SRI SARADA COLLEGE FOR WOMEN

(AUTONOMOUS)

SALEM -636016

Reaccredited with "A" grade by NAAC

(Affiliated to Periyar University)

Salem-636 016

DEPARTMENT OF CHEMISTRY

PG-CBCS OUTCOME BASED

SYLLABUS

2020-2021 Onwards

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM -16.

DEPARTMENT OF CHEMISTRY

M.Sc. CHEMISTRY COURSE STRUCTURE UNDER CBCS

CANDIDATES ADMITTED FROM THE YEAR 2020-2021 ONWARDS

Total Credits: 90+15*
Credit for MOOC courses

I SEMESTER				
Course	**Code**	**Title**	**Hrs**	**Credits**
Core-I	20PCHC1	Inorganic Chemistry-I	5	5
Core-II	20PCHC2	Organic Chemistry-I	6	5
Core-III	20PCHC3	Physical Chemistry-I	5	5
Elective-I No.1	20PCHEC1	Advanced Chemistry	5	4
Elective-I No.2	20PCHESC1	Water Chemistry		
Core-IV	-	Inorganic Chemistry Practical	3	**
Core-V	-	Organic Chemistry Practical-I	3	**
Core-VI	-	Physical Chemistry Practical-I	3	**
Extra Skills	• *Productive preparation for CSIR/SET/JRF - I (19PCHSC1) (Self study paper – 1 credit extra)* • *Articulation and Idea fixation – 2 Hours per Semester (out of college hours)* • *Life skills Promotion - 2 Hours per Semester (out of college hours – 1 credit extra)* • *Physical Fitness Practice – 20 Hours per Semester (out of college hours – 1 credit extra)*			
	Total		**30**	**19+3***
II SEMESTER				
Course	**Code**	**Title**	**Hrs**	**Credits**
Core-VII	20PCHC4	Inorganic Chemistry-II	6	5
Core-VIII	20PCHC5	Organic Chemistry-II	6	5
Elective –II No.1	20PCHEC2	Chemical kinetics and Thermodynamics	6	5
Elective –II No.2	20PCHESC2	Green Chemistry		
Core-IV	20PCHQC1	Inorganic Chemistry Practical	3	3
Core-V	20PCHQC2	Organic Chemistry Practical-I	3	3
Core-VI	20PCHQC3	Physical Chemistry Practical-I	4	3
	20PHRSC	Human Rights	2	2
	20PVENC	Value Education		
Extra Skills	• *Productive preparation for CSIR/SET/JRF - I (19PCHSC2) (Self study paper– 1 credit extra)* • *Articulation and Idea fixation – 2 Hours per Semester (out of college hours – 1 credit extra)* • *Life skills Promotion - 2 Hours per Semester (out of college hours – 1 credit extra)* • *Physical Fitness Practice – 20 Hours per Semester (out of college hours – 1 credit extra)*			

		Total	**30**	**26+4***
III SEMESTER				
Course	**Code**	**Title**	**Hrs**	**Credits**
Core-IX	19PCHC6	Organic Chemistry-III	5	4
Core-X	19PCHC7	Physical Chemistry-II	5	4
Core -XI	19PCHC8	Coordination Chemistry	5	4
Elective-III No.1	19PCHEC3	Group Theory and Spectroscopy	5	4
Elective-III No.2	19PCHESC3	Biomolecules		
EDC	19PCHEDC	Therapeutical Chemistry	4	4
Core-XII	19PCHQC4	Organic Chemistry Practical-II	3	**
Core-XIII	19PCHQC5	Physical Chemistry Practical-II	3	**
Extra Skills	• *Productive preparation for CSIR/SET/JRF - I (19PCHSC3) (Self study paper– 1 credit extra)* • *Articulation and Idea fixation – 2 Hours per Semester (out of college hours)* • *Life skills Promotion - 2 Hours per Semester (out of college hours – 1 credit extra)* • *Physical Fitness Practice – 20 Hours per Semester (out of college hours – 1 credit extra)* • *Pre-preparation for the project – 5 hours per week (out of college hours)*			
		Total	**30**	**20+4***
IV SEMESTER				
Course	**Code**	**Title**	**Hrs**	**Credits**
Core-XIV	19PCHC9	Physical Methods in Chemistry	6	5
Elective –IV No:1	19PCHEC4	Advanced Organic Chemistry	6	5
Elective –IVNo:2	19PCHESC 4	Material Science Chemistry		
Elective –V No:1	19PCHEC5	Photochemistry and Organic Spectroscopy	6	5
Elective –V No:2	19PCHESC 5	Medicinal Chemistry		
Core-XII	19PCHQC4	Organic Chemistry Practical-II	3	3
Core-XIII	19PCHQC5	Physical Chemistry Practical-II	3	3
Core- XIV	19PCHPC	Project	6	4
Extra Skills	• *Productive preparation for CSIR/SET/JRF - I (19PCHSC4) (Self study paper– 1 credit extra)* • *Articulation and Idea fixation – 2 Hours per Semester (out of college hours – 1 credit extra)* • *Life skills Promotion - 2 Hours per Semester (out of college hours – 1 credit extra)* • *Physical Fitness Practice – 20 Hours per Semester (out of college hours – 1 credit extra)*			
		Total	**30**	**25+4***

*****Examination at the end of the year***

DEPARTMENT OF CHEMISTRY

Programme Title: M.Sc. Chemistry

Programme outcomes (PO)

On completion of M.Sc. Chemistry programme, the students are expected to

PO No.	PO statement
PO1	possess deep and extensive knowledge on the key aspects and advanced concepts in chemistry
PO2	plan, execute, record, interpret the observations and present the results of the chemical experiments
PO3	have relevant knowledge, critical thinking, problem solving skills so as to enable them to face competitive exams and pursue research
PO4	have gate way to varied avenues like research laboratories, industries and academic sectors.
PO5	can design and perform interdisciplinary projects to meet the requirements related to the society

Programme specific outcome:

After completion of this programme the student

PSO No.	PSO statement
PSO1	has gained scientific reasoning and analytical problem solving ability
PSO2	can implement the knowledge of chemical laboratory principles required to work in a team and possess Pedagogical skills
PSO3	can get placement in industries, laboratories and work with flexibility, adaptability and leadership quality
PSO4	is able to apply the knowledge to identify, formulate and solve problems in industries or during research work

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-I: INORGANIC CHEMISTRY- I

Course Code : 20PCHC1 Hours/Week : 5 Credit: 5

Semester : I Batch: 2020-22

Course Objectives:

- *To study about nuclear chemistry and radiation chemistry*
- *To learn about boron compounds, polyacids and silicates.*
- *To understand Photochemical reactions*

Syllabus

UNIT-I **15 Hours**

Nuclear Chemistry-I

1.1. Nuclear structure-sub-atomic particles, nuclear properties - nuclear radii, nuclear spin and moments, nuclear forces-meson field theory, salient feature of liquid drop model and shell model.

1.2. Artificial radioactivity, positron emission, orbital electron capture, nuclear isomerism and internal conversion.

1.3. Detection and determination of activity - Cloud chamber, Bubble chamber, GM, Scintillation and Cherenkov counters.

UNIT-II **15 Hours**

Nuclear Chemistry II

2.1. Natural radioactivity: α decay-tunnel effect, β-decay-types - β^+ and β^- - range of α and β radiation - Geiger-Nuttall rule, unit of radioactivity.

2.2. Application of radioactive isotopes as tracers and chemical investigations, radiation protection and safety precautions.

2.3 Analytical applications - neutron activation analysis, isotope dilution analysis - industrial and medicinal application.

Radiation chemistry

2.3. Radiation dosimetry, radiolysis of water and the hydrated electron.

UNIT – III **15 Hours**

Boron compounds and Clusters

3.1. Boron cage compounds- Diboranes- preparation, properties and bonding in higher boranes – B_4H_{10}, B_5H_9, B_6H_{10}, B_5H_{11}, $B_{10}H_{14}$ and $[B_{12}H_{12}]^{2-}$ and structures, calculation of framework electron, styx numbers, wades rule,

Carboranes - types such as closo and nido - preparation, properties and structures.

3.2. Metallocarborane - a general study.

3.3. Polyacids – Structural aspects of isopolyacids of V, Cr, Mo and W and heteropolyacids of Mo and W.

UNIT – IV **15 Hours**

Inorganic Polymers

4.1. Silicates -types of silicates (structural study only), Zeolites, Silicon based polymer: Silicone rubber, silicone greases, silicone resins and high thermal silicones.

4.2. Phosphorous based polymers: –Phosphonitrilic compounds (Phosphazenes)-linear, trimer and tetramer structures, preparation of $(PNCl_2)_3$, $(PNBr_2)_3$ and $(PNF_2)_3$, structure of $(PNCl_2)_3$, Craig and Peddock model, Dewar model.

4.3. Sulphur based polymers: Polymeric sulphur-S_4N_4-Polymeric sulphur nitride$(SN)_n$

UNIT – V **15 Hours**

Photochemical reactions

5.1 Ligand field photochemistry-Emission spectra, Photochemical reaction-Adamson's rules-photosubstitution-aquation, anation and ligand exchange, photorearrangement-geometrical isomerism, racemization, linkage isomerism and ligand rearrangement, photochemical redox reactions.

5.2. Photochemistry of metal carbonyls and metallocenes, Photochemical reactions of Fe(II) and Fe(III) complexes.

5.3. Photochemical substitution process in Pt(II), Ru bipyridyl complex in solar energy conversion.

BOOKS FOR STUDY

1. H. J. Arnicker, *Essentials of nuclear chemistry*, 4th edition. New Age International (p) Ltd.,2003.
2. Shriver and Atkins, *Inorganic chemistry*, 4th edition, Oxford University Press, 2006.
3. B. R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry* 33rd edition, Vishal Publishing Co., 2016.
4. S.Arunachalam, *Inorganic Photochemistry*, Raasi print house, 2002.

BOOK FOR REFERENCES

1. N. N. Greenwood and A. Earnshaw, *Chemistry of the Elements*. 2nd edition. Butterworth Heinemann Linacre House, Jordan Hill, Oxford, 1997.
2. Keith F. Purcell and John C. Kotz, *Inorganic Chemistry*, WB Saunders Co. USA, 1985.
3. Rohatgi-Mukherjee, *Fundamentals of photochemistry,* revised ed.(1986), Wiley Eastern Ltd.

Web sources:

https://preparatorychemistry.com/Bishop_Book_atoms_16.pdf
https://cd1.edb.hkedcity.net/cd/science/chemistry/s67chem/pdf/tOL_5_Silicates.pdf

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	summarize the basic concepts of nuclear chemistry and determination of radioactivity	K1,K2
CO2	acknowledge in depth study of natural radioactivity and application of radioactive isotopes	K1,K2
CO3	comprehend and compare the structure of boranes, carboranes and polyacids	K1, K2
CO4	gain the knowledge about the inorganic polymers	K2, K4

CO5	gain the knowledge about the Photochemical reactions	K2,K4

Mapping of Cos with POs/ PSOs

COs		POs/ PSOs							
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	S	L	M	S	S	M	M	S	L
CO2	S	L	M	S	S	M	S	S	L
CO3	S	M	S	S	S	S	S	S	S
CO4	S	M	M	S	S	L	S	S	M
CO5	S	M	L	S	S	M	S	S	M

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-II: ORGANIC CHEMISTRY- I

Course Code : 20PCHC2 Hours/Week : 6 Credits: 5

Semester : I Batch: 2020-22

Course Objectives:

- *To understand the chemistry of organic compounds based on the spatial orientation of constituent atoms or groups.*
- *To understand the stereochemistry of reactions*
- *To acquire knowledge about the dynamic stereochemistry and reactivity.*
- *To get exposed to nucleophilic substitution and elimination reactions.*

Syllabus

UNIT – I **18 Hours**

Stereochemistry- I

1.1 **Stereoisomerism, projection formulae, symmetry and chirality**

Stereoisomerism -optical isomerism-definitions –conventions used in chemistry- Wedge, Newmann Sawhorse and Fischer notations and interconversions- concept of chirality- principles of symmetry- classification of chiral molecules as asymmetric and dissymmetric

1.2 **Molecules with axial, planar chirality and helicity. Specification of configuration**

Molecules with axial chirality, planar chirality and helical structures- a brief study of dissymmetry of ansa compounds, cyclophanes, transcyclooctene and hexahelicene. Specification of configuration- R & S (allenes, spirans and biphenyls)

1.3 **Compounds with more than one chiral centre**

Calculation of number of stereoisomers- erythro and threo nomenclature- Stereospecific and stereoselective synthesis with suitable examples- asymmetric synthesis, Cram's rule.

1.4 **Topicity and prochirality**

Homotopic, enantiotopic, diastereotopic ligands and faces- prochiral carbons.

UNIT – II **18 Hours**

Stereochemistry- II

2.1 **Conformational analysis of cyclohexane and substituted cyclohexanes**

Conformational analysis of cyclohexane, Stabilisation of flexible conformers. conformational analysis of mono and disubstituted cyclohexanes.

2.2 **Conformational analysis of a few atypical disubstituted cyclohexanes**, **cyclopentane, cyclooctane, cyclohexanone and decalin**

Conformational analysis of a few atypical disubstituted cyclohexanes. cyclopentane and cyclohexanone, 2-alkyl and 3-alkylketone effect- 2-halocyclohexanone. Conformational analysis of cyclooctane and trans annular interactions. Conformational analysis of cis and trans-decalin, 9- Methyldecalin.

2.3 **Conformation and reactivity** - substituted cyclohexanols (acylation and oxidation)- cyclohexane carboxylic acid derivatives (hydrolysis of ester)- nucleophilic substitution and elimination reactions.

