial molar quantities - methods of determination of partial molar volume - chemical potential - Gibbs-Duhem equation - chemical potential of mixture of gases - chemical potential in terms of U, H - variation of chemical potential with temperature and pressure - determination of partial molar properties from apparent molar properties - free energy of mixing - entropy of mixing and volume of mixing- fugacity - definition - methods of determination - variation of fugacity with temperature, pressure and composition - Duhem-Margules equation - fugacity of solids, liquids and mixture of gases - determination of fugacity in gas mixtures (Lewis-Randall Rule).

Unit-V Chemical Thermodynamics II (15 Hours)

Activity and activity coefficients - definition - standard state- reference state- choice of standard state for gases, liquids and solids, liquid solvent and solute - dependence of activity

on temperature and pressure - determination of activity coefficient of non-electrolyte - mean ionic activity - determination of activity coefficient of electrolytes by freezing point method.

Books for Study

1. Miessler G L, Fischer P J and Tarr D A, *Inorganic Chemistry*, 5th Edition, Pearson Education, New York, 2014.
   Unit-I *Chapter 14* **Unit-II** *Chapters 14* **Unit-III** *Chapters 8*
2. Kuriakose J C and Rajaram J C, *Thermodynamics*, Shoban Lal Co., Jalandar, 1999.
   Unit IV and V*Chapter 8 and 10*

Books for Reference

1. Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry*, 7th Edition, Oxford University Press, London, 2018.
2. Spessard G O and Miessler G L, *Organometallic Chemistry*, 2nd Edition, Oxford University Press, New York, 2010.
3. Gupta M C, *Statistical Thermodynamics*, 2nd Edition, New Age International Publishers, Chennai, 1998.
4. McQuarrie D A, *Statistical Thermodynamics*, 1st Indian Edition, Viva Books Private Ltd., New Delhi, 2003.

Web resources

Organometallic Chemistry Applications

Semester	Course Code					Title of the Course					Hours	Credits
IV	21PCH4ES04A					DSE-4:SELECTED TOPICS IN INORGANIC AND PHYSICAL CHEMISTRY- I					5	4
Course Outcomes (COs)	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean Scores of COs	
CO-1	3	3	2	2	2	3	3	2	2	2	2.4	
CO-2	3	2	2	2	1	3	2	2	2	1	2.0	
CO-3	2	2	2	2	2	2	2	2	2	2	2.0	
CO-4	2	2	2	2	3	2	2	2	2	3	2.2	
CO-5	2	3	2	2	2	2	3	2	2	2	2.2	
Mean Overall Score											2.16 (Medium)	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PCH4ES04B	DSE-4: SELECTED TOPICS IN CHEMISTRY	5	4

CO. No.	CO-Statements	Cognitive Levels (K- Level)
	On successful completion of this course, students will be able to	
CO-1	know the different types of measurements and instrumentation	K1
CO-2	understand the importance of operational amplifiers	K2
CO-3	understand the basics of non- equilibrium thermodynamics	K2
CO-4	apply the concepts of non-equilibrium thermodynamics	K3
CO-5	explain the basics of digital electronics	K4

Unit-I Measurement and Instrumentation (15 Hours)

Introduction - the nature of a measurement - choice of a method of measurement - control of variables - basic design patterns - general properties of modules - propagation of uncertainty - single channel design- limit of detection and amplification - automatic operation and computer control

Unit-II Operational Amplifiers (15 Hours)

The operational amplifier - limitations on amplifier performance -mathematical operations - differentiation - integration - measurement of current and voltage - precise control of current and voltage

Unit-III Digital Electronics (15 Hours)

Binary logic concepts - logic gates - multivibrators - counters - wave shaping - analog to digital converters - instruments and digital computers

Unit-IV Non-equilibrium Thermodynamics-I (15 Hours)

Introduction to non-equilibrium thermodynamics - methods of study of non-equilibrium thermodynamics - mass conversion de-Donder equation - energy conservation - entropy production in systems involving heat transfer - entropy production in chemical reactions - affinity and equilibrium constant - affinity and Gibbs free energy - affinity and rate derivations - coupled and non-coupled reaction systems - entropy production and entropy flow in open system - Onsager theory -phenomenological relations - an introduction - characteristics of direct and cross coefficients - rate expression using Onsager equation - kinetic approach - thermodynamic approach - derivation of Onsager reciprocity relation using a cyclic coupled reaction (Proof of L12 = L21).

Unit-V Non-equilibrium Thermodynamics-II (15 Hours)

Linear law - condition for coupled and non-coupled reactions with reference to cross coefficients - decomposition of cyclohexane and linear law - non coupled reaction - isomerization of xylene - coupled reaction - reaction taking place in liver - experimental verification of Onsager's reciprocity relation - thermoelectricity - Seebeck effect - Peltier effect - electro kinetic effect - thermo molecular pressure difference - L12 = L21 by transference number method - irreversible thermodynamics and biological systems.

