ALAGAPPA UNIVERSITY

(A State University Established in 1985)

Karaikudi - 630003. Tamil Nadu, India

2017 Accredited with A+ Grade by NAAC (CGPA : 3.64)

2018 MHRD Govt. of India UGC Graded on Category - 1 & Granted Autonomy

2018 MHRD Swachh Campus Rank : 4

2021 nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK Rank : 33

2021 UNIVERSITY RANKINGS Asia Rank : 199

FACULTY OF SCIENCE

DEPARTMENT OF INDUSTRIAL CHEMISTRY

M.Sc., CHEMISTRY

REGULATIONS AND SYLLABUS

(For the candidates admitted from the Academic Year 2022 - 2023)

DEPARTMENT OF INDUSTRIAL CHEMISTRY
M.Sc., Chemistry

REGULATIONS AND SYLLABUS

[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

ALAGAPPA UNIVERSITY
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle andGraded as Category-I University by MHRD-UGC)
Karaikudi -630003, Tamil Nadu.

ALAGAPPA UNIVERSITY
DEPARTMENT OF INDUSTRIAL CHEMISTRY
Karaikudi -630003, Tamil Nadu.

REGULATIONS AND SYLLABUS - (CBCS-University Department)
[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

Name of the Department : Industrial Chemistry

Name of the Programme : M.Sc., Chemistry

Duration of the Programme : Full Time (Two Years)

Choice-Based Credit System

Choice-Based Credit System is a flexible system of learning. This system allows students to gain knowledge at their own tempo. Students shall decide on electives from a wide range of elective courses offered by the Department in consultation with the Departmental committee. Students undergo additional courses and acquire more than the required number of credits. They can also adopt an inter-disciplinary and intra-disciplinary approach to learning, and make the best use of the expertise of available faculty and resources.

Programme

"Programme" means a course of study leading to the award of a degree in a discipline.

Course

'Course' is a component (a paper) of a programme. Each course offered by the Department is identified by a unique course code. A course contains lectures / tutorials / laboratory / seminar / project work / internship / report / viva-voce, etc or a combination of these, to meet effectively the teaching and learning needs.

Credit

The term "Credit" refers to the weightage given to a course, usually in relation to the instructional hours assigned to it. Normally in each of the courses, credit(s) will be assigned on the basis of the number of lectures / tutorial / laboratory and other forms of learning required to complete the course contents in a 15-week schedule. One credit is equal to one hour of lecture per week. For laboratory / field work, one credit is equal to two hours.

Semester

An academic year is divided into 2 semesters. In each semester, courses are offered in 15 teaching weeks and the remaining 5 weeks are to be utilized for conduct of examination and evaluation purposes. Each week has 30 working hours spread over 5 days a week.

Medium of Instruction

Medium of Instruction is English.

Departmental committee

The Departmental Committee consists of the faculty of the Department. The Departmental Committee shall be responsible for admission to all the programmes offered by the Department including the conduct of entrance test, verification of records, admission, and evaluation. The Departmental Committee determines the deliberation of courses and specifies the allocation of credits semester-wise and course-wise. For each course, it will also identify the number of credits for lectures, tutorials, practicals, seminars etc. The courses (Core / Discipline Specific Elective / Non-Major Elective) are designed by teachers and approved by the Departmental Committee. Courses approved by the Departmental Committee shall be approved by the Board of Studies or Broad Based Board of Studies as the case may be. A teacher offering a course will also be responsible for maintaining attendance and performance sheets (CIA-1, CIA-2, assignments and seminar) of all the students registered for the course.

For non-major elective course, MOOCs coordinator and internal mentor are responsible for submitting the performance sheet to the Head of the department. The Head of the Department consolidates all such performance sheets of courses pertaining to the course offered by the Department and then forwards the same to the Controller of Examinations.

Programme Educational Objectives (PEO)

PEO-1	To acquire deep knowledge in fundamental aspects of all branches of Chemistry.
PEO-2	To provide thorough, well designed studies of theoretical and experimental Chemistry, a worthwhile educational experience.
PEO-3	To acquire basic knowledge in the specialized thrust areas
PEO-4	To develop abilities and skills that are relevant to the study and practice of Science
PEO-5	To develop abilities and skills those are useful in everyday life.
PEO-6	To develop attitudes relevant to Science such as accuracy, precision, integrity, enquiry, initiative, inventiveness.
PEO-7	Content for chemistry students, designed to complement lecture material with a focus on the application of computational chemistry.
PEO-8	To introduce students to the field of bio-inorganic chemistry, which is increasingly relevant due to the growing role of metals in medicine.
PEO-9	To acquaint students with the synthesis, including polynuclear compounds, heterocyclic compounds, reagents in organic synthesis, and basic concepts of supramolecular chemistry.
PEO-10	To enable students to understand polymerization kinetics and thermodynamics, the course will cover various techniques for determining molecular mass and the applications of polymers in different fields of life.

Programme Specific Objectives (PSO)

PSO-1	To relate the properties, reactions and applications of various chemical entities using the theories and principles.
PSO-2	To evaluate various reaction mechanisms to plan routes in the synthesis.
PSO-3	To choose the right modus operandi for reactions and processes in the laboratory with safety and environmental security.
PSO-4	To comprehend the mathematical and physical basis of the behaviour of chemical species and processes.
PSO-5	To develop analytical and problem solving skills.

Programme Outcome (PO)

PO-1	To apply knowledge obtained in Chemistry lecture to problem-solving and critical thinking.
PO-2	To utilize mathematical knowledge gained from Chemistry to perform common calculations, including mass balance, limiting reagent, percentage yield.
PO-3	To maintain scientific notebook using notional and descriptive content of information on reagents, procedures and data.
PO-4	To characterize chemical samples by physical, chemical and spectroscopic means.
PO-5	To clear competitive examinations such as GATE / NET / SET etc.
PO-6	To acquire sound basics to continue Chemistry related higher studies or research and employment.
PO-7	They will develop skills in using scientific instruments, planning, and conducting laboratory experiments.
PO-8	Students will develop a scientific mindset and gain the necessary skills for success in research or the industrial sector.
PO-9	Students will be able to think creatively to propose novel ideas for explaining facts and figures or providing new solutions to problems in chemistry.
PO-10	Students will design solutions for environmental issues such as global warming, climate change, acid rain, and ozone depletion, and raise awareness in society.

Programme Specific Outcome (PSO)

PSO-1	Students will gain an understanding of basic scientific concepts, fundamental principles, and scientific theories as they relate to various phenomena in everyday life.
PSO-2	They will also acquire knowledge about the fundamentals and applications of chemical and scientific theories.
PSO-3	Students will discover that Chemistry is interconnected with every branch of science and technology, fostering a scientific perspective not only in science subjects but also in all aspects of life.
PSO-4	Students will gain familiarity with various branches of chemistry, including analytical, organic, inorganic, physical, environmental, polymer, and biochemistry
PSO-5	Students will learn how to apply appropriate techniques for qualitative and quantitative chemical analysis in laboratories and industries.

Eligibility for admission

A candidate who is a B.Sc. graduate of this University or any other recognised University in the main subject(s) mentioned or who has passed an examination accepted by the Syndicate as equivalent thereto is eligible for admission to M.Sc. Chemistry programme:

- B.Sc., Degree with Chemistry / Industrial Chemistry / Applied Chemistry / any other specialization in Chemistry as main subject of study and
- Any two of Mathematics, Physics, Botany, Zoology, Computer Application, Microbiology, Applied Chemistry as ancillary subjects.

The admission is subject to the prevailing rules and regulations for PG admission of this University. The candidate has to undergo this programme in the Department of Industrial Chemistry, Alagappa University and complete all the examinations prescribed under the four semesters to qualify for this degree.

Minimum duration of the programme

The programme is for a period of two years. Each year shall consist of two semesters viz. odd and even semesters. Odd semester shall be from July to Oct./Nov. and even semester shall be from Dec. to Apr./May. In each semester, there shall be 90 working days consisting of 6 teaching hours per working day (5 days/week).

Components

A PG programme consists of a number of courses. The term "course" is applied to indicate a logical part of the subject matter of the programme and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of the courses suggested for the PG programmes:

***Core courses (CC)**:* they relate to the programme concerned including practicals and project work offered under the programme and shall cover core competency, critical thinking, analytical reasoning, and research skill.

***Discipline-Specific Electives (DSE)**:* the courses offered under the programme relate to the major, but are to be selected by the students, shall cover additional academic knowledge, critical thinking, and analytical reasoning.

***Non-Major Electives (NME)**:* Exposure to knowledge beyond the discipline. Students have to undergo a total of 2 Non-Major Elective courses with 2 credits each offered by other Departments (one in II Semester, another in III Semester). A uniform time frame of 3 hours on a common day (Tuesday) shall be allocated for the Non-Major Electives. NME courses offered by the Departments pertaining to a semester should be announced before the end of previous semester. Students have to register for the NME course within 15 days from the commencement of the semester either in the Department or NME portal (University Website).

***Self Learning Courses (SLC)**:* They are available from SWAYAM platform. Massive Open Online Courses (MOOCs) shall be voluntary for the students. Students have to undergo a minimum of 2 Self Learning Courses (MOOCs) one in semester II and another in semester III. The actual credits earned through MOOCs shall be transferred to the credit plan of programme as extra credits. Otherwise 2 credits/course be given if the Self Learning Course (MOOCs) is without credit.

Preference shall be given to the course related to employability skills while selecting the MOOCs.

Project work or Internship:The student shall undertake the project work or internship during the fourth semester.

Project work: The candidate shall undergo Project Work during the final semester. The candidate should prepare a scheme of work for the project and should get approval from the supervisor allotted. The candidate, after completing the project work, shall be allowed to submit it to the Department at the end of the final semester. If the

candidate is desirous of availing the facility from other Departments / Universities / Research laboratories / organizations, they will be permitted only after getting approval from the supervisor and Head of the Department. In such a case, the candidate shall acknowledge the same in their project work.

Format of the project report

Title page
Certificate
Acknowledgment
Content as under:

Chapter	Title	Page number
1	Introduction	
2	Aim and objectives	
3	Review of literature	
4	Materials and methods	
5	Result	
6	Discussion	
7	Summary	
8	References	

Project Work Title

Project Work Report submitted in partial fulfillment of the requirement for the award of degree of Master of Science to the Alagappa University, Karaikudi.

By
(Student Name)
(Register Number)

University Logo

Department of Industrial Chemistry
Alagappa University
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC)
Karaikudi – 630003
(Year)

Certificate from the Supervisor

This is to certify that the Project work entitled "----------" is submitted to Alagappa University, Karaikudi in partial fulfillment for the award of degree of Master of Science in Chemistry by Mr/Ms ---------- (Reg No: ----------) under my supervision. This report is based on the results of studies carried out by the student in the Department of Industrial Chemistry, Alagappa University, Karaikudi. This Project or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any University or Institution.

Place: Karaikudi
Date: _____ Supervisor

Certificate from the Head of the Department

This is to certify that the project work entitled **"----------"** submitted by Mr/Ms ----------(Reg No: ----------) to the Alagappa University, in partial fulfillment for the award of the degree of Master of Science in Chemistry is a bonafide record of project work done under the supervision of Dr.----------, --------, Department of Industrial Chemistry, Alagappa University. This is to certify further that the project work or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Date: _____

Head of the Department

Declaration by the student

I hereby declare that the project work entitled "----------"submitted to the Alagappa University for the award of the degree of Master of Science in Chemistry has been carried out by me under the guidance of Dr.----------, ----------, Department of Industrial Chemistry, Alagappa University, Karaikudi. This is my original and independent work and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Date: _____ Student

***Internship**:* Students who have opted for an Internship must undergo industrial / Research training to accrue industrial / Research knowledge in the final semester. The student have to find the industry (Public / Private / NGO etc.,) related to their discipline in consultation with the supervisor allotted and get approval from the Head of the Department and Departmental Committee before going for an internship.

Title of internship

Internship report submitted in partial fulfillment of the requirement for the award of Master of Science in Chemistry to the Alagappa University, Karaikudi

By
(Student Name)
(Register Number)

University Logo

Department of Industrial Chemistry
Alagappa University
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC)
Karaikudi - 630003.
(Year)

Certificate from the Faculty/Staff in-charge

This is to certify that the Internship Report entitled "----------" submitted to Alagappa University, Karaikudi in partial fulfillment for the award of Master of Science in Chemistry by Mr/Ms---------- (Reg No:----) under my supervision is based on the internship carried out by the student in the organization M/s ----------. This Internship report or any part of this internship has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place:
Date: _____

Faculty/Staff in-charge

Certificate from the Head of the Department

This is to certify that the Internship report entitled **"----------"** submitted by Mr/Ms----------(Reg No:----------) to the Alagappa University, in partial fulfillment for the award of the Master of Science in Chemistry is a bonafide record of Internship done under the supervision of ----------, ----------, Department of Industrial Chemistry, Alagappa University and the internship carried out by the candidate in the organization M/s ----------.

This is to further certify that the Internship Report or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Date: _____

Head of the Department

Certificate from the Industry / Organization

This is to certify that the Internship report entitled "----------" submitted to Alagappa University, Karaikudi in partial fulfillment for the award of Master of Science in Chemistry by Mr/Ms---------- (Reg No: ----------) under my supervision. This is based on the internship carried out by the candidate in our organization M/s ----------during the period from ---------- to ----------. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place:
Date: _____

Representative of the Industry / Organization

Declaration by the student

I hereby declare that the Internship Report entitled **"----------"** submitted to the Alagappa University for the award of the Master of Science in Chemistry has been carried out by me under the supervision of ----------, ----------, Department of Industrial Chemistry, Alagappa University, Karaikudi. This is the internship carried out by me in the Industry / organization M/s ---------- during the period from ---------- to ---------- and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Date: _____

Student

Acknowledgment

Content

No. of copies of the project report/ internship report*:* The candidate should prepare three copies of the project report / internship report and submit the same to the Department for the evaluation. After evaluation, one copy will be retained in the Department library, one copy will be retained by the supervisor and the student shall hold one copy.

Teaching methods.

The classroom teaching would be through conventional lectures and use of Power-Point-presentations and smart classroom facilities. The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill. In the laboratory, instruction would be given for the experiments followed by demonstration and finally the

students have to do the experiments individually. Periodic tests would be conducted. For the students of slow learners, special attention would be given.

Attendance

Students must have earned 75% attendance in each course for appearing for the examination. Students who have earned 70-74% attendance need to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 60-69% attendance need to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% attendance are not eligible to appear for the End-Semester Examination. They shall re-do the semester(s) after completion of the programme.

Examination

The examinations shall be conducted separately for theory and practical to assess (remembering, understanding, applying, analysing, evaluating, and creating) the knowledge required during the study. There shall be two systems of examinations viz., internal and external. The internal examinations shall be conducted as Continuous Internal Assessment (CIA) Test-I and Test-II.

Internal Assessment

The internal assessment shall comprise a maximum of 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

Theory - 25 marks

Sl.No	Content	Marks
1	Average marks of two CIA test	15
2	Seminar/group discussion/quiz	5
3	Assignment/field trip report/case study report	5
	Total	25

Practical - 25 marks

Sl.No	Content	Marks
1	Major Experiment	10
2	Minor Experiment	5
3	Spotter (2x5) or any other mode	10
	Total	25

Project/ Internship - 50 Marks (assessed by Faculty in-charge / HoD / Supervisor)

Sl.No	Content	Marks
1	Two presentations (mid-term)	30
2	Progress report	20
	Total	50

External Examination

There shall be examinations at the end of each semester, for odd semesters in the month of Oct./Nov.; for even semesters in the month of Apr./May. A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in Oct./Nov. or Apr./May.

However, candidates who have arrears in Practical shall be permitted to take their arrear Practical examination only along with Regular Practical examination in the respective semester. A candidate should get registered for the first semester examination. If registration is not possible owing to shortage of attendance beyond condonation limit / regulation prescribed or belated joining or on medical grounds, the candidate is permitted to move to the next semester. Such candidate shall re-do the missed semester after the completion of the programme.

For the Project Report/ Internship, the maximum marks will be 100 marks for project report evaluation and 50 marks for the Viva-Voce.

Viva-Voce: Each candidate shall be required to appear for Viva-Voce Examination (in defense of the Project work / Internship).

Scheme of External Examination (Question Paper Pattern)

Theory - Maximum 75 Marks

Section A	10 questions. All questions carry equal marks (objective type questions)	10x1=10 Marks	10 questions (2 from each unit)
Section B	5 questions. Either or type like 1.a (or) b. All questions carry equal marks.	5x5=25 marks	5 questions. (1 from each unit)
Section C	5 questions. Either or type like 1.a (or) b. All questions carry equal marks	5x8=40 marks	5 questions. (1 from each unit)

Practical – Maximum 75 Marks

Section A	Major experiment	15 Marks
Section B	Minor experiment	10 Marks
Section C	Experimental setup	5 Marks
Section D	Spotters (5x5 marks)	25 Marks
Section E	Record note	10 Marks
Section F	Viva-voce	10 Marks

Project report/ Internship report - Scheme of evaluation

Project report/ Internship report	100 Marks
Viva-voce	50 Marks

Results

The results of all the examinations will be published through the Department where the student underwent the course as well as through University Website.