UNIT-III **18 Hours**

Aliphatic Nucleophilic Substitution

3.1 **Types of Aliphatic Nucleophilic Substitution**

S_N1 , S_N2 & S_Ni mechanisms- kinetic and stereochemical characteristics.

3.2 **Neighbouring group mechanism**, **Nucleophilic substitution at allylic, vinylic and acyl carbon**

Neighbouring group participation by π and σ bonds- nonclassical carbocations. Nucleophilic substitution at allylic and vinylic carbon, nucleophilic acyl substitution.

3.3 **Factors affecting aliphatic nucleophilic substitution reactions**

Distinction between nucleophilicity and basicity. Effect of substrate structure, attacking nucleophile, leaving group and reaction medium on the rate- ambident nucleophiles- regioselectivity.

UNIT-IV **18 Hours**

4.1 **Aliphatic nucleophilic substitution reactions**

Study of the following reactions – Von Braun reaction, hydrolysis of ester, Claisen and Dieckmann condensation.

4.3 **Aromatic nucleophilic substitution- Types, reactivity**

Aryl halides- S_NAr- nucleophilic substitution involving diazonium ions- S_N1- benzyne mechanism, cine substitution-methods of generation of benzyne

intermediate, trapping of aryne intermediates- reactivity – effect of substrate structure.

4.4 Aromatic nucleophilic substitution reactions

Zeigler alkylation, Chichibabin reaction, Von-Richter rearrangement.

UNIT-V **18 Hours**

Elimination reactions

5.1 **Types of elimination reactions and orientation of double bond**

E1, E2 and E1CB mechanisms, Orientation of double bond-Hofmann and Zaitsev's rule- Bredt's rule.

5.2 **Pyrolytic elimination and factors affecting elimination reactions**

Pyrolytic elimination-mechanism and orientation. Effect of substrate structure, leaving group, attacking base and medium. Competition between substitution and elimination reactions.

5.3 **Elimination reactions**

Dehydration, dehydrohalogenation, Chugaev reaction, Hofmann degradation and Cope elimination.

BOOKS FOR STUDY

1. P.S. Kalsi, *Stereochemistry,Conformation and Mechanism*, Sixth edition, Wiley Eastern Limited, 2005.
2. D. Nasipuri, *Stereochemistry of Organic Compounds*, Second edition, New York International Publishers, 1994.
3. R.T. Morrison and Boyd, *Organic chemistry*, Sixth edition, Prentice Hall, 1992.

BOOKS FOR REFERENCE

1. Jerry March, *Advanced Organic Chemistry- Reactions, Mechanisms and Structure*, Fourth Edition, John Wiley and Sons 1992.
2. Francis A. Carey, *Organic Chemistry*, Third edition, The McGraw Hill Companies, Inc, 1996.
3. E.S.Gould, *Mechanism and Structure in Organic Chemistry,* Holt Dryden,1959.
4. I.L. Finar, *Organic Chemistry*, Volume II, Fifth edition, Pearson Education Asia Private Ltd. 2000.

Web Sources:

https://www.masterorganicchemistry.com/2012/04/17/homotopic-enantiotopic-diastereotopic/

https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104105086/lec10.pdf

http://content.inflibnet.ac.in/data-server/eacharya-

https://www.coursehero.com/file/44100228/1515564176CHE-P1-M17-etextpdf/

https://epgp.inflibnet.ac.in/view_f.php?category=

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)

Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	determine and interpret absolute stereochemical assignments in organic molecules identify prochirality, chirality centres and the topical relationship in organic molecules	K3,K4
CO2	predict the stability of various conformers of cyclic systems using steric and electronic effect and correlate them to reactivity	K3,K4
CO3	describe and formulate the mechanism of various nucleophilic substitution reactions and predict the role of substrate structure and reaction medium on the rate	K4,K5
CO4	compare and appreciate the reactivity of aliphatic and aromatic compounds with respect to nucleophilic substitution reactions	K4
CO5	predict major and minor products of elimination reactions with appropriate stereochemistry and regiochemistry.	K4, K5

Mapping of Cos with POs/ PSOs

COs	**POs/ PSOs**								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	S	L	S	S	S	S	S	S	S
CO2	S	L	S	S	M	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	M	M	S	S	M
CO5	S	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-III: PHYSICAL CHEMISTRY-I

Course Code : 20PCHC3 Hours/Week : 5 Credit: 5

Semester : I Batch: 2020-22

Course Objectives:

- *To apply basic principles of Thermodynamics to open systems.*
- *To introduce basic concepts of quantum mechanics and find solution .for Schrodinger wave equation for some simple systems.*

Syllabus

UNIT-I **15 Hours**

Classical Thermodynamics-I

1.1.1 Maxwell's relations and thermodynamic equations of state –Applications in the evaluation of Cp-Cv for van der Waals gases, Cp-Cv in terms of coefficient of compressibility - Relation between Cp and Cv.

1.1.2 Partial molar properties - Gibbs-Duhem equation - partial molar free energy (chemical potential) - Determination of chemical potential (direct method and method of intercepts). Variation of chemical potential with temperature and pressure

1.3. Application of phase rule to three component systems involving solids and liquids such as (CH_3COOH - $CHCl_3$ - H_2O, NaCl – Na_2SO_4 - H_2O and NaCl - KCl - H_2O).

UNIT –II **15 Hours**

Quantum Chemistry-I

2.1 Black body radiation- photoelectric effect-de-Broglie equation

2.2 Heisenberg's uncertainty principle - Compton effect - Operators and commutation relations

2.3 Quantum mechanical postulates – Time independent schrödinger equation - Condition for normalisation and orthogonality.

UNIT-III **15 Hours**

Quantum chemistry - II

3.1 Application of Schrödinger equation to a particle in one, two dimensional boxes.

3.2 Application of Schrödinger equation to a particle in three dimensional boxes, Simple harmonic oscillator

3.3 Rigid rotator -Slater type orbitals-Slater rules.

UNIT-IV **15 Hours**

4.1 Application of Schrödinger equation in arriving solution for energy and Wave function of the Hydrogen atom.

4.2 Approximation methods-Perturbation method (upto second order in energy) and variation methods and their application to hydrogen and helium atom.

4.3 Spin orbit interactions: LS-coupling and jj-coupling-term symbols (only ground state term symbol for simple atoms and 3d transition series.

UNIT-V **15 Hours**

Quantum chemistry-III

5.1. Born-Oppenheimer approximation-LCAO-MO approximation for hydrogen molecule ion -Valence bond theory of hydrogen molecule-

5.2. Comparison of MO and VB theories-concept of hybridization - sp, sp^2 and sp^3 hybridisation.

5.3. Huckel molecular orbital (HMO) theory for conjugated π-system - applications to simple systems-(ethylene, butadiene and benzene)-self consistent field approximation-Hartree's and Hartree-Fock Self Consistent Field theory.

BOOKS FOR STUDY

1. Samuel Glasstone. Thermodynamics for chemists, Eleventh edition, affiliated east west press, New Delhi, 1960.
2. B.R. Puri, L.R. Sharma, Madan S. Pathania. Principles of Physical Chemistry, 41st edition, Vishal publishing company, Jalandhar, 2004.
3. D.N. Bajpai, Advanced Physical Chemistry, First edition, S.Chand & Company Ltd, New Delhi, 1994.
4. R.K.Prasad. Quantum Chemistry, Third edition, Wiley Eastern Ltd, New Delhi, 1985.

BOOKS FOR REFERENCE

1. Ira.N.Levine, Quantum chemistry, Fifth edition, Pearson Prentice hall, New Delhi, 2000.
2. A.K.Chandra, Introduction to quantum chemistry, Fourth edition, Tata Mc Graw Hill, New Delhi, 1994.

Web Source:

http://www.iiserpune.ac.in/~p.hazra/FULL_Thermodynamics_lecture.pdf

http://ursula.chem.yale.edu/~batista/classes/vvv/v570.pdf

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)

Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of classical thermodynamics; construct and analyse phase diagram for three components systems	K2,K3, K4
CO2	Profound understanding of the fundamental concepts of quantum mechanics.	K2, K3, K4
CO3	Set up and Solve the Schrodinger equation for various systems	K3, K4
CO4	Give an overview of approximation methods such as variation and perturbation methods; spin orbit interactions and ground state term symbols	K2, K3
CO5	Gain insights on various approximations- BO, LCAO-MO, HF; HMO theory for conjugated systems	K2, K3

Mapping of Cos with POs/ PSOs

COs	POs/ PSOs								
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	s	S
CO2	S	M	S	S	S	S	S	S	S
CO3	S	L	S	S	M	S	S	M	S
CO4	S	M	M	S	S	S	S	S	S
CO5	S	M	L	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE-I No.1: ADVANCED CHEMISTRY

Course Code : 20PCHEC1 Hours/Week : 5 Credit: 4

Semester : I Batch: 2020-22

Course Objectives:

- *To introduce to students the modern analytical techniques like GC, HPLC, polarography etc.*
- *To know the advances in applied fields like nanotechnology and polymer chemistry.*

Syllabus

UNIT-I **15 Hours**

1.1. GLC-Principle, Instrumentation, Carrier gas, column preparations, Types of detectors-Thermal conductivity, Flame ionization, electron capture.

1.2. HPLC-Scope, column efficiency, Instrumentation, pumping systems, column packing, detectors.

1.3 Applications of GLC, HPLC

UNIT –II **15 Hours**

2.1. Differential thermal analysis (DTA) and differential scanning calorimetry (DSC)-Basic principles. Polarography - Basic principles.

2.2. Polarography - Instrumentation, Factors affecting limiting current, residual current, migration current, diffusion current, half wave potentials.

2.3. Applications of polarography-Determination of Cadmium in solution (wave height concentration plot and method of standard solutions), determination of lead and copper in steel.

UNIT –III **15 Hours**

3.1. Amperometry-Basic principles, Instrumentation, Amperometric titration.

3.2. Determination of lead with dichromate, sulphate with lead nitrate solution using amperometric method.

3.3. Atomic absorption spectroscopy-Basic principles, Instrumentation, advantage over Flame photometry, detection limit, interferences -Applications.

UNIT –IV **15 Hours**

4.1. Polymers- Monomers, polymers- definition, classification of polymers based on micro structures, macro structures and application.

4.2. Chemistry of polymerization-Chain (Addition) polymerization - free radical, ionic, coordination, Condensation (step) polymerization.

4.3. Number average and weight average molecular weight, Bio polymers, conducting polymers.

UNIT- V **15 Hours**

Nanotechnology

5.1. Introduction, importance-various stages of nanotechnology, nanoparticles, Fullerenes.

5.2. Nanodendrimers - Nanopore channels, Fibres, and scaffolds.

5.3. CVD diamond technology-FCVA technology and its applications, nano imaging techniques.

BOOKS FOR STUDY

1. J. Bassett, Vogel's *Text book of Quantitative Inorganic Analysis*, Fourth edition, English Language Book Society/Longman, 1978.
2. Gurdeep Chatwal, Sham Anand, *Instrumental methods of Chemical Analysis,* Fifth Edition, Himalaya Publishing House, 2007.
3. M. S. Bhatnagar*, A Textbook of Polymers*, Volume I, First Edition, S. Chand and Company Ltd, 2004

BOOKS FOR REFERENCE

1. Douglas A. Skoog and Donald M. West, *Analytical Chemistry: An Introduction,* Fourth Edition, CBS International Editions, 1986.

2.Mahinder Singh, *A Textbook of Analytical Chemistry*, First Edition, Dominant Publishers and Distributors, 2005.

3. G. S. Misra, *Introductory Polymer Chemistry*, First Edition, Wiley Eastern Ltd, 1993.
4. Mick Wilson, *Nanotechnology-Basic Science and Emerging Technologies*, First Edition, Overseas Press Private Ltd, 2008.

Web Sources:

https://www.researchgate.net/publication/301700056_Gas_Liquid_Chromatography

https://laboratoryinfo.com › Biochemistry

https://www.researchgate.net/publication/235987484_High_performance_liquid_chromatography_A_short_review

scholar.cu.edu.eg › files › polarography

https://www.researchgate.net/publication/308371884_Atomic_Absorption_Spectroscopy_AAShttps://www.researchgate.net/publication/329380844_Amperometry

http://www.as.utexas.edu/astronomy/education/fall08/scalo/secure/309l_oct09_protein.pdf

https://www.britannica.com/science/fullerene

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	explain the principle and instrumentations of GLC & HPLC and illustrate with corresponding applications	K1, K2, K3
CO2	summarize the principle, instrumentation of DTA, DSC and polarography and determine Cd, Pb & Cu ions	K2, K3, K4
CO3	discuss the principles, instrumentation of amperometry, AAS and estimate lead & sulphate using amperometric titrations	K2, K3, K4

CO4	generalize polymers and detail bio & conducting polymers and illustrate the kinetics of polymerisation	K1, K2
CO5	elaborate the classification of nanomaterials and comprehend various nanotechnologies, characterization techniques	K1, K2, K3

Mapping of Cos with POs/ PSOs

COs	**POs/PSOs**								
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	M	M	S	S	M	S	S	S
CO2	S	M	M	S	S	M	S	S	S
CO3	S	M	M	S	S	M	S	S	S
CO4	S	L	M	M	M	L	M	S	M
CO5	S	M	M	S	S	M	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE-I No.2: WATER CHEMISTRY

Course Code : 20PCHESC1 Hours/Week : 5 Credit: 4

Semester : I Batch: 2020-22

Course Objectives:

- *To understand the water quality parameters and disinfectants methods*
- *To learn about the waste water treatment methods*

Syllabus

UNIT – I **15 Hours**

Introduction

1.1. Sources of water, unique properties of water- water characteristics -water pollution-waste water generation.

1.2. classification of water pollutants, constituents and characteristics of waste water 1.3. measurement techniques -sampling, colour & odour ,dissolved oxygen, BOD, COD, TOC, N&P, suspended solids and bacteriological measurements.

