RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)

THANJAVUR – 613 005

(Re-Accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University)

M.Sc., CHEMISTRY - SYLLABUS

(Under Choice Based Credit System - CBCS)
For Candidates admitted from the year 2018 – 19 onwards

Finalized (for the I to IV semester) in the
BOARD OF STUDIES MEETING HELD ON 18.04.2018
&

APPROVED BY THE ACADEMIC COUNCIL ON _____

PG & RESEARCH DEPARTMENT OF CHEMISTRY

RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS), THANJAVUR-5

CBCS PATTERN FOR ALL P.G COURSES

SUBJECT: CHEMISTRY

(Applicable to the Candidates admitted from the Academic Year 2018 – 2019 onwards)

PART	CODE	COURSE	TITLE	HRS / WEEK	MARKS		TOTAL	CREDIT	Page No.
					IA	AE			
SEMESTER – I									
III	**S1PCH1**	CC 1	Inorganic Chemistry I	5	25	75	100	5	3
III	**S1PCH2**	CC 2	Organic Chemistry I	5	25	75	100	5	5
III	**S1PCHP1**	CC 3	Inorganic Chemistry Practical I **(6 Hrs)**	10	***40***	***60***	100	6	8
III	**S1PCHP2**	CC 4	Organic Chemistry Practical I **(6 Hrs)**	5	***40***	***60***	100	4	9
III	**S1PCHEL1A**	EC - 1	Analytical Chemistry	5	25	75	100	4	10
	S1PCHEL1B		Solid State Chemistry						12
	S1PCHEL1C		Supramolecular Chemistry						14
TOTAL				**30**	**155**	**345**	**500**	**24**	
SEMESTER – II									
III	**S2PCH3**	CC 5	Inorganic Chemistry II	5	25	75	100	5	16
III	**S2PCH4**	CC 6	Organic Chemistry II	5	25	75	100	5	18
III	**S2PCHP3**	CC 7	Inorganic Chemistry Practical II **(6 Hrs)**	10	***40***	***60***	100	6	20
III	**S2PCHP4**	CC 8	Organic Chemistry Practical II **(6 Hrs)**	5	***40***	***60***	100	4	21
III	**S2PCHEL2A**	EC - 2	Physical Chemistry I	5	25	75	100	4	22
	S2PCHEL2B		Pharmaceutical Chemistry						25
	S2PCHEL2C		Bio-organic Chemistry						27
TOTAL				**30**	**155**	**345**	**500**	**24**	

SEMESTER – III									
III	**S3PCH5**	CC 9	Inorganic Chemistry III	5	25	75	100	5	29
III	**S3PCH6**	CC 10	Organic Chemistry III	5	25	75	100	5	32
III	**S3PCH7**	CC 11	Physical Chemistry II	5	25	75	100	4	35
III	**S3PCHP5**	CC 12	Physical Chemistry Non Electrical Practical **(6 Hrs)**	10	**40**	**60**	100	6	38
III	**S3PCHEL3A**	EC - 3	Industrial Chemistry	5	25	75	100	4	39
III	**S3PCHEL3B**		Green Chemistry						41
III	**S3PCHEL3C**		Catalysis						43
TOTAL				**30**	**140**	**360**	**500**	**24**	
SEMESTER – IV									
III	**S4PCH8**	CC 13	Physical Chemistry - III	5	25	75	100	4	45
III	**S4PCHP6**	CC 14	Physical Chemistry Electrical Practical **(6 Hrs)**	10	***40***	***60***	100	3	47
III	**S4PCSPW**	CC 15	Project Work	5	25	75	100	3	48
III	**S4PCHEL4A**	EC - 4	Applied chemistry	5	25	75	100	4	49
	S4PCHEL4B		Scientific Research Methodology						51
	S4PCHEL4C		Heterocyclic chemistry						53
III	**S4PCHEL5A**	EC - 5	Nano and Computational Chemistry	5	25	75	100	4	55
	S4PCHEL5B		Chemistry of Nanoscience and Nanotechnology						57
	S4PCHEL5C		Applied Organic chemistry						59
TOTAL				**30**	**140**	**360**	**500**	**18**	
GRAND TOTAL				**120**	**590**	**1410**	**2000**	**90**	

No. of Papers **Credit**

Core Courses 15 (6x5=30, 3x6=18, 4x4=16, 2x3=6 Credits) 70
Elective Courses 5 (Each of 4 Credits) 20
Total 20 **90**

Separate passing minimum is prescribed for Internal and External

a). The passing minimum for CIA shall be 40% out of 25 Marks. (i.e., 10Marks)

b). The passing minimum for Autonomous Examinations shall be 40% out 75 Marks. (i.e. 30 Marks)

c). The passing minimum not Less than 50% in the aggregate

SEMESTER - I

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Core Course – I (Major Theory) – CC 1

Credits : 5 **Code: S1PCH1**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – I

(For students admitted from 2018 onwards)

Inorganic Chemistry – I

Objectives
❖ To learn about acids ,bases ,chains, rings, clusters and isopoly anions of inorganic compounds. ❖ To acquire the knowledge of ionic structure. ❖ To study the various concepts and applications of metal ions in biological systems. ❖ To understand the various metallurgical processes
Learning Outcomes
At the completion of this course the student will be able to ❖ Predict geometrics of simple molecules ❖ Use of group theory to recognize and assign symmetry characteristics to molecules. ❖ Structures, relativities and application of coordination complexes.