Passing minimum

- A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 50% in the aggregate, taking Continuous Assessment and End Semester Examinations marks together.
- The candidates not obtained 50% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing the CIA tests and by submitting assignments.

- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (ESE + CIA), are permitted to improve their Internal Assessment mark in the following semester and/or in University examinations.
- A candidate shall be declared to have passed in the Project / Internship if he/she gets not less than 40% in each of the Project / Internship Report and Viva-Voce and not less than 50% in the aggregate of both the marks for Project Report and Viva-Voce.
- A candidate who gets less than 50% in the Project / Internship Report must resubmit the Report. Such candidates need to take again the Viva-Voce on the resubmitted Project report.

Grading of the Courses

The following table gives the marks, Grade points, Letter Grades and classifications meant to indicate the overall academic performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in Paper / Course)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90 - 100	9.0 – 10.0	O	Outstanding
80 - 89	8.0 – 8.9	D+	Excellent
75 - 79	7.5 – 7.9	D	Distinction
70 - 74	7.0 – 7.4	A+	Very Good
60 - 69	6.0 – 6.9	A	Good
50 - 59	5.0 – 5.9	B	Average
00 - 49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0 and marks from 90 – 100 shall be declared to have Outstanding (O).
b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marks from 80 - 89 shall be declared to have Excellent (D+).
c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 and marks from 75 - 79 shall be declared to have Distinction (D).
d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 and marks from 70 - 74 shall be declared to have Very Good (A+).
e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 and marks from 60 - 69 shall be declared to have Good (A).
f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 and marks from 50 - 59 shall be declared to have Average (B).
g) Candidates earning GPA between 0.0 and marks from 00 - 49 shall be declared to have Re-appear (U).
h) Absence from an examination shall not be taken as an attempt.

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

GRADE POINT AVERAGE (GPA) = $\Sigma_i C_i \ G_i / \Sigma_i C_i$

GPA = Sum of the multiplication of Grade Points by the credits of the courses
Sum of the credits of the courses in a Semester

Classification of the final result

CGPA	Grade	Classification of Final Result
9.5 – 10.0	**O+**	First Class – Exemplary*
9.0 and above but below 9.5	**O**	
8.5 and above but below 9.0	**D++**	First Class with Distinction*
8.0 and above but below 8.5	**D+**	
7.5 and above but below 8.0	**D**	
7.0 and above but below 7.5	**A++**	First Class
6.5 and above but below 7.0	**A+**	
6.0 and above but below 6.5	**A**	
5.5 and above but below 6.0	**B+**	Second Class
5.0 and above but below 5.5	**B**	
0.0 and above but below 5.0	**U**	Re-appear

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a) Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+), those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class –Exemplary*.
b) Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D), those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+), those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.
c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A), those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+), those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class.
d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4 shall be given Letter Grade (B), those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade (B+) and declared to have passed in Second Class.
i) Candidates those who earned CGPA between 0.0 and 4.9 shall be given Letter Grade (U) and declared to have Re-appear.
e) Absence from an examination shall not be taken as an attempt.

CUMULATIVE GRADE POINT AVERAGE (CGPA) = $\Sigma_n \ \Sigma_i C_{ni} G_{ni} / \ \Sigma_n \ \Sigma_i C_{ni}$

CGPA = Sum of the multiplication of Grade Points by the credits of the entire Programme
Sum of the credits of the courses for the entire Programme

Where '**Ci**' is the Credit earned for Course i in any semester; '**Gi**' is the Grade Point obtained by the student for Course i and 'n' refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters of the PG Programme are alone eligible for this classification.

Maximum duration of the completion of the programme

The maximum period for completion of M.Sc. Chemistryprogramme shall not exceed eight semesters continuing from the first semester.

Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the Degree only after he/she has earned the minimum required credits for the programme prescribed (i.e. 90 credits).

Village Extension Programme

Alagappa University has jurisdiction with two districts such as Sivaganga and Ramanathapuram. These districts are said to be economically and educationally backward. As a social responsibility, Village Extension Programme (VEP) is being arranged annually by conducting outreach activities such as environmental awareness, hygiene and health to the rural people in this region. Students in their third semester have to visit the designated (adopted) village within the jurisdiction of Alagappa University and to engage themselves in the VEP to serve the rural mass for three days. A minimum of two faculty members can accompany the students and guide them.

M.Sc. Chemistry Programme Structure

Sl. No.	Course Code	Title of the Course		T / P	Credit	Hours / Week	Marks		
	I Semester						**CIA**	**ESE**	**Total**
1	536101	Core 1	Inorganic Chemistry-I	T	5	5	25	75	100
2	536102	Core 2	Organic Chemistry-I	T	5	5	25	75	100
3	536103	Core 3	Physical Chemistry-I	T	5	5	25	75	100
4	536104	Core 4	Inorganic Chemistry - Practical	P	5	8	25	75	100
5	536052	DSE-1		T	4	4	25	75	100
		Library/Yoga/ counseling/ Field-trip				3			
Total					**24**	**30**	**125**	**375**	**500**
II Semester									
	536201	Core 5	Inorganic Chemistry-II	T	5	5	25	75	100
7	536202	Core 6	Organic Chemistry-II	T	5	5	25	75	100
8	536203	Core 7	Physical Chemistry-II	T	5	5	25	75	100
9	536204	Core 8	Organic Chemistry - Practical	P	5	8	25	75	100
10	536051	DSE-2		T	4	4	25	75	100
11	536701	NME-1		T	2	3	25	75	100
12	SLC	MOOCs			Extra credit				
Total					**26**	**30**	**150**	**450**	**600**
III Semester									
13	536301	Core 9	Advanced Inorganic Chemistry	T	5	5	25	75	100
14	536302	Core 10	Advanced Organic Chemistry	T	5	5	25	75	100
15	536303	Core 11	Advanced Physical Chemistry	T	5	5	25	75	100
16	536304	Core 12	Physical Chemistry - Practical	P	5	8	25	75	100
17	536053	DSE-3		T	4	4	25	75	100
18	536702	NME-2		T	2	3	25	75	100
19	SLC	MOOCs			Extra credit				
Total					**26**	**30**	**150**	**450**	**600**
IV Semester									
20	536401	Core 13	Project Work / Internship		15	30	50	150	200
Total					**15**	**30**	**50**	**150**	**200**
Grand Total					**91 +**		**475**	**1425**	**1900**

CIA: Continuous Internal Assessment; ESE: End-Semester Examination; DSE: Department Student Elective; NME: Non-Major Elective; SLC: Self-Learning Course; MOOC: Massive Open Online Course; T:Theory; P: Practical

Department Student Elective Courses

Course Code	Course Title
536051	Natural Products and Introductory Biochemistry
536052	Instrumental Methods of Analysis
536053	Spectroscopic Methods of Analysis
536054	Environmental and Green Chemistry
536055	Materials Chemistry
536056	Chemical and Electrochemical Energy Systems

Non-Major Elective Courses for Other Department Students

Course Code	Course Title
536701	Chemistry in Everyday Life
536702	Basics in Environmental Science

Semester – I					
Core	**Course Code: 536101**	**Inorganic Chemistry - I**	**T**	**Credits: 5**	**Hours: 5**

UNIT – I

Objective 1	➢ To familiarize basic information about chemical periodicity, structure and bonding.

Structure and Bonding, Concept of Acid and Bases

Chemical periodicity–periodic trends. Concept of hybridization-Molecular orbitals, electronic configuration of homo-nuclear and hetero-nuclear diatomic molecules. Shapes of polyatomic molecules-VSEPR theory. Bond order and magnetism. Types of chemical bonds-Inter molecular Forces - Dipole Moment-Lattice energy – Born Land Equation-Born Haber cycle. Bronsted and Lewis concept of acids and bases. Hard and Soft Acid and Bases (HSAB) Principle – applications - limitations.

Outcome 1	Learners understand the fundamental concepts of Predict the shape and chemical bonding, and Born Haber cycle.	**K2**

UNIT – II

Objective 2	➢ To provide technical knowledge in valence bond theory, crystal field theory and spectrochemical series.

Coordination Compounds-I

Valence Bond Theory-octahedral, square planar and tetrahedral complexes- limitations of VBT; Crystal Field Theory-splitting of d-orbitals in square planar, trigonal bipyramidal, octahedral, tetrahedral complexes. -Factors affecting the magnitude of 10 Dq, spectro chemical series, crystal field stabilization energy of octahedral and tetrahedral complexes-distortion of octahedral complexes-Jahn-Teller distortion, applications of CFT; Spinels-structure, classification and site selection.

Outcome 2	Students discuss the structure and stability of complexes.	**K3**

UNIT – III

Objective 3	➢ To educate on recent developments in co-ordination compounds, VBT, CFT and MOT.

Coordination Compounds-II

Molecular Orbital Theory–sigma and pi bonding in octahedral complexes. Comparison of VBT, CFT and MOT. Ligand Field Theory, brief introduction to theory beyond MOT (LFT), Extended huckel theory, angular over lap and semi empirical methods.

Outcome 3	Students analyze the recent techniques in co-ordination compounds, VBT, CFT and MOT.	**K4**

UNIT – IV

Objective 4	➢ To learn the structure of ionic crystals, solid state chemistry, AB and AB2 type of crystals.

Solid State Chemistry

Packing of ions in HCP, FCC and BCC structure–determination of packing fraction in SC,BCC, FCC and HCP structure-density of cubic crystals; limiting radius ratio of trigonal, tetrahedral, octahedral and cubic site–its influence on ionic structures; structure of ionic crystals - AB type

of crystals -Sodium chloride, Zinc blende, Wurtzite and Cesium chloride - AB2 type of crystals-Fluorite, Rutile and Calcium carbide; A2B type of crystals Anti-fluorite; structure of covalent crystals – graphite and diamond.		
Outcome 4	Learns acquire knowledge on structure of solids.	**K5**
UNIT-V		
Objective 5	To educate the recent techniques in lanthanide and actinides.	
Chemistry of Lanthanides and Actinides Lanthanides- occurrence, position in the periodic table- electronic configuration-oxidation states- size relationships-lanthanide contraction-spectral and magnetic properties-condition compounds of lanthanides-uses of lanthanides and their compounds. Actinides: Synthesis of elements-position in the periodic table, electronic configuration and oxidation states-spectraland magnetic properties-comparative account of lanthanides and actinides.		
Outcome 5	Learners critically evaluate the recent trends in lanthanide and actinides.	**K6**

Suggested Readings:

WahidMalik,U.,Tuli,G.D.Madan,R.D.,Chand,S.&Co.,(2014).*Selected Topics in Inorganic Chemistry.*

Miessler,G.L., Fischer,P.J., Tarr,D.A.(2013). *Inorganic Chemistry* (5th ed.), Person Edu.India.

De, A.K.(2003). *A TextBook of Inorganic Chemistry*,(9th ed.),NAIP.

Huheey,J.E.,Keiter,E.A.,Keiter,R.L.,Methi,O.K.(2009).*Inorganic Chemistry-Principle of Structure and Reactivity* (4th ed.),5th Impression, Pearson-Education.

Cotton,F.A.,Wilkinson,G.,Murillo,F.A.,Bochmann,M.(2007). *Advanced Inorganic Chemistry* (6th ed.), JohnWiley.

Willam,L.(2007). *Modern Inorganic Chemistry*(2nd ed.). McGraw-Hill.

Sathyaprakash,Tuli,G.D.,Basu,S.K.,Madan,R.D.,Chand,S.&Co.(2011). *Advanced Inorganic Chemistry(Vol I& II)*. NewDelhi.

Westar.(1984). *Solid State Chemistry and its Applications*. Wiley, New York.

Kettles,S.F.A. (1996). *Physical Inorganic Chemistry.* Springer.

Online Resources:

https://ncert.nic.in/textbook/pdf/kech103.pdf

https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802:molecular- and-ionic-compound-structure-and-properties/x2eef969c74e0d802:vsepr/v/vsepr-for-2- electron-clouds

http://www.adichemistry.com/inorganic/p-block/group-14/silicates/silicates-1.html

https://www.youtube.com/watch?v=ecn8bPDV6Sc&list=PLfIFNJ1DPG4mPl_4FP2o-8d23eiwGY7Sr

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by Dr.G. Gopu & Dr.N. Sengottuvelan

Course Outcome Vs Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S - Strong (3), M - Medium (2), L - Low (1)

Course Outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.AV	**3**	**2.8**	**3**	**2.4**	**2.6**

S - Strong (3), M - Medium (2), L - Low (1)

Semester – I					
Core	**Course Code: 536102**	**Organic Chemistry - I**	**T**	**Credits: 5**	**Hours: 5**

UNIT – I

Objective 1	➢ Understand the fundamental concepts of inductive effect, resonance effect, and other electron effects, along with their role in chemical reactions. ➢ Master the IUPAC nomenclature rules for complex compounds like bicyclic and heterocyclic structures, enhancing naming accuracy.

Introductory concepts and Reaction Mechanism

Basic concepts: Inductive effect, electromeric effect, resonance effect, hyper conjugation, the formalism of curved arrow mechanisms. IUPAC nomenclature: Bicyclic, polycyclic, spiro compounds and heterocyclic compounds. Aromaticity: concept of aromaticity, delocalization of electrons-Hückel's rule, criteria for aromaticity, examples of neutral and charged aromatic systems–annulenes-NMR as a tool for aromaticity- anti- and homo-aromatic systems- fullerenes (C_{60}).

Outcome 1	By the end of this unit, students should be able to: Demonstrate a comprehensive understanding of electron effects and their roles in chemical reactions, enabling analysis of reaction mechanisms and reactivity patterns.	**K2**

UNIT – II

Objective 2	➢ Develop the ability to propose reaction mechanisms using energy profiles and intermediate species, deepening understanding of reaction pathways. ➢ Grasp the concept of kinetic and thermodynamic control, along with methods to determine reaction mechanisms, fostering mechanistic insight

Physical Organic Chemistry

Determination of reaction mechanism: Factors affecting the strength of acids and bases, Bronsted and Lewis concepts of acids and bases. Guidelines to propose a reasonable reaction mechanism– Energy profile, intermediate, transition state–kinetic and thermodynamic control –Hammond postulate–methods of determining reaction mechanism–kinetic methods– primary and secondary kinetic isotopic effect–nonkinetic methods. Mechanism according to free energy correlation and correspondence with theory of orbital interaction. Linear free energy relationship–Curtin-Hammett principle–significance of *sigma* and *rho*–Hammett and Taft equations.

Outcome 2	By the end of this unit, students should be able to: Formulate and propose reaction mechanisms based on energy profiles and transition states, showcasing proficiency in analyzing reaction pathways.	**K3**

UNIT - III

Objective 3	➢ Acquire mastery over the mechanisms and stereochemistry of nucleophilic substitution reactions (S_N1 and S_N2), connecting structure to reactivity. ➢ Understand the competition between elimination and substitution reactions, focusing on factors governing E_1, E_2 and E_1CB mechanisms.

Substitution and Elimination Reactions

Aliphatic Nucleophilic Substitution: S_N1 and S_N2 mechanisms–kinetic and stereochemical features–Neighbouring group participation and nature of nucleophile, solvent polarity, leaving

group ability on the course of the reactions–S_NI reaction-Allylic and vinylic substitution. Aliphatic electrophilic substitution: Mechanism of aliphatic electrophilic substitution reactions–S_E1, S_E2 and S_EI mechanisms. Elimination Reactions: E_1, E_2, E_1CB mechanisms-Stereochemistry of elimination-Hofmann and Zaitsev rules-competition between elimination and substitution. Bredt's rule. Aromatic Electrophilic Substitution: The arenium ion mechanism, Friedel-Crafts alkylation, acylation and diazonium coupling, orientation and reactivity. Aromatic Nucleophilic substitution: The benzyne intermediate mechanism, aromatic nucleophilic substitution of activated halides-Ziegler alkylation.

Outcome 3	By the end of this unit, students should be able to: Predict and explain theoutcomes of substitution and elimination reactions, utilizing knowledge of mechanisms, stereochemistry, and reaction competition.	**K4**

UNIT - IV

Objective 4	➢ Grasp the principles of configuration, conformation, and chirality, enabling accurate determination of stereoisomeric relationships. ➢ Become proficient in using projection methods and nomenclature rules to define absolute configuration and diastereoisomers

Fundamentals of Stereochemistry

Introduction to molecular symmetry and chirality-axis, plane, centre, alternating axis of symmetry. Stereoisomerism-definition based on symmetry and energy criteria-configuration and conformational stereoisomers. Center of chirality-molecules with C, N,S based chiral centers-absolute configuration-Sawhorse, Fischer and Newman projections, interconversion of projections-enantiomers-racemic modifications-R and S nomenclature using Cahn-Ingold-Prelog rules-molecules with a chiral center and Cn-molecules with more than one center of chirality-definition of diastereoisomers-constitutionally symmetrical and unsymmetrical chiral molecules-*erythro* and *threo* nomenclature-E and Z nomenclature-out/in isomers.

Outcome 4	By the end of this unit, students should be able to: Apply principles of symmetry, chirality, and stereoisomerism to accurately describe and predict the configurations and relationships of complex molecules.	**K4**

UNIT - V

Objective 5	➢ Explore the conformational analysis of molecules, recognizing the effects of steric and electronic influences on reaction outcomes. ➢ Understand how conformational insights contribute to reaction mechanisms, emphasizing neighboring group participation and reactivity outcomes.