UNIT – II **15 Hours**

Potable water

2.1. Potable water standards-WHO and other standards-bacteriological standards.

2.2. Disinfectants methods-oxidation method-bleaching powder, chlorine, ozone and UV.

2.3. Desalination - reverse osmosis and dialysis, nanofilteration.

UNIT – III **15 Hours**

Waste water treatment

3.1. Waste water treatment-pretreatment -screening, grit removal and pre-chlorination 3.2. Primary treatment-settling and sedimentation,

3.3. Secondary treatment -trickling filter process, activated sludge process, Aeration.

UNIT – IV **15 Hours**

Industrial waste water treatment

4.1. Industrial waste water treatment - activated sludge treatment plants - mass balances, with and without recycle plants-single tank, contact stabilisation, biosorption plants.

4.2. Biofilters - Hydraulic film diffusion, two component diffusion -types of plants - trickling filters

4.3. Submerged filters and rotating disc, removal of particulate organic matter.

UNIT – V **15 Hours**

Treatment plants

5.1. Treatment plants for nitrification-mass balances- nitrifying plants and types of plants.

5.2. Treatment plant for denitrification - mass balances-denitrifying plants and types of plants, redox zones in the biomass.

5.3. Anaerobic waste water treatment -Plant types, pretreatment, plant with suspended sludge and filter process.

BOOKS FOR REFERENCE

1. A.K. De, *Environmental Chemistry*, Wiley Eastern .
2. S.K. Banerji, *Environmental Chemistry*, Prentice Hall of India, New Delhi.
3. M.M. Saxena, *Environmental Analysis of Water, Soil and Air*, Agro Botanica, Bikaner.
4. B. Ghosh, J.C. Bajaj, R. Hasan and D. Singh, *Soil and Water Testing Methods, A Laboratory Manual*, IARI, New Delhi.

Web Sources:

https://www.organicawater.com/primary-secondary-tertiary-wastewater-treatment-work/

https://www.ias.ac.in/article/fulltext/reso/005/11/0056-0068

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	explain the characteristics of water and measurement techniques	K1, K2, K3
CO2	summarize the potable water standards and disinfectant methods	K2, K3, K4

CO3	discuss waste water treatment methods	K2
CO4	generalize industrial waste water treatment methods	K1, K2
CO5	elaborate treatment plants	K1, K2

Mapping of Cos with POs/ PSOs

COs	**POs/PSOs**								
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	M	S	S	S	S	M	S	S	S
CO2	M	S	S	S	S	M	S	S	S
CO3	M	M	M	S	S	M	M	M	S
CO4	M	M	M	S	S	M	M	M	S
CO5	M	M	M	S	S	M	M	M	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-VII: INORGANIC CHEMISTRY-II

Course Code : 20PCHC4 Hours/Week : 6 Credit: 5

Semester : II Batch: 2020-22

Course objectives

- *To improve sound knowledge in contemporary inorganic chemistry for the new generation of students.*
- *To understand the concept of coordination compounds.*
- *To understand the HSAB principle*
- *To know the action of biologically important complexes.*

Syllabus

UNIT I **18 Hours**

Structural aspects

1.1 Geometry and coordination numbers (two -six) and high (seven and above) coordination numbers.
Macrocyclic ligands: Types –Porphyrins, corrins, and Schiff's bases.

1.2 Stability of the complexes- stepwise and overall stability constants Factors affecting the stability, chelate effect and stability of complexes. Determination of stability constant by polarographic, spectrophotometric and potentiometric methods.

1.3 Stereochemical aspects-Sterioisomerism in inorganic complexes, Isomerism arising out of ligand distribution and ligand conformation.

UNIT-II **18 Hours**

Metal-Ligand bonding

2.1 Crystal field theory-splitting of d-orbitals in octahedral, tetrahedral and square planar complexes, Factors affecting the magnitude of Δo, CFSE calculation, applications of CFSE,

2.2 Irwing Williams series, Spectrochemical series, Jahn-Teller distortion- Jahn -Teller effect. Evidences for metal-ligand overlap-esr, nmr, nephelauxetic effect. Limitation of CFT.

2.3 MO theory and energy level diagram, concept of weak and strong field, sigma and pi- bonding in complexes. Magnetic properties of complexes.

UNIT-III **18 Hours**

Solid state chemistry

3.1 Structure of NiAs, CdI_2, Pervoskite, Spinels and inverse Spinels.
Defects in solids-Point defects-line defects and surface defects, Non-stoichoimetric compounds.

3.2 Electrical properties of solids: Band theory, explanation of insulators, conductors, semiconductors and super conductors.

3.3 Diffusion types and mechanism: vacancy, interstitial, interstitialcy and ring diffusions. Solid solution and order disorder transformation and super structures.

UNIT-IV **18 Hours**

4.1 **Hard and soft acids and bases:** Classification, symbiosis, theoretical basis of hardness and softness, HSAB principle.

4.2 Solid state electrolytes, Reaction in solid state and phase transitions, Magnetic properties - dia, para, ferro, anti-ferro and ferrimagnetism, hysterisis, ferrites, garnets, Optical properties-solid state lasers and inorganic phosphors.

4.3 **Supramolecular chemistry**: Introduction-self assembly into mono and multilayer structure- application of crown ethers, crypts and fullerenes.

UNIT-V **18 Hours**

Bio- Inorganic chemistry

5.1 Metal ions in biological systems-essential and trace metals,

5.2 Biologically important complexes of Iron (transport proteins), haemoglobin, myoglobin, Iron-sulphur proteins, cytochrome-C,

5.3 Magnesium (chlorophyll, Photosystem-I and II), cobalt (vitamin B_{12}), Zinc (carbonic anhydrase, carboxy peptidase and insulin).

BOOKS FOR STUDY

1. Gurdeep Chatwal and M.S.Yadav, "*Coordination Chemistry*", 1st edition, Himalaya Publishing House,1992 .
2. Leonid V. Azaroff, "*Introduction of Solids",* Tata McGraw-Hill Publishing Company Ltd,1986.
3. Lasley Smart and Elain Moore.,"*Solid state Chemistry an Introduction",2nd edition, Replica Press Pvt. Ltd, 2004*.
4. Anthony R. West, "*Solid State Chemistry and its Application*", John Wiley Sons,1987.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, "*Inorganic Chemistry Principles of structure and reactivity",* 4th edition, Harpercollins College Publishers, 1993.
6. J.D.Lee. *"Concise Inorganic Chemistry",* 5th edition, Blackwell Science,1996.
7. Asim K. Das, *Bioinorganic Chemistry*, Books and Allied (P) Ltd. Kolkata, Reprint 2011.

BOOKS FOR REFERENCE

1. Shriver and Atkins, " Inorganic Chemistry", Fourth Edition, Oxford University Press, 2006.

2. F.A.Cotton and G.Wilkinson, "Advanced Inorganic Chemistry". Wiley Eastern, Fifth Edition, 1998.

3. Sathya Prakash, G.D.Tuli, S.K.Basu, R.D.Madan, "Advanced Inorganic Chemistry" 17th Edition, S Chand & Co Limited, 1999.

Web Source:

https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(Inorganic_Chemistry)/Coordination_Chemistry/Structure_and_Nomenclature_of_Coordination_Compounds/Coordination_Numbers_and_Geometry

https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(Inorganic_Chemistry)/Coordination_Chemistry/Complex_Ion_Equilibria/Complex-Ion_Equilibria

https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(Inorganic_Chemistry)/Coordination_Chemistry/Structure_and_Nomenclature_of_Coordination_Compounds/Coordination_Numbers_and_Geometry

https://www.chemtube3d.com/category/inorganic-chemistry/advanced-solid-structures/

http://web.iitd.ac.in/~elias/links/Basic%20Inorganic%20chemistry%20part%203%0

Bioinorganic%20chemistry.pptx

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	acquire sound knowledge on coordination compounds; stereochemical aspects and stability of complexes	K1, K2, K3
CO2	understand the theories of coordination compounds; CFT, MO	K3, K4
CO3	acquire the knowledge of structure and defects in solids; superconductivity and magnetic property of solids	K1, K2,K3,K4
CO4	learn and apply HSAB principle; Have deep knowledge on the band structure of solids and role of band gap in determining the electrical properties (conductors, semiconductors and insulators) of materials	K1,K2, K3
CO5	understand and appreciate the role of metals in biological systems	K1, K2

Mapping of Cos with POs/ PSOs

COs		POs/ PSOs							
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	M	S	M	M
CO2	S	M	S	S	S	S	S	S	M
CO3	S	L	S	S	S	S	M	S	L
CO4	S	L	S	S	S	S	M	L	S
CO5	S	S	S	S	S	S	L	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-VIII: ORGANIC CHEMSITRY – II

Course Code : 20PCHC5 Hours/Week : 6 Credits: 5

Semester : II Batch: 2020-22

Course Objectives:

- *To understand the effect of structure on reactivity*
- *To know the various methods of determining reaction mechanisms*
- *To impart knowledge about addition reaction*
- *To appreciate the reactivity of aromatic compounds by learning electronic distribution.*
- *To get exposed to molecular rearrangements, oxidation and reduction reactions.*

Syllabus

UNIT-I **18 Hours**

Structure and Reactivity

1.1 **Effect of structure on reactivity**

Resonance and field effects- Hammett equation and Linear free energy relationship- substituent and reaction constants - simple problems-Taft equation.

1.2 **Thermodynamic and kinetic requirements for reactions**

Hammond's postulate-Microscopic reversibility- Curtin Hammett principle –transition states and intermediates.

1.3 Kinetic and non-kinetic methods of determining reaction mechanisms

Primary and secondary kinetic isotopic effects- identification of products and study of intermediates- isotopic labeling and cross over experiments.

UNIT-II **18 Hours**

Addition to Carbon-Carbon and Carbon-Hetero Multiple Bonds.

2.1 **Electrophilic addition**

Mechanism of electrophilic addition-Addition of halogen and hydrogen halide to olefin- regiochemistry, Markovnikov and anti-Markovnikov addition, hydration of olefins and acetylenes.

2.2 Hydroboration, hydroxylation, Diels-Alder reaction, 1,3-dipolar addition reaction.

Addition of carbenes and nitrenes to double bond- singlet and triplet carbene- generation and their addition.

2.3 **Nucleophilic addition**

Mechanism of nucleophilic addition -Reactions of carbonyl groups- Benzoin condensation, Mannich, Darzen, Wittig and Thorpe reactions.

UNIT-III **18 Hours**

Electrophilic Substitution Reactions

3.1 **Aromatic electrophilic substitution, Mechanism, Reactivity and Orientation**

Arenium ion mechanism- orientation and reactivity- orientation and reactivity in mono substituted benzene rings – ortho/para ratio- ipso attack – orientation in benzene rings with more than one substituent

3.2 **Aromatic electrophilic substitution reactions**

Nitration, sulphonation, halogenation, Friedel-Crafts alkylation and acylation, formylation- Vilsmeier-Haack, Gatterman, Reimer Tiemann and Houben-Hoesch reactions. Bischler –Napieralski, Hofmann-Martius and Jacopsen reactions.

3.2 **Aliphatic Electrophilic substitution reactions**

S_E1, S_E2 front, S_E2 back andS_Ei, Hell-Volhard-Zelinski reaction, Friedel-Crafts acylation at olefinic carbon, Stork-enamine reaction.

UNIT-IV **18 Hours**

Molecular Rearrangements

4.1 Nucleophilic, electrophilic and free radical rearrangements- intramolecular and intermolecular rearrangements - migratory aptitudes - memory effects.

4.2 Wagner-Meerwin and related 1,2 shifts, Benzilbenzilic acid, Demyanov, Dienone-phenol, Favorski, Baeyer-Villiger, Hydroperoxide, Stevens, Sommelet-Hauser and Smiles rearrangements.

UNIT-V **18 Hours**

Oxidation and Reduction Reactions

5.1 **Oxidation**

Introduction- oxidation of alcohols to aldehydes and ketones- oxidative cleavage of glycols and related compounds- ozonolysis- Criegee mechanism, oxidation of methylene to carbonyl- oxidation of aryl methanes – oxidation of allylic and benzylic compounds- oxidation of carbonyl compounds to 1,2 – dicarbonyl compounds.

5.2 **Reduction**

Introduction- heterogeneous hydrogenation– homogeneous hydrogenation metal hydride reduction- LAH, Lithium tributoxyaluminiuim hydride, sodium borohydride ($NaBH_4$), $NaBH_3(CN)$, diborane, Birch reduction, Clemmensen reduction, Wolff-Kishner reduction, MPV reduction, Acyloin condensation.

BOOKS FOR STUDY

1. R.T. Morrison and Boyd, *Organic chemistry*, Sixth edition, Prentice Hall, 1992.
2. V.K. Ahluwalia and R.K. Parashar, *Organic Reaction Mechanism*, Second edition, Narosa Publishing House (2005).