Books for Study

1. Strobel H A, *Chemical Instrumentation: A systematic Approach*, 2nd Edition, Addision Wesley Publishing Company, London, 1973
   Unit I *Chapter 1* **Unit II** *Chapter7* **Unit III** *Chapter 9*
2. Kuriakose J C and Rajaram J C, *Thermodynamics*, Shoban Lal Co., Jalandar,1999.
   Unit IV and V *Chapter Appendix A & B*

Books for Reference

1. Skoog D A, Holler J F and Crouch S R, *Principles of Instrumental Analysis*, 7th Edition, Boston, 2018.
2. Skoog D A, West D M, Holler F J, and Crouch S R, *Fundamentals of Analytical Chemistry*, 9th Edition, Brooks/Cole Cengage Learning, Belmont, CA 94002-3098, USA, 2014.
3. Gupta M C, *Statistical Thermodynamics*, 2nd Edition, New Age International Publishers, Chennai, 1998.
4. McQuarrie D A, *Statistical Thermodynamics*, 1st Indian Edition, Viva Books Private Ltd., New Delhi, 2003.

Web Resources

Chemical Process Instrumentation

Semester	Course code	Title of the Course	Hours	Credits
IV	21PCH4ES04B	DSE-4: SELECTED TOPICS IN CHEMISTRY	5	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	1	3	2	3	2	1	2.2
CO-2	3	2	2	2	2	3	2	2	3	2	2.2
CO-3	2	2	2	2	1	2	2	2	2	1	1.8
CO-4	3	3	2	2	2	2	3	3	2	2	2.4
CO-5	2	3	2	2	2	2	2	3	2	2	2.2
Mean overall Score											2.16 (Medium)

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PCH4PW01	PROJECT WORK AND VIVA VOCE	6	5

CO. No.	CO-Statement	Cognitive Level (K - level)
	On successful completion of this course, students will be able to	
CO-1	relate and understand the basic aspects of research.	K1 & K2
CO-2	identify current chemical literature and other search engines judiciously.	K3
CO-3	discover synthetic skills in carrying out research problem.	K4
CO-4	appraise scientific writing and presentation skill for preparing project reports.	K5
CO-5	design new research problems and carry out systematically.	K6

Unit-I Introduction and Fundamentals of Research (5 hours)

Research: Definition - search for knowledge - role of theory-research hypothesis and null hypothesis - populations and sampling - purposes of research - types of educational research: fundamental research - applied research - action research - descriptive research, assessment, and evaluation.

Unit-II Problem identification and Research Design (5 hours)

Scientific research problem: Definition, objectives, purposes and components of research problem-ethics in research.

Unit-III Chemical Literature Survey (5 hours)

Introduction to the chemical literature-non-patent primary literature: communications, articles, reviews, conference papers, reports, abstracts and preprints-chemical patents.
Searching using text: beyond web search engines-searching by structure and substructure.

Unit-IV Project Work-Lab (70 hours)

Identification of research problem - collection of materials -preliminary analysis - finalizing the methodology - execution of the research work - collection of data and evidences - finalizing the results.

Unit-V Compilation of Report (5 hours)

Scientific Writing and Effective Presentation: Requirement of scientific communications: eliminating wordiness and jargon-tautology, redundancy, imprecise words, superfluous phrases - style of writing-footnotes and end notes- referencing styles-bibliography-journal abbreviations (CAS source index) -abbreviations used in scientific writing-Effective presentation: slide presentation and poster presentation- Report preparation:

Format of the Research Report

I. Title Page
- Title
- Author's name and institutional affiliation
- Running head

II. Introduction (no heading)
- Statement of the problem
- Background/review of literature
- Purpose and rationale/hypothesis

III. Method
- 1.Apparatus or instrumentation
- 2. Procedure

IV. Results
- Tables and figures, as appropriate (these follow the author note)
- Statistical/ analytical presentation

V. Discussion
- 1.Support or nonsupport of hypotheses
- 2. Practical and theoretical implications
- 3. Summary and Conclusions

VII. References

VIII. Appendix (if appropriate)

Books for Study

1. Best J W, Kahn J V, *Research in Education*, 10th Edition. Pearson Education Inc. 2006, USA.
Unit I *Chapters 1* **Unit II** *Chapters 2* **Unit V** *Chapter 3*

2. Currano, J and Roth, D (editors), *Chemical Information for Chemists: A Primer*, Royal Society of Chemistry, 2013. **Unit III** *Chapters 1-5*
3. Coghill, A M and Garson, L R (editors), *The ACS Style Guide: Effective Communication of Scientific Information*; 3rd Edition, American Chemical Society: Washington, DC, Oxford University Press, NY, 2006. **Unit V** Style guide

Books for Reference

1. Dominoswki, R L, *Research Methods*, Prentice Hall, 1981.
2. Ebel, H F, Bliefert, C and Russey, W E, *The Art of Scientific Writing*, VCH, Weinheim, 1988.
3. Dawson, C, *Introduction to Research Methods: A practical guide for anyone undertaking a research project* 5th Edition, Robinson, 2019.