Conformational analysis and Reactivity

Conformational analysis: Introduction to conformational analysis, steric, electronic and stereoelectronic effects in governing the conformation of acyclic and cyclic (5 and 6 membered rings) systems, A-strains and anomeric effect, decalins, transannular interactions in medium size rings. Conformation and reactivity: steric and electronic effects in syn-elimination, E2 elimination and neighboring group participation (Woodward, Prevost methods) of acyclic and cyclohexyl systems, esterification, substitution reaction and formation and opening of epoxide in cyclohexyl systems (Furst Plattner rule).

Outcome 5	By the end of this unit, students should be able to: Assess and predict the conformational effects on reactivity, enabling strategic analysis of reaction outcomes and product formation.	**K3**

Suggested Readings:

Morrison, R. T., Boyd's, R. N. (2008). *Organic Chemistry* (6th ed.). Springer.

Micheal B. Smith, jerry March's. (2007). *Advanced Organic Chemistry Reactions, Mechanismand Structure.* (6th ed.). John Wiley & Sons Inc. New Jersey.

Narain, R. P. (2011). *Fundamentals of Reaction Mechanisms in Organic Chemistry*. PHI Learning Private Limited, New Delhi.

Mukherji, S. P., Singh, S. P. (2004). *Reaction Mechanism in Organic Chemistry* (3rd ed.) Macmillan India Ltd, New Delhi.

Finar, I. L. (2004). *Organic Chemistry Vol. I & II* (5thed.) Pearson Education, Singapore,

Kalsi, P. S. (2014). *Organic reaction and their Mechanism* (2nd ed.). New Age International Private Limited, New Delhi.

Francis A. Carey. (2009). *Organic chemistry* (7thed.) New York.

Stevan A. Fleming., Norton, W. W. & Compound. (2010). *Organic Chemistry,* (4th ed.). London.Harris, J. M., Wamser, C. C. (1976). *Fundamentals of Organic Reaction Mechanisms.* John Wiley & Sons, New York.

Lowry, T. H., Richardson, K. S. (1976). *Mechanism and theory in Organic Chemistry.* Harperand Row, New York. 1976.

Bansal, R. K. (2003). *Reaction Mechanism in Organic Chemistry (*4th ed.) New Age International.

Peter Skyes. (2003). *A Guidebook to Mechanism in Organic Chemistry.* Orient Longman Private Limited., New Delhi.

V.K. Ahluwalia, V. K., Prashar, R. K. (2011). *Organic Reaction Mechanisms* (4th ed.) AlphaScience International, UK.

AMIT Arora. (2003). *Aromatic Organic Synthesis.* Discovery Private Limited., New Delhi.Badger, G. M. (1969). *Aromatic Character and Aromaticity*, Cambridge.

Garratt, P. J., Mc Graw Hill. (1971). *Aromaticity*.

Online Resources

https://nptel.ac.in/

https://ocw.mit.edu/

https://www.masterorganicchemistry.com/

https://chem.libretexts.org/Bookshelves/Organic_Chemistry

https://chemistrynotes.com/pages/organic-chemistry-notes

https://www.khanacademy.org/science/organic-chemistry

https://www.chemguide.co.uk/

https://commonorganicchemistry.com/

https://www.organic-chemistry.org/

https://hbu.libguides.com/chemistry

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr. M. Sundrarajan & Dr.S. Viswanathan

Course Outcome Vs Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.AV	**3**	**2.8**	**3**	**2.4**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

Semester - I					
Core	**Course code: 536103**	**Physical Chemistry - I**	**T**	**Credits: 5**	**Hours: 5**

UNIT - I

Objective 1	To achieve an understanding of the theory of quantum mechanics, and an ability to apply the quantum theory to important physical systems

Fundamental of Quantum Chemistry

Basic principles of quantum mechanics: Postulates of quantum mechanics, wave functions and probabilities, Black-body radiation, Photoelectric effect, Planck's radiation law, Compton effect, Atomic hydrogen spectra, The Bohr model, Wave-particle duality of material particles and de Broglie's hypothesis, Quantisation of angular momentum, Heisenberg's uncertainty principle. Quantum mechanics: Schrodinger equations, Eigen functions and Eigen values.

Outcome 1	The students understand the fundamental basics of quantum mechanics and the principles, behavior of atoms and molecules. This knowledge is essential for understanding the electronic structure, bonding, and various spectroscopic techniques used in the field of quantum chemistry.	**K2**

UNIT - II

Objective 2	amental principles of molecular symmetry and group theory.

Group Theory

Symmetry elements and symmetry operations Centre of symmetry, Plane and its types of Symmetry, Proper and Improper axis of Symmetry, Principal axis and subsidiary axes. The concept of groups, Assigning Point groups with illustrative examples, Symmetry operations and order of a group - Group theoretical rules (Group postulates), reducible and irreducible representations, matrix representations of symmetry operations, Construction of Character Tables for C_{2V} and C_{3V} point group molecules, and Great orthogonality theorem and its proof.

Outcome 2	To the concept of molecular symmetry and the utilization of group theory for characterizing and analyzing symmetrical properties of molecules.	**K3**

UNIT - III

Objective 3	Students with a comprehensive understanding of reaction kinetics, transport properties, complex reactions, unimolecular reactions, and elementary reactions in solutions.

Theories of Chemical Kinetics

Theories of Reaction Rates: Rate laws and rate constants, reaction order, determination of rate law, reactions approaching equilibrium, temperature dependence of reaction rates, Arrhenius parameters, consecutive elementary reactions, steady-state approximation, Kinetic isotope effect. Transport properties: Diffusion, Thermal conductivity, Viscosity, Effusion, Drift velocity, Nernst-Einstein equation, Stokes-Einstein equation Complex reactions Chain reactions. Unimolecular reactions: Lindemann- Hinshelwood mechanism and activation energy of a composite reaction. Elementary Reactions in Solutions: Activated complex theory; Bronsted-Bjerrum equation - Primary and secondary salt effects, Eyring equation.

Outcome 3	The students understanding of various aspects related to reaction kinetics, transport properties, complex reactions, and elementary reactions in solutions.	**K2**

UNIT - IV		
Objective 4	To provide students with a comprehensive understanding of the fundamental principles and concepts of chemical thermodynamics.	
Thermodynamics Chemical Thermodynamics: Thermodynamic properties, Boyle's Laws, Ideal-gas absolute temperature scale, Reversible and irreversible P-V works, first law of thermodynamics, Joule-Thomson experiments, Second law of thermodynamics, Carnot's principle, Gibbs and Helmholtz energies, The Maxwell relations, Le Chatelier principle. Solids: Thermodynamics of solids - Einstein and Debye models. Metals: Fermi function, Fermi energy, free electron model and density of states, chemical potential of conduction electrons.		
Outcome 4	The student learns, the fundamental principles of thermodynamics and its application to gases, solids, and metals, and its relevance to various chemical and physical processes.	**K2**
UNIT - V		
Objective 5	To provide students brief knowledge about photochemical processes.	
Photochemistry and Solar Energy Conversion Photochemistry: Photochemical laws, Quantum yield, Electronically excited states, Jablonski diagram, Radiation-less processes, Energy level diagrams, Assignment of n, π^* and π, π^* configurations, Forbidden transitions, Fluorescence and Phosphorescence, Emission lifetimes, Mechanism of energy transfer. Marcus theory of electron transfer, Free energy and rate relation, Rehm Weller behaviour, Marcus Inverted Region. Solar energy conversion: Solar cell structure, materials and properties, Solar cell fabrications, Dye sensitized solar cells, efficiency and measurements.		
Outcome 5	Students have gained a comprehensive understanding of photochemistry and its applications in areas such as energy conversion and solar cell technology	**K5**

Suggested Readings:

Atkins, P., Paula, J. (2014). Physical Chemistry (10th ed.), Oxford University Press, Oxford.

Ira Levine, Physical Chemistry, Edition 6, (2011) McGraw Hill Education, New York, United States.

Mc Quarrie, D. A. (1983). Quantum Chemistry. University Science Books.

Cotton, F. A. (1996). Chemical Applications of Group Theory. Wiley.

Laidler, K. J. Harper & Row. (1998). Chemical Kinetics (3rd ed.). New York.

Enrico Fermi, Thermodynamics, (2010) Snowballpublishing.com, California, USA.

Rohatgi - Mukherjee, K. K. (2014). Fundamentals of Photochemistry. (3rd ed.). New Age International Pvt. Ltd. New Delhi.

N. J. Turro, V. Ramamurthy, J. C. Scaiano, (2010) Principles of Molecular Photochemistry, University Science Books, Sausalito.

Stephen J. Fonash. (2010). Solar Cell Device Physics (2nd ed.). Academic Press is an imprint of Elsevier, Kidlington, Oxford, OX5 1GB.

Online Resources

Fundamentals of Quantum Chemistry - 2nd Edition (elsevier.com)
https://people.bath.ac.uk/gt223/MA30237/lnotes.pdf
https://www.askiitians.com/revision-notes/chemistry/chemical-kinetics/
soaneemrana.com/onewebmedia/Thermodynamics by PK Nag.pdf
Presentation on solar energy conversion.pptx (slideshare.net)

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.T. Stalin

Course Outcome Vs Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S-Strong (3), M-Medium (2), L- Low (1)

Course Outcome Vs ProgramSpecific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M(2)	L(1)	M(2)	S(3)	M(2)
CO2	S(3)	M(2)	L(1)	M(2)	S(3)
CO3	M(2)	M(2)	S(3)	M(2)	S(3)
CO4	M(2)	S(3)	S(3)	M(2)	L(1)
CO5	S(3)	L(1)	L(1)	M(2)	S(3)
W. AV	2.4	1.8	2	2.2	1.4

S-Strong (3), M-Medium (2), L- Low (1)

Semester - I					
Core	**Course Code: 536104**	**Inorganic Chemistry Practical**	**P**	**Credits: 5**	**Hours: 8**

Objective	➢ To get practical skills in (i) EDTA & redox titrations; (ii) preparation and analysis of complexes; (iii) analysis of a mixture containing cations.
	1.Quantitative Analysis (a) EDTA titrations: (i) Ca, (ii)Mg, (iii)Ni, (iv) Zn. (b) Redox titrations: Fe (II) Vs Ce (IV), Fe (II) Vs Dichromate, NO^{2-} Vs Ce (IV) **2.Preparation and Analysis of Coordination Complexes** a) Preparation of co-ordination complexes by double stage method (AnyFour). b) Characterization of prepared complexes: Solubility, Melting point, UV spectroscopy, Infrared spectroscopy, Thermal analysis. **3. Semi-microqualitative analysis:** Analysis of mixtures containing two ions: Less familiar cations: Ce, W, Mo, Zr, Ti, V, and Li. Familiar cations: Pb, Cu, Bi, Cd, Mn, Ni, Co, Zn, Ca, Ba, Sr and Mg.
Outcome	The student would be able to gain practical knowledge in (i) titrations; (ii) preparation of complexes; (iii) identifies familiar and less familiar cations form a mixture of salts.

Suggested Readings:

Basset, J., Denney, R.C., Jeffery G.H., Mendham, J. (1994). *Vogel's textbook of quantitative inorganic analysis.* ELBS.

Palmer, W.G., Van Nostrand Reinhold Co. (1972). *Experimental Inorganic Chemistry,* London.

Grindley, D.N. (1964). *An advanced course in practical Inorganic Chemistry*. Butterworths.

John Bernard Ekeley, (2010). A *Laboratory Manual of Inorganic Chemistry*. Biblio Life.

Veeraswamy, R., Kulandaivelu, Ar., Venkateswaran, V., SultanChand&Sons (1997). *Basic Principles of Practical Chemistry (*2nded.).

Online Resources:

https://www.youtube.com/watch?v=H3aZ_Xdmu0U

https://vlab.amrita.edu/?sub=2&brch=191&sim=692&cnt=1

https://iscnagpur.ac.in/study_material/dept_chemistry/4.1_MIS_and_NJS_Manual_for_Inorganic_semi-micro_qualitative_analysis.pdf

Course Outcome Vs Programme Outcomes

	PGO1	**PGO2**	**PGO3**	**PGO4**	**PGO5**	**PGO6**	**PGO7**	**PGO8**	**PGO9**	**PGO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S - Strong (3), M - Medium (2), L - Low (1)

Course Outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.AV	**3**	**2.8**	**3**	**2.4**	**2.6**

S - Strong (3), M - Medium (2), L - Low (1)

Semester - II					
Core	**Course Code: 536201**	**Inorganic Chemistry - II**	**T**	**Credits: 5**	**Hours: 5**

UNIT - I

Objective 1	➢ To familiarize basic information about structure and bonding in inorganic rings.

Main Group Elements

Compounds of alkali and alkali neearth metals-preparation and uses. Catenation- hetero catenation- intercalation chemistry-Polyanions and isopoly anions of Phosphorous, Vanadium, heteropoly anions of Molybdenum and Tungsten. Hydrides, oxides and oxy acids of nitrogen, phosphorous, sulphur; phosphines, phosphazines, sulphur-nitrogen compounds. Silicates, borazines and boronnitrides–Heterogenous catalysis–Zeolites– structure and reactivity.

Outcome 1	Learners understand the fundamental concepts of inorganic ring structure	**K2**

UNIT - II

Objective 2	➢ To provide technical knowledge in cages and metal clusters

Cages and Metal Clusters

Inorganic chains-rings-cages and clusters-Chemistry of boron–borane, higher boranes, carboranes, Structure and bonding in polyhedral boranes and carboranes, metalloboranes, metallocarboranes, styx notation; Wade's rule; Jemmis MNO rule in polyhedral boranes. electron count in polyhedral boranes; isolobal analogy; Metal clusters - dinuclear clusters - trinuclear clusters - tetranuclear clusters - hexanuclear cluster. Metal Organic Framework –basics and applications.

Outcome 2	Students discuss the cages and metal clusters.	**K3**

UNIT - III

Objective 3	➢ To understand and educate on recent developments in ligand- Substitution in complexes.

Ligand substitution reactions in Complexes

Types of substitution reactions-S_N1, S_Ni and S_N2 reaction mechanism in octahedral complexes- aquation, factors affecting aquation; base hydrolysis, conjugate base mechanism, anation reactions-substitution reactions without breaking metal-ligand bond. Sterochemistry of substitution reaction in octahedral complexes. Substitution reactions in square planar complexes-Trans effect–uses factors affecting the rate of substitution reactions- isomerisation in planar complexes; electron transfer reactions in coordination compounds- inner sphere mechanisms-outer sphere mechanisms-complementary- non-complementary electron transfer reaction mechanism.

Outcome 3	Students analyze the recent techniques in ligand-substitution Reactions in complexes	**K4**

UNIT - IV		
Objective 4	➢ To learn the structure of metal-carbon bonding.	
Metal Carbon Bonding Review of formalisms such as oxidation state, 18-electron rule, classes of ligands, Valence electron count (16/18 electron rules); Metal carbon bond types. Structure and bonding in mono and polynuclear metal carbonyls; substituted metal carbonyls and related compounds; reactivity of metal carbonyls; vibrational spectra of metal carbonyls; dinitrogen and dioxygen as ligands in organo metallic compounds Nitrosyls: terminal bridging and bent.		
Outcome 4	Learns acquire knowledge on metal-carbon bonding.	**K6**
UNIT – V		
Objective 5	➢ To educate the recent techniques in nuclear chemistry, uses of radio isotopes.	
Nuclear Chemistry Radioactive decay-Nuclear structure: mass-energy relationship, nuclear binding energy, nuclear stability rules. Q value-threshold energy-cross reaction. Various types of nuclear reactions- photonuclear, spallation, Transmutation and thermonuclear reaction. Nuclear fission and Fusion: Probability, mass and charge distribution, Nuclear reactors and their uses for power production. Nuclear fusion-conditions necessary-energy released in fusion-steller energy. Usage of radio isotopes in neutron activation analysis and isotopic dilution analysis; radioactive waste management and disposal.		
Outcome 5	Learners critically evaluate the recent trends in nuclear chemistry.	**K5**

Suggested Readings:

Lee, J.D. (2008). *Concise Inorganic Chemistry* (5th ed.). Oxford.

JohnC.Kotz, PaulM.Treichel, JohnTownsend. (2012). *Chemistry&ChemicalReactivity* (8thed.) Cengage Learning, USA.

Sodhi, G.S. (2006). *Inorganic Chemistry* (Ist ed.) VB(P) Ltd.

Huheey, J.E., Keiter, E.A., KeiterR.L., Methi, O.K. (2009). *Inorganic Chemistry-Principles of structure and reactivity* (4th ed.). 5thImpression, Pearson-Education.

Emeleus, H.J., Sharpe, A.G. (1999). *Modern Aspects of Inorganic Chemistry*. UBS.

Carbtree, R.H. (2019). *The Organometallic Chemistry of the Transition Metals(7thed.)* Wiley.

Weller, M., Overton, T., Rourke, J., Armstrong, F. (2018). *Inorganic Chemistry* (7th ed.) Oxford University Press.

