Dr. N.G.P.ARTS AND SCIENCE COLLEGE (Autonomous)

REGULATIONS 2019-20 for Post Graduate Programme
(Outcome Based Education model with Choice Based Credit System)

M.Sc. Degree

(For the students admitted during the academic year 2020-21 and onwards)

Programme: M.Sc. Chemistry

Eligibility

A pass in B.Sc. Chemistry as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent there to by the Academic Council, subject to such conditions as may be prescribed there to are permitted to appear and qualify for the **Master of Science (CHEMISTRY)** Degree Examination of this College after a course study of two academic years.

Programme Educational Objectives

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To build the firm foundation in the fundamentals and correlate the application with the current developments in chemistry.
2. To get sufficient expertise in the operational knowledge and laboratory skills in all major fields of chemistry.
3. To emphasize on integrating various disciplines of Science and encourage for interdisciplinary approach.
4. To acquire problem solving capacity, interpretation of results with the use of sophisticated instruments and devises new preparation techniques.
5. To motivate the students to prepare for competitive examinations, job carriers and get trained for industrial entrepreneurship.

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	Make use of knowledge in the major fields of Chemistry which would make them to analyze the significant role played in the field of energy, materials, health sector and environment.
PO2	Select the appropriate modern scientific instruments, to plan and execute in laboratory.
PO3	Interpret the Knowledge and skills to develop independent writing reports and to execute the ideas.
PO4	Take part in research- based knowledge in interdisciplinary approach including design of experiments, analysis and interpretation of data for Provide better solution in emerging issues.
PO5	Utilize the knowledge for social, economic, and environmental challenges globally and formulate for life –long learning in the broadest context of technological change.

Guidelines for Programmes offering for Semesters:

Part	Subjects	No. of Papers	Credit	Semester No.
III	Core Theory	13	13 x 04 = 52	I - IV
	Core Practical	03	02 x 03 = 06 01 x 04 = 04	I - IV
	Elective	04	04 x 04 = 16	I - IV
	EDC	01	01 x 04 = 04	II
	Project Work	01	01 x 08 = 08	IV
TOTAL CREDITS			**90**	**-**

CURRICULUM

M.Sc. CHEMISTRY PROGRAMME

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
192CE2A1CA	Core - I	Organic Reaction Mechanisms	4	1	-	3	25	75	100	4
202CE2A1CB	Core - II	Coordination Chemistry	4	1	-	3	25	75	100	4
192CE2A1CC	Core - III	Thermodynamics, Electrochemistry and Kinetics	4	1	-	3	25	75	100	4
202CE2A1CD	Core - IV	Analytical Chemistry	4	1	-	3	25	75	100	4
202CE2A1CP	Core Practical - I	Organic Chemistry	-	-	6	6	40	60	100	3
202CE2A1DA	DSE - I	Polymer Chemistry	4	-	-	3	25	75	100	4
192CE2A1DB		Pharmaceutical Chemistry								
192CE2A1DC		Supramolecular Chemistry								
		Total	**20**	**4**	**6**	**-**	**-**	**-**	**600**	**23**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
192CE2A2CA	Core - V	Stereochemistry, Photochemistry and Rearrangements	4	1	-	3	25	75	100	4
202CE2A2CB	Core - VI	Bio-inorganic & Organometallic Chemistry	4	-	-	3	25	75	100	4
202CE2A2CC	Core - VII	Principles of spectroscopy	4	1	-	3	25	75	100	4
193BC2A2EA	EDC - I	Drug Biochemistry	4	-	-	3	25	75	100	4
202CE2A2CP	Core Practical - II	Inorganic Chemistry	-	-	8	6	40	60	100	4
202CE2A2DA	DSE - II	Environmental Chemistry	4	-	-	3	25	75	100	4
192CE2A2DB		Nano Science and Technology								
192CE2A2DC		Bio- organic Chemistry								
		Total	**20**	**2**	**8**	**-**	**-**	**-**	**600**	**24**

Course Code	Course Category	CourseName	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
192CE2A3CA	Core -VIII	Chemistry of Natural Products	4	1	-	3	25	75	100	4
202CE2A3CB	Core -IX	Solid state, Nuclear and Main group Chemistry	4	1	-	3	25	75	100	4
202CE2A3CC	Core -X	Quantum Chemistry and Group theory	4	1	-	3	25	75	100	4
202CE2A3CD	Core -XI	Applications of Spectroscopy & Photochemistry	4	1	-	3	25	75	100	4
202CE2A3CP	Core Practical-III	Physical Chemistry	-	-	6	6	40	60	100	3
192CE2A3DA	DSE -III	Industrial Chemistry	4	-	-	3	25	75	100	4
192CE2A3DB		Inorganic Rings, Cages and Clusters								
192CE2A3DC		Organic Reactions and Reagents								
202CE2A3CT	IT	Industrial Training	Grade A to C							
Total			20	4	6	-	-	-	600	23

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
192CE2A4CA	Core - XII	Synthetic Organic Chemistry	4	1	-	3	25	75	100	4
202CE2A4CB	Core - XIII	Statistical Thermodynamics, Macromolecules and Computational Chemistry	4	1	-	3	25	75	100	4
192CE2A4CV	Core - Project	Project & Viva Voce	-	-	16		80	120	200	8
192CE2A4DA	DSE - IV	Medicinal Chemistry	4	-	-	3	25	75	100	4
192CE2A4DB		Catalysis								
192CE2A4DC		Green Chemistry								
Total			**12**	**2**	**16**	**-**	**-**	**345**	**500**	**20**
Grand Total									**2300**	**90**

DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semester I to IV

Semester I (Elective I)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	202CE2A1DA	Polymer Chemistry
2.	192CE2A1DB	Pharmaceutical Chemistry
3.	192CE2A1DC	Supramolecular Chemistry

Semester II (Elective II)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	202CE2A2DA	Environmental Chemistry
2.	192CE2A2DB	Nano Science and Technology
3.	192CE2A2DC	Bio- organic Chemistry

Semester III (Elective III)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	192CE2A3DA	Industrial Chemistry
2.	192CE2A3DB	Inorganic Rings, Cages and Clusters
3.	192CE2A3DC	Organic Reactions and Reagents

Semester IV(Elective IV)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	192CE2A4DA	Medicinal Chemistry
2.	192CE2A4DB	Catalysis
3.	192CE2A4DC	Green Chemistry

EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S. No.	Course Code	Course Name
1	192CE2ASSA	Research Methodology
2	192CE2ASSB	Energy, Diary and Drug chemistry

MOOC (NPTEL/SWAYAM/ SPOKEN TUTORIAL)

The following are the online courses offered:

Please refer the following link to select the courses

- www.swayam.org
- www.nptel.ac.in
- www.spoken-tutorial.org

Regulation
(2020-2021)

PG Programme

Effective from the academic year 2020-21 and applicable to the students admitted to the Degree of Master of Arts/Commerce/Management/Science.

1. NOMENCLATURE

1.1 Faculty: Refers to a group of programmes concerned with a major division of knowledge. Eg. Faculty of Computer Science consists of Programmes like Computer Science, Information Technology, Computer Technology, Computer Applications etc.

1.2 Programme: Refers to the Master of Arts/Management/Commerce/Science Stream that a student has chosen for study.

1.3 Batch: Refers to the starting and completion year of a programme of study. Eg. Batch of 2015–2017 refers to students belonging to a 2-year Degree programme admitted in 2015 and completing in 2017.

1.4 Course: Refers to a component (a paper) of a programme. A course may be designed to involve lectures / tutorials / laboratory work / seminar / project work/ practical training / report writing / Viva voce, etc or a combination of these, to effectively meet the teaching and learning needs and the credits may be assigned suitably.

a) **Core Courses**

   A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

b) **Extra Departmental Course (EDC)**

   A course chosen generally from a related discipline/subject, with an intention to seek exposure in the discipline relating to the core domain of the student.

c) **Discipline Specific Elective Course (DSE)**: DSE courses are the courses offered by the respective disciplinary/ interdisciplinary programme.

d) Project Work:

It is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. The Project work will be given in lieu of a Core paper.

e) Extra credits

Extra credits will be awarded to a student for achievements in co-curricular activities carried out outside the regular class hours. The guidelines for the award of extra credits are given in section two, these credits are not mandatory for completing the programme.

e) Advanced Learner Course (ALC):

ALC is doing work of a higher standard than usual for students at that stage in their education. Research work carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days.

2. EXTRA CREDITS

- Earning extra credit is mandatory. However, it is not essential for programme completion.
- Extra Credits will be awarded to a student for achievement in co-curricular/ extracurricular activities carried other than the regular class-hours.
- A student is permitted to earn a maximum of 10 extra Credits during the programme duration of PG from I to IV Semester.
- Candidate can claim a maximum of 1 credit under each category listed.

The following are the guidelines for the award of Extra credits:

2.1 Proficiency in Foreign Language

Qualification	Credit
A pass in any foreign language in the examination conducted by an authorized agency	1

2.2 Proficiency in Hindi

Qualification	Credit
A pass in the Hindi examination conducted by Dakshin Bharat Hindi Prachar Sabha	1

Examination passed during the programme period only will be considered for extra credit

2.3 Self-study Course

Qualification	Credit
A pass in the self-study courses offered by the department	1

The candidate should register in the self-study course offered by the department only in the III semester

2.4 Typewriting/Short hand

A Pass in shorthand /typewriting examination conducted by Tamil Nadu Department of Technical Education (TNDTE) and the credit will be awarded.

Qualification	Credit
A pass in the type writing /short hand examination offered by TNDTE	1

2.5 Diploma / Certificate

Courses offered by any recognized University / NCVRT

Qualification	Credit
A pass in any Certificate /Diploma/PG Diploma Course	1

2.6 CA /ICSI/ CMA

Qualification	Credit
Qualifying foundation/Inter level/Final in CA/ICSI/CMA etc.	1

2.7 Sports and Games

The Student can earn extra credit based on their achievement in sports as given below:

Qualification	Credits
Achievement in University/State /National/ International	1

2.8 Online Courses

Pass in any one of the online courses

Qualification	Credit
SWAYAM/NPTEL/Spoken Tutorial etc.,	1

2.9 Publications / Conference Presentations (Oral/ Poster) /Awards

Qualification	Credit
Research Publications in Journals/oral/poster presentation in Conference	1

2.10 Innovation / Incubation / Patent / Sponsored Projects / Consultancy

Qualification	Credit
Development of model/ Products/ Prototype/ Process/App/Registration of Patents/ Copyrights/ Trademarks/Sponsored Projects/Consultancy	1

2.11 Representation

Qualification	Credit
Participation in State / National level celebrations such as Independence day, Republic day Parade, National Integration camp etc.,	1

3. EXAMINATIONS

The following are the distribution of marks for External and Internal i.e., Comprehensive examination and Continuous Internal Assessment and passing minimum marks for theory papers of PG programmes.

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for External alone		
100	75	38	25	50
50	50	25	----	25

The following are the Distribution of marks for the Continuous Internal Assessment in the theory papers of PG programmes.

S. No.	For Theory– PG courses	Distribution of Marks
1	TESTS I (2 hours)	5
2	TESTS II / End semester Model test (3 hours)	10
3	OBE- Rubrics	10
	TOTAL MARKS	**25**

The following are the distribution of marks for the External Assessment in PG Theory courses

S. No.	For Theory– PG courses	Distribution of Marks	
1	Comprehensive (Written) Examination	65	50
2	Online MCQ Examination	10	--
	TOTAL MARKS	**75**	**50**

The following are the distribution of marks for External examinations (CE) and Continuous Internal Assessment (CIA) and passing minimum marks for the practical courses of PG programmes.

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for External alone		
100	60	30	40	50
200	120	60	80	100

The following are the distribution of marks for the Continuous Internal Assessment (CIA) in PG practical courses

S. No.	For Theory – PG Practical courses	Distribution of Marks	
1	Tests: Two tests out of which one shall be during the mid semester and the other to be conducted as model test at the end of the semester.)	24	48
2	OBE- Rubrics	16	32
	TOTAL MARKS	**40**	**80**

The following are the distribution of marks for the External Assessment in PG practical courses

S. No.	For Theory – PG Practical courses	Distribution of Marks	
1	Experiment-I	25	50
2	Experiment-II	25	50
3	Record & Viva-Voce	10	20
	TOTAL MARKS	**60**	**120**

The following are the distribution of marks for Project and Viva voce examinations/Industrial Training and Continuous Internal Assessments and passing minimum marks for the project courses/Industrial Training of PG programmes

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for External alone		
100	60	30	40	50
200	120	60	80	100

The following are the distribution of marks for the Continuous Internal Assessment in PG Project/ Industrial Training courses.

S. No.	For- PG Project courses/ Industrial Training	Distribution of Marks	
1	Review-I	8	16
2	Review-II	8	16
3	Review-III	8	16
4	OBE- Rubrics	16	32
	TOTAL MARKS	**40**	**80**

The following are the distribution of marks for the External Examination (CE) in PG Project / /Industrial Training courses

S. No.	For- PG Project courses/ Industrial Training Courses	Distribution of Marks	
1	Record Work and Presentation	40	80
2	Viva-Voce	20	40
	TOTAL MARKS	**60**	**120**

- The end semester examinations shall normally be conducted after completing 90 working days for each semester.

- The maximum marks for each theory and practical course (including the project work and Viva-Voce examination in the final Semester) shall be 100 with the following breakup.

(i) **Theory Courses**

Continuous Internal Assessment (CIA) : 25 Marks

End Semester Exams (ESE) : 75 Marks

(Online Exam: 10 Marks &Written Exam: 65 Marks)

(ii) **For Practical Courses**

Continuous Internal Assessment (CIA) : 40 Marks

End Semester Exams (ESE) : 60 Marks

Continuous Assessment OBE Rubrics Score Sheet

Degree: _____ Branch: _____ Semester: _____

Course Code: _____ Course: _____

Max. Marks: Internal:_____ External: _____ Total: _____

S. No.	REG. NO.	THEORY / PRACTICAL & LIBRARY CLASS PARTICIPATION (15) (Compulsory)				RUBRICS ASSESSMENT (SELECT ANY ONE)									Total Marks out of : 30	Total Marks out of : 16 / 10 / 08 / 04
						PAPERS / REPORTS (15)			ASSIGNMENTS (15)			CLASS PRESENTATION (15)				
		Library	Integration of Knowledge	Interaction & Participation	Demonstration of Knowledge	Organization & Knowledge	Format & Spelling	Reference / Experiments	Demonstration of Knowledge	Format & Spelling	Reference	Content & Coherence	Creativity and Speaking Skills	Duration of Presentation		
		6	3	3	3	5	5	5	5	5	5	5	5	5		
1																

a) Utilization of Library

Marks will be awarded to the student based on the hours spent in the library after the working hours and submission of report by the student.

Hours spent in Library	Marks	Type of Document submitted
2	1	Report/ Assignment/ Class presentation
4	2	
6	3	
8	4	
10	5	
12	6	

- During the Library hour, the student must spend time in reading the articles, books, journals of their subject of interest
- Each student should borrow minimum three books during the semester

b) Class Participation

Active participation in classroom discussion by the student will be evaluated based on Integration of knowledge, Interaction and Participation and demonstration of knowledge.

c) Papers / Reports/ Assignments/ Class Presentation

The student will be evaluated based on his ability to do analysis of application of theory to real world problems or creative extension of class room learning and his/her ability to communicate the given topic effectively and clearly. The following are the distribution of marks for the continuous internal assessment in PG practical courses

4. FOR PROGRAMME COMPLETION

Programme Completion (for students admitted during the A.Y.2019-20 and Onwards)

Student has to complete the following:

i) Core, EDC, DSE, Project as mentioned in the scheme
ii) Internship / Industrial/ Institutional training as mentioned in the scheme

Students must undertake industrial / institutional training for a minimum of 15 days and not exceeding 30 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

Based on the performance Grade will be awarded as follows:

Marks Scored	**Grade to be awarded**
75 and above	A
60-74	B
50-59	C
< 50	Re-Appearance

Course Code	Course Name	Category	L	T	P	Credit
192CE2A1CA	ORGANIC REACTION MECHANISMS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic principles of acids and bases, electronic effects and aromaticity of organic compounds.
- About the mechanism involving in the various aliphatic, aromatic electrophilic and nucleophilic substitution reactions.
- The basic knowledge about addition, elimination reactions involved in multiple bonds.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Apply the electronic effects in organic chemistry and know about aromaticity in order to understand the stability of organic compounds.	K3
CO2	Utilize various methods to determine the reaction mechanisms.	K3
CO3	Summarize reaction mechanisms of the aliphatic and aromatic nucleophilic substitution reactions.	K2
CO4	Illustrate the reaction mechanisms of the aliphatic, aromatic electrophilic substitution reactions.	K2
CO5	Compare the addition and elimination reactions.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	L	M	S
CO2	S	S	L	M	S
CO3	M	M	L	L	M
CO4	M	M	L	L	M
CO5	S	S	M	S	S

S Strong M Medium L Low

192CE2A1CA	ORGANIC REACTION MECHANISMS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Electronic Effects, Aromaticity and Acids and Bases 12 h

Electron displacement – Inductive and field effect – Delocalised bonds – Rules of resonance-steric inhibition of resonance, steric enhancement of resonance, Hyperconjucation – Hydrogen bonding – Intra and inter molecular hydrogen bonding – effect of hydrogen bonding and hyperconjugation on physical and chemical properties. Effect of structure and medium on the strengths of acids and bases.