BOOKS FOR REFERENCE

1. Jerry March, *Advanced Organic Chemistry- Reactions, Mechanismsand Structure*, Fourth edition, John Wiley and Sons (1992).
2. Somorandranath, Sanyal and Sanyal, *Reactions, Rearrangements and Reagents*, BharatiBhawan Publishers (1997).
3. Jagadamba Singh and L.D.S. Yadav , *Advanced Organic Chemistry, Pragati Prakashan,* Eighth edition, (2012).
4. Jagadamba Singh and L.D.S. Yadav , *Organic Synthesis, Pragati Prakashan,* Eighth edition, (2012).
5. Ratan Kumar Kar, *Applications of Redox and Reagents in Organic Synthesis*, Vol-I , New Central Book Agency Private Ltd.,(2008).

Web sources:

https://epgp.inflibnet.ac.in/view_f.php?category=664

https://epgp.inflibnet.ac.in/view_f.php?category=660

https://www.masterorganicchemistry.com/2011/10/03/introduction-to-addition-reactions/

https://www.masterorganicchemistry.com/2013/03/22/hydroboration-of-alkenes/

https://www.masterorganicchemistry.com/2013/04/25/summary-alkene-reaction-pathways/

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	understand the effect of structure on reactivity understand and apply various methods of determining reaction mechanisms	K2,K3
CO2	design the synthetic route for unknown molecule by applying the accepted mechanism of addition reaction of alkenes and carbonyl compounds	K3,K4
CO3	compare and appreciate the reactivity of aliphatic and aromatic compounds with respect to electrophilic substitution reactions	K3,K5
CO4	devise reasonable high yield synthesis of a target molecule from the given starting materials applying molecular rearrangements	K3,K4
CO5	predict the product, mechanism and uses of reactions involving selected oxidising and reducing agents	K5

Mapping of COs with POs and PSOs

	POs/PSOs								
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE-II No.1: CHEMICAL KINETICS AND THERMODYNAMCS

Course Code : 20PCHEC2 Hours/Week : 6 Credit: 5

Semester : II Batch: 2020-22

Course Objectives:

- *To learn about theories of reaction rates, kinetics of reactions in solution and classical thermodynamics*
- *To discuss the basic concepts of classical, quantum statistics and their applications*

Syllabus

UNIT-I **18 Hours**

Chemical kinetics-I

1.1. Kinetics of simultaneous reactions–consecutive, opposing and parallel reactions-steady state concept for establishing the reaction mechanism – Rice–Herzfeld mechanism for hydrogen-bromine, gas phase pyrolysis of methane and formation of phosgene reactions.

1.2. Transition state theory of reaction rates-potential energy surfaces-partition functions and activated complex - Eyring equation - comparison of results with Eyring and Arrhenius equations -free energy, enthalpy and entropy of activation and their significance.

UNIT-II **18 Hours**

Chemical kinetics-II

2.1. Reactions in solutions-comparison between gas phase and solution reactions-the influence of solvent, ionic strength, dielectric constant and pressure on reaction in solution-kinetic isotope effects-linear free energy relationship-Hammett and Taft equations.

UNIT – III **18 Hours**

Classical thermodynamics-II

3.1. Fugacity- definition-methods of determination of fugacity, variation of fugacity with temperature and pressure. Standard state for gases, liquids, solids and components of solutions.

3.2. Determination of activity and activity coefficient of solvents from freezing point and emf measurements.

3.3. Solution of electrolytes -mean ionic activity, mean ionic molality and mean ionic activity coefficients-determination of activity coefficient from freezing point, emf and solubility measurements- Concept of ionic strength.

UNIT- IV **18 Hours**

Statistical Thermodynamics

4.1. Maxwell's law of distribution of molecular speeds, graphical representation, Experimental verification and derivation of expressions for average, most probable and root mean square velocity. Objectives of statistical thermodynamics - Concept of thermodynamical and mathematical probabilities - distribution of distinguishable and in-distinguishable particles.

4.2. Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics-comparison.Application of Planck distribution law for black body radiation, Fermi - Dirac electron gas in metal.

UNIT-V **18 Hours**

5.1. Partition functions- evaluation of translational, vibrational, rotational and electronic partition function-thermodynamic functions in terms of partition function-

5.2. Applications of partition function to monoatomic and diatomic gases -heat capacities of monoatomic crystals-Einstein and Debye theory of heat capacities.

BOOKS FOR STUDY

1. D.N. Bajpai, *Advanced Physical Chemistry*, 2nd revised edition, S.Chand & Company Ltd., 1998.
2. Keith. J. Laidler, *Chemical Kinetics*, 3rd edition Pearson education, 2007Samuel Glasstone, *Thermodynamics for Chemists,* 11th edition, Affiliated East West Press, 1960. 4.
3. Gurdeep Raj, *Advanced Physical Chemistry*, 18th revised edition, Goel Publishing Company, 1994.

BOOKS FOR REFERENCE

1. P.W Atkins and J.de Paula, *Physical Chemistry*, 8th edition., Oxford University Press, 2006.
1. S.K. Dogra and S.Dogra *Physical ChemistryThrough Problems* Wiley Eastern Limited., 1984.

Web Source:

1.http://staff.um.edu.mt/jgri1/teaching/che2372/notes/09/03/chain.html

2.https://www.educator.com/chemistry/physical-chemistry/hovasapian/statistical-thermodynamics_-the-various-partition-functions-i.php

3.https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Book%3A_Physical_Chemistry_(Fleming)/11%3A_Chemical_Kinetics_I

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	explicate the kinetics of simultaneous reactions and comprehend the significance of ARRT	K4
CO2	examine the influence of physical parameters on reaction in solutions	K3
CO3	assess the importance of determining fugacity, activity and activity co-efficient	K5
CO4	summarize the objectives, distribution law and applications of statistical thermodynamics	K4
CO5	calculate different partition function and know about theories of heat capacity	K2, K3

Mapping of Cos with POs/ PSOs

COs	POs/ PSOs								
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	M	M
CO5	M	M	S	M	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE-II No.2: GREEN CHEMISTRY

Course Code : 20PCHESC2 Hours/Week : 6 Credit: 5

Semester : II Batch: 2020-22

Course Objectives:

- *To learn about the green reagents and green synthesis*
- *To discuss about the aqueous phase reactions and organics synthesis in solid state*

Syllabus

UNIT – I **18 Hours**

Need for green chemistry

Introduction, sustainability, green chemistry and eco efficiency, environmental problems. Inception and evolution of green chemistry- twelve principles of green chemistry- international organisations promoting green chemistry.

UNIT – II **18 Hours**

Green reagents and catalysts

DMC, polymer supported reagents, aid catalysts, oxidation catalysts, polymer supported catalysts, PTC, crown ethers, biocatalysts in organic synthesis, enzyme catalysed reactions, microbial oxidation and reduction.

UNIT – III **18 Hours**

Microwave induced green synthesis

Microwave assisted reactions in water and organic solvents, solvent free reactions, ultrasound assisted green synthesis, saponification, substitution, coupling reactions, Friedel - Craft's reaction, Diels-Alder reaction, Cannnizaro reaction, Reformatsky reaction.

UNIT – IV **18 Hours**

Aqueous phase reactions

Diel's-Alder reactions, Claisen rearrangement, Aldol condensation, Knoevenegal reaction, Pinacol coupling benzoin condensation, reduction of C=C. Carbonyl compounds, aromatic compounds polymerisation, photochemical reactions, cycloaddition, electrochemical synthesis, adiponitrile, sebacic acid.

UNIT – V **18 Hours**

Organic synthesis in solid state

Michael addiiton, Grignard reaction, nuclear halogenation, nitration, Beckmann rearrangement, dimerisation of fullerene, synthesis of β-lactam, synthesis of aziridines, synthesis of quinoline.

BOOKS FOR REFERENCE

1. Ahluwalia, Kidwai, *New trends in Green chemistry*, second Ed., Anamaya publishers, New Delhi.
2. Sanghi, Srivastava, *Green Chemistry* , Narosa publishing house New Delhi.

Web Source:

https://www.epa.gov/greenchemistry/basics-green-chemistry

https://www.researchgate.net/publication/308995209_THE_ROLE_OF_CATALYSTS_IN_GREEN_SYNTHESIS_OF_CHEMICALS_FOR_SUSTAINABLE_FUTURE

https://www.researchgate.net/publication/261872979_Microwave_assisted_synthesis_a_green_chemistry_approach

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	explicate the need for green chemistry	K1, K2
CO2	examine the green reagents and catalysts	K3
CO3	assess the importance of microwave induced synthesis	K5
CO4	explain the aqueous phase reactions	K2,K3
CO5	illustrate about the organic synthesis in solid state	K2, K3

Mapping of Cos with POs/ PSOs

COs		POs/ PSOs							
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	S	L	L	M	M	L	S	L	M
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-IV: INORGANIC CHEMISTRY PRACTICAL

Course Code : 20PCHQC1 Hours/Week : 3 Credits: 3

Semester : I & II Batch: 2020-22

Course objectives

Enable the students to

- *Stimulate the interest in the field of qualitative analysis and to understand the reactivity of common and rare earth cations.*
- *Learn about Photocalorimetric, Cerimetric and complexometric titrations.*

Syllabus

1. **Qualitative analysis:**

   Semi-micro qualitative analysis of mixture containing two common and two rare cations. The following rare cations to be included: W, Se, Te, Ce, Th, Ti, Zr, V, Be, U and Li

2. **Quantitative analysis**:

   a. Photocolorimetry- Estimation of Fe, Ni, Mn, Ti and Co(II)
   b. Complexometric titrations using EDTA- Estimations of Zn, Ca, Mg, Ni and Hardness of water
   c. Cerimetry: Cerimetric estimation of Fe (II) and oxalic acid.

REFERENCE BOOKS

1. V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu, "*Basic Principles of Practical Chemistry"*, 2nd edition, Sultan Chand and Sons, 1997.

2. V. V. Ramanujam, "*Inorganic Semi Micro Qualitative Analysis"*, 3rd edition, The National Publishing Company, 1990.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	understand the principle of qualitative inorganic analysis	K1, K2, K3
CO2	identify various ions present in mixture of salts	K1, K2
CO3	learn to detect the rare earth qualitatively	K1, K2, K3
CO4	estimate the amount ions by complexometric and cerimetric methods	K1, K2
CO5	acquire skills to estimate Fe, Ni, Mn, Ti and Co(II) by photocolorimetry	K1,K2, K3

Mapping of Cos with POs/ PSOs

COs	PO/ PSO								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	S	S	S	M	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-V: ORGANIC CHEMISTRY PRACTICAL- I

Course Code : 20PCHQC2 Hours/Week : 3 Credits: 3

Semester : I & II Batch: 2020-22

Course Objectives:

- *To familiarize the students with estimation of organic compounds like phenol, aniline etc.,*
- *To train students in the synthesis of organic compounds*
- *To train students in the analytical techniques such as chromatography*

Syllabus

Organic Estimations:

1. Phenol
2. Aniline
3. Methyl ketone
4. Glucose
5. Carboxylic Acid/Ascorbic acid
6. Iodine value of an Oil
7. Saponification value of an oil

Organic preparations involving two/three stages

1. Sym-tribromobenzene from aniline
2. 5-Nitrosalicylic acid from methyl salicylate
3. Aspirin from methyl salicylate
4. p-Nitroaniline from acetanilide/aniline
5. p-Bromoaniline from acetanilide/aniline
6. Bezanilide from Benzophenone

Extraction of natural products

1. Citric acid from lemon/pineapple
2. Caffeine from tea leaves

Chromatographic Separations

1. TLC-Separation of a mixture of two or more organic compounds.
2. Paper chromatography-Identification of natural amino acids.
3. Column chromatography-Separation of a mixture of o & p-nitroaniline.

REFERENCE BOOKS

1. N.S. Gnanaprakasam& G. Ramamurthy, *Organic Chemistry Lab Manual*, S. Viswanathan (printers and publishers) Private Ltd. 2002.
2. B.B. Dey and M.V. Seetaraman *Laboratory Manual of Organicchemistry*, Third edition, Allied Publishers Ltd.1992.

3. Raj K. Bansal, *Laboratory Manual of Organic Chemistry*, Third edition, New Age International(p) Ltd.1996.
4. B.S. Furniss, A.J. Hannaford, P.W.C. Smith and A.R. Tatcell, *Vogel's Practical Organic chemistry*, Fifth edition, ELBS, 1989.
5. N.K. Vishnoi,*Advanced Practical Organic Chemistry*, Vikas Publishing House Pvt. Ltd. Second reprint, 1994.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Identify limiting reagents, calculate the theoretical yield and percentage yield	K3
CO2	perform experiments safely by handling chemicals, glass wares and equipment's appropriately	K2
CO3	develop skills in the synthesis of organic compounds and perform common laboratory techniques including refluxing, distillation, recrystallization and vacuum filtration	K3
CO4	explain the theory behind the operations performed and give a detailed mechanism for all laboratory reactions	K2,K4
CO5	independently perform two or more step organic synthesis and extract compounds from natural products	K3

Mapping of COs with POs and PSOs

	POs/PSOs								
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	M	S	S	S	S	S	S	S	S
CO2	M	S	S	S	S	S	S	S	S
CO3	L	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S
CO5	L	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-VI: PHYSICAL CHEMISTRY PRACTICAL- I

Course Code : 20PCHQC3 Hours/Week : 4 Credits: 3

Semester : I & II Batch: 2020-22

Course Objectives:

Enable the students

- *To develop skill, practical knowledge about potentiometric experiments and to impart knowledge about phase diagrams*

Syllabus

Phase rule and thermodynamics

1) Two component systems-simple eutectic system.

2) Two component systems-compound formation with congruent melting point.

3) Three component systems (chloroform –water - acetic acid).

4) Distribution coefficient of iodine between carbon tetrachloride and water.

5) Determination of equilibrium constant for the reaction $KI+I_2 \rightleftharpoons KI_3$.