Elias, A. Gupta, B.D. (2013). Basic Organometallic Chemistry(2nded.). Universities Press.

Arnikar, H.J. (2011). *Essentials of Nuclear Chemistry*(4thed.) NAEP Ltd.

Online Resources:

https://kanchiuniv.ac.in/coursematerials/Mrs.%20MP%20-20Coordination%20Chemistry.pdf

http://home.iitk.ac.in/~madhavr/CHM102/Lec3.pdf

https://www.youtube.com/watch?v=_6d80lX4pSk

https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch103-allied-health-chemistry/ch103-chapter-3-radioactivity/

http://www.nou.ac.in/econtent/Msc%20chemistry%20paper%202/MSc%20Chemistry%20Paper-II%20Unit-3.pdf

https://prgc.ac.in/uploads/study_material/CHEMISTRY%20OF%20F-BLOCK%20ELEMENTS%20BY%20K.N.S.SWAMI..pdf473.pdf					
K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by Dr.G. Gopu & Dr.N. Sengottuvelan					

Course Outcome Vs Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S - Strong (3), M - Medium (2), L - Low (1) Course

Outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.AV	**3**	**2.8**	**3**	**2.4**	**2.6**

S - Strong (3), M - Medium (2), L - Low (1)

Semester - II					
Core	**Course Code: 536202**	**Organic Chemistry - II**	**T**	**Credits: 5**	**Hours: 5**

UNIT - I

Objective 1	➢ Develop a deep understanding of carbanion chemistry, focusing on C-X bond formations, enolate and enamine reactions, and their role in complex synthesis.

Carbanions and Addition Reactions

C-X bond (X=C,O,N) formations through the intermediacy of Carbanions: Chemistry of enolates and enamines, Kinetic and Thermodynamic enolates, Lithium and boron enolates in aldol and Michael reactions, Alkylation and acylation of enolates, Nucleophilic additions to carbonyls and stereochemical aspects through various models (Cram/Cram chelation/Felkin-Anh models); Organolithium, Organomagnesium, Organozinc, Organocopper reagents (restricted to 1,4-addition) in synthesis, Name reactions under carbanion chemistry - Claisen, Dieckmann, Knoevenegal, Stobbe, Darzen, Acyloin condensations, Shapiro reaction, Julia olefination, Peterson olefination. Ylides: Chemistry of Phosphorous and Sulphur ylides.

Outcome 1	Gain expertise in carbanion chemistry and apply it to predict C-X bond formations, enolate and enamine reactions, and advanced synthetic methods.	**K3**

UNIT - II

Objective 2	➢ Explore molecular rearrangements, from electron-deficient to electron-rich systems, and study the generation, reactivity, and rearrangements of carbenes and nitrenes.

Molecular Rearrangements

Classification of Rearrangements-Electron deficient and electron rich skeletal rearrangements Wagner-Meerwein, Pinacol-pinacolone, semi-pinacol rearrangement, Migratory attitude- Memory effect-C-C bond formation involving carbocations, oxymercuration, halolactonisation. Stevens-Wittig- Sommelet- Hauser- Grovenstein- Zimmermann rearrangements, non-cyclic rearrangements, Chapman-Wallach rearrangement. Carbenes and Nitrenes: Structure of carbenes, generation of carbenes, addition and insertion reactions, rearrangement reactions of carbenes such as Wolff rearrangement, Structure of nitrene, generation and reactions of nitrene and related electron deficient nitrogen intermediates, Curtius, Hoffmann, Schmidt, Beckmann rearrangement reactions.

Outcome 2	Develop the ability to analyze and predict molecular rearrangements, including carbene and nitrene reactions, showcasing insight into their mechanisms and synthetic potential.	**K3**

UNIT - III

Objective 3	➢ Master stereoselectivity principles, analyze methods for determining absolute configuration, and grasp the concept of topicity and prostereoisomerism in various chiral systems.

Stereochemistry and Reactivity

Stereoselectivity: Classification, terminology, principle of stereoselectivity, examples of diastereoselectivity using Cram, Cram-Chelate, Felkin-Ahn, anti-Felkin, Houk models, Cieplak and cation coordination models, and Zimmerman-Traxler transitionstates, enantioselectivity.

Desymmetrization and kinetic resolution, methods of determination of absolute configuration. Topicity and prostereoisomerism-topicity of ligands and faces, and their nomenclature – NMR and Steroisomers- Axial, planar and helical chirality – examples – stereochemistry and absolute configuration of allenes, biphenyls and binaphthyls, ansa and cyclophanic compounds, spiranes, exo-cyclic alkylidene cycloalkanes.		
Outcome 3	Master stereoselectivity principles, apply methods to determine absolute configuration, and understand the stereochemical complexities of diverse chiral systems.	**K3**
UNIT - IV		
Objective 4	➢ Investigate radical generation, their reactivity, and their application in synthetic transformations, while understanding the intricacies of photochemical reactions and their synthetic value.	
Radicals and Photochemical Reactions Radicals: Generation of radical intermediates and its (a) addition to alkenes, alkynes (inter & intra molecular) for C-C bond formation and Baldwin's rules (b) olefin metathesis (c) fragmentation and rearrangements. Organic Photochemistry: Thermal versus photochemical reactions-Photochemical reactions of Ketones-Norrish I & II type reactions - Photoreduction -Photosensitization - Reactions of α,β-unsaturated ketones - Isomerization and cycloadditions -cis-trans isomerisation of simple olefins-Paterno-Buchi reaction-Di-pi-methane rearrangement-Photooxidation-Oxidative coupling-Sandmeyer reaction, Gomberg-Bachmann reaction, Pschorr reaction, Ullmann reaction and Hunsdiecker reaction, McMurry coupling, Barton deoxygenation and decarboxylation.		
Outcome 4	Explore radical and photochemical reactivity, mastering their synthetic applications and predicting the outcomes of photochemical transformations.	**K4**
UNIT - V		
Objective 5	➢ Examine pericyclic reactions and apply Woodward Hoffmann rules, elucidating stereochemical outcomes and their applications in designing complex reactions.	
Concerted Reactions Pericyclic Reactions: Classification, electrocyclic, sigmatropic, cycloaddition, chelotropic and ene reactions, Woodward Hoffmann rules, Frontier Orbital and Orbital symmetry correlation approaches, examples highlighting pericyclic reactions in organic synthesis such as Claisen, Cope, Diels-Alder and Ene reactions (with stereochemical aspects), introductory dipolar cycloaddition. Unimolecular pyrolytic elimination reactions: Cheletropic elimination, Decomposition of cyclic azo compounds, beta-eliminations involving cyclic transition states such as sulphoxides, selenoxides, N-oxides, acetates and xanthates eliminations.		
Outcome 5	Acquire the skills to classify pericyclic reactions, predict their stereochemical outcomes, and strategically plan complex synthesis pathways involving concerted rearrangements.	**K4**
Suggested Readings: Narain, R.P. (2011). *Fundamentals of Reaction Mechanisms in Organic Chemistry.* PHI Learning Private Limited, New Delhi.		

Mukherji, S.P. Singh, S.P. (2004). *Reaction Mechanism in Organic Chemistry* (3rd ed.). Macmillan India Ltd, New Delhi.
Kalsi, P. S. (2014). *Organic reaction and their Mechanism* (2nd ed.). New Age International Private Limited, New Delhi.
Carruthers, W., Coldham, I. (2005). *Modern methods of Organic Synthesis.* First South Asian Edition, Cambridge University Press.
March, J., Smith, M. B. (2007). *March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure* (6th ed.). Wiley.
Fleming. (1976). *Frontier Orbitals and Organic Chemical Reactions.* Wiley, London.
Singh, J. (2005). *Photochemistry and Pericyclic Reactions.* New Age International.
Klán, P., Wirz, J. (2009). *Photochemistry of Organic Compounds: From Concepts to Practice.*Wiley, Chichester.
Sankararaman, S. (2005). *Pericyclic Reactions- A Text Book,* Wiley VCH.
Carey, F. A. Sundberg, R. A. (2007). *Advanced Organic Chemistry, Part B: Reactions and Synthesis* (5th ed.). Springer, New York.
StevanA.Fleming, W.W. Norton & Compound. (2010) *Organic Chemistry* (4th ed.). London.
Harris, J.M. Wamser, C.C. (1976). *Fundamentals of Organic reaction Mechanisms.* John Wiley& Sons, New York.
Lowry T.H., Richardson, K. S., Harper and Row. (1976). *Mechanism and theory in Organic Chemistry.* New York.
Clayden, J. Geeves, N., Warren, S. (2012). *Organic Chemistry* (2nd ed.). Oxford Uni. Press.
Brückner, R. (2010). Organic Mechanisms - Reactions, Stereochemistry and Synthesis (Ist ed.). Springer.
Paula Y. Bruice. (2010). *Organic Chemistry* (6th ed.) Prentice Hall.
Mark G. Moloney. (2008). *Structure and Reactivity in Organic Chemistry* (Ist ed.). Wiley-Blackwell.
Turro, N. J., Ramamurthy, V., Scaiano, J. C. (2010). *Modern Molecular Photochemistry of Organic Molecules.*University Science Books, Sausalito.

Online Resources

https://nptel.ac.in/
https://ocw.mit.edu/
https://www.masterorganicchemistry.com/
https://chem.libretexts.org/Bookshelves/Organic_Chemistry
https://chemistrynotes.com/pages/organic-chemistry-notes
https://www.khanacademy.org/science/organic-chemistry
https://www.chemguide.co.uk/
https://commonorganicchemistry.com/
https://www.organic-chemistry.org/
https://hbu.libguides.com/chemistry

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by Dr M. Sundrarajan & Dr.S. Viswanathan

Course Outcome Vs Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.AV	**3**	**2.8**	**3**	**2.4**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

SEMESTER - II					
Core	**Course code: 536203**	**Physical Chemistry-II**	**P**	**Credits: 5**	**Hours: 5**

UNIT - I		
Objective 1	To make them understand the knowledge about the quantum chemistry applications.	
Quantum Chemistry: Application of wave mechanics: Rigid rotor, harmonic oscillators, shapes of orbitals, shape quantization. Solution of the Schrodinger equation for exactly solvable problems for bound states such as particle-in-a-box, particle-in-a-ring, distortions, John-teller effect, quantum numbers, zero-point energy, tunneling, and perturbation theory		
Outcome 1	Students understand the application of the quantum chemistry and solve the derivations.	**K5**

UNIT - II		
Objective 2	To teach the group theory based on Spectroscopy application.	
Spectroscopy Application of Group Theory: Spectroscopy application: Spectroscopy application of group theory to IR spectral activity of vibrational modes of ammonia molecule, selection rules for vibrational IR and RAMAN spectra, Mutual exclusion rule for molecules with center of symmetry, Selection rules for n-π^* and π-π^* transitions in formaldehyde molecule. SALC procedure, Applications of SALC procedure to ethylene and butadiene molecules. Application of group theory to atomic orbitals in ligand fields, molecular orbitals, hybridization		
Outcome 2	The students should be able to understand the spectroscopy principles, selection rules and the applications of group theory.	**K3**

UNIT - III		
Objective 3	To provide students with a comprehensive understanding of the fundamental principles and concepts of chemical kinetics.	
Chemical Kinetics: Solution and gas phase kinetics: Chain reactions and its rate laws, Hydrogen-bromine reaction, Polymerization kinetics: stepwise and chain polymerizations. Homogeneous catalysis: Features of acid-base catalysis. Enzymes: Michaelis-Menten mechanism of enzyme catalysis, Salt effects, catalytic efficiency of enzymes, Enzyme reaction, mechanisms of enzyme inhibition. Fast reaction kinetics: Relaxation methods (T- and P-jump methods), Stopped flow methods, Shockwave technique, Flash photolysis.		
Outcome 3	The students understanding the kinetics reaction and their rates in the solution and gas phase.	**K2**

UNIT - IV		
Objective 4	To provide students brief knowledge about classical thermodynamics.	
Classical Thermodynamics: Thermodynamics concept: Concept of entropy, reversible and irreversible processes, Free energies. Fundamental equations for open systems, Partial molar quantities and chemical potential, Gibbs-Duhem equation, Real gases and Fugacity. Thermodynamics of ideal and non-ideal solutions: Liquid-liquid solutions, liquid-solid solutions, multi component systems and mean ionic activity coefficients. Debye-Huckel limiting law and its extensions. Applications of Debye-Huckel Theory.		
Outcome 4	The student learns the thermodynamics concepts and the fundamental equations and theories.	**K2**
UNIT -V		
Objective 5	To gain knowledge the surface chemistry based on the principles and understand the catalysis and their applications.	
Surface Chemistry and Heterogeneous Catalysis: Surface and interfaces: Surface tension, solid-liquid interfaces; contact angle and wetting; Solid-gas interface; Physisorption and chemisorptions, Freundlich, Gibbs, Langmuir, and BET adsorption isotherms; Surface area determinations. Heterogeneous catalysis: Kinetics of surface reactions involving adsorbed species, Langmuir-Hinshelwood mechanism, Langmuir-Rideal mechanism. Basic aspects of semiconductor catalysis and applications. Model catalysts: Ammonia synthesis; Hydrogenation of carbon monoxide; Hydrocarbon conversion.		
Outcome 5	Students have received knowledge about the surface chemistry and catalysts and create the applications in the related fields.	**K3**

Suggested Readings:

1. Atkins, P., Paula, J. (2014). Physical Chemistry (10th ed.). Oxford University Press, Oxford.
2. Mc Quarrie, D. A. (1983). *Quantum Chemistry.* University Science Books.
3. Kunju A. Salahuddin, and Krishnan G., Group Theory and Its Applications in Chemistry (2015), PHILearning Private Limited, Delhi.
4. K.V.Raman, Group Theory and Its Applications to Chemistry, (1990) McGraw-Hill Education, NewYork, United States.
5. Cotton, F. A. (1996). *Chemical Applications of Group Theory.* Wiley.
6. Laidler, K. J., Harper & Row. (1998).*Chemical Kinetics* (3rd ed.), New York, 1998.
7. Denis James Evans, Debra Joy Searles, Stephen Rodney Williams, (2016) Fundamentals of Classical Statistical Thermodynamics: *Dissipation, Relaxation, and Fluctuation Theorems*, Wiley, New York, United States.
8. Arthur W. Adamson, Alice P. Gast (1997). *Physical chemistry of surfaces,* 6th*Edition*, WileyNew York, United States.

Online Resources

https://www.britannica.com/science/quantum-mechanics-physics
https://www.jove.com/v/10442/application-of-group-theory-to-ir-spectroscopy
https://byjus.com/jee/chemical-kinetics/
https://www.sciencedirect.com/topics/physics-and-astronomy/classical-thermodynamics
https://byjus.com/chemistry/adsorption-theory-heterogeneous-catalyst/

K1- Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by : Dr. T. Stalin

Course Outcome Vs Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	M(2)	M(2)	L(1)
CO4	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	L(1)	S(3)	M(2)	M(2)
CO5	M(2)	S(3)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	2.2	2.8	2.4	2.2	2.2	3	1.4	2.6	2.2	1.6

S-Strong (3), M-Medium (2), L- Low (1)

Course Outcome Vs ProgramSpecific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M(2)	L(1)	M(2)	S(3)	M(2)
CO2	S(3)	M(2)	S(3)	M(2)	S(3)
CO3	M(2)	M(2)	S(3)	M(2)	L(1)
CO4	M(2)	S(3)	S(3)	S(3)	L(1)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	2.4	2.2	2.8	2.6	2

S-Strong (3), M-Medium (2), L- Low (1)

Semester - II					
Core	**Course Code: 536204**	**Organic Chemistry - Practical**	**P**	**Credits: 5**	**Hours: 8**

Objective	➢ To acquire practical skills on (i) organic double stage preparation; (ii) separation and identification of components in a mixture; (iii) TLC and column chromatographic separation; (iv) extraction of organic compounds from natural products; (v) UV-vis, FT-IR, elemental analysis of the extract.	
	1. Qualitative analysis: Separation and Identification of components in a two component mixture and preparation of their derivatives. Determinations of boiling point/melting point for components and melting point for their derivatives. **2. Double stage Organic preparation:** Benzanilide from benzophenone. Eosin from phthalic anhydride. Methyl orange from Aniline. Benzoic acid from Aniline. **3. Thin layer and Column Chromatographic separation of mixtures of organic compounds:** Purification of anthracene. Separation of aminoacids. Separation of benzoic acid from benzaldehyde. **4. Extraction of natural products such as** Piperine, Casein, Caffeine. **5. Identification of functional groups of organic compounds prepared and extracted.** UV-VIS spectra of α, β-unsaturated carbonyl systems.FT IR spectra of few organic compounds. Determination of C, H, N, S, O in an organic compound using elemental analyser.	
Outcome	**Outcomes:** The student would be able to acquire practical skills in the double-stage preparation of organic compounds, separation of component in organic mixture, identification of organic compounds, chromatographic separations, extraction of compounds from natural products and analysis using instrumental methods.	**K6**

Suggested Readings:

Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell A.R. (1989). *Vogel's PracticalOrganic Chemistry* (5th ed.). ELBS.

Raj K. Bansal. (1996). *Laboratory Manual of Organic Chemistry* (3rd ed.). New Age International (P) Ltd.