Aromaticity: Aromatic systems with 2, 6, 10 electrons, alternent and non-alternent hydrocarbons, systems of more than 10 electrons-annulenes-aromaticity of azulenes, ferrocene and sydnones - concept of homoaromaticity.

Unit II Methods of Determining Reaction Mechanisms 12 h

Thermodynamic and kinetic requirements of reactions: Types of mechanism, Thermodynamic and kinetic control – methods of determination of reaction mechanisms – product analysis – determination of the presence of intermediate, isolation, detection, trapping – cross over experiments – isotopic labeling – isotopic effect – stereo chemical evidence – kinetic evidence.

Kinetic methods of determination of reaction mechanisms: Curtin-Hammett principle, Hammett equation – significance of substitution and reaction constant – Hammond postulates -Linear free energy relationship – limitations and deviations– Taft equation.

Unit III Aliphatic and aromatic nucleophilic substitution reactions 12 h

SN1, SN2, SNi and neighbouring group participations - kinetics - effects of structure - solvent and leaving and entering group - stereochemistry. Hydrolysis of esters - Wurtz reaction - Claisen and Dieckmann condensation - Williamson reactions. Different mechanisms of aromatic nucleophilic substitution - Ziegler alkylation - Chichibabin reaction - cine substitution - diazonium group as leaving group. Carbenes and nitrenes- structure and generation-addition reaction with alkenes- insertion reactions.

Unit IV Aliphatic and Aromatic Electrophilic Substitution Reactions 12 h

SE1 and SE2 reactions - mechanisms and reactivity - typical reactions involving migration of double bond - keto-enol tautomerism - halogenation of carbonyl compounds - Stork enamine reactions - decarboxylation of aliphatic acids - Friedel-Crafts acylation of olefinic carbon.

Aromatic electrophilic substitution - reactivity - orientation and mechanisms - nitration - halogenation and sulphonation - Friedel-Crafts alkylation - FriedelCrafts arylation (Scholl reaction) and acylation - Jacobsen reaction - Vilsmeyer- Haack reaction, Gattermann reaction, Reimer - Tiemann reaction- Kolbe Schmidt reaction) -amidation with isocyanates - hydroxyalkylation (hydroxyalkyl - dehydrogenation)- Bradsher reaction and Bischler - Napieralski reaction - haloalkylation - aminoalkylation and amido alkylation - thioalkylation -acylation Hoesch reaction - cyanation - hydroxylation.

Unit V Addition and Elimination Reactions 12 h

Addition to C-C and C-O multiple bonds - electrophilic, nucleophilic and free-radical additions - additions to conjucated systems - orientation - Birch reduction - hydroboration - Michael condensation - 1,3 dipolar additions - Diels-Alderreactions - hydration of olefines. Mannich reaction - Meerwein-Pondorf reduction -Grignard reactions - Aldol - Claisen - Stobbe - Darsen - Wittig - Thorpe and benzoincondensations - Cannizarro reaction.

Elimination reactions - E1 and E2 mechanisms - orientations - Hofmann and Saytzeff rules - elimination versus substitution - Chugaev reaction - Hofmann degradation and Cope elimination - dehydration of alcohols - dehydrohalogenation - mechanisms and orientation in pyrolytic elimination.

Text Books

1 Michael B. Smith, 2015, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th Edition, Willey & USA.

2 Morrison R.N. Boyd R.N. and Bhattacharjee, 2010, "Organic Chemistry". 7th Edition, Pearson Education & UK.

3 Bansal R.K., 2012, "Organic Chemistry Reaction mechanisms." New Age International Private Ltd & New Delhi.

References

1 Lowry and Richardson, 1997, "Mechanism and theory in organic chemistry", 3rd Edition. Pearson Publishers & UK.

2 Mukherji and Singh S. P, 1984, "Reactions mechanisms in organic chemistry". 3rd Edition. Macmillan Publishers & USA.

3 Ahluwalia. V.H and Parashar. R.K," Organic Reactions and Mechanisms", 4th Edition, Narosa Publishing House& New Delhi.

4 Clayden J, Greeves N and Warren S, 2014, "Organic Chemistry" 2nd Edition. Oxford University Press & UK.

Course Code	Course Name	Category	L	T	P	Credit
202CE2A1CB	COORDINATION CHEMISTRY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- About the various theories, reaction mechanism and geometries of coordination complexes.
- The basics of electronic spectroscopy and maganetism of transition metal complexes.
- The Combined applications of IR and Raman spectra for structural elucidation of simple molecules.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the various theories of coordination compounds, distortion and constructing MO diagrams of complexes.	K2
CO2	Choose the various types of inorganic reaction mechanism in different geometries.	K3
CO3	Make use of importance of electronic spectroscopy by using energy level diagrams.	K3
CO4	Compare the various symmetries/geometries of coordination complexes.	K4
CO5	Examine the IR and Raman active vibrations of simple compounds.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	L	L	M
CO2	S	S	L	M	S
CO3	S	S	L	M	S
CO4	S	S	M	S	S
CO5	S	S	M	S	S

S Strong M Medium L Low

202CE2A1CB	COORDINATION CHEMISTRY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Theories of coordination compounds 12 h

Theories of coordination compounds -VB theory - CFT - splitting of d orbitals in ligand fields and different symmetries - CFSE - factors affecting the magnitude of 10 Dq - evidence for crystal field stabilization - spectrochemical series - site selection in spinels - tetragonal distortion from octahedral symmetry - Jahn-Teller distortion - Nephelauxetic effect – MO theory - octahedral - tetrahedral and square planar complexes -pi bonding and molecular orbital theory - experimental evidence for pibonding.

Unit II Reaction Mechanism in Coordination Complexes 12 h

Substitution reactions in square planar complexes - the rate law for nucleophilic substitution in a square planar complex - the trans effect - theories of trans effect - mechanism of nucleophilic substitution in square planar complexes - kinetics of octahedral substitution - ligand field effects and reaction rates - mechanism of substitution in octahedral complexes - reaction rates influenced by acid and bases - racemization and isomerization - mechanisms of redox reactions - outer sphere mechanisms - excited state outer sphere electron transfer reactions - inner sphere mechanisms - mixed valent complexes.

Unit III Electronic spectra and magnetism 12 h

Microstates, terms and energy levels for d1 – d9 ions in cubic and square fields - selection rules - band intensities and band widths - energy level diagrams of Orgel and Tanabe - Sugano - spectra of Ti3+, V3+, Ni2+, Cr3+, Co2+, Cr2+ and Fe2+ - calculation of 10Dq and B for V3+ (oct) and Ni2+(oct) complexes - charge transfer spectra - magnetic properties of coordination compounds - change in magnetic properties of complexes in terms of spin orbit coupling - temperature independent paramagnetism - spin cross over phenomena.

Unit IV Structure of coordination complexes 12 h

Structure of coordination compounds with reference to the existence of various coordination numbers - complexes with coordination number two - complexes with coordination number three - complexes with coordination number four - tetrahedral and square planar complexes - complexes with coordination number

five - regular trigonal bipyramidal and square pyramidal - site preference in trigonal bipyramidal complexes - site preference in square planar complexes - isomerism in five coordinate complexes - coordination number six - distortion from perfect octahedral symmerty - trigonal prism - geometrical isomerism in octahedral complexes - coordination number seven and eight.

Unit V IR and Raman spectroscopy 12 h

Structural elucidation of simple molecules like N2O, ClF3, NO3-, ClO4- - effect of coordination on ligand vibrations - uses of group vibrations in the structural elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate, nitrate,sulphate and DMSO - effect of isotopic substitution on the vibrational spectra of molecules - applications of Raman spectroscopy.

Text Books

1 Huheey. J.E, Keiter. E.A and Keiter. R.L, 2006, "Inorganic Chemistry, Principles of Structure and Reactivity", 4th Edition, Pearson Education & UK

2 Cotton. F.A, Wilkinson. G, Murillo. C.A and Bochmann. M, 1999, "Advanced Inorganic Chemistry", 6th Eition, A Wiley - Interscience Publications, John Wiley and Sons, USA.

3 Gopalan. R, Ramalingam. V, 2001, "Concise Coordination Chemistry", 3rd Edition, Vikas Publishing house pvt. Ltd & New Dehli.

References

1 Lewis. J and Wilkins. R.G, 1967, "Modern Coordination Chemistry", Inter Science Publisher.

2 Shriver. D. F, Weller. M.T, Overton. T, Rourke. J and Armstrong. F.A, 2014, "Inorganic Chemistry", 6th Edition, New York, W.H. Freeman and Company & USA.

3 Gurdeep Raj, 2014, "Advanced Inorganic Chemistry", 12th Edition, Geol Publishing House & New Delhi.

4 Gurdeep Raj, 2014, "Advanced Inorganic Chemistry", 12th Edition, Geol Publishing House & New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A1CC	THERMODYNAMICS, ELECTROCHEMISTRY AND KINETICS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The Fundamentals of thermodynamics and electrochemistry.
- The adequate knowledge in chemical equilibrium and catalysis.
- The application oriented knowledge about surface phenomenon.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Analyze the concepts of equilibrium thermodynamics and non-equilibrium thermodynamics.	K4
CO2	Apply the basic principles involved in electrochemistry.	K3
CO3	Analyze the concepts and functions involved in the electrochemical reactions.	K4
CO4	Interpret the knowledge about chemical kinetics in molecular reactions.	K5
CO5	Apply concept involved in catalysis and adsorption for various applications.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	L	M	S
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	S	S	S	M	S

S Strong M Medium L Low

192CE2A1CC	THERMODYNAMICS, ELECTRO CHEMISTRY AND KINETICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Equilibrium Thermodynamics and Non-equilibrium Thermodynamics 12 h

General review of enthalpy, entropy and free energy concepts - second law of thermodynamics - concept of entropy - Gibbs function- Gibbs- Helmholtz equation- Maxwell relations - genesis of third law and its limitations-thermodynamics of systems of variable compositions-partial molar quantities and their determination - chemical potential - Gibbs-Duhem equation - Gibbs-Duhem-Margules equation - fugacity and its determination.

Non-equilibrium thermodynamics - conservation of mass and energy-entropy production - entropy production in chemical reactions-entropy production and entropy flow in open systems - Onsager's theory - validity and its verification.

Unit II Electrochemistry-I 12 h

Activity - mean ion activity and mean activity coefficient of electrolytes in solution - ion association - ionic strength - ion-atmosphere - Debye-Hückel theory and DebyeHückel limiting law - its validity and limitations - strong and weak electrolytes -Debye theory of electrolytic conductance - Debye-Hückel-Onsager equation -verification and limitations - electrode potentials, standard redox potentials -electrochemical cells-concentration cells - applications of standard redox potentials.

Unit III Electrochemistry-II 12 h

The electrical double layer - polarizable and non-polarizable interfaces - structure of electrical double layer - double layer models - Helmholtz, Guoy-Chapman and Stern models. Kinetics of electrode processes - current-potential curve - ButlerVolmer relation and its approximations - symmetry factor and transfer coefficient - Tafel equation - charge transfer resistance - Nernst equation from Butler-Volmer equation - primary and secondary batteries - fuel cells - corrosion and its prevention methods.

Unit IV Chemical Kinetics-I 12 h

Basic kinetic concepts - Theories of reaction rates-collision theory - transition State theory - salt effect - temperature effects, Arrhenius equation, chemical

interpretation of activation parameters, microscopic reversibility - Lindemann, Hinshelwood, RRK, RRKM and Slater treatments - fast reaction kinetics - Study of fast reactions - stopped flow method - chemical relaxation method.

Unit V Chemical Kinetics-II 12 h

Homogenous catalysis - activation barrier - Hammett acid-base catalysis - rate of acid and base catalysis - acidity function. Enzyme catalysis: Brief introduction on enzymes - advantages – Michaelis -Menton kinetics -Lineweaver Burk plot - enzymatic inhibitor.

Heterogenous catalysis: Adsorption, physisorption and chemisorptions, Langmuir and BET adsorption, Gibbs adsorption isotherm, insoluble surface films, electrokinetic phenomena, zeta potential. Surface active agents - classification, micellization, hydrophobic interaction, CMC and factors affecting CMC - reverse micellization.

Text Books

1 Glasstone. S, 2008, "Thermodynamics for Chemists", 11th Edition, Ewp Publishers & USA

2 Atkins. P and Julio de Paula, 2014, "Physical Chemistry" 10th Edition, Oxford University Press & UK.

3 Kapoor. K.L, 2009, "A Textbook of Physical chemistry, Vol 2", 3rd Edition (Reprint), Macmillan Publishers India Ltd & Chennai.

References

1 Grow. D.R, 1994, "Principles and applications of electrochemistry", 4th Edition, CRC Press publishers & UK.

2 Laidler. K.J, 2003, "Chemical Kinetics", 3rd Edition. Pearson Education Publishers& India.

3 Adamson. A.W, 1982, "Physical chemistry Surfaces", 4th Edition, Wiley-Blackwell & USA.

4 Bockris. J.O.M and Reddy A. K. N, 1998, "Modern Electrochemistry", Plenum Press & USA.

Course Code	Course Name	Category	L	T	P	Credit
202CE2A1CD	ANALYTICAL CHEMISTRY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The nature of errors and their types.
- The various techniques involved in chromatography.
- The principles and instrumentation of thermoanalytical, Radiochemical, Fluorescence and electroanalytical techniques.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Identify the nature of errors and their analysis.	K3
CO2	Apply the various methods of chromatographic techniques in purification process.	K3
CO3	Examine the basis involved in Spectrophotometry, XRD and Fluorescence Spectroscopy.	K4
CO4	Explain the basic analysis of Radiochemical and Thermal methods of analysis.	K4
CO5	Analyze the various electroanalytical techniques.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	L	M	L
CO2	S	S	L	M	L
CO3	S	S	M	M	M
CO4	S	S	M	M	S
CO5	S	S	M	M	M

S Strong M Medium L Low

202CE2A1CD	ANALYTICAL CHEMISTRY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Data and Error Analysis 12 h

Various types of error – accuracy, precision, significant figures – frequency distributions, the binomial distribution, the Poisson distribution and normal distribution – describing data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements. Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t-Test, paired t-Test – analysis of variance (ANOVA) – correlation and regression. Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals – general polynomial equation fitting, linearizing transformations, exponential function fit – r and its abuse – multiple linear regression analysis, elementary aspects.

Unit II Chromatography 12 h

Solvent extraction–factors favouring solvent extraction, principles of ion exchange, paper, thin-layer and column chromatography techniques – principles, columns, adsorbents, methods, Rf values, McReynold's constants and their uses – HPTLC, HPLC techniques – adsorbents, columns, detection methods, estimations, preparative column – GC-MS techniques -instrumentation methods, principles and uses.

Unit III Spectrophotometry, XRD and Fluorescence Spectroscopy 12 h

Atomic absorption spectrophotometry (AAS)-principle, instrumentation and applications, types of interferences. Flame emission spectroscopy (FES)-theory, instrumentation and applications-Difference between AAS and FES. Inductively coupled.

Plasma atomic emission spectroscopy (ICEP-AES)-principle and applications. XRDprinciple single crystal-powder crystal methods and application. Basic aspects of synchronous fluorescence spectroscopy - spectral hole burning - flow cytometry - fluorometers (quantization) – instrumentation -applications..

Unit IV Radiochemical and Thermal Methods of Analysis 12 h

Isotopic dilution methods - neutron activation analysis – Radiometric titrations - applications- principles, instrumentations and applications of thermogravimetry,

Principles – instrumentations and applications of thermogravimetry analysis (TGA), Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) –thermometric titrations – types – advantages.

Unit V Electroanalytical Techniques 12 h

Electrochemical sensors, ion-sensitive electrodes, glass - membrane electrodes, solid-liquid membrane electrodes - ion-selective field effect transistors (ISFETs) - sensors for the analysis of gases in solution. Polarography - principles and instrumentation - dropping mercury electrode -advantages, diffusion current-Ilkovic equation -applications of polarography -polarographic maxima - oscillographic polarography, AC polarography -cyclic voltammetry - advantages over polarographic techniques - chronopotentiometry -advantages - controlled potential coulometry - amperometric titrations: principles - techniques - applications - estimation of lead. Basic principles of coulometry-principlecoulometry at controlled potential-coulometry at constant current-coulometric titrations-advantages and applications.

Text Books

1 Skoog and West, 2014, "Instrumental methods of analysis" 6th Edition, Cengage Publishers & USA.

2 Sharma B.K, 2011, "Instrumental methods of chemical analysis", 1st Edition, Krishna Prakashan Media pvt. Ltd & New Delhi

3 Kapoor. S.M, 2008, "Basic Concepts of Analytical Chemistry", 3rd Edition, New Age International Publishers, New Delhi.

References

1 Willard H.W, Merrit. L.I, Dean. J.J.A and Settle. F.A, 2004, "Instrumental methods of analysis". 7th edition, CBS Publishers & New Delhi.