6) Determination of unknown concentration of KI.

Potentiometry

7) Strong acid Vs strong base (HCl Vs NaOH).

8) Weak acid Vs strong base (CH_3COOH Vs NaOH).

9) Mixture of acids Vs strong base (CH_3COOH+Hcl Vs NaOH).

Precipitation titrations

10) Sodium chloride Vs silver nitrate

11) Potassium iodide Vs silver nitrate

12) Potassium bromide Vs silver nitrate

13) Mixture of halides Vs silver nitrate.

Redox titrations

14) Ferrous ions Vs potassium permanganate.

15) Ferrous ions Vs potassium dichromate.

16) Ferrous ions Vs ceric ammonium nitrate

17) KI Vs potassium permanganate.

Miscellaneous

18) Determination of pH of buffer solution – quinhydrone electrode.

19) Determination of solubility, solubility product of AgI-Half cell method, concentration method.

20) Determination of transport number of Ag+ and NO_3^- ions.

21) Determination of dissociation constant of a weak acid.

22) Determination of activity coefficient ($AgNO_3$).

23) Determination of single electrode potentials(Ag/ Ag+, Zn/Zn^{2+}, Cu/Cu^{2+}).

BOOKS FOR REFERENCE

1. B. Viswanathan and P. S. Raghavan, *Practical Physical Chemistry*, First edition, Viva books Pvt. Ltd.2005.
2. B. P. Levitt, *Findlay's practical physical chemistry*, ninth edition, Longman group Ltd. 1973.
3. J. B. Yadav, *Advanced practical physical chemistry,* 27th Edition Goel publishing house. 2008.

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	construct and analyse the phase diagram to determine the eutectic point	K2, K3
CO2	understand Nernst distribution law and its applications	K2
CO3	develop skills in the estimation of acid-base, precipitation and redox titrations	K3
CO4	determine the solubility of sparingly soluble salts	K3
CO5	Apply and analyze the principles of potentiometric Titrations	K3

Mapping of Cos with POs/ PSOs

COs		POs/ PSOs							
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	S	M	L	S	L	S	M	L	S
CO2	S	S	M	S	L	S	M	L	S
CO3	S	S	M	S	S	S	S	M	S
CO4	S	M	M	S	S	S	S	M	S
CO5	S	S	S	S	M	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-IX: ORGANIC CHEMISTRY-III

Course Code : 19PCHC6 Hours/Week : 5 Credit: 4

Semester : III Batch : 2019-21

Course Objectives:

Enable the students

- *To know the synthesis and properties of heterocyclic compounds.*
- *To know about bioorganic polymers such as carbohydrates, protein and Nucleic acids.*
- *To get an insight of natural products and synthesis of alkaloids, terpenoids , carotenoids and steroids.*
- *To learn the method of designing an organic synthesis using various reagents in synthetic organic chemistry.*

Syllabus

UNIT-I **No. of Hours: 15**

Heterocyclics:

Synthesis and properties of imidazole, oxazole , thiazole, structural elucidation and synthesis of anthocyanidins, synthesis and structural elucidation of flavones and isoflavones – synthesis of pyrimidine and its derivatives-synthesis of uric acid, purine and its derivatives.

UNIT-II **No. of Hours: 15**

Bio-organic chemistry

Configuration and Conformation analysis of carbohydrates, polysaccharides-structure of starch and cellulose- photosynthesis of carbohydrates.

Peptides and their synthesis-determination of primary structure of a protein-oxytocin, geometry of peptide linkage secondary and tertiary structure of proteins-DNA and RNA-biosynthesis.

UNIT – III **No. of Hours: 15**

Alkaloids, Terpenoids and Carotenoids

Synthesis and structural elucidation of quinine, morphine and reserpine.

Biosynthesis of alkaloids and terpernoids (elementary treatment only)-Chemistry of juvenile hormone, abietic acid, squalene –α,β,γ carotenoids-lycopene-Vitamin A_1.

UNIT – IV **No. of Hours: 15**

Steroids:

Structure and stereochemistry of Cholesterol, Ergosterol, Oestrone, cortisone. Application of ORD and CD, detection of absolute configuration, octant rule, cotton effect-axial haloketone rule for cholesterol - Conversion of Cholesterol to progesterone, Testerone and Oestrone –conversion of Ergosterol to Progesterone.

UNIT – V **No. of Hours: 15**

Reagents in organic Synthesis:

Use of the following reagents in organic synthesis and functional group transformation –Gilman's reagent(lithium dimethyl cuprate),Lithium diisopropyl amide(LDA),DCC,1,3 –Dithiane (reaction umpolung),trimethyl silyl iodide, diisobutyl aluminium hydride(DIBAL-H), DDQ, Baker's yeast, DBU, 9-BBN.

BOOKS FOR STUDY

1. I.L.Finar, *Organic Chemistry,* Vol II, V edition, ELBS.2011
2. P.S.Kalsi, *Chemistry of Natural Products*, Kalyani publications,1983.
3. R.O.C.Norman, *Principles of organic synthesis*, II edition, Chapman and Hall,1978,

BOOKS FOR REFERENCE

1. Gurdeep K.Chatwal, ,*Organic Chemistry of Natural Products*, vol.II V edition,Himalaya Publishing House, 2013.
2. O.P. Agarwal ,*Chemistry of Organic Natural Products* ,Vol. II,VII edition, Goel publishing House,1984.
3. S.Renuga, Name Reactions and Reagents in Organic Synthesis,

   Vishal Publishing Co.,Copy right 2016-2017.

Web Sources

1. https://www.pharmatutor.org/articles/imidazole-synthesis-properties-biological-activity
2. http://www.chem.ucla.edu/~harding/tutorials/carbos/representations.pdf
3. http://renaud.dcb.unibe.ch/topic-review/topic-review-2012/tr2012_05-morphine.pdf

4. https://en.wikibooks.org/wiki/Structural_Biochemistry/Lipids/Cholesterol

5.https://www.tcichemicals.com/pdf/ReagentGuide_8th_SynthesticOrganicChemistry_MaterialsChemistry.pdf

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	sketch the synthesis and compare the properties of Oxygen, Nitrogen, Sulphur heterocycles and Flavonoids	K2,K3
CO2	analyse the structure, configuration and conformation of carbohydrate, protein, nucleic acids and their biological functions	K3, K4
CO3	elucidate the structure of terpenoids, alkaloids and outline their synthesis	K3, K4
CO4	discuss and elucidate the structure of steroids and outline their synthesis; apply ORD and CD to analyse the stereochemistry of steroids	K3, K4
CO5	apply the utility of organic reagents in organic synthesis and functional group transformation for analysis and research	K3, K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	M	S	S	S	S	M	M	M	S
CO2	S	L	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	S	S

Programme Title : MSc. CHEMISTRY

Course Title : CORE-X : PHYSICAL CHEMISTRY-II

Course Code : 19PCHC7 Hours/Week : 5 Credit: 4

Semester : III Batch: 2019-21

Course Objectives:

Enable the students

- *To cover basic concepts like chain reactions, adsorption & theoretical electrochemistry*
- *To present the latest advances and trends in applied electrochemistry.*

Syllabus

UNIT-I **No. of Hours: 15**

Chemical kinetics-I

Kinetics of chain reactions - General treatment of chain reaction-chain length-Rice-Herzfeld mechanism - explosion limits-Free radical polymerisation reactions.

Study of fast reactions. Luminescence and energy transfer process-Study of kinetics by relaxation methods, temperature and pressure methods, Stopped flow technique and Flash photolysis.

UNIT-II **No. of Hours: 15**

Chemical kinetics-II

Surface chemistry and catalysis.

Kinetics of surface reactions-physical and chemical adsorption-adsorption isotherms- types of adsorption isotherms-Langmuir adsorption isotherm--B.E.T theory for multilayer adsorption.

Application of transition state theory to adsorption -measurement of surface area-mechanism of heterogeneous catalytic reactions.

Acid base catalysis-mechanism-Bronsted catalysis law-catalysis by enzymes-rate of enzyme catalysed reactions-effect of substrate concentration, pH and temperature on enzyme catalyzed reactions-influence of enzyme catalyzed reactions.

UNIT-III **No. of Hours: 15**

Electrochemistry-I

Ion transport in solution-migration, convection and diffusion-Ficks law of diffusion. Debye Huckel theory of strong electrolytes - Debye Huckel Onsager equation.-verification and limitation -conductivity at high field and at high frequency-Debye Huckel limiting law and its extension -effect of ion association on conductivity.

UNIT-IV **No. of Hours: 15**

Electrochemistry-II

Electrode - Electrolyte interface - adsorption at electrified interface-Electrical double layer-Electrocapillary phenomena, Lippmann equation-structure of double layers-Helmholtz -Perrin, Gouy-Chapman and stern

models-Electrokinetic phenomena-Tiselius method of separation of proteins-membrane potential.

UNIT-V **No. of Hours: 15**

Electrodics-mechanism of electrode reactions-polarisation and over potential-the Butler Volmer equation for one step one electron transfer reactions-significance of equilibrium exchange current density and symmetry factor-significance of transfer coefficient-mechanism of hydrogen and oxygen evolution reactions.
Electrochemical inorganic and organic reactions of technological interest-corrosion and passivation of metals-construction of Pourbaix and Evans diagrams. Prevention of corrosion-electrochemical energy systems-Dry cells, lead acid storage battery, zinc cell, nickel cadmium battery-fuel cells –electrodeposition--principles and applications.

BOOKS FOR STUDY

1. D.N. Bajpai, *Advanced Physical Chemistry*, 2nd revised edition, S.Chand & Company Ltd., 1998.
2. Keith J. Laidler, *Chemical Kinetics*, 3rd edition, Pearson education Inc., 2007.
3. Samuel Glassstone, *Introduction to Electrochemistry*, 10th printing, Affiliated East West Press, 1942.

BOOKS FOR REFERENCE

1. J.O.M.Bockris & A.K.N. Reddy, *Modern Electrochemistry*, Volume 2A and 2B, 2nd edition, Springer, 2000.
2. L. Antropov, *Theoretical electrochemistry*, 1st edition, Mir publishers, 1972.

Web Source:

1.https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Book%3A_Physical_Chemistry_(Fleming)/11%3A_Chemical_Kinetics_I

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Comprehend the kinetics of chain and fast reactions	K2
CO2	Analyse the concepts of adsorption isotherm and enzyme catalysis	K3
CO3	Evaluate the behaviour of strong and weak electrolyte	K5
CO4	Assess different double layer model and their applications	K5
CO5	Categorize different electrochemical energy systems and their impact on society	K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	M	M
CO5	M	M	S	M	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-XI: COORDINATION CHEMISTRY

Course Code : 19PCHC8 Hours/Week : 5 Credit: 4

Semester : III Batch: 2019-21

Course objectives

Enable the students

- *To know different term states in different ligand fields.*
- *To discuss the electronic spectra and different energy level diagrams.*
- *To know different reaction mechanisms in inorganic complexes.*
- *To discuss the bonding involved in organometallics and its applications.*

Syllabus

UNIT- I **No. of hours-15**

Electronic spectra of complexes

Spectroscopic term symbols for d^n ions-derivation of term symbols and ground state term symbol.

Selection rules-breakdown of selection rules.

Spin-orbit coupling, band intensities, weak and strong field limit.

Energy level diagrams - Orgel and Tanabe-Sugano diagrams, effect of distortion and spin orbit coupling on spectra,

Evaluation of D_q and B values for octahedral complexes of nickel.

Charge transfer spectra.

Spectral and magnetic properties of lanthanides.

UNIT-II **No. of hours-15**

Reaction mechanism in complexes

Outer sphere electron transfer reactions , Inner sphere electron transfer reactions, atom transfer reactions, formation and rearrangement of precursor complexes, the bridging ligand, successor complexes,

Kinetics and mechanism of substitution reaction in square planar complexes. Factors affecting square planar substitution reactions - trans effect, trans influence, Influence of entering and leaving groups and central metal atom on square planar substitution reactions.

UNIT-III **No. of hours-15**

Substitution in octahedral complexes.

Discussion of A, D, Ia, Id and DcB mechanism.

Replacement of coordinated water, mechanism of acid and base hydrolysis,

Evidence for conjugate base mechanism.

Synthesis of platinum and cobalt complexes.

Template reactions, Rearrangement reactions in four coordinate and six coordinate complexes.

UNIT-IV **No. of hours-15**

Organometallic chemistry

Metalation reactions in alkyls and aryls.

Structure and bonding of metal carbonyls.

Isolobal concept and its application.

Bonding modes of metallic nitrosyls (linear, bent, bridging, nitrosyl complexes).

Synthesis, structure and bonding of metal-olefin and acetylene complexes, Synthesis, structure and bonding of ferrocene.

Reactions — ligand protonation, carbonylation and decarbonylation, electrophilic attack on ligands.

UNIT-V **No. of hours-15**

Oxidative addition and reductive elimination in organometallics.

Fluxional isomerism.

Hydrogenation of olefins (Wilkinson catalyst),

Oxo process (Co and Rh catalyst),

Oxidation of olefins to aldehydes and ketones (Wacker's process).

Polymerisation (Ziegler –Natta Catalyst).

Cyclo oligomerisation of acetylene using Ni catalyst (Reppe's catalyst); polymer bound catalyst

BOOKS FOR STUDY

1. R.S. Drago., *Physical methods in chemistry*, Reinhold, New York 1968.
2. D.F. Shriver, P.W.Atkins and C.H. Longford. *Inorganic chemistry*, ELBS 4th edition, 2006.
3. W.U.Malik, G.D.Tuli, R.D.Madan, *Selected Topics in Inorganic Chemistry*, S.Chand, 1st edition, 1976.
4. B.R.Puri, L.R.Sharma, K.C.Kalia, *Principles of Inorganic Chemistry*, Miles stone publishers, New Delhi,2007.