VogelA. I.(2011).*Elementary practical organic chemistry: Quantitative organic analysis Part-III, 2e(pb).*Pearson Education Asia.

VogelA.I. (2011). *Elementary practical organic chemistry: Qualitative organic analysis Part-II.* Pearson Education Asia.

Online Resources
https://vlab.amrita.edu/
https://praxilabs.com/
https://www.mheducation.ca/higher-education/learning-solutions/virtual-labs
https://uwaterloo.ca/racicot-organic-chemistry-lab/online-resources
https://nptel.ac.in/
https://ocw.mit.edu/
https://www.masterorganicchemistry.com/
https://chem.libretexts.org/Bookshelves/Organic_Chemistry
https://chemistrynotes.com/pages/organic-chemistry-notes
https://www.khanacademy.org/science/organic-chemistry
https://www.chemguide.co.uk/
https://commonorganicchemistry.com/
https://www.organic-chemistry.org/
https://hbu.libguides.com/chemistry

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by Dr. M. Sundrarajan & Dr.S. Viswanathan

Course Outcome Vs Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S-Strong (3), M-Medium (2), L-Low (1) Course

Course Outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.AV	**3**	**2.8**	**3**	**2.4**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

Semester - III					
Core	**Course Code: 536301**	**Advanced Inorganic Chemistry**	**T**	**Credits: 5**	**Hours: 5**

UNIT - I

Objective 1	➢ To familiarize basic information about organometallic complexes, ring opening, ring closing metathesis in organic synthesis and Metal arene complexes.

Synthesis of Organometallic Complexes

Synthesis and reactivity of metal alkyls, alkene, alkynes and complexes; pi-complexes with olefins,acetylenes. Metal (W, Cr, Rh, Ru, Mo) carbene complexes, Fischer, Schrock and Grubbs typecarbine complexes, comparison of their stability and reactivity, simple and cross metathesis reactions, ring opening, ring closing metathesis inorganic synthesis-cyclopentadienyl complexes-bonding with transition metals-metallocenes-ferrocene; Metalarene complexes-synthesis
and reactivity.

Outcome 1	Learners understand the fundamental concepts on synthesis of organometallic complexes.	**K2**

UNIT - II

Objective 2	➢ To provide technical knowledge in Reactions of Organometallic Complexes, Catalysis and polymerization.

Reactions of Organometallic Complexes

Reaction mechanism-Lig and substitution, oxidative addition, reductive elimination, migratory insertion and hydride elimination, trans metallation, Nucleophilic and Electrophilic attack on coordinated ligands inorganometallics. Fluxional molecules. Catalysis-Hydrogenation, Hydroformylation, pauson Khand reaction, Monsanto process, Wacker process, alkene polymerization -Ziegler-Natta Polymerisation.

Outcome 2	Students discuss the Reactions of Organometallic Complexes	**K4**

UNIT - III

Objective 3	➢ To educate on recent developments in Spectral and Magnetic Properties of Complexes.

Spectral and Magnetic Properties of Complexes

Electronic spectra of coordination compounds - Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule, Derivation of the term symbol for a d^2configuration, Electronic spectra of transition metal complexes–Laporte'orbital'selection rule, spin selection rule. Characteristics of d-d transitions. Nephel auxetic effect, energy level diagrams of Orgel and Tanabe- Sugano Diagrams of octahedral complexes with d^2 & d^8 configuration. Magnetic susceptibility-Gouy balance, SQUID magnetometry, Magnetic properties of coordination compounds -dia,-para-ferro and anti-ferro magnetism-spin cross over phenomena.

Outcome 3	Students analyze the recent trends in Orgel and Tanabe- Sugano Diagrams of octahedral complexes and Magnetic properties of Coordination compounds	**K3**

UNIT - IV		
Objective 4	➢ To learn the structure of Bio inorganic Chemistry and Photosynthesis.	
Bioinorganic Chemistry Essential and trace metal ions in biology and their distribution-nucleotides and their potential metal- binding sites; Metal storage and transport-molecular mechanism of ion transport across membranes- ionophores. Na^+/K^+pump. Electron transport, Monooxygenase, dioxygenase, phosphorylase, reductase, Processes in Photosynthesis–Photosystems I and II. Metals in medicine-therapeutic applications of *cis*- platin, radio-isotopes (e.g., Tc & I2) and MRI agents. Toxicity of metals–Al, Cd, Hg and Cr toxic effects with specific examples, detoxification by chelation.		
Outcome 4	Learns acquire knowledge on Essential and trace metal ions in biology and their distribution and Processes in Photosynthesis.	**K4**
UNIT - V		
Objective 5	➢ To educate the recent techniques in Metalloenzymes and Metalloproteins.	
Metalloenzymes and Metalloproteins Transport and Storage of Dioxygen- Heme proteins & oxygen uptake, structure and functions of haemoglobin, myoglobin, hemocyanins and hemerythrin. Metallo enzymes- The principle involved and role of various metals in (i) Zinc containing enzymes-carboxy peptidase- A and carbonic anhydrase, (ii) Fe-enzyme-Cytochrome P-450, (iii) Cu-enzyme: Super Oxide dis mutase, (iv) Co-enzyme- Vit.B12. Electrontransfer in Biology- Structure and functions of metallo proteins in electron transfer proteins, cytochromes & Fe-S proteins, Non-heme iron proteins; Rubredoxins, Biological Nitrogen fixation. Structure and properties of Chlorophyll.		
Outcome 5	Learners critically evaluate the recent trends in Metalloenzymes and Metalloproteins.	**K5**

Suggested Readings;

Gopalan, R. (2009). *Concise Coordination Chemistry*. 1E2nd reprint, VPH(P) Ltd.

WilliamJolly, L., McGraw-Hill. (2007). *Modern Inorganic Chemistry* (2^{nd} ed.).

WahidU.Malik, Tuli, G.D., Madan, R.D., Chand, S.&Co. (2013). *Selected Topics in Inorganic Chemistry*.

Huheey, J.E., Keiter, E.A., Keiter, R.L., Methi, O.K. (2009). *Inorganic Chemistry- Principles of structure and reactivity* (4^{th}ed.). 5^{th} Impression, Pearson-Education.

Cotton, F.A., Wilkinson, G., F. AMurillo, F.A., Bochmann, M. (2007). *Advanced Inorganic Chemistry* (6^{th}ed.). JohnWiley.

Sathyaprakash, J.D., Tuli, S.K., Basu, K., Madan, R.D., S. Chand&Co. (2006). *Advanced Inorganic Chemistry* (I^{st}ed.). (Vol I&II).

Das, A.K., Das, M., ArunabhaSen. (2018). *Biophysical, Bio organic and Bio inorganic Chemistry Books* and Allied (P) Ltd.

Online Resources:

https://www.youtube.com/watch?v=XLY_V7gEeb8
https://www.uou.ac.in/lecturenotes/science/MSCCH-17/CHE-501%20Lecture%202%20Metal%20Cluster.pdf
https://www.sscasc.in/wp-content/uploads/downloads/Chemistry/Inorganic-Chemistry.pdf
https://www.surendranathcollege.ac.in/new/upload/SOURAV_MISRABIO-INORGANIC%20CHEMISTRY2021-06-25bioinorganic.pdf

K1-Knoledge	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by Dr.G. Gopu & Dr. N. Sengottuvelan

Course Outcome Vs Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S - Strong (3), M - Medium (2), L - Low (1)

Course Outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.AV	**3**	**2.8**	**3**	**2.4**	**2.6**

S - Strong (3), M - Medium (2), L - Low (1)

Semester - III					
Core	**Course Code: 536302**	**Advanced Organic Chemistry**	**T**	**Credits: 5**	**Hours: 5**

UNIT - I

Objective 1	➢ Learn to effectively employ metal and non-metal oxidizing agents to transform alcohols, alkenes, and ketones into diverse functional groups. ➢ Understand the mechanisms and applications of oxidations, including epoxidation, dihydroxylation, and bond cleavage reactions, and their role in complex synthesis.

Oxidizing Reagents in Organic Synthesis

Metal based and non-metal based oxidations of alcohols to carbonyls (Cr, Mn, Al, hypervalent iodine and TEMPO based reagents), phenols (Fremy's salt, silver carbonate), alkenes to epoxides (peroxides/per acids based), Sharpless asymmetric epoxidation, alkenes to diols (Mn, Os based), Sharpless asymmetric dihydroxylation, Prevost reaction and Woodward modification, alkenes to carbonyls with bond cleavage (Os and Ru, ozonolysis), alkenes to alcohols/carbonyls without bond cleavage (hydroboration-oxidation, Wacker oxidation, Se, Cr based allylic oxidation) and ketones to ester/lactones (Baeyer-Villiger).

Outcome 1	Master the application of diverse oxidizing agents to convert alcohols, alkenes, and ketones into functional groups, while comprehending their mechanisms and roles in intricate synthesis.	**K4**

UNIT - II

Objective 2	➢ Master the art of using reducing agents like catalytic hydrogenation, borohydrides, and hydride transfer reagents to strategically accomplish diverse reductions and stereo/enantioselective transformations. ➢ Comprehend the mechanisms and selectivity involved in various reduction reactions, both catalytic and non-catalytic, for efficient synthetic strategies.

Reducing Reagents in Organic Synthesis

Catalytic hydrogenation-Heterogeneous: Pd/Pt/Rh/Ni, Homogeneous, Wilkinson, Li/Na/Ca in liquid ammonia-Birch, Pinacol formation, McMurry, Acyloin formation, dehalogenation and deoxygenations, Hydride transfer reagents from Group III and Group IV in reductions– $LiBH_4$, $NaBH_4$, triacetoxyborohydride, L-selectride, K-selectride, Luche reduction; $LiAlH_4$, DIBAL-H; Trialkylsilanes, Meerwein-Pondorff-Verley reduction-Stereo/enantioselective reductions -Chiral Boranes, Corey-Bakshi-Shibata.

Outcome 2	Develop expertise in using reducing agents to strategically accomplish a variety of reductions and stereo/enantioselective transformations, and understand the mechanisms behind these processes.	**K4**

<table>
<tr><th colspan="3">UNIT - III</th></tr>
<tr><td>Objective 3</td><td colspan="2">➢ Familiarize yourself with cutting-edge synthetic methodologies like metal-mediated coupling reactions, phase transfer catalysts, and solid-state synthesis to construct complex molecules.
➢ Explore modern reactions such as Baylis-Hillman, Heck, Stille, and Suzuki, understanding their applications in creating intricate organic structures.</td></tr>
<tr><td colspan="3">Modern Organic Synthesis
Baylis-Hillman reaction, Henry reaction, Nef reaction, Ritter reaction, Sakurai reaction and Tishchenko reaction. Tebbe olefination. Metal mediated C-C and C-X coupling reactions: Heck, Stille, Suzuki, Negishi and Sonogashira, Nozaki-Hiyama, Buchwald-Hartwig Ullmann coupling reactions, Directed ortho metalation. Phase transfer catalysts, Crown ethers, Solid state synthesis - Merrifield resin. Robinson annulations.</td></tr>
<tr><td>Outcome 3</td><td>Familiarize yourself with contemporary synthetic methodologies like metal-mediated coupling reactions and solid-state synthesis, and gain insight into their application for complex molecule construction.</td><td>K3</td></tr>
<tr><th colspan="3">UNIT - IV</th></tr>
<tr><td>Objective 4</td><td colspan="2">➢ Develop proficiency in devising strategies for the synthesis of various ring sizes, including three, four, five, and six-membered rings, through cyclization and inter-conversion approaches.
➢ Understand advanced concepts like Pauson-Khand reaction, Bergman cyclization, and ring-closing metathesis, gaining expertise in constructing complex ring systems.</td></tr>
<tr><td colspan="3">Construction of Ring Systems
(i) Different approaches towards the synthesis of three, four, five, and six-membered rings; (ii) Pauson-Khand reaction, Bergman cyclization; Nazarov cyclization, cation-olefin cyclization and radical-olefin cyclization, inter-conversion of ring systems (contraction and expansion); (iii) Construction of macrocyclic rings and ring closing metathesis.</td></tr>
<tr><td>Outcome 4</td><td>Learn strategies for synthesizing different ring sizes and understand advanced concepts such as Pauson-Khand reaction, Bergman cyclization, and ring-closing metathesis, for constructing intricate ring systems.</td><td>K4</td></tr>
<tr><th colspan="3">UNIT - V</th></tr>
<tr><td>Objective 5</td><td colspan="2">➢ Grasp the principles of retrosynthetic analysis, using one and two-group disconnections to plan systematic synthetic routes for target molecules.
➢ Learn to protect and deprotect functional groups selectively, understanding chemoselectivity and regioselectivity, and apply these strategies in complex synthesis.</td></tr>
<tr><td colspan="3">Retrosynthesis and Functional Group Protection
Basic principles and terminology of retro-synthesis, one group and two group C-X disconnections, one group and two group C-C disconnections, important strategies of retro-synthesis and important functional group inter-conversions. Protection and deprotection of hydroxy, carboxyl, carbonyl, carboxy amino groups, alkene, 1,3 butadiene, alkyne,; chemoselective and regioselective protection and deprotection. Systematic synthetic routes for jasmone, ascorbic acid and retinol. Asymmetric Synthesis-Basics, Classical reactions and stereochemistry involved in the synthesis.</td></tr>
</table>

Outcome 5	Acquire the ability to perform retrosynthetic analysis and design systematic routes for target molecules, while mastering the selective protection and deprotection of functional groups in complex synthesis.	**K4**

Suggested Readings:

Morrison, R.T. and Boyd's, R. N. (2008). *Organic Chemistry* (6th ed.) Springer.

MichealB.Smith, Jerry March. (2007). *March's Advanced Organic Chemistry Reactions, Mechanisms and Structure*(6th ed.) JohnWiley& Sons Inc., New Jersey.

Mukherji, S. P., Singh, S. P. (2004). Reaction Mechanism in Organic Chemistry (3rd ed.). Macmillan India Ltd, New Delhi.

I.L. Finar, I. L. (2004). *Organic Chemistry Vol. I &II*(5th ed.). Pearson Education, Singapore.

Kalsi, P. S. (2000). *Organic Reactions and Mechanisms,* (2nd ed.). New Age International Publishers.

Pine, S. H., Hendrickson, J. B., Cram, D. J., Hammond, G. S. (1980). *Organic Chemistry* (4th ed.). McGraw-Hill Company.

Mukherji, S. M., Singh, S. P.(1984). Reaction Mechanism in Organic Chemistry (3rd ed.). 1984, Mac Millan.

R.O.C. Norman, R. O. C. (1978). *Principles of Organic Synthesis* (2nd ed.). Chapman and Hall.

Mackie, R. K., Smith. (1990).*Organic Synthesis* (2nd ed.). Longman Group UK Ltd.

Ahluwalia, V. K., Parashar, R. K. (2002). *Organic Reaction Mechanisms*. Narosa Publishing House.

Carrothers, W. (1982). *Some modern methods of organic synthesis.* OUP. House, H. O. *Modernsynthetic reactions.* Allied publishers.

F. A. Carey, F. A., R. A. Sundberg, R. A. (2007). *Advanced Organic Chemistry, Part A: Structure and Mechanisms*(5th ed.). Springer, New York.