2 Srivastava.V.K and Srivastava. K.K, 1985, "Introduction to Chromatography" 2nd Edition, Holden Day & New York.

3 Hibbert. D.B and Gooding. J.J, 2006, "Data Analysis for Chemistry", 1st Edition, Oxford University Press, UK.

4 Bard. A. J and Faulkner. L. R, 2001, "Electrochemical Methods-Fundamentals and Applications", 2nd Edition, John Wiley & Sons. & USA.

202CE2A1CP	CORE PRACTICAL : ORGANIC CHEMISTRY	SEMESTER I

Total Credits: 3
Total Instructions Hours: 72 h

S.No	List of Experiments
1	Analysis of two component mixtures - separation and characterization of the components - I
2	Analysis of two component mixtures - separation and characterization of the components - II
3	Analysis of two component mixtures - separation and characterization of the components - III
4	Analysis of two component mixtures - separation and characterization of the components - IV
5	Analysis of two component mixtures - separation and characterization of the components - V
6	Estimation of phenol
7	Estimation of Aniline
8	Preparation of p-Bromoacetanilide from aniline
9	Preparation of Acetylsalicylic acid from methyl salicylate
10	Preparation of Benzilic acid from benzoin (rearrangement)
11	Preparation of Benzanilide from benzophenone (rearrangement)
12	Preparation of 1,3,5-Tribromobenzene from aniline

Note: Out of 12 – 10 Mandatory

References

1 Gnanaprakasam. N.S and Ramamurthy. G, 1998, “Organic Chemistry - Lab Manual”, S. Viswanathan Co.Pvt. Ltd & Chennai.

2 Furniss. B.S, Brian. S, Hannaford. A.J and Antony. J, 2016, "Vogel's Text book of Practical Organic Chemistry", 5th Edition, ELBS/ Longman, UK.

3 Mann. F.G, Saunders, 2011, "Practical Organic Chemistry", 4th Edition, Pearson & India.

4 Ahluwalia. V.K, Bhagat. P and Agarwal. R, 2005, "Laboratory Techniques in Organic Chemistry", I. K. International Publishing House Pvt. Ltd & New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
202CE2A1DA	POLYMER CHEMISTRY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The significance of Polymers.
- Polymer structure, properties and characteristics.
- Polymer processing techniques and its applications.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Summarize the Mechanism of polymerization process. Illustrate the difference between polymers and plastics.	K2
CO2	Categorize the different polymerization techniques.	K4
CO3	Analyze the various characteristics of polymers using physical and chemical methods.	K4
CO4	Examine the structure, properties and fabrication techniques.	K4
CO5	Summarize the functionalities of commercial polymers and polymer additives.	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	M	L
CO2	S	S	S	S	M
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	M	S	S	M	L

S Strong M Medium L Low

202CE2A1DA	POLYMER CHEMISTRY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Chemistry of Polymers 10 h

Classification of polymers, Types of polymerization – addition, free radical, ionic and coordination polymerization – Zigler-Natta, Stereo regular polymerization, Condensation polymerization – Mechanism and Kinetics of polymerization –degree of polymerization – kinetic chain length – factors affecting chain polymerization-inhibition and retardation – Carother's equation. Difference between polymers and plastics. Composition of plactics.

Unit II Polymerization Techniques and Types 10 h

Polymerization Techniques – bulk, solution, suspension and emulsion polymerization, melt-condensation, solution, poly condensation, interfacial condensation, solid-gas phase polymerization. Types of copolymers- ideal, alternating, block and graft copolymer – Types of copolymerization – Free radical ionic copolymerization –polycondensation –copolymer equation – significance – monomer and radical reactivity – Q-e scheme -Determination of monomer reactivity ratio – Mayo-Lewis and Fineman Ross methods – block and graft copolymerization – methods of preparation and mechanism.

Unit III Polymer Characteristics and Characterization 10 h

Types of degradation – thermal, mechanical and photodegradations – management of plastics in the environment. The concept of number average and weight averages. Molecular weight methods - Molecular weight distribution, separation of polymers – precipitation and analytical methods – determination of molecular weights – Osmotic pressure, light scattering, viscosity and end group analysis, ultra centrifugation methods. Analysis and testing of polymers- physical / mechanical and chemical analysis of polymers – spectroscopic methods, x-ray diffraction study.

Unit IV Polymer Properties and Fabrication 10 h

Morphology and order in crystalline polymers – configurations of polymer chain – types of stereo isomerism in polymer – tacticity (eg. Mono and disubstitute polyethylene, polypropylene, polybutadiene) significance of stereoregularity. Polymer structure and physical properties – crystalline melting point Tm – melting points of homogeneous series – effect of chain flexibility and heat of fusion. The

glass transition temperature, Tg-relationship between Tm and Tg, effects of molecular weight, chemical structure, property requirements and polymer utilization. Fabrications of polymers – Moulding, casting and spinning polymers.

Unit V Commercial polymers and Applications 8 h

Preparation, properties and applications - Polyethylene, polyvinyl chloride, polyamides, polyesters, PMMA, polystyrene, polycarbonates, phenolic resins and epoxy resins. Dendrimers – Types and applications. Basic concept of conducting polymers, liquid crystalline polymer. Polymer additives: Fillers, plasticizers, colourants, auto oxidants, fire retardants and thermal stabilizers – polymer blends and composites.

Text Books

1 Gowariker. V.R and Viswanathan. N.V, 2019, "Polymer science", 3rd Edition, New Age International Publishers & New Delhi.

2 Billmeyer. F.W, 2007, "Text book of Polymer science", 3rd Edition, Wiley India Pvt. Ltd & New Delhi

3 George Odian, 2007, "Principles of polymerization", 4th Edition, Wiley India Pvt. Ltd & New Delhi

References

1 Manas Chanda, 2013, "Introduction to Polymer Science and Chemistry", 2nd Edition, CRC Press & USA.

2 Goel R. Fried, 2003, "Polymer science and technology", 2nd Edition, Prentice Hall & New Jersey

3 Ghosh. P, 2017, "Polymer Science and Technology: Plastics, Rubber, Blends and Composites", 3rd Edition, McGraw Hill Education & New Delhi.

4 Misra. G.S, 1994, "Introductory Polymer Chemistry", Wiley-Blackwell & USA.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A1DB	PHARMACEUTICAL CHEMISTRY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The common diseases and cure-terms of pharmacology.
- The mechanism of drug action, get introduced to antibiotics, analgesic and antipyretics.
- The basis of clinical chemistry.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Infer the information about basis of common diseases and their treatment methods.	K3
CO2	Classify the types of antibiotics and their mode of actions.	K2
CO3	Explain the critical understanding of the goals and actions analgesic and antipyretics.	K2
CO4	Identify the characteristics of various anaesthetics and local anaesthetics.	K3
CO5	Analyze the different methods to identify the components present in blood and urine samples.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	M	M	S	L	M
CO3	M	M	S	L	M
CO4	S	S	M	M	S
CO5	M	M	L	S	M

S Strong M Medium L Low

192CE2A1DB	PHARMACEUTICAL CHEMISTRY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Basics of Pharmaceutical Chemistry 9 h

Definitions – the terms – drugs, pharmacology, pharmacy, chemotherapy, therapeutics – pharmacologically active principles in plants – first aid –important rules of first aids, cuts, fractures, bleeding for blood, maintaining breathing burns and first aid box – tuberculosis (T.B.), jaundice, piles, typhoid, malaria, cholera – causes – symptoms, diagnosis – prevention and treatment – medicinally important compounds of iron – ferrous gluconate, ferrous sulphate and ferric ammonium citrate.

Unit II Antibiotics 9 h

Definition – introduction – classification and biological actions – penicillin, chloramphenicol, streptomycin and tetracycline – structure, properties and therapeutic uses – chemical structure and pharmacological activity – effect of unsaturation, chain length, isomerism, halogens, amino groups, hydroxyl groups and acid groups.

Unit III Analgesic and Antipyretics 10 h

Narcotic analgesic – analgesic action of morphine – derivatives of morphine – heroin and apomorphine – synthetic analgesics – pethidine, methadone – nonnarcotic analgesic – aspirin, paracetamol and phenacetin – analgin – preparation, properties and uses – ibuprofen and ketoprofen – structure and uses.

Unit IV Anaesthetics and Local Anaesthetics 10 h

Characteristics of anaesthetics – classification of anaesthetics – general anaesthetics – volatile anaesthetics – ether, chloroform and halothane – advantages and disadvantages – non-volatile anaesthetics (intravenous anaesthetics) – methohexitone and propanidid – structure and uses – cocaine and amethocaine – structure and uses – benzocaine and procaine – structure, synthesis and uses.

Unit V Clinical Chemistry 10 h

Determination of sugar (glucose) in serum – o-toluidine method – diagnostic test for sugar in urine – Benedict's test – detection of diabetes – detection of cholesterol in urine – detection of anaemia – estimation of haemoglobin (Hb concentration) – red cell count.

Text Books

1 Jayashree Ghosh, 2012, "Pharmaceutical Chemistry", 3rd Edition, S. Chand and Company & New Delhi.

2 Bentley and Driver's, 1977, "Text Book of Pharmaceutical Chemistry revised by Artherden L.M", Oxford University Press & London.

3 Romas Nogrady, 2004, "Medicinal Chemistry" 2nd Edition, Oxford Univ. Press & London.

References

1 Lakshmi. S, 1995, "Pharmaceutical Chemistry", 1st Edition, S. Chand & Sons & New Delhi.

2 Ashutosh Kar, 2018, "Medicinal Chemistry", 7th edition, New Age International Publishers & New Delhi.

3 Donald Cairns, 2012, "Essentials of Pharmaceutical Chemistry", 4th revised Edition, Pharmaceutical Press & UK.

4 David G. Watson, 2011, "Pharmaceutical Chemistry", 1st Edition, Churchill Livingstone & UK.'

Course Code	Course Name	Category	L	T	P	Credit
192CE2A1DC	SUPRAMOLECULAR CHEMISTRY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamentals of supramolecules.
- The co-receptor molecules and multiple recognitions.
- The supramolecular reactivity and their catalytic activity.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Interpret the information about various concepts involved in supramolecular chemistry.	K2
CO2	Compare the different model for the metallo organic frameworks.	K2
CO3	Explain the various co-receptor molecules and multiple recognitions in metalloreceptors.	K2
CO4	Examine the Supramolecular reactivity and their catalytic activity.	K4
CO5	Analyze the role of supramolecular chemistry in the development of nanoscience and technology.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	M	M
CO2	M	M	M	M	M
CO3	M	M	M	M	M
CO4	M	M	L	S	M
CO5	M	M	L	S	M

S Strong M Medium L Low

192CE2A1DC	SUPRAMOLECULAR CHEMISTRY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Concepts of Supramolecular Chemistry 9 h

Concepts and languages of supramolecular chemistry – various types of non-covalent interactions – hydrogen bonds, C-H...X interactions, halogen bonds – p-p interactions, non–bonded interactions – various types of molecular recognition.

Crystal engineering of organic solids – hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and noncovalent synthesis – polymorphism and pseudopolymorphism – supramolecular isomorphism / polymorphism – crystal engineering of pharmaceutical phases.

Unit II Metallo Organic Frameworks 9 h

M.O.F (Metallo Organic Frameworks) – organometallic systems – combinations of different interactions to design molecular rods, triangles, ladders, networks, etc. – design of nanoporous solids – interligand hydrogen bonds in metal complexes – implications for drug design – crystal engineering of NLO materials, OLED.

Unit III Co-receptor Molecules and Multiple Recognition 10 h

Dinuclear and polynulclear metal ion cryptates – linear recognition of molecular length by ditopic co-receptors – heterotopic co-receptors – cyclophane receptors, amphiphilic receptors and large molecular cages – multiple recognition in metalloreceptors – supramolecular dynamics..

Unit IV Supramolecular Reactivity and Catalysis 10 h

Catalysis by reactive macrocyclic cation receptor molecules – catalysis by reactive anion receptor molecules – catalysis with cyclophane type receptors – supramolecular metallocatalysis – cocatalysis – catalysis of synthetic reactions – biomolecular and abiotic catalysis. upramolecular chemistry in solution – cyclodextrin, micelles, dendrimers, gelators – classification and typical reactions – applications.

Unit V Supramolecular Devices 10 h

Supramolecular devices and sensors – various types of supramolecular devices – an overview – supramolecular photochemistry – molecular and supramolecular photonic devices – light conversion and energy transfer devices – molecular and

supramolecular electronic devices – electronic conducting devices – molecular wires, modified and switchable molecular wires – molecular and supramolecular ionic devices – tubular mesophases, molecular protonics – switching devices – electro-photo switch – ion and molecule sensors – role of supramolecular chemistry in the development of nanoscience and technology.

Text Books

1 Desiraju. G.R and Steiner. T, 2001, "The Weak Hydrogen Bond in Structural Chemistry and Biology", International Union of Crystallography.

2 Lehn. J. M, 1995, "Supramolecular Chemistry", 1st Edition, Wiley VCH & USA.

3 Asim K. Das and Mahua Das, 2017, "An Introduction to Supramolecular Chemistry", 1st Edition, CBS Publishers & Distributors Pvt Ltd & New Delhi.

References

1 Lehn. J. M, 1999, "Transition Metals in Supramolecular Chemistry", John Wiley and Sons & USA.

2 Jeffrey. G.A, 1997, "Introduction to Hydrogen Bonding", Oxford University Press & UK

3 Jonathan W. Steed and Jerry L. Atwood, 2009, " Supramolecular Chemistry", 2nd Edition, Wiley-Blackwell & USA.

4 http://www.pubs.acs.org/journals/cgdefu/index.htm.

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
192CE2A2CA	Core - V	Stereochemistry, Photochemistry and Rearrangements	4	1	-	3	25	75	100	4
202CE2A2CB	Core - VI	Bio-inorganic & Organometallic Chemistry	4	-	-	3	25	75	100	4
202CE2A2CC	Core - VII	Principles of spectroscopy	4	1	-	3	25	75	100	4
193BC2A2EA	EDC - I	Drug Biochemistry	4	-	-	3	25	75	100	4
202CE2A2CP	Core Practical - II	Inorganic Chemistry	-	-	8	6	40	60	100	4
202CE2A2DA	DSE - II	Environmental Chemistry	4	-	-	3	25	75	100	4
192CE2A2DB		Nano Science and Technology								
192CE2A2DC		Bio- organic Chemistry								
		Total	**20**	**2**	**8**	**-**	**-**	**-**	**600**	**24**

Course Code	Course Name	Category	L	T	P	Credit
192CE2A2CA	STEREOCHEMISTRY, PHOTOCHEMISTRY AND REARRANGEMENTS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic principles of stereochemistry and conformational analysis of organic compounds
- About photochemistry and pericylic reaction mechanisms
- The basic knowledge about various molecular rearrangement reactions

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the stereochemistry of organic molecules in 3-D arrangements	K2
CO2	Interpret the various methods of conformational analysis of organic molecules	K2
CO3	Categorize the various light induced photo reactions and their rearrangements	K4
CO4	Examine the basic principles involved in the peri cyclic reactions	K4
CO5	Analyze the reaction mechanism of various molecular rearrangement reactions.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	L	M
CO2	M	M	S	L	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S Strong **M** Medium **L** Low

192CE2A2CA	STEREOCHEMISTRY,PHOTOCHEMISTRY AND REARRANGEMENTS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Stereochemistry 12 h

Stereoisomerism – symmetry – enantiomers and diastereomers – R and S / E and Z nomenclature. Topicity – homotopic, heterotopic enantiotopic and diastereotopic systems. Stereochemistry of biphenyls, allenes, spiranes, Ansa compounds and helical structures. Asymmetry synthesis – Cram's and Prelog's rules – asymmetric catalysis.

Unit II Conformational Analysis 12 h

Conformational Analysis of acyclic system: Conformations of ethane, butane and halogenoalkanes - effect of conformation on reactivity- addition and elimination reaction of acyclic systems.

Conformational Analysis of Cyclic Compounds: cyclohexane - mono and disubstituted cyclohexane. Physical properties - Von AuwersSkitta rule - Conformation and reactivity of cyclohexane derivatives. Conformation of decalins.

Unit III Organic photochemistry 12 h

Fundamental concepts – energy transfer – characteristics of photoreactions – photoreduction, photooxidation and photosensitization. Photoreactions of ketones and enones – Norrish Type I and II reactions – Paterno-Büchi reaction – photo-Fries rearrangement – photochemistry of alkenes, dienes and aromatic compounds – di-π-methane rearrangement– Barton reaction.

Unit IV Pericylic reactions 12 h

Concerted reactions: Conservation of orbital symmetry – Woodward-Hoffman rules. Electrocyclic reactions – 1,3-dienes and 1,3,5-trienes. Analysis of reaction using orbital correlation diagram and FMO methods. Cycloadditions [2+2] and [4+2] – analysis using correlation diagram and FMO methods. Sigmatropic rearrangements – Cope and Claisen rearrangements.

Unit V Molecular rearrangements 12 h

Classification – mechanism and applications of Wagner - Meerwein, Neber, Baeyer–Villiger, Dienone phenol, Favorski, Benzidine, Stevens, ArdntEister, Schmidt, Lossen and Wallach rearrangements.