BOOKS FOR REFERENCE

1. K.F. Purcell and J.C. Kotz, *Inorganic chemistry*, WB. Saunders. co., USA.
2. J.E. Huheey, E.A. Keiter & L. Kieter, *Inorganic Chemistry - Principles of Structure and reactivity* 4th edition, Pearson Education,1997.
3. R.C. Mehrotra and A. Singh, *Organometallic Chemistry-A Unified Approach*. New Age,International (P) Ltd, 1st Edition, 2009 .
4. Gary L.Miessler, and Donald A Tarr, *Inorganic Chemistry*, 3rd Edition, Dorling Kindersley (India) Pvt Ltd., 2009.

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2.https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Inorganic_Chemistry_(Saito)/6%3A_Chemistry_of_Transition_Metals/6.4%3A_Reactions_of_Complexes

3.https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(Inorganic_Chemistry)/Organometallic_Chemistry/Fundamentals_of_Organometallic_Chemistry/Associative_Ligand_Substitution

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5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104108062/lec29.pdf

6. https://www.chemtube3d.com/oxo_reaction/

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	acquire sound knowledge on concepts of electronic spectra of transition metals; derive G.S and excited state terms symbols ; gain the skills to identify the spectral transition for the d^n configuration.	K1, K2, K3, K4
CO2	have elaborate understanding of electron transfer, square planar substitution reaction mechanism and interpreting the rates of electron transfer	K3, K4
CO3	acquire insights on substitution in octahedral complexes and rearrangement in 4 & 6 coordinate systems	K1, K2, K3
CO4	obtain an overall idea on structure and bonding involved in organometallic compounds	K1, K2
CO5	appreciate the role of organometallic catalysts in the synthesis of selective organic compounds	K1, K2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	M	L	L
CO2	S	M	S	M	S	S	M	M	M
CO3	S	S	S	L	S	M	M	M	M
CO4	S	M	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE – III No.1: GROUP THEORY AND SPECTROSCOPY

Course Code : 19PCHEC3 Hours/Week : 5 Credit: 4

Semester : III Batch: 2019-21

Course Objectives:

Enable the students

- *Concepts of symmetry are introduced.*
- *Spectral activity and hybridization were derived based on symmetry considerations.*
- *Theory and principles of spectroscopic techniques such as microwave, IR, Raman, UV, Visible, NMR and NQR are discussed in detail.*

Syllabus

UNIT-I **No. of Hours: 15**

1.1 Symmetry elements and symmetry operations: Axis of symmetry, reflections, symmetry planes, inversion-centre, improper rotations, effect of performing successive operations (commutative and non-commutative).

1.2 Definition of Group-basic properties of group-abelian group-cyclic group-sub group-isomorphic group-similarity transformation and classes-group multiplication tables –symmetry classification into point groups (schoenflies symbol only), determination of point groups.

1.3 Matrices: Definition of square matrix, diagonal matrix, null matrix, unit matrix, row matrix, column matrix, matrix notation for symmetry operations of C_{2V} and C_{3v} point group.

UNIT- II **No. of Hours: 15**

2.1 Definition of reducible and irreducible representations - irreducible representations as orthogonal vectors-direct product rule-the great orthogonality theorem and its consequences (statement only, proof not needed.

2.2 Construction of character tables (C_{2V} and C_{3V} point groups) using orthogonality theorem, calculation of translational, rotational and binary co-ordinates in the character tables for C_{2V} and C_{3V} point groups. Calculation of

character values of reducible representations per unshifted atom for each type of symmetry operation.

2.3 Group theory and vibrational spectroscopy-vibrational modes as basis for group representation-symmetry selection rules for IR and Raman spectra-mutual exclusion principle- determination of representation of vibrational modes in non-linear molecules *viz.*, H_2O, NH_3, BH_3 & CH_4

2.4 Application of group theory in determining hybridization of CH_4

UNIT-III **No. of Hours: 15**

3.1 **Proton NMR spectroscopy**

Theory-Chemical shift-factors affecting chemical shift-spin spin splitting (n+1 rule)- coupling constant –deuterium exchange-first order and non first order spectra -a review, chemical and magnetic equivalence, simplification of complex spectra-shift reagents-NMR instrumentation -FT NMR.

3.2 **Carbon-13 NMR spectroscopy**

^{13}C nucleus-chemical shifts-spin spin splitting-double resonance techniques: spin tickling, inter nuclear double resonance (INDOR)-nuclear overhauser effect (NOE)-homo and hetero nuclear decoupling-broad band decoupling.

UNIT-IV **No. of Hours: 15**

4.1 **Nuclear quadrupole resonance**

Theory-applications of NQR-(nature of chemical bond-study of chloro methanes chloro acetyl chlorides, structural information about the group III halides, study of charge transfer compounds).

4.2 **Microwave spectroscopy**

Theory –Rotation of molecules-Rotational spectra of diatomic molecules –rigid rotator, non-rigid rotator –Intensity of spectral lines-effect of isotopic substitution-Stark effect (derivation not needed)-Application of microwave spectroscopy.

UNIT-V **No. of Hours: 15**

5.1 **IR spectroscopy**

Basic principles- harmonic oscillator-anharmonic oscillator-vibrating rotator (PQR branch lines) –fundamental, overtone, combination, difference bands and hot bands-Fermi resonance- IR spectra of polyatomic molecules (H_2O and CO_2) –factors affecting vibrational frequencies –finger print region

5.2 **Raman spectroscopy**

Theory of Raman effects (Quantum theory and classical theory)-stokes and antistokes lines-rotational and vibrational Raman spectra-mutual exclusion principle

5.3 **Electronic spectroscopy**

Electronic spectra of diatomic molecules-vibrational coarse structure-Franck-Condon principle-dissociation energy and dissociation products-predissociation-Birge spooner method of evaluation of dissociation energy from electronic spectra-rotational fine structure of electronic vibrational transitions.

BOOKS FOR STUDY

1. K.Veera Reddy, *Symmetry and Spectroscopy of Molecules*, 2nd editionNew Age International Ltd., 2009.
2. F.A.Cotton, *Chemical Applications Of Group Theory*, John Wiley and sons inc.,2nd edition, New York, 1971.
3. C.N.Banwell, *Fundamentals of molecular spectroscopy*, Tata McGraw Hill publishing company limited, 4th edition, New Delhi, 1966.
4. Jag Mohan, *Organic Spectroscopy – Principles and Applications*, Narosa Publishers, Second Edition, 2001.

BOOKS FOR REFERENCE

1. P.K. Bhattacharya, *Group Theory and Its Chemical Applications*, Himalaya Publishing House, 1st edition, 1986
2. Gurdeep R. Chatwal, Sham K. Anand. *Instrumental methods of Chemical Analysis,* Fifth edition, Himalaya Publishing House, Mumbai, 2007.
3. G.W.Kemp, *NMR in chemistry,* Macmillan Education ltd, Hampshire, 1986.

4. Y.R. Sharma, *Elementary organic spectroscopy*, Fourth Edition, S. Chand & Company Ltd. New Delhi, 2009.

Web Source:

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Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	understand and implement details of molecular symmetry including symmetry elements, operations and symmetry point groups to different chemical compound structures and the necessary mathematical basics needed for group theory	K1, K2, K3, K4
CO2	familiarise the basic concept in matrices, irreducible and reducible representations, construction of character table, and prediction of hybridisation, IR - Raman activity of molecular vibrations.	K2, K3, K4, K5
CO3	conceive the theory behind NMR and techniques used in simplification of spectra hence appreciate its utility in structure solving	K2, K3
CO4	have deeper insights on the principles of microwave spectroscopy; hence solve the problems relating to structure determination. Also have basic idea on NQR spectroscopy and its selective applications	K2, K3, K5
CO5	gain a thorough overview on the physical concepts underlying the IR, Raman and electronic spectroscopy	K1, K2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	M	M	M	S	S	M	L
CO2	S	S	M	M	M	S	S	S	M
CO3	S	S	M	M	M	M	S	S	M
CO4	S	M	M	S	S	M	S	M	M
CO5	S	M	M	S	S	S	S	S	M

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE – III No.2: BIOMOLECULES

Course Code : 19PCHESC3 Hours/Week : 5 Credit: 4

Semester : III Batch: 2019-21

Course Objectives:

Enable the students

- *To know about carbohydrates, proteins and lipids.*
- *To understand chemistry of nucleic acids, enzymes and analytical biochemistry.*

Syllabus

UNIT-I **No. of Hours: 15**

Carbohydrates

Definition-classification-mono, di and polysaccharides- isolation-preparation, properties and uses of monosaccharides- glucose and fructose- their structures pyranose and furanose structures (elucidation not needed)-interconversion of glucose and fructose- disaccharides- isolation of sucrose and maltose (elucidation not needed)- distinction between mono and disaccharide. General structure of polysaccharides- starch and cellulose- bioenergy derived from carbohydrate.

UNIT – II **No. of Hours: 15**

Proteins and Lipids

Amino acid- structure- proteins- classification- peptide bond- protein classification, structure- primary, secondary, tertiary and quarternary – Albumins-egg and milk protein- membranes in pumps and ion-channels- glycolipids and sulpholipids.

UNIT – III **No. of Hours: 15**

Nucleic acids and bioenergetics

Nucleotides- nucleosides- DNA, RNA- types & metabolism of nucleic acids-bioenergetics- ADP, ATP-low and high energy metabolites-metabolism- concept of entropy and free energy change- exergonic and endergonic reactions- glycolysis-simplified reaction- Kreb's cycle.

UNIT – IV ***No. of Hours: 15***

Enzymes

Nomenclature, classification & biological role of enzymes- specifying enzyme action- Michaelis-Menton equation- models- Fischer's Lock and key model- Koshland's induced fit model- coenzymes- NAD, NADPH- chymotrypsin-coenzymes.

UNIT – V ***No. of Hours: 15***

Analytical biochemistry

Application of various analytical tools to various biomolecules- chromatography-column, paper, TLC, ion exchange- X-ray diffraction- isotopic tracer techniques- neutron activation analysis- ultra centrifugation- electrophoresis.

BOOKS FOR REFERENCE

1. Jain, J.L., Jain, S and Jain, *Fundamentals of Biochemistry,* S.Chand report, New Delhi
2. Jain, J.L., Jain, S and Jain, *Elementary Biochemistry,* S.Chand report, New Delhi

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	understand about the chemistry of carbohydrates	K1, K2
CO2	familiarise about the proteins and lipids	K1, K2
CO3	conceive the knowledge about the nucleic acid and bioenergetics	K2, K3
CO4	have deeper insights on the chemistry of enzymes	K2, K3
CO5	gain a thorough overview on the techniques of analytical biochemistry	K1, K2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	M	M	S	S	M	M	S	M
CO2	S	M	S	S	S	M	M	S	M
CO3	S	L	S	S	S	S	M	M	S
CO4	S	L	M	S	S	M	M	M	S
CO5	S	L	S	S	S	M	M	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : EXTRA DISCIPLINARY COURSE:
THERAPEUTICAL CHEMISTRY

Course Code : 19PCHEDC Hours/Week : 4 Credit: 4

Semester : III Batch:2019-21

Course Objectives:

Enable the students

- *To know the terms of pharmacology.*
- *To learn about medicinal flora in India.*
- *To understand the common diseases and their cure.*
- *To acquire knowledge about antibiotics, sulpha drugs etc., & to understand the drugs used for diabetes, cancer and hypertension.*
- *To have general awareness on blood grouping, first aid, vitamins and hormones.*

Syllabus

UNIT-I **No. of Hours: 12**

1. Introduction

1.1 Important Terminologies used in Medicinal Chemistry – Pharmacology, Drug, Pharmacognosy, Pharmacy, Therapeutics, Toxicology, Chemotherapy, Pharmacopoeia, Viruses, Bacteria, Vaccines, Therapeutic Index, Encapsulation.

1.2 Routes of Drug Administration.

UNIT-II **No. of Hours: 12**

2. **Medicinal Flora in India:**

2.1 Some Indian Healers and their significance – Neem, Adathoda Vasica, Amla, Turmeric, Thulasi, Thoothuvalai, Kizhanelli, Shoe Flower.

2.2 Cancer curing plants.

2.3 Medicinal plants in the kitchen garden.

2.4 Spices as medicine.

2.5 Ayurveda and Siddha medicines.

UNIT-III **No. of Hours: 12**

3. **Common diseases and Drugs (Reason and treatment)**

3.1 Common air borne diseases – Common cold, Influenza, Measles, Mumps, Diphtheria, Whooping cough, Tuberculosis.

3.2 ommon water borne diseases – Dysentery, Cholera, Typhoid, Jaundice.

3.3 Common insect-borne diseases – Malaria, Elephantiasis.

3.4 Some other common diseases – Asthma, Epilepsy.

UNIT-IV **No. of Hours: 12**

4. **Classification of Drugs**

4.1 Sulpha drugs, Antibiotics, Analgesics, Antiseptics and Disinfectents, Anaesthetics, Psychopharmacology.

4.2 Life-style diseases and treatment- Obesity, Diabetes, Cardiovascular diseases including blood pressure, Cancer, Aids. [Reason, drugs (Structure not needed), prevention].