Online Resources

https://nptel.ac.in/
https://ocw.mit.edu/
https://www.masterorganicchemistry.com/
https://chem.libretexts.org/Bookshelves/Organic_Chemistry
https://chemistrynotes.com/pages/organic-chemistry-notes
https://www.khanacademy.org/science/organic-chemistry
https://www.chemguide.co.uk/
https://commonorganicchemistry.com/
https://www.organic-chemistry.org/
https://hbu.libguides.com/chemistry

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by Dr. M. Sundrarajan & Dr.S. Viswanathan

Course Outcome Vs Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	L(1)	M(2)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
W.AV	2.4	2.8	2.6	2.4	2.2	3	1.6	2.4	2.2	1.6

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)
W.AV	**3**	**2.8**	**3**	**2.4**	**2.6**

S-Strong (3), M-Medium (2), L-Low (1)

Semester - III					
Core	**Course code: 536303**	**Advanced Physical Chemistry**	**T**	**Credits: 5**	**Hours:5**

UNIT –I		
Objective 1	To achieve an understanding of the electronic structure and spectra of many-electron atom, term symbols, and selection rules.	
Advanced Quantum Chemistry Structure of many-electron atoms: Helium and Hydrogen atoms, hydrogen molecule ion, hydrogen molecule, Pauli principle, electron affinities, Self-consistent field, atomic orbitals, Slater Type Orbitals, Slater exponents and the periodic properties of elements; LCAO-MO, Hückel orbitals; Born-Oppenheimer approximation, Potential energy surface, Hellman-Feynman theorem. Structure and spectra of hydrogenic atoms: Separation of internal motion and radial solutions. Spectra of complex atoms: Spin-orbit couplings, term symbols, and selection rules.		
Outcome 1	The students have a solid understanding of the electronic structure of many-electron atoms, the effects of electron-electron interactions, and the interpretation of atomic spectra.	**K2**

UNIT-II		
Objective 2	The fundamental principles and techniques of spectroscopy, focusing on the interaction of radiation with matter and the analysis of molecular energy states.	
Molecular Spectroscopy Introduction to spectral energy domains and measurement of spectra, Implications of discrete energy levels, Population of States–Boltzman Distribution, Interaction of radiation with matter, origin of line widths in molecular spectra, Transition dipole moment and Fermi's Golden Rule. Lasers and Masers. Rotational (Microwave) spectroscopy, Molecular vibrations - Infrared spectroscopy, Normal mode analysis, Raman Scattering, Non-Linear Spectroscopy, Nuclear quadrupole resonance spectroscopy.		
Outcome 2	To the concept and classification of various spectroscopic techniques, their applications, and their significance in analyzing molecular properties and interactions.	**K3**

UNIT -III		
Objective 3	Students with a comprehensive understanding of electrochemistry in solution, focusing on ion-solvent interactions, double-layer structure, electrode potentials, reference electrodes, current-potential relationships, and electrochemical cells.	
Electrochemistry of Solutions and Interfaces Electrochemistry of solutions: Ion-solvent interactions, ion-ion interactions, ionic migration and diffusion. Theories of Double-Layer structure, diffuse-double-layer theory of Gouy and Chapman, the Stern Model, Adsorption of ions and neutral compounds, Electrocaplillary and differential capacitance measurements. Influence of double layer on charge transfer processes. Equilibrium electrode potentials, Classification of electrodes. Reference electrodes: Polarizable and non-polarizable systems, Types of reference and working electrodes, Current-potential relationship (derivation of Butler-Volmer and Tafel equations). Types of over-potentials: origin and minimization, mechanism, Origin of emf and classification of electrochemical cells.		
Outcome 3	The students learn principles of electrochemistry, including electrode potentials, double-layer structures, over-potentials, and the behavior of electrochemical cells.	**K2**

UNIT -IV		
Objective 4	Learn about the principles of statistical mechanics and their application to thermodynamics, molecular behavior, and chemical reactions.	
Molecular Energetics and Dynamics Statistical view of entropy. Laws of thermodynamics from statistical considerations Molecular view of temperature and heat capacity. Boltzmann distribution. Thermodynamic quantities in terms of partition functions. Statistical mechanics of simple gases and solids. Equilibrium constant in terms of partition functions. Bose-Einstein and Fermi-Dirac statistics. Complex Reactions, Catalysis. Temperature dependence and Arrhenius law, Potential energy surfaces. Kinetic theory of collisions, Transition state theory. RRK and RRKM theories. Reaction cross-sections, rate coefficients, reaction probabilities.		
Outcome 4	Students have a solid grasp of the statistical foundations of thermodynamics, molecular interactions, and chemical kinetics. They will be equipped to analyze and predict the behavior of systems, as well as understand the underlying principles governing complex reactions and reaction rates.	**K2**
UNIT- V		
Objective 5	The fundamental concepts of solid-state physics and the structure-property relationships of various types of solids**.**	
Solid State Chemistry Lattices and unit cells, Identification of lattice planes; Miller indices, separation of planes. Investigation of structure; X-ray diffraction, Bragg's law, Scattering factors. Metallic solids: Close packing, Less closely packed structures, Molecular solids, and covalent networks. The properties of solids; Mechanical properties: Electrical properties; formation of bands. Optical properties: Light absorption by molecular solids, metallic conductors, and semiconductors, Light emission by solid-state lasers and light-emitting diodes.		
Outcome 5	Students understand crystal structures, solid-state properties, and the behavior of various types of solids.	**K5**

Suggested Readings:

Atkins, P., de Paula, J. (2006). *Atkins' Physical Chemistry* (8th ed.). Oxford University Press.

Mc Quarrie, D. A. (1983). *Quantum Chemistry.* Oxford University Press.

Levine, I. R. (1995). *Quantum Chemistry*. Prentice Hall India (Ltd).

Banwell, C. M., McCash, E. M. (1983). *Fundamentals of Molecular Spectroscopy*. TataMcGraw Hill.,Barrow, G. M. (1962). *Molecular Spectroscopy*. McGraw Hill.

O'M. Bockris, J. J., Reddy, A. K. N. (1998). *Modern Electrochemistry* (2nd ed.). Vol. I &II, PlenumPress.

Bagotsk V. S., Hoboken. (2006). *Fundamentals of Electrochemistry* (2nd ed.). Wiley-Inter science.

Dill, K. A., Bromberg, S. (2003). *Molecular Driving Forces: Statistical Thermodynamics in Chemistry and Biology.* Garland Science.

Mc Quarrie, D. A., Simon, J. D. (2004). *Molecular Thermodynamics*. Viva Books.

Houston, P. L. (2001). *Chemical Kinetics and Reaction Dynamics.* McGraw-Hill Higher Education.

Anthony R. West, Solid State Chemistry and its Applications, John Wiley & Sons, 2014.

Online Resources

https://www.uou.ac.in/sites/default/files/slm/MSCPH-512.pdf
https://www.uou.ac.in/lecturenotes/science/MSCPHY-17/Spectroscopy%20by%20Dr.%20Papia%20Chowdhury.pdf
Brett Ch., Brett A. Electrochemistry. principles, methods, and applications (Oxford, 1994) (T)(444s).pdf (hu.edu.jo)
https://www.bhu.ac.in/Content/Syllabus/Syllabus_300631282020042911363 3.pdf
https://nios.ac.in/media/documents/313coursee/l8.pdf

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by : Dr.T.Stalin

Course Outcome Vs Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)
CO2	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)
CO3	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
CO5	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)
W.AV	2.4	2.6	2.2	2	2.2	2.8	2.4	2.4	2.2	1.8

S-Strong (3), M-Medium (2), L- Low (1)

Course Outcome Vs Program Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S(3)	M(2)	M(2)	S(3)	S(3)
CO2	L(1)	M(2)	M(2)	M(2)	S(3)
CO3	M(2)	M(2)	S(3)	S(3)	M(2)
CO4	M(2)	S(3)	M(2)	M(2)	M(2)
CO5	S(3)	S(3)	M(2)	S(3)	M(2)
W.AV	2.2	2.4	2.2	2.6	2.4

S-Strong (3), M-Medium (2), L- Low (1)

Semester - III					
Core	**Course code: 536304**	**Physical Chemistry-Practical**	**P**	**Credits: 5**	**Hours: 8**

EXPERIMENT - I		
Objective 1	To study the acid hydrolysis of ester based on chemical kinetics and evaluate the value of the rate constants.	
Title: Kinetics - acid hydrolysis of ester		
Outcome 1	Student Understanding Ester Hydrolysis and based on chemical kinetics.	**K5**
EXPERIMENT - II		
Objective 2	To teach the Kinetics-Acid hydrolysis of ester-comparison of strengths of acids/determination of Ea.	
Title: Kinetics-acid hydrolysis of ester-comparison of strengths of acids/determination of ea.		
Outcome 2	The students should have a solid grasp of the fundamental concepts related to kinetics, acid-base reactions, and activation energy determination	**K3**
EXPERIMENT - III		
Objective 3	To provide students with a comprehensive understanding of the iodine- Iodine equilibrium based on the distribution law.	
Title: Distribution Law-Study of iodine- Iodine equilibrium		
Outcome 3	The students understanding Distribution Law, Equilibrium Concepts, Partition Coefficient.	**K2**
EXPERIMENT- IV		
Objective 4	To provide students brief knowledge about acid-alkali titration by conductometry method	
Title: Acid-Alkali titration by conductometry		
Outcome 4	Students acquire an understanding of the techniques and expertise needed to conduct acid-alkali titrations utilizing conductometric methods.	**K2**
EXPERIMENT -V		
Objective 5	To gain knowledge the dissolution constants of weak acids with the help of conductometry titration.	
Title: Determination of dissolution constants of weak acids by conductometry		
Outcome 5	Students should possess the expertise and practical skills necessary to ascertain thedissolution constants of weak acids through the utilization of conductometric techniques.	**K3**

EXPERIMENT - VI		
Objective 6	To provide students brief knowledge about critical micelle concentration by conductometry	
Title: Determination of Critical Micelle Concentration by conductometry		
Outcome 6	Students should have the understanding and practical expertise needed to ascertaincritical micelle concentrations through the application of conductometric techniques.	**K3**
EXPERIMENT - VII		
Objective 7	To teach the redox titration by potentiometry method	
Title:Potentiometric Titrations – Redox titration		
Outcome 7	Students should grasp potentiometric techniques in redox titrations, covering theoretical concepts, practical electrode potential application, and quantitative analysis for determining unknown analyte concentrations.	**K3**
EXPERIMENT - VIII		
Objective 8	To teach the dissolution constant of weak acids by Potentiometric titrations**.**	
Title: Determination of dissolution constant of weak acids by Potentiometric Titrations.		
Outcome 8	Students should be well-equipped to sound understanding of the theoretical foundations, practical procedures, and data analysis methods necessary for accurate determination of K_a values.	**K4**
EXPERIMENT - IX		
Objective 9	To gain knowledge the freezing point activities	
Title: Determination of activities by freezing point		
Outcome 9	students should be well-versed the relationship between freezing point depression, solute activity, and concentration, and possess the skills to conduct accurateexperiments and calculate activities in various solution systems.	**K4**
EXPERIMENT - X		
Objective 10	To provide students brief knowledge about the principle of dipole moment	
Title: Determination of dipole moment		
Outcome 10	students should appreciate the significance of dipole moments in understanding molecular properties and interactions.	**K5**
EXPERIMENT–XI		
Objective 11	To provide students brief knowledge about the quantum yield	
Title: Determination of quantum yields		
Outcome 11	students should appreciate the significance of quantum yields in understanding and characterizing photochemical processes.	**K4**

EXPERIMENT - XII		
Objective 12	To teach the heats of vaporization and depressions of freezing points of solutions.	
Title: Determination of heats of vaporization and depressions of freezing points of solutions.		
Outcome 12	students should equip to design and conduct experiments, analyze data, and calculate these important properties of solutions.	**K2**
EXPERIMENT - XIII		
Objective 13	To provide students with a comprehensive understanding of the electrodes with different substrates for H_2 evolution	
Title: Determination of Electrodes with different substrates for H_2 evolution.		
Outcome 13	students should be equipped to design and conduct experiments, analyze data, and draw conclusions related to the performance of different electrode substrates for H_2 evolution.	**K4**
	EXPERIMENT - XIV	
Objective 14	To provide students brief knowledge about the photoelectrochemical solar cells working principle**.**	
Title: Determination of Photoelectrochemical solar cells.		
Outcome 14	Students should be equipped to design and conduct experiments, analyze data, and draw conclusions related to the performance of photoelectrochemical solar cells for solar energy conversion.	**K4**

Suggested Readings:

1. Viswanathan, B., Raghavan, P. S. (2015). *Practical Physical Chemistry*. Viva Books.
2. Levitt, B. P. (1985). *Findlay's Practical Physical Chemistry* Revised (9th ed.). Longman, London.
3. Gurtu, J. N., Kapoor, R., Chand, S. & Co. (1980). *Advanced Experimental Chemistry.* Vol.I, NewDelhi, 1980.
4. Rajbhoj, S. W., Chondhekar, T. K. (2017). *Systematic Experimental Physical Chemistry*. Anjali Publication, Aurangabad.

K1-Remember	***K2-Understand***	***K3-Apply***	***K4- Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by Dr.T. Stalin

Course Outcome Vs Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)
CO3	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	L(1)	M(2)	M(2)	L(1)
CO4	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	L(1)	S(3)	M(2)	M(2)
CO5	M(2)	S(3)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO6	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)
CO7	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)
CO8	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO9	M(2)	S(3)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO10	M(2)	S(3)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO11	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)
CO12	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)
CO13	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)
CO14	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	2.3	2.9	2.1	2.1	2.5	3	1.9	2.6	2.7	1.8

S-Strong(3), M-Medium(2), L- Low(1)

Course Outcome Vs ProgramSpecific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	L(1)	M(2)	S(3)	M(2)
CO2	S(3)	M(2)	S(3)	M(2)	S(3)
CO3	M(2)	M(2)	S(3)	M(2)	L(1)
CO4	M(2)	S(3)	S(3)	S(3)	L(1)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
CO6	M(2)	S(3)	S(3)	S(3)	L(1)
CO7	M(2)	M(2)	S(3)	M(2)	L(1)
CO8	M(2)	S(3)	S(3)	S(3)	L(1)
CO9	S(3)	S(3)	S(3)	S(3)	S(3)
CO10	S(3)	L(1)	M(2)	S(3)	S(3)
CO11	M(2)	S(3)	S(3)	S(3)	L(1)
CO12	S(3)	S(3)	S(3)	S(3)	S(3)
CO13	M(2)	M(2)	S(3)	M(2)	L(1)
CO14	S(3)	M(2)	S(3)	M(2)	S(3)
W.AV	2.4	2.2	2.8	2.6	1.9

S-Strong (3), M-Medium(2), L- Low(1)

Elective Courses					
DSE	**Course code: 536051**	**Natural Products and Introductory Biochemistry**	**T**	**Credits:4**	**Hours:4**

UNIT-I		
Objective 1	The synthesis and reactivity of some heterocyclic compounds	
Heterocyclic Compounds Heterocyclic compounds: Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms; Synthesis and properties of imidazole, oxazole, thiazole andindole, anthocyanidins, cyanidinchloride, flavones and isoflavones, pyrimidines, purines, uricacid and caffeine.		
Outcome 1	The students will be able to write the structure, synthesis and reactivity of heterocyclic compounds	**K1**
UNIT - II		
Objective 2	About the types and structural features of different steroids and knowledge regarding ORD and CD	
Steroids, ORD and CD Steroids: Types of steroids – structure, stereochemistry of cholesterol – Structural features of bile acids–Sex harmones–androsterone, testerosterone, estrone, estriol, estradiol, progesterone-Structure of ergosterol. ORD and CD: Circular birefringence, optical rotary dispersion, circular dichroism–Cotton effect curves–octant rule– axial haloketone rule-Applications of chiropticalproperties in configurational assignments.		
Outcome 2	Students would be able to understand the details about steroids and ORD and CD.	**K2**
UNIT- III		
Objective 3	To learn the structural elucidation, stereochemistry and biosynthesis of alkaloids and terpenoids	
Alkaloids and Terpenoids Alkaloids: General methods of structural elucidation of alkaloids- structure and stereochemistry of the alkaloids: Quinine, Morphine and Lysergic acid- Biosynthesis of alkaloids. Terpenoids: Classification- Structure, stereochemistry of Camphor, Zingiberene and Abieticacid-Biosynthesis of terpenoids.		
Outcome 3	Students will be able to elucidate the structure of alkaloids and terpenoids and understand their biosynthesis.	**K4**
UNIT - IV		
Objective 4	To learn the structure and stereochemistry of antibiotics and vitamins	
Antibiotics and vitamins Antibiotics: A detailed study of structure and stereochemistry of penicillin, cephalosporin and griseofulvin- structural features of streptomycin. Vitamins: Chemistry and physiological action of ascorbic acid, thiamin, riboflavin and pyridoxine– Elementary aspect of Vitamin A, E, K and B12.		
Outcome 4	Students will understand the details about structure and stereochemistry of the antibiotics and vitamins.	**K3**

UNIT– V		
Objective 5	To acquire the knowledge of biochemical aspects–metabolism, anabolism and catabolism.	

Biochemistry

Structure and functions: Aspects of structure and classification of carbohydrates, lipids, amino acids, proteins and nucleic acids. Flow of genetic information, nature of genetic code, replication of DNA, transcription and translation, regulation of gene expression.

Metabolism: Bioenergetics, thermodynamic considerations, redox potentials, bioenergetic principles. Catabolism and anabolism; Enzymes involved, catalytic mechanism and regulatory steps in glycolysis, TCA cycle, mitochondrial electron transport and oxidative phosphorylation.

Outcome 5	Student gain the knowledge and understanding of biochemistry aspects	**K5**

Suggested Readings:

Finar, I.L. (2004). Organic Chemistry (5thed.). Vol.I&II, Pearson Education, Singapore.

Ahluwalia, V.K., LalitaS.Kumar., SanjivKumar. (2006). Chemistry of Natural Product. Ane Book's India, NewDelhi-2006.

Agarwal, O.P. (1988). Chemistry of Organic Natural Products.Vo l I&II, Goel publishing House.

Gupta, R.R., Kumar, M., Gupta, V. (2009). Heterocyclic Chemistry II (2nd ed.). NewDelhi.

Kalsi, P.S. and Sangeethajagtap. (2013). Pharmaceutical Medical and Natural Product. Narosa International Private Limited, NewDelhi.

Ahluwalia, V.K. (2013). Heterocyclic Chemistry-II, Narosa International Private Limited, NewDelhi.

Krishnamoorthy, N.R. (2010). Chemistry of Natural Products (2nd ed.) Hyderabad.

Gurdeep R. Chatwal. (2007). Organic Chemistry of Natural Products (4th ed.). NewDelhi.

Joule, J.A., Smith, G.F. (1978). Heterocyclic Chemistry.Van Notrand Reishord Co., London.

Syed Aftab Iqbal. (2011). Chemistry of Natural Products. Discover Publishing House Private Limited, NewDelhi.

Atta-Ur-Rahman, Choudhary, M.I. (1998). New Trends in Natural Product Chemistry(1sted.) Gordon& Breach Science Publishers.