Text Books

1 Nasipuri. D, 2018, "Stereochemistry of Organic Compounds: Principles and Applications", 3rd Edition, New Age International Publishers, Delhi.

2 Chatwal. G.R, 1998, "Organic Photochemistry", First Edition, Himalaya Publications house, Delhi.

3 Sanyal. S. N, 2013, "Reactions, Rearrangements and Reagents"' 4th Edition, BharatiBhawan Publishers & Distributors, Delhi.

References

1 Michael B Smith. B, 2015, "March's Advanced Organic Chemistry: ReactionsMechanisms and Structure", 7 th Edition, Wiley, Delhi.

2 Kalsi. P.S, 2015, "Stereochemistry: Conformation and Mechanism", 10th Edition, New Age International Private Limited, Delhi.

3 Depuy. C.H, 1972, "Molecular Reactions and Photochemistry", First Edition, Prentice Hall, Delhi.

4 Turro. N. J, 2010, "Modern Molecular Photochemistry of Organic Molecules", 10th Edition, University Science Books, United States.

Course Code	Course Name	Category	L	T	P	Credit
202CE2A2CB	BIO-INORGANIC & ORGANOMETALLIC CHEMISTRY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The structure and bonding of organometallic complexes.
- About structure and reactions of Metal - alkylidene - alkene - alkyne complexes.
- The importance of trace elements in biological systems, medicinal applications of bioinorganic compounds.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Examine the structure and bonding of organometallic complexes.	K4
CO2	Analyze the synthesis and reactivity of Metal-alkylidene/alkene/alkyne complexes.	K4
CO3	Examine the synthesis and applications of metallocene compounds.	K4
CO4	Interpret toxic and non-toxic metal ions to the biological systems.	K2
CO5	Survey the role of inorganic complexes in medicinal applications.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	M	S
CO3	M	M	S	S	M
CO4	M	M	L	L	M
CO5	S	S	S	S	S

S Strong M Medium L Low

202CE2A2CB	BIO-INORGANIC & ORGANOMETALLIC CHEMISTRY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Structure and bonding in organometallics 10 h

Introduction and classification of organometallic compounds. 18 electron and effective atomic number rule. Metal carbon bond types – ionic bond – sigma covalent bond - electron deficient bond - delocalized bond – dative bond. Metal carbonyl complexes - synthesis - structure and reactions of metal carbonyls - the nature of M-CO bonding- binding mode of CO and IR spectra of metal carbonyls, metal carbonyl anions - metal carbonyl hydrides -metal carbonyl clusters–Wade's rule and isolobal relationship-Metal nitrosyl complexes

Unit II Metal-alkylidene/alkene/alkyne complexes 10 h

Synthesis of alkylidene complexes in low oxidation states and in high oxidation states. Alkene complexes - synthesis – bonding - reactivity - ligand substitution – reactions with nucleophiles. Olefin hydrogenation - Wilkinson's catalyst - hydrosilation - Wacker process. Alkyne complexes – synthesis by reduction method. Insertion reactions - cobalt catalyzed alkyne cycloaddition with nitrile, alkene and alkyne.

Unit III Metallocenes 10 h

Cyclopentadienyl complexes - metallocenes - synthesis of metallocenes - reactions of metallocenes – redox reactions of ferrocene-substitution reactions on cp ring - Application of ferrocenes - blood glucose sensors - Anticancer drugs - synthesis of bent metallocene complexes – reactivity of bent metallocenes- halide metathesis - ligand exchange by reduction - cyclopentadiene as a non-spectator ligand

Unit IV Metal ions in biological system 10 h

Classification of elements according to their action in biological systems, Na & K ion transport, Na / K pump. Consequences of excess and deficiency of trace metals. Toxicity of metal ions (Hg, Pb, Cd and As) - reasons for toxicity. Use of chelating agents in medicine. Bio membranes and calcium carriers

Unit V Medicinal Applications 8 h

Pt complexes in cancer therapy: Cisplatin and its mode of action - cytotoxic compounds of other metals - Gold containing drugs as antirheumatic agents and their mode of action - Lithium in psychopharmacological drugs - Metal complexes as probes of nucleic acid - Function of metal ions in genetic regulation.

Text Books

1 Bochmann. M, 1994, "Organometallics 1: Complexes with transition metal-carbon σ - bonds", 1st Edition, Oxford Science Publications & UK.

2 Bochmann. M, 1994, "Organometallics 2: Complexes with transition metal-carbon ıı-bonds", 1st Edition, Oxford science publications & UK.

3 Hussain Reddy, K. 2007, "Bioinorganic Chemistry", 1st Edn, New Age Internation (P) limited, New Delhi.

References

1 Collman. J. P, 1987, "Principles and Applications of Organotransition Metal Chemistry", 1st Edition, Macmillan Publishers & USA.

2 Crabtree. R.H, 2019, "The Organometallic Chemistry of Transition Metals", 7th Edition, Wiley-VCH & Germany.

3 Rosette M Roat-Malone, 2007, "Bioinorganic chemistry - A short course", 2nd Edn,:A John Wiley & Sons Inc. Publication, USA

4 Stephen J Lippard, 2005, Principles of Bioinorganic Chemistry, 2nd Edn, Panima publishing corporation, New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
202CE2A2CC	PRINCIPLES OF SPECTROSCOPY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The principle and mechanism of different types of molecular spectroscopy.
- The basic knowledge about the activity of molecules using various spectroscopic techniques.
- The insight details on the use of spectroscopic techniques for structural investigation.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the fundamental concepts of microwave spectroscopy and Raman spectroscopy.	K2
CO2	Apply intense knowledge about the basic principles instrumentation of IR spectroscopy and electronic spectroscopy.	K3
CO3	Develop the basic principles of NMR spectroscopy.	K3
CO4	Analyze in-depth knowledge about the 2D techniques involved in NMR spectroscopy.	K4
CO5	Utilize the basic principles involved in ESR spectroscopy and to know the fundamental concepts and application of analytical techniques in determining few complexes.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	M	S	S	S	S
CO3	M	S	M	S	S
CO4	M	S	M	M	M
CO5	S	S	M	M	S

S Strong M Medium L Low

202CE2A2CC	PRINCIPLES OF SPECTROSCOPY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Introduction, Microwave and Raman Spectroscopy 9 h

Electromagnetic radiation - interaction of electromagnetic radiation with molecules - types of molecular spectroscopy - factors affecting line width and intensity - signal to noise ratio and resolving power.

Microwave Spectroscopy - Rotation of molecules - rotational spectra of rigid rotator, intensities of rotational lines, effect of isotopic substitution - rotational spectrum of non-rigid rotator - linear & symmetric top molecules - Stark effect. Applications of microwave spectroscopy - determination of bond length, bond angle dipole moment and atomic mass from microwave spectra.

Raman spectroscopy- classical and quantum theory of Raman effect - rotational Raman spectra of linear and symmetric top molecules - vibrational Raman spectra- Rule of mutual exclusion principle – Instrumentation.

Unit II Infrared and Electronic spectroscopy 9 h

Infrared Spectroscopy: vibrating diatomic molecule - harmonic and anharmonic oscillators – selection rules - diatomic vibrating rotator - vibrations of polyatomic molecules - molecular vibrations, types of molecular vibrations, rotational vibrational spectra of linear and symmetric top molecules – Factors influencing vibrational frequencies - Fourier transformation in IR spectroscopy- Instrumentation.

Electronic Spectra of diatomic molecules - Frank Condon principle- vertical transitions- selection rules- parity, symmetry and spin selection rules - polarization of transitions- Russell Sanders coupling - different types of electronic transitions- UV-Vis instrumentation.

Unit III NMR Spectroscopy-I 10 h

Nuclear spin states and NMR active nuclei, nuclear magnetic moments- mechanism of resonance absorption- population of nuclear spin states. 1H NMR Spectroscopy – Multiplicity – Coupling constant – First order and second order proton, Spin-spin splitting – Dependence of J on dihedral angle – Vicinal and geminal coupling constants – Karplus equation – Long range coupling constants – Factors influencing coupling constant, splitting of nmr signals- AB, AX and AMX types - Influence of stereochemical factors on chemical shift of protons.

Unit IV NMR Spectroscopy-II 10 h

13C nucleus, chemical shifts, spin -spin splitting, double resonance techniques - homonuclear and hetero nuclear decoupling, broad band decoupling, off resonance decoupling, 13C relaxtion mechanism - Overhauser effect.

FT and 2D NMR spectrscopy: principle of FT-NMR, FID, Introduction of 2D techniques: DEPT, J-resolved, H,H-COSY, C,H-COSY, HMBC and NOESY spectra - NMR Imaging - MRI.

Unit V ESR Spectroscopy 10 h

Electron spin - Electronic Zeeman effect – Presentation of the spectrum-EPR spectrum of hydrogen atom (first order treatment) - g factors - Hyperfine splitting: nuclear spin (I = 1/2, 1, 3/2, 5/2) interaction with electron spin - hyperfine coupling constants - EPR spectra of organic radicals (AA and AB type). Theory of EPR spectroscopy – spin densities and McConnell relationship – factors affecting the magnitude of g and A tensors in metal species – zero-field splitting and Kramers degeneracy – spectra of V(II), Mn(II), Co(II) and Cu(II) complexes – applications of EPR to a few biological molecules containing Cu(II) and Fe(III) ions.

Text Books

1 Pavia. D.L, 2011, "Spectroscopy", 5th Edition, Brooks/Cole Publications & UK.

2 Yadav. M.S, 2011, "Molecular Spectroscopy", 1st Edition, Arise Publishers and Distributors & New Delhi.

3 Drago. R.S, 1978, "Physical methods in Inorganic Chemistry", 1st Edition, East west Pvt.Ltd & New Delhi.

References

1 Kalsi. P.S, 2014, "Spectroscopy of Organic Compounds", 6th Edition, New Age International (P) Ltd & New Delhi.

2 Silverstein. R.M, 2009, "Spectrometric Identification of Organic compounds, 6th Edition, John Wiley Publications & Germany.

3 William Kemp, 2008, "Organic Spectroscopy", 3rd Edition, Palgrave Publications & USA.

4 Sharma. Y.R, 2013, "Elementary Organic Spectroscopy", 5th Edition, S. Chand and Company Pvt Ltd & New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
193BC2A2EA	DRUG BIOCHEMISTRY	EDC	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The drug types, characteristics and action of drugs on the body.
- The basic knowledge on mechanism of action, therapeutic uses, kinetics and adverse effects of drugs used for various clinical conditions.
- The principles of chemotherapy, treatment strategies for cancer.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the concept and principles of drug interaction with the body.	K2
CO2	Interpret the effect of drug interaction in the body.	K2
CO3	Explain the basic concepts of disease status and mechanisms of drug action.	K2
CO4	Examine the mechanism of action and effect of various drugs.	K4
CO5	Select the usage of different drugs for the treatment ofvarious ailments.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	S
CO2	M	M	M	S	S
CO3	M	S	S	S	M
CO4	L	L	L	S	M
CO5	S	S	S	S	S

S Strong **M** Medium **L** Low

193BC2A2EA	DRUG BIOCHEMISTRY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Pharmacology and Pharmacokinetics 10 h

Pharmacology: Classification of drugs, sources and preparation; natural source, synthetic drugs, drug preparation: crude drug, pure drug compounds, pharmaceutical preparations. Routes of drug administration: sublingual, buccal, oral, rectal, intravenous, intramuscular, subcutaneous, transdermal, inhalational and topical administration.

Pharmacokinetics: drug absorption, drug distribution, drug biotransformation (role, formation and phases), drug excretion: quantitative pharmacokinetics, drug plasma concentration curve, bioavailability, volume of distribution, drug clearance.

Unit II Pharmacodynamics 08 h

Definition. Drug receptors: Types, classification, drug-receptor interaction (binding and affinity, signal transduction, efficacy, receptor regulation and drug tolerance). Dose-response relationships (gradal and quantal). Adverse effects of drugs. Factors affecting drug safety and efficacy.

Unit III Antidepressant drugs and neurodegenerative diseases 10 h

Antidepressant drugs: Mechanism of action, therapeutic uses, kinetics and adverse effects of tricyclic antidepressants and monoamine oxidase inhibitors.

Treatment of neurodegenerative diseases: neurotransmission in CNS, synaptic potentials, drugs used for Alzheimer disease and Parkinson disease. Mechanism of action, therapeutic uses, kinetics and adverse effects of Hypnotic drug (barbiturates).

Unit IV Drugs for peptic ulcer, inflammation and anesthetics 10 h

Anti-peptic ulcer drugs: H2 receptor antagonists and inhibitors of H+K+ ATP-ase pump.

Anti-inflammatory drugs: Mechanism of action, therapeutic uses, pharmacokinetics and adverse effects of Anti-inflammatory drugs -aspirin and colchicine.

Anesthetics: patient factors in selection of anesthesia, induction, maintenance and recovery from anesthesia, features, potency, uptake, distribution, action and adverse effects of inhalation anesthetics. Intravenous and local anesthetics.

Unit V Anticancer drugs 10 h

Introduction to chemotherapy, treatment strategies, treatment regimens and scheduling, limitations of chemotherapy. Mechanism of action, therapeutic uses, pharmacokinetics and adverse effects of antimetabolites (Methotrexate and 5–fluorouracil), antibiotics (Dactinomycin and Bleomycin), microtubule inhibitor (Vincristine and Vinblastine), steroid hormones and their antagonist (Tamoxifen) and interferons.

Text Books

1 Richard D. Howland, Mary. J. Mycek, Willaim L. Wilkins, 2006, "Lippincott's illustrated reviews: pharmacology", 3rd Edn, Wolters Kluwer health (India) Pvt. Ltd., Delhi.

2 George M. Brunner, Craig W. Stevans. 2011, "Pharmacology", 3rd Edn, Saunders, an imprint of Elsevier Inc, United States.

References

1 Sharma H.L, Sharma, K. K., 2011, "Principles of Pharmacology", 2 Edn, Paras Medical Publisher, India.

2 Satoskar, R. S, Nirmala N, Reje, Bhandarkar S. D, 2011, "Pharmacology and Pharmacotherapeutics", 22nd Edn, Popular Prakashan Pvt. Ltd, India.

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202CE2A2CP	CORE PRACTICAL: INORGANIC CHEMISTRY	SEMESTER II

Total Credits: *4*
Total Instructions Hours: 96 h

S.No	List of Experiments
	Semi micro qualitative Analysis of mixtures containing two common and two less common cations.
	Ions of the common metals: Pb, Cu, Mn, Cr, Al, Ni, Co, Ba, Sr, Ca, Mg
	Ions of less common metals: W, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Be, Li
1	Analysis of Inorganic Mixture - I
2	Analysis of Inorganic Mixture - II
3	Analysis of Inorganic Mixture - III
4	Analysis of Inorganic Mixture - IV
	Analysis involving volumetric and gravimetric estimations of mixtures of cations.
5	Volumetric and gravimetric estimations of Cu and Ni
6	Volumetric and gravimetric estimations of Zn and Cu
7	Volumetric and gravimetric estimations of Fe and Zn
	Complexometric titrations
8	Estimation of calcium
9	Estimation of magnesium
10	Estimation of zinc
	Colorimetric estimation of metals using photoelectric colorimeter.
11	Estimation of iron
12	Estimation of copper

Note: Out of 12 - 10 Experiments

References

1. Venkateswaran. V, Veeraswamy. R and Kulandaivelu. A.R, 2017, "Principles of Practical Chemistry", 1st Edition, Sultan Chand & Sons & New Delhi.
2. Giri. S, Bajpai. D.N and Panday. O.P, 2013, "Practical Chemistry Vol. I & II", 30th Edition, S. Chand & Company & New Delhi.
3. Bassart. J, Dennay. R.C, Jeffery. G.H and Mendham, 1989, "Vogels text book of qualitative Inorganic analysis", 5th Edition, The ELBS & Longman & UK.
4. Ramanujam. V.V, 1988, "Inorganic Semimicro Qualitative Analysis" 3rd Edition, National Pubs & London.

Course Code	Course Name	Category	L	T	P	Credit
202CE2A2DA	ENVIRONMENTAL CHEMISTRY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic knowledge about the structure of atmosphere and various energy resources and environment.
- To know about the different types of pollution, health effects and control measures
- To identify the various toxic chemicals and analysis methods of polluted samples.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Examine the composition, structure of atmosphere and various energy resources in the environment	K4
CO2	Identify the aquatic pollution and their monitoring techniques	K3
CO3	Explain the sources, effects and control measures of Air pollution	K2
CO4	Summarize the toxic chemicals and their health effects, sources of nuclear pollution and nuclear disaster managment	K3
CO5	Examine the various analysis methods of pollutants.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	L	M	S
CO2	S	S	L	M	S
CO3	M	M	L	L	M
CO4	M	M	L	L	M
CO5	S	S	M	S	S

S Strong M Medium L Low

202CE2A2DA	ENVIRONMENTAL CHEMISTRY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Atmosphere, Energy and Environment 10 h

Composition of Atmosphere, Atmosphere structure, Earth Radiation balance, particles, ions and radicals in the Atmosphere chemical and photochemical reactions in the atmosphere- oxygen and ozone chemistry - El Nino phenomenon- Asian Brown cloud. Mineral Resources - Metals and Non metals - Wood- major renewable and non renewable resources for energy- Consumption and conservation.