UNIT-V **No. of Hours :12**

5. Miscellaneous topics

5.1 Blood groups, Rh factor, Composition of blood, Types of anaemia and drugs.

5.2 Accidents and First aids.

5.3 Poisons and antidotes.

5.4 Vitamins and hormones.

5.5 Analysis of blood and urine.

BOOKS FOR REFERENCE

1. Dr. S. Lakshmi, *Pharmaceutical Chemistry*, Sultan Chand & Sons, 3rd edition, 2004 .
2. Jayashree Ghosh, *Fundamental concepts of applied chemistry*, 1st Edition, S.Chand, 2006.

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-XIV: PHYSICAL METHODS IN CHEMISTRY

Course Code : 19PCHC9 Hours/Week : 6 Credit: 5

Semester : IV Batch: 2019-21

Course Objectives:

Enable the students

- *To understand the principle behind UPES, XPES, MB, flame emission, NMR and EPR spectroscopy.*
- *To know the application of different spectral techniques in inorganic systems.*
- *To acquire basic knowledge in computational chemistry.*

Syllabus

UNIT-I **No. of Hours: 18**

Photoelectron spectroscopy and Inorganic photochemistry

Principle of PES, Koopman's theorem, PES spectra of HCl, HBr, HI, CO, NH_3, N_3^-, N_2, O_2, H_2O

Photo electron spectroscopy in the study of bonding, anti-bonding and non-bonding orbitals, Applications of PES. Auger electron spectroscopy, Flame emission spectroscopy - Principle and applications.

UNIT-II **No. of Hours: 18**

IR and Raman Spectra

Selection rules, mutual exclusion principle, Application of IR and Raman to structural determination of inorganic compounds such as NSF_3, ClF_3, N_2O, SO_2, NO_3^- & ClO_3^-, site symmetry, identification of cis-trans isomers, linkage isomers, ionisation isomers, hydrate isomers.

Change in spectra of donor molecule upon coordination- use of group vibrations in the structural elucidation of complexes of urea, thiourea, cyanide, thiocyanate and DMSO.

IR spectra of carbonyls.

UNIT-III **No. of Hours: 18**

NMR

Application of spin-spin coupling to structure determination.

^{19}F NMR Spectra of ClF_3, $F_2PO(OH)$, $FPO(OH)_2$, BrF_5.

^{31}P NMR Spectra of $HP_2O_5^{3-}$, HPF_2, $HPO(OH)_2$, P_4S_3 and $H_2PO(OH)$

^{11}B NMR spectra of $B_3H_8^-$.

^{13}C NMR spectra of CO_2 in Water

NMR Spectra of paramagnetic compounds

Application of NMR in the study of Fluxional molecules, double resonance technique and lanthanide shift reagents.

UNIT –IV **No. of Hours: 18**

EPR spectra

Theory, g value, Factors affecting g, Hyperfine splitting, Fine splitting, Zero field splitting and Kramer's degeneracy, EPR spectra of bissalicylaldimine Copper (II) complexes & $[Mn(H_2O)_6]^{2+}$. Applications of EPR.

Mossbauer spectroscopy

Theory and principle of Mossbauer spectroscopy-Doppler effect, isomer shift, Quadrupole interactions and magnetic interactions. Applications to tin and iron compounds.

UNIT-V **No. of Hours: 18**

Applications of computers in chemistry

Computational chemistry as a tool and its scope, Terminologies-Potential energy surface, stationary point, transition state, local and global minima. Methods in computational chemistry- Molecular mechanics: Force fields and important features of common force fields-MM3, AMBER, CHARMM. Basic Idea of Ab initio methods and density functional methods. Applications of computational chemistry in determination of energy, HOMO-LUMO, atomic charges etc., Elementary idea on molecular dynamics and QSAR techniques.

BOOKS FOR STUDY

1. E.A.V Ebsworth, D.W.H Rankin and S. Craddock, *Structural methods in inorganic chemistry*, 1st edition ELBS, 1987.
2. K.Veera Reddy, *Symmetry and Spectroscopy of Molecules*, 2nd editionNew Age International Ltd., 2009.
3. R.S. Drago, *Physical methods in chemistry*, Reinhold, Saunders College Publishing, USA, 1977.

BOOKS FOR REFERENCE

1. Gurdeep R. Chatwal, Sham K. Anand. *Instrumental methods of Chemical Analysis,* 5th edition, Himalaya Publishing House, Mumbai, 2007.

2. D.C.Young, *Computational Chemistry: A Practical Guide for Applying Techniques to Real World Problems*, 1st edition, John Wiley & Sons, 2001.
3. F.Jensen, *Introduction to Computational Chemistry*, 2nd Ed., John Wiley, 2007.

Web sources:

https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Magnetic_Resonance_Spectroscopies/Electron_Paramagnetic_Resonance/EPR_-_Interpretation

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	have a firm foundation in the fundamentals and applications of photoelectron spectroscopy and flame emission spectroscopy	K1, K2, K3
CO2	apply the IR and Raman spectroscopy in the structural determination of Inorganic compounds	K2, K3, K4
CO3	structural elucidation of inorganic compounds using NMR spectroscopy	K2, K3
CO4	understand in depth the concepts and utilities of EPR and Mossbauer spectroscopy.	K2, K3
CO5	have an overview of computational Chemistry, the methods involved and scope of the subject	K1, K2, K3

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	L	S	M	L	S	M
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	M	S	S	M

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE-IV-No1: ADVANCED ORGANIC CHEMISTRY

Course Code : 19PCHEC4 Hours/Week : 6 Credit: 5

Semester : IV Batch: 2019-21

Course Objectives:

Enable the students

- *To comprehend and get an insight into the basic concept of aromaticity.*
- *To study about the general reactions of free radicals.*
- *To learn the generation and fate of excited molecules obtained on photo-excitation.*
- *To understand and learn the concept of pericyclic reactions –their classification and basic aspects of electrocyclic, cycloaddition, sigmatropic and chelotropic reaction.*
- *To get a basic idea of retro synthetic analysis of simple organic compounds*.

Syllabus

UNIT-I **No. of Hours: 18**

Aromaticity

Aromaticity of benzenoid ,heterocyclic and non-benzenoid compounds,
Huckel's rule, aromatic systems with pi-electron- compounds other than six pi –electrons, non aromatic and antiaromatic systems(cyclo octatetraene, cyclobutadiene, etc.) systems with more than 10 pi-electrons, annulenes, heteroaromatic systems and fullerenes(C_{60}),
(synthesis not expected).

UNIT-II **No. of Hours: 18**

Free radical reaction:

Long lived and short lived radicals-generation and configuration –mechanism and characteristics of radical reactions –reactions to include auto oxidation-decomposition of peroxides, aromatic radical substitution-decomposition of diazo compounds-Sandmeyer, Gomberg-Bechmann, Pschorr, Ulmann reactions-stereochemistry of radical reactions.

UNIT – III **No. of Hours: 18**

Organic photochemistry:

Photochemical reaction-fate of excited molecules, photophysical processes, Jablonski diagram,photosensitized and non-sensitized reactions,Norrish type- I and- II reactions-photo reduction of ketones-

photo addition reaction –Paterno-buchi reaction ,

Rearrangement–di- Π methane rearrangement, oxa- di- Π methane rearrangement,photoisomerisation (cis-trans isomerisation)-photo cycloaddition.

UNIT – IV **No. of Hours: 18**

Pericyclic reactions

Classification, orbital symmetry, Woodward-Hoffmann rules, selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts-analysis by correlation diagram method and Frontier Molecular Orbital method, Sommelet-Hauser ,Cope and Claisen Rearrangement.

UNIT – V **No. of Hours: 18**

Retro synthetic analysis of simple organic compounds

Terminology and definitions-disconnection, functional group interconversion(FGI), synthon, reconnection, synthetic equivalence, symbols, reagent, functional group addition(FGA), target molecule- Direct synthesis versus retro synthesis-protecting groups, illogical electrophile and illogical nucleophile- one group disconnection, two groups disconnection- synthon and synthetic equivalents-types -a systematic analysis of total synthesis of the following-Prelog-Djerran lactone, juvabione longifolene, quinine, displalure and z-jasmone.

BOOKS FOR STUDY

1. Charles H. Depuy and Urillesh Chapman, *Molecular reactions and photochemistry*, Prentice Hall India Pvt. Ltd.NewDelhi,1975.
2. Jerry March, *Advanced Organic Chemistry Reactions Mechanisms and structure* IV edition, John Wiley and Sons, 1999.
3. Paula Yurkanis Bruice,Organic ChemistryIIedition Prentice Hall International.Inc,1998.
4. F.A. Carey & R.J.Sundberg, *Advanced Organic Chemistry*,Part A Springer Science Business Media,LLC,2007.

5. Ratan Kumar Kar, *Fundamentals of Organic Synthesis*-Vol.II,Revised edition, New Central Book Agency Pvt. Ltd. Kolkata 2008.

BOOKS FOR REFERENCE

1. K.S. Mukherjee, M*echanism of Organic Reactions*, I edition,Books and Allied (p) Ltd 2012..
2. S. Warren, *Designing Organic synthesis-a Programmed introduction to synthon approach*, Wiley, Newyork.

Web Source

1. https://www.masterorganicchemistry.com/2017/02/23/rules-for-aromaticity/
2. https://www.masterorganicchemistry.com/2013/07/30/free-radical-reactions/
3. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Basic_Principles_of_Organic_Chemistry_(Roberts_and_Caserio)/28%3A_Photochemistry/28.2%3A_Organic_Photochemistry
4. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Basic_Principles_of_Organic_Chemistry_(Roberts_and_Caserio)/21%3A_Resonance_and_Molecular_Orbital_Methods/21.10%3A_Pericyclic_Reactions
5. https://profiles.uonbi.ac.ke/andakala/files/sch_302_retrosynthetic__analysis_and_synthetic_planning.pdf

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	understand the concepts of aromaticity, anti aromaticity, non aromaticity and apply them to classify and compare the stability of organic compounds	K3, K4
CO2	know the generation and analyse configuration, general reactions and name reactions of free radicals	K2, K3
CO3	apply the principles of photochemistry in organic reactions and research	K3, K4
CO4	comprehend and apply the concepts of pericyclic reactions to classify and identify them in general and research	K3, K4
CO5	employ retrosynthesis to design synthetic routes of organic compounds and natural products	K3, K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	M
CO2	S	M	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	M	S	S
CO4	S	M	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE-IV-No 2: MATERIAL SCIENCE CHEMISTRY

Course Code : 19PCHESC4 Hours/Week : 6 Credit: 5

Semester : IV Batch: 2019-21

Course Objectives:

Enable the students

- *To comprehend about electrolytes, conductors and insulators*
- *To understand about the metallic glasses and biomaterials.*
- *To get a basic idea for synthesising* nanoparticles and nano imaging techniques.

Syllabus

UNIT-I **No. of Hours: 18**

Ionic conductivity and solid electrolytes

Types of ionic crystals- alkali halides- alkali earth fluoride- simple stoichiometric oxides.

Types of ionic conductors: Halide ion conductors-oxide ion conductors- solid electrolytes-electrochemical cell-principle-batteries, sensors and fuel cells.

Crystal defects in solids-line and plane defects-point defects- Schottky and Frenkel defects.

Electronic properties and band theory; metals, semiconductors-inorganic solids - colour, magnetic and optical properties, luminescence, lasers.

UNIT – II **No. of Hours: 18**

Introduction- types of magnetic materials -diamagnetism-paramagnetism, ferromagnetism.

Ferrites: preparation and their applications in microwave-floppy disk-magnetic bubble memory and applications.

Insulating material: Classification - on the basis of temperature- Blymer insulating materials and ceramic insulating materials.

Ferro electric materials: Examples- applications of ferroelectrics.

UNIT – III **No. of Hours: 18**

Metallic glasses:- introduction- composition, properties and application. **Shape memory alloys**: Introduction- examples- application of SMA- advantages and disadvantages.

Biomaterials: Introduction – metals and alloys in biomaterials- ceramic biomaterials, composite biomaterials- polymer biomaterials.

UNIT – IV ***No. of Hours: 18***

Introduction- techniques for synthesis of nanophase materials- sol-gel synthesis- Electrode position- inert gas condensation- mechanical alloying- properties of nanophase, materials- applications of nanophase materials, composite materials: Introduction- types

UNIT – V **No. of Hours: 18**

Introduction-importance- various stages of nanotechnology- nanotube technology- nanoparticles- fullerenes- nanodendrimers- nanopore channels, fibres and scaffolds- CVD dismond technology- FCVA technology and its applications- nanoimaging techniques.

BOOKS FOR REFERENCE

1. Aathony, R. West, *Solid state chemistry and its applications*, John Wiley & Sons.
2. Raghavan, V.R, *Material science and engineering*, Printice Hall (India), Ltd.
3. Kenneth, J. Klabunde, *Nanoscale materials in chemistry*, A. John Wiley and Sons Inc. Publications.

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)

Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	understand the concepts of ionic conductivity, crystal defects and electronic properties	K1, K2
CO2	know the types of magnetic, electric and insulating materials	K2, K3
CO3	gain knowledge about biomaterials	K1, K2
CO4	comprehend the synthetic techniques and applications of nanomaterials	K3, K4
CO5	able to explain nano imaging techniques	K2, K3

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	M	S	S	L
CO2	S	M	S	S	S	M	M	S	S
CO3	S	S	S	S	S	M	M	S	S
CO4	S	S	S	S	S	L	M	M	M
CO5	S	S	S	S	S	M	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE-V No.1: PHOTOCHEMISTRY AND ORGANIC SPECTROSCOPY

Course Code : 19PCHEC5 Hours/Week : 6 Credit: 5

Semester : IV Batch: 2019-21

Course Objectives:

Enable the students

- To discuss the principles of photochemistry-radiative and non-radiative processes
- To apply the spectral techniques in the structural elucidation of organic compounds

Syllabus

UNIT- I **No. of Hours: 18**

Photochemistry-I

Absorption and emission of radiation:

Franck-Condon principle-decay of electronically excited states - Jablonski diagram -radiative and nonradiative processes - spin allowed and spin forbidden transition

Non-radiative processes: Theory of radiationless transition - internal conversion and inter system crossing.