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by Dr.M. Sundrarajan and Dr S. Umadevi

CourseOutcome Vs ProgramOutcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**
CO1	M(2)	L(1)	M(2)	S(3)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	M(2)	L(1)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)
CO3	L(1)	S(3)	M(2)	S(3)	M(2)	L(1)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	M(2)	S(3)	S(3)	L(1)	S(3)	M(2)	S(3)	M(2)	(-)
CO5	M(2)	S(3)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	-
W.A V	2.2	2.4	2	2.4	2	2.4	2	2.8	2.2	1

S-Strong (3), M-Medium(2),L-Low(1)

CourseOutcomeVsProgramSpecificOutcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	L(1)	L(1)	M(2)	L(1)	L(1)
CO2	L(1)	M(2)	L(1)	M(2)	S(3)
CO3	M(2)	M(2)	S(3)	M(2)	L(1)
CO4	M(2)	S(3)	-	L(1)	L(1)
CO5	S(3)	L(1)	L(1)	L(1)	-
W.AV	1.8	1.8	1.4	1.4	1.2

S-Strong(3),M-Medium(2),L-Low(1)

DSE	Course code: 536052	Instrumental Methods of Analysis	T	Credits:4	Hours:4

UNIT - I		
Objective 1	To acquire knowledge in chromatographic techniques	
Separation Techniques Theory of chromatography, mechanism-adsorption and partition-classification-column, paper and thin layer chromatography–Gas Chromatography (GC), GC/MS, LC/MS-High Performance Liquid Chromatography(HPLC), Ion Exchange Chromatography.		
Outcome 1	The students will understand the different chromatographic techniques.	**K2**

UNIT - II		
Objective 2	The types of errors	
Error Analysis Classification of errors-accuracy-precision-minimization of errors. Significant figures. Mean and standard deviation andomand normal errors. Comparison of results. Student-tests curve fitting-multiple linear regression, correlation co-efficient.		
Outcome 2	Students would be understanding and analyze the error.	**K3**

UNIT - III		
Objective 3	To learn the principle and applications of spectrometric techniques	
Spectrometric Techniques Principles and applications of Atomic Absorption Spectrometry (AAS), Atomic Fluorescence Spectrometry, Atomic Emission Spectrometry(AES)- Flame photometry-Atomic Mass spectrometry.		
Outcome 3	Students will be able to understand the principles of spectrometric techniques and knowledge about their application.	**K4**

UNIT - IV		
Objective 4	To acquire the knowledge about thermal and surface analysis techniques	
Thermal and Surface Analysis Principles and applications of Thermo gravimetry (TG)- Differential Thermal Analysis (DTA)-Differential Scanning Calorimetry (DSC)- Thermo Mechanical Analysis (TMA) –BET Surface Area Analyzer -X-ray diffractometer (XRD)- X-ray photoelectron spectroscopy (XPS)-Scanning Electron Microscopy (SEM)-Transmission Electron Microscopy (TEM) -Atomic Force Microscopy (AFM).		
Outcome 4	Students will learn about different thermal and surface analysis techniques and able to apply for characterization.	**K2**

UNIT - V		
Objective 5	To acquire the knowledge of electro analytical methods	
Electro analytical Methods Electroanalytical techniques: Principles of Amperometry,Potentiometry, Electrogravimetry, Voltammetry, Stripping Voltammetry methods, Electrochemical sensors. Applications to chemical and biological systems.		
Outcome 5	Student gain the knowledge, understanding and applications of electroanalytical methods.	**K2**

Suggested Readings:

Vogel,A.I.(1987). TextBook of Quantitative organic Analysis(3rd ed.). ELBS.

Chatwaland Anand.(2000). Instrumental methods of chemical analysis.
Himalaya publishing House, NewDelhi.

Valcarcel.(2000). Principles of Analytical Chemistry, Springer-Verlag, Berlin.

AllenJ.Bard. Faulkner., JohnWileyandSons.(1983). Electrochemical Methods, Fundamentals and Applications. New York.

Gary.D.Christian, John Wiley and Sons.(2003). Analytical Chemistry. NewYork.

Willard Merit Dean and Settle.(1986). Instrumental Methods of Analysis (4th ed.). CBS Publishers.

Schoog, Holler, Crouch.(2004). Principles of Instrumental Analysis, (6th ed.). Asia Pvt.Ltd., Singapore.

D.A.Skoog,D.A.,West,D.M.(2004). Fundamentals of Analytical Chemistry (4th ed.) Winston Publications.

SkoogandWests.(2014). Fundamentals of Analytical Chemistry (9th ed.). Winston Publications.

Lakowicz,J.R.(2006). Principles of Fluorescence Spectroscopy (3rd ed.). Springer, New York.

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by Dr.M. Sundrarajan and Dr S. Umadevi

Course Outcome Vs Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**
CO1	M(2)	L(1)	M(2)	S(3)	M(2)	S(3)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	S(3)	M(2)	L(1)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)
CO3	L(1)	S(3)	M(2)	S(3)	M(2)	L(1)	L(1)	S(3)	M(2)	L(1)
CO4	S(3)	M(2)	S(3)	S(3)	L(1)	S(3)	M(2)	S(3)	M(2)	(-)
CO5	M(2)	S(3)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	-
W.A V	2.2	2.4	2	2.4	2	2.4	2	2.8	2.2	1

Course Outcome Vs Program Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	L(1)	M(2)	L(1)	L(1)
CO2	L(1)	M(2)	L(1)	M(2)	S(3)
CO3	M(2)	M(2)	S(3)	M(2)	L(1)
CO4	M(2)	S(3)	-	L(1)	L(1)
CO5	S(3)	L(1)	L(1)	L(1)	-
W.AV	1.8	1.8	1.4	1.4	1.2

S-Strong(3),M-Medium(2),L-Low(1)

DSE	Course Code: 536053	Spectroscopic Methods of Analysis	T	Credits:4	Hours:4

UNIT- I

Objective 1	To acquire knowledge about UV-Vis, IR and Raman spectroscopy techniques

UV-Vis, IR and Raman Spectroscopy

UV-Visible spectroscopy: Simple chromophoric groups-conjugated and aromatic systems-electronic excitations-factors that affect the position and intensity of absorption bands-Beer's-Lambert's law-Woodward–Fisher rules for spectra of dienes, α, β -unsaturated ketones and aromatic carbonyl compounds–-charge transfer complexes**.** IR Spectroscopy: Predicting number of active modes of vibrations- Hook's Law-Characteristic group frequencies of organic and inorganic compounds-Effects of substitution, conjugation, bond angle and hydrogen bond on carbonyl vibrational frequencies- IR spectra of metal complexes. Raman Spectroscopy: Raman spectra of simple organic and inorganic molecules-resonance and surface enhanced resonance Raman scattering.

Outcome 1	Students will learn about the techniques and will be able to apply in the analysis of organic and inorganic compounds	K2

UNIT - II

Objective 2	**To acquire knowledge and understanding of NMR spectroscopy**

NMR Spectroscopy

NMR Spectroscopy: NMR Phenomenon–NMR spectroscopy of compounds containing spin½ nuclei (^{1}H,^{13}C, ^{31}P, ^{19}F, Al, B, Si)-chemical shift (δ) –^{1}HNMR- inductive and anisotropic effects on δ–spin–spin coupling and coupling constant J–geminal, vicinal and long-range coupling-factors that affectthese parameters, Karplus equation. ^{13}C NMR Broad-band and off-resonance decoupling and gamma gauche effect-Nuclear Overhauser Effect –Applications of NMR in inorganic and organometallic chemistry. Simplification of complex NMR spectra–shift reagents-double resonance –deuterium exchange reactions –high fields.

Outcome 2	Students understand the technique and will be able to apply for the structural elucidation	K2

UNIT - III

Objective 3	To learn about different two dimensional NMR spectroscopy and EPR spectroscopy

Two Dimensional NMR and EPR Spectroscopy

Two dimensional NMR: COSY(H-H, C-H), INADEQUATE, HMBC, DEPT and NOESY.EPR Spectroscopy: Zeeman splitting, introduction to zero-field splitting, g-values, anisotropying-values, hyper fine and superhyper fine coupling constants, -selected applications inorganic inorganic compounds Cu, Mn and V complexes, EPR of complexes having spin>1/2.

Outcome 3	Students will be able to understand the technique and apply in structural elucidation	K4

UNIT - IV		
Objective 4	To learn about the Mass and Mossbauer Spectroscopy	
Mass and Mossbauer Spectroscopy Mass Spectroscopy: molecular ion, isotope abundance, fragmentation processes of organicmolecules, McLafferty Rearrangement-deduction of structure through mass spectral fragmentation, high resolution MS, softionization methods, ESI-MS and MALDI-MS, studies of inorganic/ coordination and organometallic representative compounds. Hypenated techniques. Mossbauer spectroscopy - Mossbauer effect, recoilless emission and absorption, hyperfine interaction, chemical isomershift, magnetic hyperfine and quadruple interaction and interpretation of spectra-Fe, Sn.		
Outcome 4	Students understand and will be able to apply Mass and Massbauer techniques for structural analysis of compounds	**K4**
UNIT - V		
Objective 5	To learn the use of spectroscopic instruments	
Spectroscopic Laboratory Use of spectroscopic instrumentation to obtain familiarity with important types of spectrometers and spectroscopic methods, spectrometers include electronic ultraviolet/visible absorption, fluorescence, Raman, Fourier transform infrared and nuclear magnetic resonance, Mass and EPR spectroscopic techniques.		
Outcome 5	Students will be able handle the spectroscopic instruments for the analysis of the compounds	**K3**

Suggested Readings:

Kalsi,P.S.(1995). Spectroscopy of Organic Compounds.Wiley Eastern Ltd.,Madras.

ChatwalandAnand.(2000).Instrumental methods of chemical analysis. Himalaya publishing House NewDelhi.

Silverstein,R.M.,Bassler,C.G.,Morril,T.C.(2002).Spectrometric identification of organic compounds(6thed.). JohnWiley&Sons, NewYork.

Banwell,C.N.,E.M.McCash,E.M.(1994). Fundamentals of Molecular Spectroscopy (4thed.). McGraw-Hill, NewYork.

Keelar,J.(2002).Understanding NMR Spectroscopy. Wiley,Germany.

Williams,D.H.,Fleming,I.(1988). Spectroscopic methods inorganic chemistry.Tata McGraw Hill.

Kemp,W.(1987).Organic Spectroscopy(2nded.).ELBS-Macmillan.

Hollas,M.J.(2004).Modern Spectrscopy(4thed.). Wiley.

Willard,R.,Merit Dean and Settle.(1986).Instrumental Methods of Analysis(4thed.). CBS Publishers.

Schoog,Holler,Nieman,Thomson.(2004). Principles of Instrumental Analysis. Asia Pvt.Ltd., Singapore.

SkoogD.A.,West,D.M.(2004). Fundamentals of Analytical Chemistry(4thed.).Winston Publications.

Mermet,J.M.,Otto,M.,Kellner,R.(2004).Analytical chemistry:a modern approach to analyti cal science. Wiley-VCH.

Rouessac,F.,Rouessac,A.(2011).ChemicalAnalysis:Modern Instrumentation MethodsandTechniques(2nded.). Wiley & sons, USA.

Kemp,W.(1986). NMR in Chemistry. MacMillan Ltd.

Mchale,J.L.Molecular Spectroscopy.CRC press, Florida.

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by Dr.M. Sundrarajan and Dr S. Umadevi

Course Outcome Vs Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	M(2)	L(1)	M(2)	L(1)	M(2)	L(1)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	M(2)	M(2)	L(1)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)
CO3	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	L(1)	S(3)	M(2)	S(3)	M(2)	(-)
CO5	M(2)	L(1)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	-
W.A V	2.6	1.8	2.2	1.8	2	2.4	2	2.6	2.2	1.2

S-Strong (3), M-Medium (2), L-Low(1)

Course Outcome Vs Program Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	L(1)	M(2)	L(1)	L(1)
CO2	M(2)	S(3)	M(2)	M(2)	S(3)
CO3	S(3)	M(2)	S(3)	M(2)	M(1)
CO4	M(2)	S(3)	-	S(3)	L(1)
CO5	L(1)	M(2)	L(1)	L(1)	-
W.AV	2	2.2	1.6	1.8	1.2

S-Strong(3),M-Medium(2),L-Low(1)

DSE	Course code: 536054	Environmental and Green Chemistry	T	Credits:4	Hours:4

UNIT - I

Objective 1	To understand (i) quality of air, water (iii) green chemistry, (iv) sustainable chemistry and technologies.

Air and Water

Air Quality and pollution: Bio-geo chemical cycles: Carbon, Oxygen, Nitrogen, Phosphorous and Sulphur. Classification of air pollutants, sources of air pollution and control methods. Effects of air pollutants: ozone depletion, acid rain, green-house effect, climate change, global warming. Water Quality and pollution: Water Quality parameters: colour, odour, temperature, turbidity, hardness, alkalinity, pH, conductivity, cations, anions, SS, VOC, TDS, DO, BOD, COD, micronutrients, heavy metals and coli-form. Potable water quality-Industrial water quality, Sources of water pollution.

Outcome 1	The students would be able to know the environmental quality of air and water.	**K3**

UNIT - II

Objective 2	Students will know about purification methods for water

Water Treatment

Pre and primary methods: aeration, filtration, sedimentation, precipitation, coagulation and flocculation, disinfection. Secondary methods: activated sludge, trickling filters, RBC, anaerobic digestion, lagoons and ponds. Tertiary/ Advanced methods: activated carbon, ultra filtration, ion-exchange, electrodialysis, reverse osmosis, Industrial wastewater treatment.

Outcome 2	To acquire information regarding different purification process of water	**K2**

UNIT - III

Objective 3	To introduce green chemistry and its application

Green Chemistry Basics

Define Green chemistry – Difference between green and environmental chemistry - The need of green chemistry – basis of green methods and green products - 12 principles of green chemistry and their illustrations with examples-Synthesis involving principles of green chemistry (caprolactam, adipic acid, vanillin, methyl methacrylate, paracetamol, ibuprofen, citrol, and polycarbonate) - Planning a green synthesis in a chemical laboratory – Commercial green products –Advantages and disadvantages of green products.

Outcome 3	Students will know the principles of green chemistry and their application in synthesis of some of the commercially important compound.	**K4**

UNIT - V

Objective 4	Information regarding the designing of green synthesis

Designing Green Synthesis

Choice of starting materials, reagents, catalysts, biocatalysts, polymer supported catalysts, solvents (water, ionic liquids, fluorous solvents, supercritical CO_2). Green reactions of Arndt–Eistert synthesis, Barton reaction, Claisen rearrangement, Darzen reaction,

Grignard reagent, Heck reaction, Knoevenagel condensation, Mukaiyamma reaction, Reformat sky reaction, Streker synthesis, Ullmann reaction, Wurtz reaction - Renewable chemicals from biomass andsustainable polymers (polylactide). Ultrasound assisted reactions: esterification, reduction, coupling reactions. Electroorganic synthesis.

Outcome 4	Students will learn the designing of green synthesis for some of the important organic reactions	**K2**

UNIT -V

Objective 5	To provide information regarding environmental benign technologies

Sustainable and Environmental Benign Technologies

Solvent free microwave assisted organic synthesis- Reactions on solid supports, phase transfer catalysis, solvent free esters saponification - Reactions without support reagent or catalyst (microwave assisted reactions in water, oxidation of toluene to benzoic acid)- Microwave induced green synthesis - Benefits and limitations of microwave. Traditional and green synthesis of some organic compounds- Reduce or reduction in materials, energy, waste, non-renewable, cost and risk hazards as greener alternatives for sustainable development. Carbon capture, carbon storage, carbon sequestration, carbon foot print and carbon trading.

Outcome 5	The students would be able to know the environmental quality of air and water, green chemical process, sustainable methods.	**K2**

Suggested and readings:

1. De,A.K.(2003). *Environmental Chemistry*. NewAge International.
2. Shangi, R.,Srivatsava,M.M.(2003). *Green Chemistry*. Narosa Publishers, NewDelhi.
3. Harnung,S.E.,Johnson,M.S.(2012).*Chemistry and the Environment.* Cambridge University Press.
4. Jacobson,M.Z.(2012). *Air Pollution and Global Warming*(2nd ed.). Cambridge University Press.
5. Bear, J.M.(2013). *Environmental Chemistry in Society*. CRC press.
6. Anasta, P.T. (2000).*Green Chemistry:Theory&Practice*. Oxford University Press.
7. Marteel-Parrish,A.E.,Abraham,M.A.(2014). *Green Chemistry and Engineering: A Pathway toSustainability*. Wiley.
8. V.K.Ahluwalia,V.K.(2006). *Green Chemistry-Environmentally benign Reactions*. Ane Books India.