Unit II Aquatic Pollution and monitoring techniques 10 h

Aquatic environment- polluting agents- pesticides, insecticides- cyclodiene organophosphates - carbamates, detergents- naphtheno aromatics-radioactive materials- coral-reef crisis- eutrophication. Mineral pollution- copper, lead, mercury, selenium and chromium. Monitoring methods -Polarigraphic, neocuproine, dithizone, persulphate and phenanthroline. Tests for identifying phenols, pesticides, surfactants, tanin and lignin.

Unit III Air Pollution 10 h

Sources of air pollution- Natural and manmade-classification and effects of air pollutants -CO, CO2, SO2, SO3,NO and NO2- hydrocarbon as pollutant- reactions of hydrocarbons and effects - particulate pollutants sources and effects of organic and Inorganic particulates - Green house effect-impact on global climate-control measures-role of CFC's -ozone holes-effects of ozone depletion-smog components of photochemical smog-effects of photochemical smog. Air pollutant accidents- TCDD- Bhopal disaster- Chernobyl disaster

Unit IV Chemical Toxicology and Nuclear Pollution 10 h

Toxic chemicals in Environment- Impact of toxic chemicals on enzymes- Effects of metals and metallic compounds-sources, toxicology and health risks of iron, arsenic, cadmium, chromium, lead, mercury and nickel. Nuclear pollution-sources-effects of ionizing and non ionizing radiation - genetic and somatic effects-effects of Cesium-137, Krypton-85 Iodine-131 and Strontium-90 - storage of nuclear wastes-disposal of nuclear wastes-nuclear disasters and their management-some major nuclear accidents.

Unit V Analysis and Control 8 h

Analysis of pollutants- CO, NO,SO2, H2S, hydrocarbons and particulate matter. Analysis of ammonia, nitrate and nitrites, chlorides, fluorides, cyanides, sulphide ,sulphate and phosphates, boron, silica and arsenic. Other tecniques- scrubbing – cold trapping – filtration - cyclone separator - gravity settling - electrostatic precipitators and thermal precipitators.

Text Books

1 De A.K, 1994, "Environmental Chemistry", Wiley Eastern Ltd, 3rd Edn. New Age International Publishers & New Delhi.

2 Kannan K , 1997, "Fundamentals of Environmental Pollution", S. Chand & Co & New Delhi.

3 Sharma B.K, 2001, " Environmental Chemistry" , 4th Edn, Goel Publishers & New Delhi.

References

1 Miller T.G.Jr, 1971, "Environmental Science", 5th Edn, Wadsworth publishing House, & Meerut Odum.E.P.

2 Manahan, 1993, "Environmental chemistry", 4th Edn, Boca Raton, Lewis publisher & UK.

3 Khopker S.M, 2007, "Environmental Pollution, Monitoring and control", 2nd Edn, New Age International & New Delhi.

4 Baird C and Cann M, 2012, "Environmental chemistry", 5th Edn, W.H. Freeman publication & UK.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A2DB	NANO SCIENCE AND TECHNOLOGY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamentals and current state of the art of nanotechnology.
- The synthesis, characterization of nanostructured materials.
- The utilization of nanomaterials in diverse applications.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the basics in the field of nanotechnology and relationship between the size and properties for various materials	K2
CO2	Identify the major properties of nano objects such as nanotubes and nanoparticles	K3
CO3	Examine the synthesis of nanomaterials using chemical and physical routes.	K4
CO4	Explain the various characterization techniques for nanomaterials	K2
CO5	Evaluate the applications of nanostructured materials in different fields.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	L	M
CO2	S	S	M	M	S
CO3	M	M	L	S	M
CO4	M	M	S	L	M
CO5	M	M	L	S	M

S Strong M Medium L Low

192CE2A2DB	NANO SCIENCE AND TECHNOLOGY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Basics of Nanochemistry 10 h

Definition of terms - nanomaterials, nanoscience, nanotechnology - scale of materials natural and manmade – properties - classification of nanomaterials – origin, phase composition, constituents, dimensions - energy at bulk and nano scale - size effect of nanomaterials - size, shape, density, melting point, specific surface area, band gap variation - Quantum confinement.

Unit II Carbon Nanostructures 10 h

Introduction - carbon molecules – nature of the carbon bond – new carbon structures - carbon clusters, fullerene - C60. Carbon nanotubes – Synthesis, electrical properties –vibrational properties – mechanical properties - applications of carbon nanotubes –field emission and shielding – computers – fuel cells – chemical sensors – catalysis – mechanical reinforcement.

Unit III Synthesis of Nanomaterials 10 h

Chemical methods - Chemical precipitation, Co-precipitation, Sol-gel synthesis, solvothermal synthesis, Thermolysis routes, Microwave heating synthesis, Sonochemical synthesis, Electrochemical synthesis amd Photochemical synthesis. Physical methods - Inert gas condensation, Ion sputtering, Laser ablation, Laser pyrolysis, Ball Milling, Chemical vapour deposition and Electro deposition.

Unit IV Characterization Techniques 8 h

Structural characterization - Electron microscopy techniques - scanning electron microscopy, transmission electron microscopy - X-ray diffraction – FTIR- UV Visible spectrophotometer. Surface characterization - XPS, atomic force microscopy, STM. Characterization of porous structures.

Unit V Applications of Nanomaterials 10 h

Solar cells - smart materials - molecular electronics – biosensors - drug delivery and therapy - food packaging-detection of cancerous cells, nanoscale catalysts for energy and automobile industries - Nonmaterial for electrodes and wearable electronics-Nanobased coating and paints.

Text Books

1. Murty B.S, Shankar P, Baldev Raj, Rath B.B, James Murday, 2013, "Textbook of Nanoscience and Nanotechnology", I st Edn, Springer-Verlag Berlin Heidelberg, Universities Press India Private Limited..
2. Pradeep T, 2008, "Nano: The Essentials: Understanding Nanoscience and Nanotechnology", 1 st Edn, McGraw-Hill Professional Publishing, New York, USA.

References

1. Kelsall, R.W, Geoghegan W.H.M, 2005, "Nanoscale Science and Technology",2 Edn, John Wiley & Sons Lt, UK.
2. Dutta, J, Tibbals H.F, Hornyak G.L, 2008, "Introduction to Nanoscience", I st Edn, CRC press, Boca Raton.
3. Cao, G, 2004, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", 2 nd Edn, Imperial College Press, London.
4. Rao, C.N.R, Muller A, Cheetham A.K, 2006, "Chemistry of Nanomaterials: Synthesis, properties and applications", 1 st Edn, Royal Society of Chemistry, Cambridge, UK.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A2DC	BIO-ORGANIC CHEMISTRY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basics of amino acids, proteins, lipids and nucleic acids.
- The structure and biological functions of enzymes and cofactors.
- The concept of bioenergetics and the principles of retro-synthesis.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the properties and functions of amino acids and proteins.	K2
CO2	Summarize chemical nature and biological functions of enzymes and cofactors.	K2
CO3	Analyze the structure and properties of lipids and nucleic acids.	K4
CO4	Apply concept of energy in living organisms and relate free energy to the chemical equilibria and Laws of Thermodynamics.	K3
CO5	Examine the disconnection approach and asymmetric synthesis in Organic chemistry.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	L	M
CO2	M	M	S	L	M
CO3	S	S	S	S	S
CO4	S	S	S	M	S
CO5	S	S	S	S	S

S Strong M Medium L Low

192CE2A2DC	ELECTIVE-BIO-ORGANIC CHEMISTRY	SEMESTER **II**

Total Credits: 4
Total Instruction Hours: 48 h

Syllabus

Unit I Carbohydrates **8** h

Classification of carbohydrates. Occurence, structure, properties and uses - sucrose, lactose and starch. Carbohydrate metabolism: glycolysis,gluconeogenesis, glycogen metabolism (overview only, structures not required). Diabetes mellitus (elementary details).

Unit II Enzymes and Cofactors **10** h

Chemical nature of enzymes – characteristics of enzymes – colloidal nature, catalytic nature, specificity of enzyme action. Mechanism of enzymes – Michaelis-Menten hypothesis – Fischer's lock and key model. Structure and biological functions of coenzyme A, NAD and FAD.

Unit III Lipids 10 h

Lipids – definition – simple lipids – fats and oils – compound lipids – phospholipids - phosphoglyceride, glycolipids - gangliosides – physical properties – solubility, melting point, surface tension, emulsification and geometric isomerism – chemical properties – reaction involving -COOH group, -OH group and double bonds.

Unit IV Bioenergetics 10 h

Concept of energy – thermodynamic principles – first law, second law, combining the two laws – relationship between standard free energy change and equilibrium constant.

Standard free energy values of chemical reactions – Adenosine triphosphate (ATP) hydrolysis and equilibria of coupled reactions – inter conversion of adenine nucleotides.

Unit V Biosynthesis of Natural Products 10 h

Biosynthesis of Terpenoids: Mevalonic acid pathway, biosynthesis of Menthol, Camphor and Caryophyllene-Biosynthesis of cholesterol.

Text Books

1. Jain, J. L (2016). Fundamentals of Biochemistry. (7 Edn.) New Delhi: S. Chand and Co.
2. Finar, I. L. (2002). Organic Chemistry: Vol.II. (5 Edn.) India: Pearson Education.

References

1. Price, N.C. (1999). Fundamental of Enzymology. (1 Edn.) UK: Oxford University Press.
2. Carey, F.A. (2008). Advanced Organic Chemistry: Part-A and Part-B.. (5 Edn.) Germany: Springer.
3. Kagan, H. B. (2009). Asymmetric Synthesis. (1 Edn.) Germany. Thieme Medical Publishers.
4. Harish. K. (2013). Bio-Organic Chemistry. (1 Edn.) United Kingdom : Alpha Science International Limited..

Course Code	Course Category	CourseName	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
192CE2A3CA	Core -VIII	Chemistry of Natural Products	4	1	-	3	25	75	100	4
202CE2A3CB	Core -IX	Solid state, Nuclear and Main group Chemistry	4	1	-	3	25	75	100	4
202CE2A3CC	Core -X	Quantum Chemistry and Group theory	4	1	-	3	25	75	100	4
202CE2A3CD	Core -XI	Applications of Spectroscopy & Photochemistry	4	1	-	3	25	75	100	4
202CE2A3CP	Core Practical-III	Physical Chemistry	-	-	6	6	40	60	100	3
192CE2A3DA	DSE -III	Industrial Chemistry	4	-	-	3	25	75	100	4
192CE2A3DB		Inorganic Rings, Cages and Clusters								
192CE2A3DC		Organic Reactions and Reagents								
202CE2A3CT	IT	Industrial Training	Grade A to C							
Total			20	4	6	-	-	-	600	23

Course Code	Course Name	Category	L	T	P	Credit
192CE2A3CA	CHEMISTRY OF NATURAL PRODUCTS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic principles involved in synthesis of various terpenoids, steroids and alkaloids
- About importance of Proteins and nucleic acids
- The synthesis and reactions of heterocyclic Compounds

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Classify the isolation and synthesis of terpenoids	K4
CO2	Interpret the various methods involved in the structure determination of steroids	K5
CO3	Analyze the various pathways to synthesize the alkaloids.	K4
CO4	Examine the basic principles and applications involved in the proteins and nucleic acids.	K4
CO5	Distinguish the reaction and their synthesis in heterocyclic chemistry.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	S	S	S
CO3	S	S	M	S	S
CO4	S	S	M	S	S
CO5	S	S	M	S	S

S Strong M Medium L Low

192CE2A3CA	CHEMISTRY OF NATURAL PRODUCTS	SEMESTER III

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Terpenoids 12 h

Isolation and classification of terpenoids — structural eIucidation and synthesis of zingiberene, eudesmol, juvenile hormone, abeitic acid and caryophyllene

Unit II Steroids 12 h

Introduction-structural elucidation of cholesterol (synthesis not required), ergosterol, equilenin, estrone, testosterone and progesterone

Unit III Alkaloids 12 h

Introduction – isolation of alkaloids, structural elucidation and synthesis of morphine, reserpine, Quinine, atropine and glaucine

Unit IV Proteins and nucleic acids 12 h

Proteins: – classification and properties (denaturation, isoelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins – synthesis of peptides and polypeptides- N-terminal and C- terminal residue analysis - oxytocin - enzymes and coenzymes - biosynthesis of protein. Test for proteins.

Nucleic acids - structure and synthesis of nucleosides and nuclotides - genetic code-structure of RNA and DNA and their biological importance.

Unit V Heterocyclic compounds 12 h

Heterocyclic compounds: Structure, synthesis and reactions of flavones, isoflavones, purines (adenine and guanine), anthocyanins (cyanin and pelargonin) and uric acid. Synthesis and reactivity of following heterocycles: oxazoles, imidazoles, thiazoles, isooxazoles, aziridines, oxiranes, azetidines, oxetanes, pyrazines and pyridazines.

Text Books

1. Finar. I.L, 2009, "Organic Chemistry", 7th Edition, Pearson education Ltd & NewDelhi.
2. Bhat. S.V, Nagasampagi. B.A and Sivakumar. M, 2005, "Chemistry of Natural Products", 2nd Edition, Springer Science & Business Media & Germany.
3. Gurdeep Chatwal, 2019, "Organic Chemistry of Natural Products. Vol II", 5th Edition, Himalaya Publishing House & New Delhi.

References

1. Michael B Smith, 2015, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th Edition, Wiley and Sons Inc & USA.
2. Stanforth. S.P, 2006, "Natural Product Chemistry at a Glance", 1st Edition, Wiley-Blackwell, USA.
3. Nicolaou. K.C and Sorensen. E.J. 1996. Classics in Total Synthesis, Targets, Strategies. 1st Edition, Wiley VCH & Germany.
4. Li. J.J and Corey. E.J, 2012, "Total Synthesis of Natural Products: At the Frontiers of Organic Chemistry", 1st Edition, Springer & Germany.

Course Code	Course Name	Category	L	T	P	Credit
202CE2A3CB	SOLID STATE, NUCLEAR AND MAIN GROUP CHEMISTRY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basics in solid state chemistry.
- The basics of nuclear chemistry, types of nuclear reactions and its applications
- The general characteristics of f-block elements

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Relate the basics of solid state chemistry.	K2
CO2	Examine crystal structure and defects in crystals.	K4
CO3	Inference the basic concepts of nuclear chemistry and types of nuclear reaction.	K4
CO4	Identify the applications of nuclear chemistry in various fields.	K3
CO5	Analyze the general characteristics of f- block elements and the electronic and magnetic properties	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	L	M	S
CO3	M	M	M	S	M
CO4	M	M	L	L	M
CO5	S	S	M	S	S

S Strong M Medium L Low

202CE2A3CB	SOLID STATE,NUCLEAR AND MAIN GROUP CHEMISTRY	SEMESTER III

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Solid State Chemistry I 12 h

Cells and description of crystal structure - Close packing of spheres - Packing efficiency - Hexagonal close packed (HCP) and cubic close packed structures (CCP) - Coordination number - Relative density of packing in simple cubic, CCP, HCP and BCC - Tetrahedral and octahedral holes - Limiting radius ratio rule. Radius ratio for trigonal, tetrahedral, octahedral and cubic sites.

Unit II Solid State Chemistry II 12 h

Perovskite structure of spinels - Stoichiometric defects - Schottky and Frenkel defects - Non-stoichiometric defects - Metal excess and metal deficiency defects - Extended defects - Line and plane defects. Band theory - Semiconductors - Intrinsic and extrinsic type - Fermi level- Flow of current in semiconductors - Hopping mechanism - Band structure - p and n type semiconductors - p-n junction - Superconductivity - 1,2,3-superconductor - Photovoltaic effect.

Unit III Nuclear Chemistry - I 12 h

Nucleus: nuclear structure - stability of nuclei - packing fraction - even - odd nature of nucleons - n/p ratio - nuclear potential - binding energy and exchange forces - shell model and liquid drop model. Decay of radio nuclei: rate of decay - determination of half-life period.

Modes of decay: alpha, beta, gamma and orbital electron capture - nuclear isomerism- internal conversions - Q value - nuclear cross section - threshold energy and excitationfunctions. Particle acceleration and counting techniques: linear accelerator - cyclotron and synchrotron - betatron .

Unit IV Nuclear Chemistry - II 12 h

Applications of radioisotopes – Esterification – Friedal Craft's reaction – Structural determination of PCl5 - Solubility of sparingly soluble substance – Isotope dilution analysis – Carbon dating – Thyroiditis - Assessing the volume of blood in a patient - Brain tumor location and bone fracture healing Control of predatory insects.

Unit V Lanthanides 12 h

General characteristics of lanthanides-Electronic configuration-Oxidation state Lanthanide contraction-Lanthanide contraction and its consequences-Term symbols for Lanthanide ions (Derivation not required)-Factors that mitigate against the formation of lanthanide complexes-Electronic spectra and magnetic properties of lanthanide complexes. Lanthanide complexes as shift reagents - difference between 4f and 5f orbitals.