Radiative processes: Fluoroscence and Phosphorescence – Theory, factors affecting fluoroscence and phosphorescence, prompt and delayed fluorescence, structure of fluoroscent compounds, quenching of fluorescence -static and dynamic quenching - Stern - Volmer equation - concentration dependence of quenching and excimer formation, quenching by added substances – charge transfer mechanism - exciplex formation and decay; electronic energy transfer mechanism – long range and short range energy transfer.

UNIT- II **No. of Hours: 18**

Techniques and applications of photochemistry:

Quantum yield - experimental determination of quantum yield - chemical actinometry, kinetics of photochemical reactions - steady state treatment of quantum yield, kinetics of photosensitized reactions, photodissociation reactions, photovoltaic and photo electrochemical cells-photo assisted electrolysis of H_2O-aspects of solar energy conversion.

UNIT- III **No. of Hours: 18**

UV-Visible, IR Spectroscopy

UV-Visible Spectroscopy – Principle, Types of excitation, transition probabilities-chromophores and auxochromes-factors affecting intensity-solvent effect and position of absorption bands-dienes, polyenes and enones - Woodward- Fieser rule, Applications of UV spectroscopy.

IR Spectroscopy – Principle, characteristic group frequencies of organic molecules-factors influencing vibrational frequencies, interpretation of IR spectra of organic molecules, Application of IR spectroscopy – Hydrogen bonding, distinction between cis-trans isomers.

UNIT- IV **No. of Hours: 18**

NMR spectroscopy

Proton nmr- Principle -chemical shift, factors affecting chemical shift-number of signals-peak areas-multiplicity-geminal, vicinal and long range coupling-factors affecting them-first order spectra, simplification technique -chemical and instrumental techniques, Applications of NMR spectroscopy.

^{13}C nmr-broad band and off- resonance -decoupling-comparison of ^{1}H and ^{13}C nmr-factors affecting intensity of signals-chemical shifts-γ gauche effect.

Elementary idea of 2D NMR - COSY, NOSY, ROSY.

UNIT-V **No. of Hours: 18**

Mass spectrometry

Basic principle-molecular ion peak, parent ion peak, fragments, meta stable ion peaks, isotope peaks -determination of molecular weight and molecular formula – McLafferty rearrangement-rules for fragmentation-nitrogen rule, ring rule - examples of mass spectral fragmentation of organic compounds – alkanes, alkenes, aromatic hydrocarbons, alkyl halides, aldehyde, ketones, alcohols, phenols, acids, esters and amines.

Structural elucidation

Structural elucidation of organic compounds using the combination of

UV, IR, NMR and Mass spectral techniques (molecular formula of organic compound restricted to 12 carbons).

BOOKS FOR STUDY:

1. K. K. Rohatgi Mukherjee, *Fundamentals of photochemistry*, Revised Edition, Wiley Eastern Ltd, 1986.
2. D. N. Bajpai, *Advanced physical chemistry,* Second Edition, S. Chand & Company Ltd, 1998.
3. Jag Mohan, *Organic Spectroscopy – Principles and Applications,* Second Edition, Narosa Publishing House, New Delhi, 2001.
4. Y. R. Sharma, *Elementary organic spectroscopy*, Fourth Edition, S. Chand & Company Ltd. New Delhi, 2009.

BOOKS FOR REFERENCE:

1. G. W. Kemp, *NMR in Chemistry*, First Edition, Mc Millan Ltd, 1986.
2. R. M. Silverstein, G. C. Bassler, T. C. Morrill, Spectrometric Identification of Organic Compounds, Fourth Edition, John Wiley & Sons, 1981.

Web Sources

1. https://www.med.unc.edu/microscopy/files/2018/06/jablonski-diagram.pdf
2. https://www.masterorganicchemistry.com/2016/11/29/ir-spectroscopy-some-simple-practice- problems/
3. https://www.masterorganicchemistry.com/2016/09/27/uv-vis-spectroscopy-some-practice-questions/

4.https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Magnetic_Resonance_Spectroscopies/Nuclear_Magnetic_Resonance/NMR%3A_Structural_Assignment/NMR14._More_Practice_with_NMR_Spectroscopy

5.https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26200%3A_Organic_Chemistry_II_(Wenthold)/Chapter_11%3A__IR_and_Mass_Spectrometry/11.09_Solving_Problems_using_Mass_Spectrometry

Question paper pattern

SE: 70 CA: 30

Time- 3 Hrs Max marks-70

Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	explain the theory of radiative and non-radiative processes	K1, K2
CO2	comprehend the kinetics of photochemical reactions and discuss about photovoltoic and photo electrochemical cells	K1, K2, K3
CO3	discuss the principle of UV and IR spectroscopy; calculate λ_{max} and interpret IR spectra of organic compounds	K2, K3, K4, K5
CO4	elaborate the principle and applications of NMR spectroscopy; interpret ^{1}H and ^{13}C NMR spectra of organic compounds	K2, K3, K4, K5
CO5	propose and illustrate different fragmentation pattern for various compounds, elucidate the structure of organic compounds using UV, IR, NMR & mass spectral techniques	K2, K3, K4, K5

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	M	L	M	M	M	L	L	L	M
CO2	M	L	M	M	M	L	L	L	M
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : ELECTIVE-V No. 2: MEDICINAL CHEMISTRY

Course Code : 19PCHESC5 Hours/Week : 6 Credit: 5

Semester : IV Batch: 2019-21

Course Objectives:

Enable the students

- To gain knowledge about analgesics and anaesthetics.
- To know about anti-histamine and anti-inflammatory drugs.
- To understand about expectorants and antitussives.

Syllabus

UNIT- I **No. of Hours: 18**

Basic concepts

Drug design- factors governing drug design, method of variation and tailoring of drugs; physical properties- factors governing drug action at active site, factors governing ability of drugs to reach active site; general anaesthetics- inhalation anaesthetics, intravenous anaesthetics and basal anaesthetics- mode of action, local anaesthetics- classification, sedatives and hypnotics- classification and synthesis, mode of action.

UNIT – II **No. of Hours: 18**

Anticonvulsants, stimulants and anti-pyretic analgesics

Anti-convulsants- classification, synthesis and mode of action. muscle relaxants- classification, synthesis and mode of action. Central nervous system stimulants- classification, synthesis and mode of action. antipyretic analgesics- classification, synthesis and mode of action.

UNIT – III **No. of Hours: 18**

Other analgesics

Narcotic or opiate analgesics- classification, synthesis and mode of action; narcotic antagonist. Cardiovascular drugs- classification, cholinomimetic drugs- antimuscarinic drugs, ganglionic blocking agents and adrenegic neuron blocking agents; diuretics- synthesis and mode of action of mercurial and non mercurail diuretics.

UNIT – IV **No. of Hours: 18**

Anti-histamines and anti-inflammatory drugs

Anti-histaminics- synthesis and mode of action of histamine H_1 receptor antagonists and Histamine H_2 receptor blockers. Prevention of histamine release; structure- activity relationship amongst H_1 receptor blockers. non-steroidal anti-inflammatory drugs (NSAID)- synthesis and mode of action of heteroaryl acetic acid analogues, aryl acetic acid analouges, aryl propionic acid analogues, naphthalene acetic acid analogues, gold compounds, salicyclic acid analogues, pyrazolones and pyrazolodiones.

UNIT – V **No. of Hours: 18**

Expectorants and antitussives

Synthesis and mode of action of sedative expectorants, stimulants expectorants and centrally active antitussive agents- sulphonamides- synthesis and mode of action of sulphonamides- antimalarials- synthesis and mode of action of aminoquinoline analogues, aminoacridine analoges, guanidine analogues, pyrimidine analogues, sulphone and quinine analogues- cardiac glycosides, bile acids. Antibiotics- synthesis and mode of action of penicillins, amino glysoside antibiotics, chloramphenicol and tetracyclines

BOOKS FOR REFERENCE

1. Ashutosh Kar, *Medicinal chemistry*, New age International.
2. W.O. Foye, *principles of medicinal chemistry,* second Ed., Lea and febiger, Philedelphia.
3. M.E. Wolff, *Burger's medicinal chemistry,* fourth Ed., John Wiley and Sons, New York.
4. F.F. Blicke and R.H. Cox, *Medicinal chemistry*, John Wiley and Sons.

Question paper pattern

SE: 70 CA: 30
Time- 3 Hrs
Maxmarks-70
Part A: Five questions-Two from each unit with internal choice (5X5=25 marks)
Part B: Five questions- One (single/ mixed) from each unit and any three to be answered. (3X15=45 marks)

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	explain the basic concepts about drug actions	K1, K2
CO2	comprehend about anticonvulsant and stimulants	K1, K2, K3
CO3	discuss about various analgesics	K1,K2, K3
CO4	elaborate about anti-histamines and anti-inflammatory drugs	K1,K2, K3
CO5	explain about expectorants and antitussives	K1,K2, K3

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	M	S	S	M	L	S	S
CO2	S	L	M	S	S	M	L	S	S
CO3	S	L	M	S	S	M	L	S	S
CO4	S	L	M	S	S	M	L	S	S
CO5	S	L	M	S	S	M	L	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE-XII: ORGANIC CHEMISTRY PRACTICAL-II

Course Code : 19PCHQC4 Hours/Week : 3 Credit: 3

Semester : III & IV Batch: 2019-21

Course Objectives:

Enable the students

- *To develop the skill of separation and identification of organic compounds.*
- *To enlighten the students in the analysis of spectra of simple organic compounds.*

Syllabus

1. Organic Analysis-separation of two component mixtures-identification of components and preparation of their derivatives.
Determination of boiling point/melting point for components and melting point for their derivatives.

2. Spectral analysis (UV,IR,^{1}H& NMR)

a. Isopropyl alcohol
b. n-propylamine
c. Acetone
d. Mesitylene
e. Benzyl bromide
f. Pyridine
g. Pinacolone
h. p-methyl benzyl alcohol
i. 4-Picoline
j. Phenyl acetone

REFERENCE BOOKS

1. V.S. Gnanaprakasam & G. Ramamurthy, *Organic Chemistry Lab manual*, S. Viswanathan Reprint Printers and Publishers Private Ltd. 2000
2. B.B. Dey and M.V. Seetaraman, *Laboratory Manual Organic Chemistry*, III edition, Allied Publishers Ltd.1957
3. N,K,Vishnoi, *Advanced Practical Organic Chemistry*, II Reprint Hindustan Offset Printers, Delhi, 1994.
4. Sathish Agarwala &R.C.Agarwala, *Advanced Organic Analysis*, II Revised edition. Pragati Prakashan, Meerut,1996.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	separate organic mixture by solvent extraction	K4
CO2	qualitative analysis of the organic compounds	K4
CO3	synthesis of suitable derivatives of the organic compounds	K4
CO4	determination of boiling point/melting point of the derivatives	K4
CO5	analyse UV-Visible, IR, NMR and Mass spectra and identify organic compounds	K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M
CO5	S	S	S	S	S	S	S	S	S

Programme Title : M.Sc. CHEMISTRY

Course Title : CORE XIII: PHYSICAL CHEMISTRY PRACTICAL -II

Course Code : 19PCHQC5 Hours/Week : 3 Credit: 3

Semester : III & IV Batch: 2019-21

Course Objectives:

Enable the students

- *To study the mechanism of the reactions through kinetics*
- *To introduce the concepts of estimations by conductivity measurements*

Syllabus

1) Kinetic studies –Acid hydrolysis of methyl acetate, $S_2O_8^{2-}$ +I^- reaction.

2) Conductivity –Kinetics of the alkaline hydrolysis of ethyl acetate.

3) Salt effect on reaction rates , $S_2O_8^{2-}$ + I^- reaction .

4) Determination of activation energy, Acid hydrolysis of methyl acetate

5) Determination of order of reaction , $S_2O_8^{2-}$ + I^- reaction .

6) Conductometric titrations

a) strong acid Vs strong base.

b) strong acid Vs weak base.

c) weak acid Vs strong base.

d) Mixture of acids Vs strong base.

e) KCl Vs $AgNO_3$.

f) $BaCl_2$ Vs K_2SO_4

7) Determination of K_a of strong electrolyte.

8) Determination of K_a of weak electrolyte**.**

9) Writing Z matrix for simple molecules and optimization at semi empirical methods using free softwares like Argus Lab.

REFERENCE BOOKS

1. B. Viswanathan and P.S. Raghavan, *Practical Physical Chemistry*, Viva books Pvt. Ltd. NewDelhi.
2. B.P. Levitt, *Findlay's practical physical chemistry*, Longman group Ltd. London.
3. J.B. Yadav, *Advanced practical physical chemistry,* Goel publishing house, Meerut.
4. www.arguslab.com

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	evaluate the relative strength of acids and energy of activation by kinetics	K3
CO2	examine the behaviour of strong and weak electrolytes	K3
CO3	To determine the order of reaction	K3
CO4	develop skills in the estimation of acid-base and halides by conductometric methods	K4
CO5	get an insight on using softwares for molecular modelling	K1, K2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	L	S	S	S	S	M	S	S	S
CO2	M	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	M	S	S	S
CO4	M	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	L	S	S	M