Web Resources

Guide to Web Resources

Semester	Course code	Title of the Course	Hours	Credits
IV	21PCH4PW01	PROJECT WORK AND VIVA VOCE	6	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	3	3	3	2	2	2	2.5
CO-2	2	2	2	2	3	2	3	2	2	3	2.3
CO-3	3	2	2	2	3	3	3	2	2	3	2.5
CO-4	2	3	2	2	3	2	3	2	2	3	2.3
CO-5	3	3	2	3	3	3	3	2	3	3	2.8
Mean overall Score											2.48 (High)

Scheme of Evaluation

Internal examination	**100 marks**
Review of literature	15 marks
Experimental work	30 marks
Manuscript preparation	30 marks
Common *viva- voce* examination	25 marks
External examination	**100 marks**
External examiner	**(75 marks)**
Review of literature	10 marks
Experimental work	20 marks
Manuscript preparation	20 marks
Viva voce examination	25 marks
Internal examiner	**(25 marks)**
Viva voce examination	25 marks

Semester	Course code	Title of the course	Hours	Credits
IV	21PCH4CE01	COMPREHENSIVE EXAMINATION	-	2

CO. No.	CO-Statements On successful completion of the course, students will be able to	Cognitive Levels (K-Level)
CO-1	recall and understand the concepts of inorganic chemistry	K1 & K2
CO-2	apply various rules and theories of physical chemistry	K3
CO-3	solve the different spectroscopic problems	K4
CO-4	revise the various aspects of inorganic chemistry	K5
CO-5	predict the reactions and mechanisms in the organic synthesis	K6

Unit-I Inorganic Chemistry 1

Transition elements, inner transition elements, ionic bonding, covalent bonding, periodicity and the chemistry of halogens and noble gases, inorganic chains, rings, cages and clusters theories of coordination chemistry, basics of organometallics.

Unit-II Inorganic Chemistry 2

Reaction kinetics in coordination chemistry, types of magnetic behavior, temperature independent paramagnetism, electronic spectra of complexes - error analysis, spinels and anti-spinels, elements of crystallography, crystal structure and properties, bio-inorganic chemistry, blue copper proteins.

Unit-III Physical Chemistry

Laws of thermodynamics - I and II law, Joule Thomson effect - thermo chemistry - Kirchhoff's equation - III law of thermodynamics, radiation chemistry, surface chemistry and heterogeneous catalysis, surface chemistry and heterogeneous catalysis rudiments and applications of group theory, EMF measurements.

Unit -IV Organic Chemistry

Stereochemistry and conformational analysis, molecular rearrangements and name reactions of organic compounds, oxidation and reduction reactions of various organic compounds. covalent bonding & aromaticity, reaction intermediates & methods of determining mechanisms. retrosynthetic analysis, pericyclic reactions - photochemistry- regioselective and diastereoselective reactions, asymmetric synthesis, organometallics in organic synthesis, electroanalytical techniques

Unit V Spectroscopy

Organic Spectroscopy: UV-visible spectroscopy, IR spectroscopy, PMR spectroscopy, ESR spectroscopy, mass spectrometry

Inorganic Spectroscopy: rotational, vibrational, Raman, NMR, Mossbauer ESR and electronic spectroscopy.

Book for Reference

1. Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3rd edition, Interscience Publishers, New York, 1972.
2. Shriver D, Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry* 6th edition , W H Freeman and Company, New York,2014.
3. Housecroft C E and Sharpe A G, *Inorganic Chemistry* 4th edition , Pearson Education Limited, Essex, 2012.
4. Ebsworth EAV, *Structural Methods in Inorganic Chemistry*, 3rd edition, Great Britain, ELBS, 1987.
5. March J, *Advanced Organic Chemistry*, 4th edition, John-Wiley and Sons, New York, 1992.
6. Kemp W, *Organic Spectroscopy*, 3rd edition, ELBS, London, 1987.
7. Jonathan Clayden, Nick Greeves, and Stuart Warren, *Organic Chemistry*, 2nd Edition, Oxford University Press, New York, 2012.
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Web Resources

EMF-Measurements

Semester	Course code	Title of the Course	Hours/Week	Credits
IV	21PCH4CE01	COMPREHENSIVE EXAMS	-	2

Course Outcomes (COs)	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean Scores of COs
CO-1	3	3	2	2	3	3	2	3	2	1	2.3
CO-2	3	2	2	2	1	3	2	3	2	1	2.1
CO-3	2	3	2	2	2	2	2	3	2	3	2.2
CO-4	3	2	2	2	2	2	2	2	2	2	2.1
CO-5	3	3	2	2	2	2	3	3	2	2	2.4
Mean Overall Score											2.2 (High)