Text Books

1. Puri B. R, Sharma L. R. and Madan Pathania S. 2006, "Principles of Inorganic Chemistry", 41st edition. Vishal Publishing Co. & New Delhi.
2. Gurdeep Raj. 2014, "Advanced Inorganic Chemistry", 12th Edition, Geol Publishing House. & India.
3. Arnikar, H.J. 2000, "Essentials of Nuclear Chemistry", 4th Edition, New Age International, New Delhi.

References

1. Chakrabarthy D.K. 2005, "Solid State Chemistry", 2nd edition, New Age International Publishers & New Delhi.
2. Arnikar H.J. 2001, "Essential of Nuclear Chemistry", 2nd edition, Wiley-Eastern Ltd. & NewDelhi.
3. Freindlander G., Kennedy J. W., Macias E.S., and Miller J. M., John 1991, "Nuclear and Radiochemistry", Wiley and Sons & US.
4. Huheey J.E., Keither E.A. and Keiter R.L., 1993, "Inorganic Chemistry", 4th edition, Harper Collins College Publisher & US.

Course Code	Course Name	Category	L	T	P	Credit
202CE2A3CC	QUANTUM CHEMISTRY AND GROUP THEORY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic concepts and applications of quantum chemistry.
- The operators and Eigen functions and formulate the approximation methods to construct molecular orbitals.
- The point groups of molecules and apply the concepts of group theory to predict the spectroscopic properties

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Make use of basic concepts and categorize the operators and Eigen functions	K3
CO2	Explain the concepts involved in the basics and theories of quantum chemical approach	K2
CO3	Analyze the approximation methods to construct molecular orbitals	K4
CO4	Summarize the basic concepts of group theory.	K2
CO5	Identify the point groups of molecules and construct the character table for point groups	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	M	S	M	L	M
CO3	S	S	S	S	S
CO4	M	M	M	L	M
CO5	S	S	S	M	S

S Strong M Medium L Low

202CE2A3CC	QUANTUM CHEMISTRY AND GROUP THEORY	SEMESTER III

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Quantum Chemistry I 12 h

Failure of Classical Mechanics and the success of quantum theory in explaining black body radiation – Photoelectric effect and the H- atom spectrum – Debroglie's equation – Heisenberg's uncertainty principle – Schrödinger equation (Time dependent and Time independent) – Bohr's interpretation of the wave function- Requirements of acceptable wave function - Postulates of Quantum mechanics.

Operators – Sums and Products of operators - commutator – linear and non-linear operators - Hermitian and Hamiltonian, Eigen functions and Eigen values - Orthogonal and Normalization theorem.

Unit II Quantum Chemistry II 12 h

Schrodinger wave equation - particle in a one dimensional box - particle in three dimensional box – principles of separation of variables.

Harmonic oscillator model of a diatomic molecule - finding asymptotic solution of Schrodinger equation for a one dimensional harmonic oscillator. Rigid rotator model of a diatomic molecule-solving the **Φ** equation of Schrodinger equation of the rigid rotator. H-atom (H like species) (solving radial and θ equations not necessary). Shapes of orbitals

Unit III Quantum Chemistry - III 12 h

Electron spin - He-atom - Pauli exclusion principle - anti symmetric wave functions. Approximate wave functions for many electron atoms. Need for approximation methods-perturbation (first order only) and variation methods, applications of perturbation method to He atom, application of variation method to He atom. Born Oppenheimer approximation - Hamiltonian operator for a hydrogen molecule using Born-Oppenheimer approximation.

Unit IV Group Theory I 12 h

Symmetry elements and symmetry operations. Inverse operations. Definition of a group-properties of a group, definition of abelian group, cyclic group, finite group, infinite group, sub-group and isomorphic group-group multiplication tables. Symmetry classification of molecules into point groups (Schoenflies symbols only). Matrices: Definition of matrix, diagonal matrix, null matrix, unit matrix, row matrix, column matrix, symmetric matrix, skew matrix and conjugate matrix. Matrix multiplication. Determination of inverse matrix. Block multiplication of matrices. Matrix notations of symmetry operations of C2v and C3v point groups.

Unit V Group Theory II 12 h

Definition of reducible and irreducible representations – Irreducible representation as orthogonal vectors – Direct product rule – The Great Orthogonality Theorem and its consequences (statement only, proof not needed) - Construction of character table of C2v and C3v point groups - Calculation of binary co-ordinates in the character tables for C2v and C3v point groups – Calculation of character values of reducible representations per unshifted atom for each type of symmetry operation

– Determination of total cartesian representation – Determination of direct sum from total cartesian representation. Type of hybridization of atomic orbitals in acetylene, CH4 and [PtCl4]2-.

Group theory and Vibrational spectroscopy – Vibrational modes as basis for group representation – Symmetry selection rules for IR and Raman spectra (Mutual Exclusion Principle – Classification of vibrational modes).

1 Chandra, A.K (2017), "Introductory Quantum Chemistry", 4th Edition : McGraw Hill Education..

2 Veera Reddy, K. 2009, " Symmetry and Spectroscopy of Molecules", 2ndEdition, Newage publishers.

References

1 Levine, 2016, "Quantum Chemistry", 7th Edition, Pearson Education India.

2 Mcquarrie, D.A., 2016, "Quantum Chemistry", Viva Students Edition, Viva Books.

3 Prasad, R.K., 2010, "Quantum Chemistry", 4th Edition, NEW AGE.

4 Cotton, F.A., 2008, "Chemical Applications of Group Theory", 3 rd Edition, Wiley..

Course Code	Course Name	Category	L	T	P	Credit
202CE2A3CD	APPLICATIONS OF SPECTROSCOPY AND PHOTOCHEMISTRY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The spectroscopic techniques and its application to the structure determination.
- Solve the problems related to spectroscopic techniques.
- The applications of spectroscopy in interpreting the unknown compounds and basics of photochemistry.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Infer the fundamentals of Inorganic Photochemistry.	K2
CO2	Make use of the basic principle of Mass spectroscopy and to apply the concept in finding out the known and unknown organic compounds.	K3
CO3	Apply the concepts of IR spectroscopy and Raman to in elucidating the structure of compounds.	K3
CO4	Make use of NMR spectroscopic basic knowledge and to examine the structure of compounds using 1D and 2D NMR techniques.	K4
CO5	Analyze and evaluate the conjoint knowledge of the spectroscopic techniques in solving the structure of unknown compounds.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	M	S	S	S	S
CO3	S	S	M	S	S
CO4	S	S	M	M	M
CO5	S	S	M	M	S

S Strong M Medium L Low

202CE2A3CD	APPLICATIONS OF SPECTROSCOPY AND PHOTOCHEMISTRY	SEMESTER III

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Inorganic Photochemistry 12 h

Elementary ideas on the photosystems I and II - Photochemistry of Cr(III), Co(III), Ru(II), Pt(II) and Pt(IV) complexes – photoaquation – photoanation – photoisomerisation – photo emission and redox properties – charge transfer photochemistry – photosensitisation – solar energy conversion – photogalvanic cell – water splitting - photophysics and photochemistry of ruthenium - polypyridine complexes.

Unit II Mass Spectroscopy 12 h

Mass Spectrometry – instrumentation – resolution – ESI, EI, CI, MALDI and FAB method, presentation of spectral data, molecular ions, meta stable ions, molecualr ion peak, Nitroge rule, isotopic abundance analysis. Fragmentation process, symbolism (scission only), even and odd electron ions, scission with rearaangement. Retro Diels Alder rearrangement, Mc Lafferty rearrangement, double bond and /or ring equivalents implied from a formula. Fragementation associated with functional groups - aliphatic compounds, aldehydes, ketones, carboxylic acids, esters, amides, alcohols, thiols, amines, ethers, sulphides and halides, aromatic compounds, elimination due to ortho groups.

Unit III IR and Raman Spectroscopy 12 h

Application of IR in Organic chemistry- characteristic group frequencies – Finger print region. Combined application of IR and Raman spectra for structural elucidation of N_2O, ClF_3, ClO_4– and NO^{3-}; Sampling techniques- group theoretical approach to find the IR and Raman active vibrations of simple compounds – Effect of coordination upon ligand vibrations of H_2O, CNS–, NO3–, CN–& SO42–.

Unit IV Applications of NMR Spectroscopy 12 h

Application NMR spectroscopy in the structural analysis of organic compounds – Uses of parameters like chemical shifts (both proton and carbon) and coupling constant – Uses of DEPT, J-resolved, H,H-COSY, C,H-COSY, HMBC and NOESY spectra; lanthanide shift reagents in NMR, Solving structural problems using NMR

Application of NMR in the structural elucidation of inorganic compounds – 31P NMR spectra of P4S3, H3PO3, and HPF2; 19F NMR spectra of ClF3, BrF5 and equimolar mixture of TiF62– and TiF4 in ethanol – Fluxional behavior of molecules 10B and 11B resonance studies.

Unit V Spectroscopic Problems 12 h

Wood ward's rule for calculating absorption maximum in conjugated dienes, polyenes, α, ß - unsaturated carbonyl compounds, benzenoid systems.

Conjoint spectroscopic problems: Structure determination of organic compounds by using UV-Vis, IR, 1H & 13C-NMR and Mass spectroscopic techniques (simple molecules only – restricted to 12 carbon systems with/ without one hetero system).

Text Books

1. Pavia. D.L, 2011, "Spectroscopy", 5th Edition, Brooks/Cole Publications & UK.
2. Yadav. M.S, 2011, "Molecular Spectroscopy", 1st Edition, Arise Publishers and Distributors & New Delhi.
3. Ramamurthy. V and Schanze. K.S, 1998, "Organic and Inorganic Photochemistry"', 1st Edition, Taylor & Francis Inc & UK.

References

1. Kalsi. P.S, 2014, "Spectroscopy of organic compounds", 6th Edition. New Age International (P) Ltd & New Delhi.
2. Silverstein. R.M, 2009, "Spectrometric Identification of Organic compounds", 6th Edition, John Wiley Publications & Germany.
3. William Kemp, 2008, "Organic Spectroscopy", 3rd Edition, Palgrave Publications & USA.
4. Drago. R.S, 1978, "Physical methods in Inorganic Chemistry", 1st Edition, East west Pvt.Ltd & New Delhi.

202CE2A3CP	CORE PRACTICAL: PHYSICAL CHEMISTRY	SEMESTER III

Total Credits: 3
Total Instructions Hours: 72h

S.No	List of Experiments
1	Determination of molecular weight by Rast Micro Method
2	Chemical kinetics – First order reaction i) Determination of rate constant of acid catalyzed hydrolysis of ester. ii) Determination of temperature coefficient and Arrhenius parameter.
3	Phase Rule studies i) Two component systems – Simple Eutectic formation. ii) Determination of CST of Phenol – water system.
4	Conductometric titrations: Acid – base Titration – Determination of the strength of strong acid, weak acid.
5	Conductometric titrations: Precipitation titration – Determination of the strength of KCl, KI and KCl and KI in the mixture.
6	Potentiometric titration: Titration of HCl Vs NaOH
7	Potentiometric titration: Titration of Mixture of acids Vs strong base.
8	Potentiometric titration: Titration of CH3COOH Vs NaOH
9	Potentiometric Titration: Redox titration - Titration of Ferrous ammonium sulphate against Potassium dichromate
10	Potentiometric Titration: Precipitation titration - Titration of mixture of halides against AgNO3 solution
11	Verification of Ostwald's dilution law and determination of molar conductance at infinite dilution of weak electrolyte using Kohlraush's law.
12	Surface Chemistry: Verification of Freundlich and Langmuir adsorption Isotherm of oxalic acid on activated charcoal

Note: Any ten experiments out of the above experiments (to be decided by course Teacher)

References

1. Peter Mathews. G, 1985, "Experimental Physical Chemistry", 1st Edition, Oxford Science Publications & UK.
2. Findlay, A.J & Kitchener,1973, " Practical Physical Chemistry", Longmann Publication
3. Khosala. D.D, Khosala. A and Gard. V.C, 1975, "Senior Practical Physical Chemistry", 1st Edition, R. Chand & Co & New Delhi.
4. Viswanathan. B and Raghavan. P.S, 2008, "Practical Physical Chemistry", 2nd Edition, Viva Books Pvt. Ltd & New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A3DA	INDUSTRIAL CHEMISTRY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamentals and current state of the art of industrial processes
- The synthesis of various industrial products.
- Utilization of the materials for diverse applications.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the basics in the field of water treatment technology.	K2
CO2	Identify the various petroleum products, hydrocarbons and their preparation methods.	K3
CO3	Examine the properties and synthesis routes of oils, fats and Soaps.	K4
CO4	Explain the different inorganic materials and their classification and properties.	K2
CO5	Evaluate the catalytic processes and applications in various organic reactions.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	L	L	M
CO2	S	S	M	M	S
CO3	S	S	S	S	S
CO4	M	M	L	M	M
CO5	S	S	S	S	S

S Strong M Medium L Low

192CE2A3DA	INDUSTRIAL CHEMISTRY	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Industrial Wastes And Treatment Processes 10 h

Introduction - characteristics of industrial wastes - basics idea about unit operation – flow chart – chemical conversion – batch versus continuous processing – chemical process selection – design – chemical process control. Principles of industrial waste treatment - protection of surface waters from pollution with industrial sewage. Types of industrial wastes - treatment of effluents with organic and inorganic impurities - treatment of waste waters from specific industries - textile industry – pulp and paper industry – electroplating industry – leather tanning industry – fertilizer industry – food processing-water hyacinth in the treatment of industrial effluents.

Unit II Petroleum And Petrochemicals 10 h

Introduction - raw materials - saturated hydrocarbons from natural gas - uses of saturated hydrocarbons - unsatutated hydrocarbons acetylene, ethylene, propylene, butylenes. Aromatic hydrocarbons – benzene, toluene, xylenes.

Chemical processing of paraffin hydrocarbons - acetylene and aromatic hydrocarbon.

Preparation of rectified spirit from beat – methylated spirit – preparation of absolute alcohol from rectified spirit – petrochemicals in India.

Unit III Oils, Fats And Soaps 10 h

Introduction - distinction between oils and fats - properties and its classifications - animal fats and oils - difference between, animal, vegetable and mineral oils - isolation of essential oils and their uses - saponification value - ester value - acid value - iodine value - wijs method - Reichert meissl value - Henher value - elaiden test - hydrogenation of oils.

Soap - types of soaps – hard and soft soaps – manufacture of soap (hot and continuous process only) – cleansing action of soap –detergents – surface active agents – biodegradability of surfactants, amphoteric detergents.

Unit IV Inorganic Engineering Material 10 h

Abrasives – properties – classification. Refractories –classification - properties – manufacture – common refractory bricks – silica – fireclay – high alumina – magnesite – carbon – chromite – carborundom – zirconia. Cement - classification – manufacture of Portland cement – chemical composition – constitution – setting and hardening – heat of hydration – special cements – Glasses – properties - manufacture – types – ceramics – clay – plasticity – whitewares – glazing – earthenwares and stonewares.

Unit V Catalytic Processes 8 h

Introduction - catalytic cracking - Houdry process - principle reactions of catalytic cracking - advantages of catalytic cracking over thermal cracking. Catalysts used in catalytic cracking - catalytic reforming - basic reactions. Catalytic hydrogenation - principal reactions - catalysts for catalytic hydrogenation. Hydrofining of petroleum distillates - catalysts for hydrofining. Hydrogen cracking.

Text Books

1. Sharma. B.K, 2003, "Industrial Chemistry", Reprint, Goel Publishing House & Meerut.
2. Jain & Jain, 2017, "Engineering Chemistry", 16th Edition, Dhanpatrai Publications & New Delhi.
3. Gopalan. R, Venkappayya. D, Nagarajan. S, 2000, "Textbook of Engineering Chemistry", 4th Edition, Vikas Publishing House Pvt. Ltd & New Delhi.

References

1. Uppal. M.M, 2001, "Textbook of Engineering Chemistry", 6th Edition, Khanna Publishers & New Delhi.
2. White. H.L, 1986, "Introduction to Industrial Chemistry", 1st Edition, A Wiley Interscience Publication & USA.
3. Pawar. R.A, Gugale. G.S, Nagawade. A.V, Gadave. K.M, 2017, "A Book of Industrial Chemistry",1st Edition, Nirali Prakashan Publishers & Pune.
4. Alan Heaton, 1996, "An Introduction to Industrial chemistry", 3rd Edition, Chapman & Hall Publishers & UK.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A3DB	INORGANIC RINGS, CAGES AND CLUSTERS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fields of inorganic structures like rings, cages and clusters in designing of new molecules.
- Importance of bonding theories in different group of elements.
- Nature of isolable analogy in p-block and d-block elements.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Identify the structure of main group clusters.	K3
CO2	Outline the structure, synthesis and reactivity of metal carbonyl clusters.	K2
CO3	Analyze the different forms of metal clusters based on isolable analogy.	K4
CO4	Categorize the structure, synthesis and reactivity of homo and hetero cycles.	K4
CO5	Examine the different polymeric structures of elements and catalysis.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	M	S	S	S	S
CO3	S	S	M	S	S
CO4	S	S	M	M	M
CO5	S	S	M	M	S

S Strong M Medium L Low

192CE2A3DB	INORGANIC RINGS, CAGES AND CLUSTERS	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Main group clusters 10 h

Geometric and electronic structure, three - four and higher connect clusters, the closo-, nido-, arachno- borane structural paradigm, Wade-Mingos and Jemmis electron counting rules, clusters with nuclearity 4-12 and beyond 12.