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. M. Sundrarajan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	S(3)	M(2)	M(2)
CO3	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	L(1)
CO4	M(2)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
CO5	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
W.AV	**2.4**	**2.2**	**3**	**2**	**1.6**	**2.2**	**2.6**	**2.2**	**2.2**	**1.8**

S–Strong (3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	M(2)	S(3)	M(2)	M(2)
CO3	S(3)	M(2)	L(1)	M(2)	M(2)
CO4	M(2)	M(2)	S(3)	S(3)	M(2)
CO5	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	**2.6**	**2**	**2.2**	**2.2**	**2**

S–Strong (3), M-Medium(2),L-Low(1)

DSE	Course Code: 536055	Materials Chemistry	T	Credits:4	Hours:4

UNIT– I

Objective1	To know about the structure of crystals	

Structure of Crystals

Amorphous Vs crystalline solids, types of bonding in solids–Unit cell–Crystal lattices–Crystal imperfections–Phase transformation diagrams-Physical properties of crystals–Classification of solids based on zone theory– Energy bands in solids–Band theory–Classification of solids based on band theory.

Outcome1	The students would learn the basics of crystals	**K4**

UNIT–II

Objective2	To provide information regarding superconductors and semiconductors

Superconductors and Semiconductors

Introduction– Properties and types of super conductors- High temperature super conductors–Applications of superconductors. Semiconducting materials- Properties of semiconductors–Determination of band gap and types of semic onductors-Various applications of semiconducting materials.

Outcome2	Students will learn the properties and applications of superconductors and semiconductors	**K3**

UNIT–III

Objective3	To provide information regarding dielectric and insulating materials

Dielectric /Insulating Materials

Introduction- Physical, chemical and electrical properties-Classification–Testing of insulating materials– Important applications of insulators. Ferro electric materials–Classification offerroelectric materials–Piezoelectric materials–Applications of ferroelectric materials.

Outcome3	Students will learn the properties of dielectric and insulating materials	**K4**

UNIT–IV

Objective4	To provide information regarding magnetic materials

Magnetic Materials

Introduction–Types of magnetic materials–Diamagnetism–Paramagnetism–Ferrromagnetism –anti- ferromagnetism –Magnetic hysteresis–Soft and hard magnetic materials–Ferrimagnetic materials(or)Ferrites–Applications of ferrites.

Outcome4	Students will learn about the properties and application of magnetic materials	**K4**

UNIT– V

Objective5	To provide information regarding the preparative methods of nanomaterials

Preparative Methods

Introduction–Solidstate thermal reaction method, sol-gel method, combustion method, hydrothermal method and microwave heating method. Physical methods– vacuum evaporation, sputtering, pulsed laser deposition, molecular beam epitoxy methods. Chemical methods–chemical vapour deposition, chemical solution deposition, electrochemical deposition, spray pyrolysis.

Outcome5	Students will acquire the information regarding the preparative methods of nanomaterials.	**K2**

Suggestion and readings:

VanvlakL.H.(1975). *Elements of Materials Science and Engineering.* Addision&Wiley, NewYork.

Goswami,A.(1996).*Thin Film Fundamentals.*NewAge International(P)Ltd, NewDelhi.

V.Raghavan,V.(2004). *Materials Science and Engineering*-a first course, (5th ed.).Prentice Hallof India.

Jayakumar,S.(2002). *Materials Science.*R.K.Publishers,Coimbatore.

Khanna,O.P.,Dhanpat Rai&Sons.(1996). *A Textbook of Materials Science and Metallurgy*., Delhi.

WilliamD.Callister.(2006).*Material Science and Engineering-An Introduction*. JohnWiley& Sons ,Inc.

David.G.Rethwisch,WilliamD.CallisterJr.(2007).*Fundamentals of Material Science and Engineering:An Integrated Approach*(3rd ed.).John Wiley& Sons,Inc.

Ward,D.J.(2008). *Material Science*. Lerner Publishing Group.

AlexanderJ.Blake,WilliamClegg,JacquelineMCole.(2009). *Crystal structure analysis: principles and practice.* Oxford Science, NewYork.

PeterY.Yu,ManuelCardona**.**(2010).*Fundamentals of Semiconductors: Physics and Materials properties* **(**4th ed.). Springer-VerlagBerling Heidelberg.

RamNaresh, Prasad Choudhary, Sunanda Kumari Patri. (2009).*Dielectric Materials: Introduction,Research and Applications***.** Nova Science Publishers**.**

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr G. Gopu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	M(2)	S(3)	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)
CO3	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
CO5	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
W.AV	**2.8**	**2.2**	**2.6**	**2.4**	**1.6**	**2.2**	**2.4**	**2.2**	**2.2**	**2.2**

-S–Strong (3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	M(2)	M(2)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	M(2)	L(1)	M(2)	M(2)
CO4	S(3)	M(2)	L(1)	M(2)	M(2)
CO5	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	**3**	**2.2**	**1.8**	**2.2**	**2.2**

S–Strong (3),M-Medium(2),L-Low(1)

DSE	Course code 536 056	Chemical and Electrochemical Energy Systems	T	Credits:4	Hours:4

UNIT - I		
Objective 1	To get knowledge in chemical and electrochemical energy systems including nuclear, electrochemical, hydrogen and solar.	
Energy and Environment Available energy options, their advantages and disadvantages. Environmental effects, comparative evaluation of energy options and energy needs. Fossil fuels: petroleum, natural gas and coal - Origin, processing and production of value-added products - available current conversion technologies.		
Outcome 1	The students would be able to acquire knowledge in various types of energy systems and their applications.	**K4**
UNIT - II		
Objective 2	To provide information about nuclear energy	
Nuclear Energy Nuclear Energy: Principles of Fission - Fission reactors, U enrichment and processing of spent fuels. Nuclear reactor kinetics and control- nuclear fusion- magnetic and other confinement- evaluation of the option of nuclear energy. Nuclear power in India.		
Outcome 2	Students will acquire knowledge about nuclear energy	**K3**
UNIT - III		
Objective 3	To impart knowledge about electrochemical energy	
Electrochemical Energy Electrochemical power sources - theoretical background on the basis of thermodynamic and kinetic considerations. Primary cells - various types, especially magnesium and aluminum based cells - magnesium reserve batteries. Secondary cells: classification based on electrolyte type, temperature of operation on the basis of electrodes - chemistry of the main secondary batteries-Batteries for electric vehicles-present status.		
Outcome 3	Students will acquire knowledge about electrochemical energy	**K4**
UNIT - IV		
Objective4	To provide information regarding fuel cells and hydrogen fuel cells	
Fuel Cells and Hydrogen Fuel Fuel cells-classification- chemistry of fuel cells-detailed description of hydrogen/oxygen fuel cells - methanol - molten carbonate solid polymer electrolyte and biochemical fuel cells. Hydrogen as a fuel- production (thermal, electrolysis, photolysis and photoelectrochemical) storage and applications of hydrogen storage		
Outcome 4	Students will acquire knowledge about fuel cells and hydrogen fuel cells	**K3**
UNIT - V		
Objective 5	To provide information regarding solar energy	
Solar Energy Solar energy conversion devices-photovoltaic cells-photoelectrochemical cell semiconductorelectrolyte junctions'photocatalytic modes for fuel conversion process-photobio chemical options.		
Outcome 5	Students will acquire knowledge about solar energy	**K4**

Suggestions and readings:

Vincent,C.A.(1984).*Modern Batteries,*Edward Arnold.

Narayanan,R.,Viswanathan,B.(1997).*Chemical and Electrochemical energy systems*.Orient Longmans. Sriram,K.(1990). *Basic Nuclear Engineering.* Wiley Eastern.

Apple by,S.J.,Foulkes,F.K. (1989).*Fuelcell HandBook.* Von Nostrand Reinhold.

Linden,D. (1984).*Hand book of batteries and Fuelcells*. McGrawHill Book Company.

Ohta,T.(1979*).Solar Hydrogen energy systems.* Peragam on Press.

Gratzel,M.(1983).*Energy Resources through photo chemistry and catalysis*. Academic Press.

Ohta,T.(1994).*Energy Technology,Sources,Systems and Frontiers conversions,* Pergamon.

Speight, J.G.(1980). *The chemistry and technology of petroleum.* Marcel Dekker Inc.

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr T. Stalin

CourseOutcome VS Programme Outcomes

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	M(2)	S(3)	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)
CO3	M(2)	M(2)	S(3)	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)
CO4	M (2)	S(3)	S(3)	M (2)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
W.A V	**2.4**	**2.2**	**3**	**2**	**1.4**	**2.2**	**2.6**	**2.2**	**2.2**	**2.2**

S–Strong (3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	S(3)	S(3)	S(3)
CO2	M(2)	M(2)	S(3)	M(2)	M(2)
CO3	S(3)	M(2)	L(1)	M(2)	M(2)
CO4	S(3)	M(2)	L(1)	M(2)	M(2)
CO5	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	**2.6**	**2.2**	**2**	**2.2**	**2.2**

S–Strong (3),M-Medium(2),L-Low(1)

NON-MAJOR ELECTIVE (NME) COURSE

NME	Course code:	Chemistry in Everyday Life	T	Credits:2	Hours:3

UNIT - I

Objective1	To understand about drugs, vitamins

Drugs and Vitamins

Drugs: Definition–Classes of drugs: Antacids, Analgesics, Antibiotics, Antiseptics, Disinfectants,Tranquilizers, Antifertility Drugs.

Vitamins: Water soluble vitamins: Vitamin B and C; Fat soluble vitamins: A, D, E & K - Sources - Physiological functions and deficiency symptoms.

Outcome 1	The students would be able to know the effect of drugs and vitamins	**K3**

UNIT - II

Objective 2	Students will know about purification methods for water

Water and Food

Water: Hydrosphere - Hydrological cycle - Water quality parameters – Potable water - Types of water pollutants - organic, inorganic, toxic metals – Treatments: filtration, chlorination, adding bleaching powder, UV irradiation and Ozonation.

Food: Artificial Sweetening Agents - Food Preservatives – Food additives

Outcome 2	To acquire information regarding different sustainability of water and food	**K2**

UNIT - II

Objective 3	To introduce the cleansing agents (iv) polymers, cosmetics, colouring substances; (v) batteries, corrosion and prevention.

Cleansing Agents

Soaps - Preparation, Types, Disadvantages of soaps - Synthetic Detergents: Anionic Detergents, Cationic Detergents and Non-ionic Detergents - Advantages of synthetic detergents over soaps. Chemistry in Cosmetics: Creams – Perfumes – Talcum Powder – Deodorants. Chemistry in Colouring Matter: Natural and synthetic colouring matters – Dyes – Classification on the basis of Constitution and applications

Outcome 3	Students will know the utilization of cleaning agent	**K4**

UNIT - IV

Objective 4	Information regarding the polymers roled in chemistry

Chemistry of polymers

Synthetic fibres - nylons, polyester – synthetic rubber - polyurethane rubber – reclaimed rubber - sponge, foam rubber, thermocole. Fuels and Energy Resources: Types of fuels - liquid fuels - petroleum products – gaseous fuel - coal gas, producer gas and biogas - Rocket fuels - solid and liquid propellants - nuclear fuels - difference between nuclear and chemical fuels. Renewable sources of energy - solar energy, wind energy and tidal energy.

Outcome 4	Students will learn the designing of green synthesis for some of the important organic reactions	**K2**

UNIT - V		
Objective 5	To provide information regarding Battery, Corrosion and Surface Coatings technologies	
Battery, Corrosion and Surface Coatings Batteries-Basic concepts, battery characteristics, classification of batteries–primary, secondary and reserve batteries, fuel cells and super capacitors. Corrosion - Definition of chemical corrosion, types of corrosion, corrosion prevention- Pretreatment of the surface metallic coating, galvanizing, tinning, inorganic coatings, organic coatings, oil paints, water paints, special paints, enamels and lacquers.		
Outcome 5	The student would be able to know the significance and uses of battery, corrosion preventing materials and coating products in our daily life.	**K2**
Suggestions and readings: Sharma, B.K. (2001). *Industrial Chem.* (12th ed.). Goel Publishing House, 12th Edition. P.C. Jain, P.C., Monica Jain. (2006). *Engineering Chemistry* (15th ed.). Dhanphatrai & Sons. Shrive, George and T Austin. (1984). *Chemical Process Industries*. McGraw Hill Book. Sharma, B. K. (2000). *Environmental Chemistry*. Goel Publishing House.		
K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr S. Viswanathan		

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	S(3)	M(2)	M(2)
CO3	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	L(1)
CO4	M(2)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)
CO5	S(3)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
W.AV	**2.4**	**2.2**	**3**	**2**	**1.6**	**2.2**	**2.6**	**2.2**	**2.2**	**1.8**

S–Strong (3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	M(2)	S(3)	M(2)	M(2)
CO3	S(3)	M(2)	L(1)	M(2)	M(2)
CO4	M(2)	M(2)	S(3)	S(3)	M(2)
CO5	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	**2.6**	**2**	**2.2**	**2.2**	**2**

S–Strong (3),M-Medium(2),L-Low(1)

NME	Course code:	Basics in Environmental Science	T	Credits:2	Hours:3

UNIT - I		
Objective 1	**Objectives:** To know about our environment, pollution, ill-effects, sustainability.	
Definitions of environment, ecology, pollution. Types of pollution and effects. Industrial effects onenvironment, general waste categorization. Hazardous materials and their ill effects**.** Acid rain, photochemical smog, ozone-hole and green-house effect.		
Outcome 1	Students will learn about the basis of environmental factors and causes.	**K1**
UNIT - II		
Objective 2	**To acquire knowledge and understanding of pollutions**	
Types of pollution and effects: air pollution, water pollution, land pollution, pesticide pollution, thermal pollution, noise pollution, radioactive pollution. Basic information about the nature and type of contaminants in industrial effluents of tannery, distillery, paper and pulp, textile, fertilizer and electrochemical.		
Outcome 2	Students understand will be able to know and solve the industrial and atmospheric polluted chemicals.	**K2**
UNIT - III		
Objective 3	To learn about different sources of water pollutions	
Basic information about the water pollution abatement methods: Pretreatment methods, Primary treatment methods, Biological or secondary treatment methods, Advanced or tertiary treatmentmethods.		
Outcome 3	Students will be able to understand the technique and treatment methods	**K4**
UNIT - IV		
Objective 4	To learn about the Sustainable Development of the environment	
Industrial hazards: types, guidelines and safety methods. Health hazards due to industrial chemicals in the category of poisons, corrosives and flammables. The need for Green Chemistry. Definition and 12 principles of Green Chemistry. Use of non-traditional "Greener" alternatives for sustainable development.		
Outcome 4	Students understand and will be able to solve the problems in society from dangerous.	**K4**
UNIT - V		
Objective 5	To learn the advancement of chemicals and techniques for avoid toxic chemicals	
Environmentally benign technologies using Greener concepts: microwave, photochemical degradation, enzymes for pulp and paper manufacture, biochemical removal of phosphorous: Exploring Green resources for drug development, essential oils.		
Outcome 5	Students will be able to handle the eco-friendly and greener techniques.	**K3**

Suggested Readings:

Agarwal. (1986). *Engineering Chemistry* Kedar Nath Ram Nath, Meerut.

Sharma, B. K., Kaur, H. (2000). *Environmental Chemistry*. Krishna Publishers, New Delhi.

R. Shangi, R., Srivatsava, M.M. (2003)*Green Chemistry.*Narosa Publishers, New Delhi.

Rao, M. N., Dutta, A. K.(1979). *Wastewater Treatment* (2/e), Oxford and IBH Publishing Co.,Delhi.

Tchobanoglous, G., Schroeder, E.D. (1985). *Water Quality.* Addison-Wesley, California.

Eckenfelder, W. W. (1980).*Principles of Water Quality Management*. CBI Publishers, Boston.

Heaton, C. A.(1984). *Industrial Chemistry*. Leonard Hill Publisher, Glasgow,

Manahan, S. E. (2001). *Environmental Chemistry*. Lewis Publishers, London.

Banerji, S. K. (2003). *Environmental Chemistry* Prentice Hall of India, New Delhi.

Trivedi, R. N. (1998). *A Text book of Environmental Pollution Control*. Anmol Publications, NewDelhi.

Srivatsava, M. M., Shangi, R. (2005).*Chemistry for Green Environment*. Narosa Publishers, New Delhi.

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by Dr.M. Sundrarajan and Dr S. Umadevi

Course Outcome Vs Program Outcomes

	PGO 1	**PGO 2**	**PGO 3**	**PGO 4**	**PGO 5**	**PGO 6**	**PGO 7**	**PGO 8**	**PGO 9**	**PGO10**
CO1	M(2)	L(1)	M(2)	L(1)	M(2)	L(1)	L(1)	S(3)	M(2)	L(1)
CO2	S(3)	M(2)	M(2)	L(1)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)
CO3	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)
CO4	S(3)	M(2)	S(3)	M(2)	L(1)	S(3)	M(2)	S(3)	M(2)	(-)
CO5	M(2)	L(1)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	-
W.AV	2.6	1.8	2.2	1.8	2	2.4	2	2.6	2.2	1.2

S-Strong(3),M-Medium(2),L-Low(1)

Course Outcome Vs Program Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	L(1)	M(2)	L(1)	L(1)
CO2	M(2)	S(3)	M(2)	M(2)	S(3)
CO3	S(3)	M(2)	S(3)	M(2)	M(1)
CO4	M(2)	S(3)	-	S(3)	L(1)
CO5	L(1)	M(2)	L(1)	L(1)	-
W.AV	2	2.2	1.6	1.8	1.2

S-Strong(3),M-Medium(2),L-Low(1)

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