Unit II Transition metal clusters 10 h

Low nuclearity metal carbonyl clusters and 14n+2 rule, high nuclearity metal carbonyl clusters with internal atoms, structure, synthesis and reactivity- capping rules.

Unit III Isolobal analogy 10 h

Heteronuclear clusters-carboranes and heteroboranes - metal clusters - structural prediction of organometallic clusters-main group transition metal clusters: Isolobal analogs of p-block and d-block clusters-interstitial systems-cubanes and zintl clusters.

Unit IV Inorganic homo & heterocycles 10 h

Synthesis, structure and reactivity- structural variety& properties of borazines and phosphazenes, borides, carbides, silicides, nitrides, phosphides, oxides and sulphides of transition elements, multiple bonds and cluster variety of transition metals.

Unit V Inorganic rings and polymers 8 h

Definition, variety and merits, P, Si, S, N, & O based polymers,poly-phosphazenes, poly-thiazenes, poly-siloxanes and poly-silanes. Molecular clusters in catalysis, clusters to materials, boron-carbides and metal-borides.

Text Books

1. Mingos. D.M.P and Wales. D.J, 1990, "Introduction to Cluster Chemistry", 1st Edition, Prentice Hall & USA.
2. Greenwoo. N.N and Earnshaw. E.A, 1997, "Chemistry of Elements, 2nd Edition, Pergaman Press & UK.
3. Haiduc. I and Sowerby. D.B, 1987, "Inorganic Homo-and Heterocycles Vols. 1 & 2", Academic Press & UK.

References

1. Mark. J.E, West. R and Allcock. H.R, 2005, "Inorganic Polymers", 2nd Edition, Academic Press & UK.
2. Fehlner. T.P, Halet. J.F and Saillard. J.Y, 2007, "Molecular Clusters: A Bridge to Solid-State Chemistry", 1st Edition, Cambridge University Press & UK.
3. Braunstein. P, Oro. L.A and Raithby. P.R, 1999, "Metal Clusters in Chemistry", 1st Edition, John Wiley and sons & USA.
4. Gonzalez. M and Guillermo, 1993, "Cluster Chemistry", 1st Edition, Springer Verlag GmbH & Germany.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A3DC	ORGANIC REACTIONS AND REAGENTS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic principle and applications of oxidative and reductive reagents involved in organic synthesis.
- About mechanism and applications of various important organic name reactions.
- The Reaction and Reagents involved in functional group transformations.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the mechanism and applications of various oxidation reagents.	K2
CO2	Interpret the mechanism and applications of reducing reagents involved in organic synthesis.	K2
CO3	Analyze the various metal mediated and multicomponent name reactions and their applications.	K4
CO4	Examine the basic principles and applications involved in name reaction on substitution.	K4
CO5	Analyze the reaction and reagents functional group transformations.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	M	M
CO2	M	M	S	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	M
CO5	S	S	S	S	S

S Strong M Medium L Low

192CE2A3DC	ORGANIC REACTIONS AND REAGENTS	SEMESTER III

Total Credits: 4
Total Instruction Hours: 48 h

Syllabus

Unit I Reagents in Oxidation Reactions 10 h

Jacobsen epoxidation, Shi epoxidation, Jones reagent, PCC, PDC, IBX, DMP, CAN, TPAP, NOCl, $Mn(OAc)_3$, $Cu(OAC)_2$, Bi_2O_3, Swern oxidation, Sommelet reaction, Elbs reaction, Oxidative coupling of phenols, Prevost reaction and Woodward modification. Applications of CrO_3, $K_2Cr_2O_7$, $KMnO_4$, OsO_4, SeO_2, $Pb(OAc)_4$, HIO_4, oxygen (singlet & triplet), ozone, peroxides and peracids as oxidizing agents.

Unit II Reagents in Reduction Reactions 10 h

Palladium / platinum / nickel based heterogeneous catalysts for hydrogenation, Wilkinson's catalyst, Noyori asymmetric hydrogenation – reductions using Li/Na/Ca in liquid ammonia. Hydride transfer reagents from group III and group IV in reductions. (i) triacetoxyborohydride, L-selectride, K-selectride, Luche reduction, Red-Al, $NaBH_4$ and $NaCNBH_3$, trialkylsilanes, tri-n-butyltin hydride and trialkylstannane, (ii) stereo/enantioselectivity reductions (Chiral Boranes, Corey-Bakshi-Shibata).

Unit III Name reactions and their Applications-I 10 h

Mukaiyama esterification, Baylis Hillman reaction, Suzuki coupling, Wacker process, Heck reaction, Sonogashira reaction and Stille Coupling. Multicomponent reactions: Strecker synthesis, Hantszch pyridine synthesis, Biginelli synthesis, Multicomponent reactions using alkyl isocyanides: Passerini and Ugi-4-component synthesis. Domino/cascade reactions: Introduction with one example.

Unit IV Name reactions and their Applications-II 10 h

Robinson Annulation, Ene reaction, Hofmann-Loffler Freytag reaction. Name reactions on Substitution and Substituents- Eschweiler Clark reaction, Polonowski reaction, Reissert reaction, Sommlett reactions, Mitsunobu reaction, Leukart reaction, Bucherer reaction, Willegerodt reaction and Willegerodt-Kindler reaction.

Unit V Functional Group Transformations 8 h

Use of the following in organic synthesis and functional group transformations. LDA ,DCC, DDQ, TMS-iodide, TMS-cyanide, TBDMS Chloride, 1,3-Dithiane (reactivity and umpolung), Merrifield resin, Baker's yeast, Prevost hydroxylation and Peterson reaction.

Text Books

1. Sanyal. S.N, 2019, "Reactions, Rearrangements and reagents" 4th Edition, Bharati Bhawan Publishers & Bengaluru .
2. Fieser. L.S, Fieser. M and Tse-Lok Ho, 2006, "Fieser and Fieser's Reagents for Organic Synthesis", 1st Edition, Wiley-Balckwell & USA.
3. Chatwal. G.R, 2015. "Reaction Mechanism and Reagents in Organic Chemistry", Himalaya Publisher House& Delhi.

References

1. Mundy. B.P, Eller. M.G, and Favarolo. F.G, 2015," Name Reactions and Reagents in Organic Synthesis", 2nd Edition. Wiley-Blackwell& USA.
2. Clayden. J, Greeves. N and Warren. S, 2014, "Organic Chemistry". 2nd Edition, Oxford University Press& UK.
3. Norman. R.O.C,2017,"Principles of organic Synthesis",2nd Edition. Taylor and Francis. Excl. Indian reprint..
4. Ahluwalia. V.H and Parashar. R.K," Organic Reactions and Mechanisms", 4th Edition, Narosa Publishing House& New Delhi.

202CE2ASSA	SELF STUDY: RESEARCH METHODOLOGY	SEMESTER III

Total Credit: 1

Syllabus

Unit I Research Concepts & Literature Survey

Importance of research in Science - Criteria of good research - Qualities of a good researcher - Sources of a research problem - Types of research - Sources of information – Primary, Secondary, Tertiary sources – Journals – Journal abbreviations – Current titles - Abstracts – Reviews – Acquisition of information - Web resources - E-journals - Journal access - building up of own literature collection - Hot articles - Citation index - Impact factor - H-index - I10 index - UGC infonet- Search engines - Google Scholar – Chem Industry – Databases – ChemSpider - Science Direct – Sci Finder - web of science - SCI - Scopus.

Unit II Scientific Writing and Computer aided packages

Components of a good research report - tabulation and computation of data- illustration of graphical data - compilation of results – characterization of research

- presentation - synopsis preparation and thesis writing - writing scientific papers – justification for scientific contributions – bibliography – description of methods – conclusions -the need for illustration – style - publications of scientific work - writing ethics - avoiding plagiarism.

Computer packages - data presentations using formulas and functions – generating graphs/charts - Applications and uses of common softwares in chemistry, MS-Excel – SPSS – Origin –Chemsketch, Chemdraw. Basic ideas on the use of Internet in Chemistry education.

Unit III X-ray Crystallography

Diffraction of X-rays by crystal lattice – Laue's formulation of X-ray diffraction – Diffraction methods – Laue Diffraction – rotating crystal method – Oscillation method – powder method – X-ray diffractometer – Data collection.

Unit IV Structure Determination and Thin Film Technology:

Scattering factor – Structure factor – phase problem – structure determination – structure refinement – structure analysis.

Thermal evaporation-General consideration-Evaporation methods- Chemical methods-Electro deposition-Chemical vapour deposition-Miscellaneous methods.

Unit V Sputtering

Cathodic sputtering-Sputtering process-Glow discharge methods-sputtering variants-Low pressure sputtering –Reactive sputtering-sputtering of multi component materials –Vacuum-Deposition apparatus-Vacuum systems-Substrate deposition Technology-Thickness measurement-Microbalance monitors-Optical Interference methods-Analytical methods-Chemical methods-Structural Analysis-Surface Structure –Volume Structure Growth process-General Description-Liquid like Coalescence.

Text Books

1 D.Velmurugan, 2008, "Elementary Crystallography",1stEdition, MJP publishers & New Delhi.

2 Kasturi L. Choprah, 1969, "Thin Film Phenomena" , 2nd Edition, McGraw Hill Company & UK.

3 Kothari. C.R, 2004, “Research Methodology Methods and Techniques”, 3rd Edition, New age international publishers & New Delhi.

References

1 GH. Stout and LH. Jensen, 1989, "X-ray structure determination", A practical guide, 2nd Edition wiley publications & UK.

2 Drago. R.S, 1978, "Physical methods in Inorganic Chemistry", 1st Edition, East west Pvt. Ltd & New Delhi.

192CE2ASSB	SELF STUDY: ENERGY, DIARY AND DRUG CHEMISTRY	SEMESTER III

Total Credit: 1

Syllabus

Unit I Pollution-Environmental Issue

The air we breathe-composition of air burning of hydrocarbons- air quality-ozone-oxygen/ozone screen-biological effect of UV radiation-ozone formation and distribution in the atmosphere-paths of ozone destruction chlorofluorocarbons and their interactions with ozone.

Chemistry of global warming-green house effect-earth's energy balance-vibrating molecules and the green house effect-molecular response to radiation-methane and other green house gases-climate modeling-Neutralizing the threat of acid rain

Unit II New Energy Sources For The New Century

Renewable energy sources- Introduction to Solar energy-Waste Bio-Mass energy-Sea wave energy-Tidal energy-Ocean thermal conversion energy-Geothermal energy-Wind energy-Nuclear fusion energy.

Solar Energy-Fuel from sunlight-splitting of water-hydrogen from sunlight-hydrogen economy-fuel cells-batteries-photovolataics-stealing the sun.

Nuclear energy- nuclear fission and fusion-production of electricity by nuclear reactor-radioactivity and the hazards of radioactivity-living with nuclear power.

Unit III Drugs Chemistry

Antibacterial Drugs-Sulpha drugs, (ii) Antibiotics-Sulphanilides- Properties of Sulphanilamides, Mechanism of Action of Sulpha drugs, Sulphanilamide, Sulphadiazine, Cibazole, Sulphafurazole, Prontosil; Antibiotics; Classification of Antibiotics; Chloramphenical; Penicillin; Streptomycin; Tetracycline; Macrolides.

Anticonvulsant Agents-Barbiturates-Synthetic uses; Mydantoin; Oxazolinediones; Acetyl Urea derivatives; Succinimides; Miscellaneous.

Unit IV Dairy Chemistry

Milk and Milk products-Composition of Milk; Flavour and aroma of Milk; Physical properties of Milk; Effect of heat on Milk; pasteurization; Homogenisation; milk products; Cream; butter; ice cream; milk powder.

Unit V Agricultural Chemistry

Fertilizers- Classification of Fertilizers; Important example for Fertilizers; Nitrogeneous fertilizers, Phosphate fertilizers, Potash fertilizers; Effects of fertilizers.

Manures, compost and saw dust- Farm yard Manure; Compost; Reinforcing Manure; Green Manure Crops; Saw dust; Night soil, sewage and sludge; Bio gas production and Manure.

Text Books

1 Conard. L. S, Luey. P. E, Catherine. H, Middle. C and Wilmer J. S, 2000""Chemistry in Context: Applying Chemistry to Society" third edition, Mc GrawHill & New Delhi.

2 Prabhakar. V. K, 2001 "Energy resources and the environment" Anmol Publications Pvt Ltd & New Delhi

3 Jayashree. G and Chand. S, 2006 "Fundamental Concepts of Applied Chemistry" S. Chand Limited & New Delhi

References

1 Bailey and Clark, 2001 "Chemistry of the environment" second edition, Elsevier publications & USA.

2 Fox. P.F.T, Uniacke. L, McSweeney, P.L.H. and O'Mahony J.A, 2015, "Dairy Chemistry and Biochemistry" second edition, Springer International Publishing & Switzerland

3 Mathur. M.P, Roy. D.D & Dinakar. P, 2008, "Text Book of Dairy Chemistry" ICAR, Govt. of India publishing.

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
192CE2A4CA	Core - XII	Synthetic Organic Chemistry	4	1	-	3	25	75	100	4
202CE2A4CB	Core - XIII	Statistical Thermodynamics, Macromolecules and Computational Chemistry	4	1	-	3	25	75	100	4
192CE2A4CV	Core - Project	Project & Viva Voce	-	-	16		80	120	200	8
192CE2A4DA	DSE - IV	Medicinal Chemistry	4	-	-	3	25	75	100	4
192CE2A4DB		Catalysis								
192CE2A4DC		Green Chemistry								
Total			**12**	**2**	**16**	**-**	**-**	**345**	**500**	**20**
Grand Total									**2300**	**90**

Course Code	Course Name	Category	L	T	P	Credit
192CE2A4CA	SYNTHETIC ORGANIC CHEMISTRY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basics involved in the disconnection approaches.
- About the importance of protection and deprotection methods
- The importance of named reaction and asymmetric synthesis in organic chemistry

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the methods involved in reterosynthetic approaches	K2
CO2	Interpret methods of two group C-C and C-X disconnections	K2
CO3	Analyze the various protective and deprotecting groups in organic synthesis	K4
CO4	Examine the various named reactions and their synthetic applications	K4
CO5	Analyze the various asymmetric synthetic methods and their selectivity	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	M	M
CO2	M	M	S	M	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S Strong M Medium L Low

192CE2A4CA	SYNTHETIC ORGANIC CHEMISTRY	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Introduction of reterosynthesis 8 h

Synthon, synthetic equivalent, target molecule, functional group interconversion, disconnection approach, importance of the order of events in organic synthesis. Chemoselectivity, one group C-C and C-X disconnection (disconnection of alcohols and carbonyl compounds).

Unit II Two group C-C & C-X disconnections 10 h

1,3 and 1,5 difunctionalised compounds, α,β-unsaturated carbonyl compounds, control in carbonyl condensation, synthesis of 3, 5 and 6 membered rings in organic synthesis. Diels- Alder reaction. Reterosynthesis of 5 and 6 membered heterocycles containing two nitrogens. Designing synthesis: Disconnection approach in Ibuprofen, Rosiglitazon and captopril.

Unit III Protection and deprotection chemistry 10 h

Need for protection and deprotection of functional groups during chemical reactions. Protection and cleavage of hydroxyl groups (by ethers)-MOM-Cl, THP and Protection and cleavage of hydroxyl groups (by esters) - trichloroacetate and 2,4,6-trimethylbenzoate. Protection and cleavage of 1,2 and 1,3-diols - Methylene dioxy derivative - methoxymethyleneacetal, ethyledineacetal,. Protection and cleavage of Amino groups - Boc, Fmoc, N-Acetyl.

Unit IV Name Reactions in Organic Synthesis 10 h

Bamford, Stevens reaction, McCombie reaction (Barton Deoxygenation), Corey-Chaykovsky reaction, Hosomi-Sakurai reaction, Julia olefination and its modifications, Nazarov cyclization - Weinreb ketone synthesis - Yamaguchi macrolactonization -McMurry reaction - Palladium based reactions: Negishi-Kumada - Fukuyama coupling - Tsuji-Trost reaction.

Unit V Asymmetric synthesis 10 h

Asymmetric synthesis - control of stereochemistry, resolution, chiral pool, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions, determination of enantiomeric and diastereomeric excess, enantio-discrimination.

Text Books

1. Warren S, 2008, "Organic Synthesis: The disconnection Approach". Second edition, Wiley and sons & UK.
2. Carruthers W, and Coldham I, 2015, "Modern Methods of Organic Synthesis", 4th edition, Cambridge University Press.
3. Noyori R, 1994, "Asymmetric Catalysis in Organic Synthesis", First edition, Wiley-Interscience & UK

References

1. Michael B Smith, 2015, "March's Advanced Organic Chemistry: Reactions Mechanisms and Structure", 7th edition, Wiley
2. Wuts G. M. P, and Theodora W. G. 2011, "Greene's Protective Groups in Organic Synthesis", 4th edition. Wiley India Pvt Ltd
3. Warren S, 2009, "Designing Organic Syntheses: A programmed introduction to the synthon Approach", Second edition. Wiley and sons.
4. Clayden J, Greeves N and Warren S, 2014, "Organic Chemistry", 2nd Edition. Oxford University Press & UK

Course Code	Course Name	Category	L	T	P	Credit
202CE2A4CB	STATISTICAL THERMODYNAMICS, MACROMOLECULES AND COMPUTATIONAL CHEMISTRY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basics of statistical thermodynamics and its applications
- The concepts in solid and liquid phase kinetics.
- The details of polymerization techniques and computational chemistry

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Examine statistical thermodynamics to the properties of identical indistinguishable particles like electrons	K4
CO2	Analyze the reaction paths and concepts in solid and liquid phase kinetics	K5
CO3	Appraise the different methods of polymerization techniques	K4
CO4	Demonstrate the Mossbauer and NQR spectroscopic techniques	K2
CO5	Inspect the compounds using the basic knowledge of the cheminformatics	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	M
CO3	M	M	S	S	S
CO4	M	M	S	M	S
CO5	S	s	M	S	M

S Strong M Medium L Low

202CE2A4CB	STATISTICAL THERMODYNAMICS, MACROMOLECULES AND COMPUTATIONAL CHEMISTRY	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Statistical Thermodynamics 10 h

Combinatory rule - probability theorem - permutations and combinations - concept of ensembles energy states and energy levels - macro-states and micro-states - Maxwell-Boltzmann statistics - thermodynamic probability, Stirling's approximation. Partition function and thermodynamic functions- molar partition function entropy and third law - separation of partition function- translational, rotational, vibrational and electronic partition functions, combined partition function equilibrium constant and partition function. Quantum statistics - Bose-Einstein and Fermi-Dirac statistics.

Unit II Chemical and Phase Equilibria 8 h

Reaction free energy/ reaction potential - reaction isotherm and direction of spontaneity - Standard reaction free energy - its calculation from thermochemical, electrochemical and equilibrium data - Temperature coefficient of reaction free energy and equilibrium constant. Gibbs phase rule - its thermodynamic derivation - application of phase rule to three component systems - Formation of one pair and two pairs of partially miscible liquids - Common ion effect – Salting out.

Unit III Macromolecules and its kinetics 10 h

Overview of polymers - structure and classification of polymers - kinetics and mechanism of free radical and ionic polymerizations - degree of polymerization - condensation and coordination polymerizations - Zeigler-Natta polymerization - copolymerization - molecular weight of polymers - number and weight average molecular weights - determination of molecular weight - light scattering and viscosity methods - gel permeation chromatography.

Unit IV Mossbauer and NQR spectroscopy 10 h

Theory of Mossbauer spectroscopy – Doppler effect – isomer shift – quadrupole splitting – magnetic hyperfine splitting – application of MB spectroscopy to inorganic compounds. NQR: Energies of quadrupole resonance – effect of a magnetic field on the spectra – relationship between electric field gradient and molecular structure

Unit V	Introduction to Cheminformatics and Computational Chemistry	10 h

Introduction to cheminformatics - history and evolution of cheminformatics - use of cheminformatics, prospects of cheminformatics - database management, cheminformatics database - introduction to molecular modeling and drug design. Concepts of computational chemistry - molecular mechanics: general features, bond stretching, angle bending, improper torsions, out of plane bending, non-bonded interactions, point charges, calculation of atomic charges, polarization, van der Waals interactions, hydrogen bond interactions, semiempirical methods, quantum mechanical methods, basic set.

Text Books

1 Gupta, M.C., 1990, "Statistical Thermodynamics ", 1st Edition, Wiley Eastern Publications & UK.

2 Laidler, Keith J., 1998, "Chemical Kinetics", Harper & Row Publishers, Inc, 3rd edition & USA.

References

1 Sears, F.W. and Salinger, G.L., 2013, " Thermodynamics, Kinetic & Statistical Thermodynamics", 3rd Edition, Narosa Publishing House & New Delhi.

2 Gowariker, Viwanathan, Jayadev Sreedhar, 1986, "Polymer Science", New Age International & New Delhi.

3 Andrew R. Leach and Valerie J. Gillet, 2007, "An Introduction to Chemoinformatics", Springer & USA.

4 Drago, R.S., 2016," Physical Methods for Chemists", Affiliated East West Press Pvt. Ltd. & New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A4DA	MEDICINAL CHEMISTRY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The types of drugs, synthesis and their pharmacological action.
- The synthesis and mode of action of nonsteroidal anti-inflamatory drugs.
- The natural and synthetic sources of drugs in chemotheraphy.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Interpret the synthesis and pharmacological application of sulpha drugs in various infectious diseases.	K5
CO2	Identify and appraise the synthesis and mode of action of mycobacterial and thyroid drugs.	K3
CO3	Analyse the anesthetics and anaesthetics and analgesics.	K4
CO4	Appraise the application and synthesis of an analgesics and anaesthetics.	K5
CO5	Analyse the mode of action and synthetic route of anti-malarial drugs.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	M	S
CO3	M	M	S	S	S
CO4	M	M	L	M	M
CO5	S	S	M	S	S

S Strong M Medium L Low

192CE2A4DA	MEDICINAL CHEMISTRY	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Antibacterial Sulpha Drugs 10 h

Introduction, Synthesis and mode of action of Sulphonamides for general infections – sulphanilamide – sulphapyridine - sulphadiazine, urinary infections – sulphacetamide - sulphafurazole - sulphisoxazoleacetyl, intestinal infections – sulphaguanidine - phthalylsulphathiazole, local infection – sulphacetamide sodium - mafedine - dapsone. Chemotherapeutic consideration of sulpha drugs.

Unit II Anti-Mycobacterial, Thyroid and Antithyroid Drugs 9 h

Introduction - synthesis and mode of action of pyrazinamide, fluoroquinolones, ofloxacin. Structure and mode of action of cycloserine, amino glycosides, clofazimine, ciproflaxacine hydrochloride and capreomycin. Synthesis and uses of Thyroxine, carbimazole, methimazole, propylthiouracil. Structure and uses of Levothyroxine sodium and Liothyronine sodium.

Unit III Anaesthetics and Analgesics 10 h

Introduction to anaesthetics – preparation of inhalation anaesthetics – ether – ethylchloride – fluroxene - halothane, intravenous anaesthetics – ketamine hydrochloride – methohexital sodium – thiamylal sodium. Introduction to analgesics, characteristic features of opioids, morphine analogues – morphine sulphate – diamorphine hydrochloride (structure only). Morphinan analogues – levorphanol tartrate – dextromethorphan hydrobromide (structure only). Synthesis and advantages of phenylpiperidine analogues - pethidine hydrochloride – diphenoxylate hydrochloride - fentanylcitrate. Phenylpropylamine analogues – methadone hydrochloride – dextropropoxyphene hydrochloride.

Unit IV Non-Steroidal Anti-Inflamatory Drugs 10 h

Introduction, classification, synthesis and mode of action of Indomethacine, Sulindac, Tolmetin sodium, ibuprophen, ibuphenac, dichlorophenal sodium, flubiprofen, naproxen, auranofin and allopurinol.

Unit V Antimalarial Drugs 9 h

Introduction, synthesis and mode of action of chloroquine phosphate, pamaquine, primaquine phosphate, proguanil hydrochloride, pyrimethamine, trimethoprim, dapsone.

Text Books

1 Razdan B., 2010," Medicinal Chemistry", First Edn, CBS Publishers and Distributors & New Delhi.

2 Ahluwalia V.K and Madhu Chopra, 2008, "Medicinal Chemistry", 4th Edn, AneBooks & NewDelhi.

References

1 Ashutosh Kar, 2015,"Medicinal Chemistry", 6th Edn, New Age International Ltd & New Delhi.

2 Jayashree G, 2014,"A Text Book of Pharmaceutical Chemistry", 5th Edn, S. Chand and Company Ltd & NewDelhi.

3 Graham L. P, 2005, "An Introduction to Medicinal Chemistry", 3rd Edn, Oxford university press & UK

4 Malleshappa N, Anurekha Jain and Harun M, 2014,"Textbook of Medicinal Chemistry Volume I", 1st Edn, CBS publishers and distributors Pvt Ltd & New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
192CE2A4DB	CATALYSIS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic principles of homogeneous and heterogeneous catalysis reactions and their types.
- The mechanism involving in the various C-C, C-X coupling reactions and CH activation reactions.
- The basic knowledge about photocatalysis reactions involved in multiple bonds.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Apply the knowledge of catalysis in green, enzyme, nano and phase transfer catalytic reactions.	K3
CO2	Utilize the different reactions to conduct C-C, C-X and C-H type of reactions.	K3
CO3	Determine various surface parameters using different spectral techniques.	K5
CO4	Illustrate the reaction mechanisms of heterogeneous catalytic reactions.	K2
CO5	Outline the different photocatalysis reactions and it's applications.	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	M
CO2	S	S	M	S	S
CO3	S	S	M	M	S
CO4	S	S	M	S	S
CO5	S	S	M	S	S

S Strong M Medium L Low

192CE2A4DB	CATALYSIS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Fundamentals 8 h

Fundamental aspects of catalysis - Homogeneous and Heterogeneous catalysis - enzyme catalysis - green catalysis - nano catalysis. The role of catalytic processes in modern chemical manufacturing - organometallic catalysts - catalysis in organic polymer chemistry - catalysis in petroleum industry - catalysis in environmental control.

Unit II Homogeneous catalysis 10 h

Metal mediated C-C and C-X coupling reactions - Negishi and Nozaki-Hiyama, Buchwald-Hartwig, Ullmann coupling reactions. Directed orthometalation - Rh and Ir catalyzed C-H activation reactions and their synthetic utility. Copper and rhodium based carbene and nitrene complexes, cyclopropanation. Introduction to N-heterocyclic carbene metal complexes.

Unit III Characterization of solid catalysts 10 h

Surface area - structure, surface morphology, porosity, pore volume, diameter, particle size. Instrumentation and applications of X-ray diffraction, SEM, TEM and Auger spectroscopy to surface studies. TPD, TPR for acidity and basicity of the catalysts. Boundary layer theory - Wolkenstein theory - Balanding's approach.

Unit IV Heterogeneous catalysis 10 h

Adsorption isotherms, surface area, pore size and acid strength measurements, porous solids. Catalysis by metals - semiconductors and solid acids - supported metal catalysts - catalyst preparation - deactivation and regeneration - ammonia synthesis -hydrogenation of carbon monoxide -hydrocarbon conversion - selective catalytic reduction - polymerization.

Unit V Photocatalysis 10 h

Introduction to photocatalysis - semiconductor as photo catalysts - porphyrins - phthalocyanines. Generation of hydrogen by photo catalysts, photocatalytic break down of water and harnessing solar energy, photocatalytic degradation of dyes, environmental applications.

Text Books

1. Schlosser M, 1996, "Organometallics in Synthesis, A manual", 1st Edition, John Wiley & USA.
2. Emmet P.H, 1954, "Catalysis (Vol I & II)", 1st Edition, Reinhold &USA.

References

1. Hegedus L.S, 1999, "Transition metals in the synthesis of complext organic 3 molecules" 3rd Edition, University Science Books & USA.
2. Chakrabarty D.K and Viswanathan B, 2008, "Heterogeneous catalysis", 1st Edition, New Age International (P) Ltd & New Delhi.
3. Kaneko M and Okura I, 2003, "Photocatalysis: Scienec and Technology", Springer & Germany.
4. Viswanathan B, Kannan S and Deka R.C, 2010,"Ctalysis and Surfaces: Characterization Techniques", 1st Edition, Alpha Science International Ltd & UK

Course Code	Course Name	Category	L	T	P	Credit
192CE2A4DC	GREEN CHEMISTRY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic principles and importance of green chemistry for industrial applications
- About the microwave and ultra sound assisted synthesis.
- The applications of phase-transfer catalyst, ionic liquids and Crown ethers in organic synthesis

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Interpreting the advantages of green synthetic methods in industrial process	K2
CO2	Discuss and appraise microwave and ultrasound assisted synthesis	K2
CO3	Analyse the synthetic applications and advantages of ionic liquids	K4
CO4	Appraise the advantages and the applications of phase transfer catalyst in organic synthesis	K5
CO5	Discuss types and applications of Crown ethers	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	L	M	M
CO3	M	M	L	L	M
CO4	M	M	M	M	L
CO5	S	S	M	S	S

S Strong M Medium L Low

192CE2A4DC	GREEN CHEMISTRY	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Basic Principles of Green Chemistry 10 h

Basic principles, prevention of waste/by-products, maximum incorporation of the reactants (starting materials and reagents) into the final product, prevention or minimization of hazardous products, designing safer chemicals, energy requirements for synthesis, selection of appropriate solvent, selection of starting materials, use of protecting groups, atom efficiency process & atom economy. Green synthesis of styrene, adipic acid - Green chemistry in day-today life - dry cleaning of clothes, versatile bleaching agents.

Unit II Ultrasound and Microwave Assisted Green Synthesis 10 h

Ultrasound: Introduction, instrumentation- the phenomenon of cavitation- Sonochemical esterification, substitution, addition, alkylation, oxidation, reduction and coupling reactions.

Microwave: Introduction, concept, reaction vessel/ medium, specific effects, advantages and limitations.

N-alkylation and alkylation of active methylene compounds, Diels –Alder reactions, Hoffmann elimination, hydrolysis and oxidation, Reactions in water and organic solvents,solvent free reactions and deprotection of esters.

Unit III Ionic Liquids as Green Solvents 10 h

Introduction, structure, synthesis and applications of some important ionic liquids in organic synthesis. Selective chemical reaction on one aldehydes group of symmetrical aldehydes, asymmetric synthesis. Reagent linked to a polymeric material: Preparation of sulfonazide polymer and application in diazotransfer reaction- Synthesis of polymer bound peracid and its applications - synthesis of polystyrene tindichloride resin and its applications, polymer supported photo sensitizers.

Unit IV Phase Transfer Catalysis in Green Synthesis 10 h

Introduction, mechanism of phase transfer catalyst reaction, types, applications and advantages of phase transfer catalyst: Nitriles from alkyl or acyl halides, alkylfluorides, alcohols. Azides from alkyl halides, generation of dichlorocarbenes, addition to olefins, elimination reaction, alkylation reaction, Willamson synthesis, Benzoin condensation, Darzen reaction, Michael reaction, Wittig reaction, oxidation under PTC condition.

Unit V Industrial Case Studies and Crown Ethers 8 h

Methyl Methacrylate (MMA) - Acetic acid manufacture, Vitamin-C. Application of Polyethylene - Ziegler Natta Catalysis, Metallocene Catalysis - Eco friendly Pesticides and Insecticides. Introduction, nomenclature, special features, nature of donor site and general synthesis of Crown ethers - synthesis of [12] Crown - 4, [18] Crown -6 and cryptates. Synthetic applications – esterification, saponification and KMnO4 oxidation.

Text Books

1. Ahluwalia V. K and Kidwai. M., 2007,"New Trends in Green Chemistry", II Edition, Anamayapublishers & New Delhi
2. Mathur N.K., Narang C.K., and Williams R.E., 1980, "Polymers as aids in Organic Synthesis", III Edition, Academic Press & NY

References

1. Starks C.M., and Halper M., 1994, "Transfer Catalysis: Fundamentals, Applications, and Industrial Perspectives", 9th Edition, Academic Press & USA
2. Anastas P.T., and Warner J.C., 1988 ,"Green Chemistry theory and Practice", 12thEdn, Oxford University press & UK
3. Sanghi R., and Srivastava M M., 2003," Green Chemistry environment friendly alternatives", 5th Edition, Narosa Publishing House & New Delhi
4. Weber W.B and Gokel G.W, 1977, "Phase Transfer Catalysis in Organic Synthesis", 5th Edition, Springer & Berlin.

192CE2A4CV	PROJECT WORK	SEMESTER IV

Total Credits: 8

Total Instructional Hours 192 h

GUIDELINES:

1. A Guide has been allotted to each student by the department. Student can select any topic in discussion with the supervisor. Students should maintain a work diary were in weekly work carried out has to be written. Guide should review the workevery week and put his/her signature. The work diary along with project report should be submitted at the time of viva voce.

2. CA Marks Distribution:A minimum of three reviews have to be done, one at the time finalizing the project title, second at framing questionnaire/identifying the primary data and the third review at the time of commencement of report writing. They should be asked to present the work doneto the respective guide in the three reviews. The guide will give the marks for CIA asper the norms stated below:

First Review	20 Marks
Second Review	20 Marks
Third Review	20 Marks
Document, Preparation and Implementation	20 Marks
Total	**80 Marks**

3. End Semester Examination:The evaluation for the end semester examination should be as per the norms Given Below:

Record work and Presentation	80 Marks
Viva-Voce	40 Marks
Total	**120 Marks**

Note: (End Semester Examination marks jointly given by the external and internal examiner).