UNIT - I

Acids and bases: Bronsted and Lewis acids and bases, pH, pka acid-base concept. Non-protonic concepts of acid base reactions – Lux concept solvent ion theory of acids bases- liquid ammonia, acetic acid as solvents - bromine trifluoride, dinitrogen tetroxide, liquid hydrogen fluoride acid solvents – classification of acids and bases as hard or soft - acid base strength, hardness and softness – symbiosis - theoretical basis of hardness and softness - electronegativity and hardness , softness.

Inorganic chains, rings and clusters: chains - catenation - hetero-catenation- silicate minerals (names and structures only) - intercalation chemistry - talc, mucovite, structures only.

Isopoly anions: basic building units of vanadates – molybdates - tungstate ions - heteropoly anions - structures only.

Rings- phosphazenes - structure-craio and Paddock model -Dewar model

UNIT - II

Ionic bond and crystal structure: radius ratio rules - calculation of some limiting radius ratio values for C.N. 3.(planar triangle), C.N. 4 (tetrahedral), C.N. 6 (octahedral).

Classification of ionic structures: AX, AX_2, AX_3, types - AX type, ZnS, NaCl, CsCl, - structures only - AX_2 type - Fluorite, rutile, beta crystobalite, structures only - layer structure CdI2, nickel arsenide, structure - lattice energy-Born. Lande equation – derivation - important points arising from Born. Lande equation - Schotky defect - Frenkel defect - explanation and calculation of no. of

defects form per cm cube - metal excess defect F centres and interstitial ions - metal deficiency defects - positive ions absent - extra interstitial negative ions.

UNIT - III

NQR Spectroscopy: Characteristics of Quadrupolar nucleus – Effect of field gradient and magnetic field upon Quadrupolar energy levels, NQR Transitions – Applications of NQR Spectroscopy.

Artificial Radioactivity: Nuclear reactions – transmutation - stripping and pick up, fission, fusion, spallation, fragmentation reactions - scattering reactions - nuclear cross section – Q value - Nuclear reactors - charged particle accelerators - neutron sources - gamma ray and x-ray sources - applications of nuclear science in agriculture and biology - neutron activation and isotope dilution analysis.

UNIT - IV

Medicinal bioinorganic chemistry: bio-inorganic chemistry of toxic metals - lead, cadmium, mercury, aluminum, thorium, iron, copper, plutonium -detoxification by metal chelation, - drugs which act by binding the metal sites of metallo-enzymes - Radiation risks - medical benefits - natural and man made radio isotopes - bio inorganic chemistry of radio pharmaceuticals - technetium.

UNIT - V

Extraction and uses of metals: metallurgy of Zr, Ge, Be, Th, preparation and uses of their compounds - metal clusters - binuclear clusters - structure of Re_2Cl_8, qualitative MO diagrams for dinuclear rhenium and molybdenum complexes to explain the strength of quadraupole bond – cluster bonding models – Wade and Luhar.

References:

1. M. C. Day and J. Selbin, "Theoretical Inorganic Chemistry",Affiliated East West Press Pvt. Ltd. 2 nd ed., 1985.
2. F.A.Cotton and G.Wilkinson, " Advanced Inorganic Chemistry", 4 th ed., A Wiley - Interscience Publication, John –Wiley & Sons, USA.
3. J.E. Huheey, "Inorganic Chemistry" 3 rd . ed., Harper & Row publisher, Singapore. 4.
4. S. Glasstone, "Source Book on Atomic Energy", D.Van Nostrand, New York 1967 (Affiliated East-West Press, New Delhi 1969)
5. G.Friedlander, J.W. Kennedy and J.Miller, "Nuclear and Radiochemistry, 3 rd Ed., Wiley Interscience Publications, John Wiley & Sons, New York.
6. J.D. Lee, A New Concise Inorganic Chemistry, 4th Ed., ELBS, 1995.
7. B. Douglas, D. H. McDaniel and J. J. Alexander, "Concepts and Models of Inorganic Chemistry", 2 nd ed., John Wiley & Sons, New York.
8. Purcell and Kotz, "Inorganic Chemistry", Saunders Golden Sunburst Series, W. B. Saunders Company, Philadelphia.
9. R. W. Hay, "Bioinorganic Chemistry".
10. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, Panima Publishing Company, New Delhi, 1997.
11. W. Kaim and B. Schewederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John Wiley & Sons, New York, USA.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Core Course – II (Major Theory)- CC 2

Credits : 5 **Code: S1PCH2**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – I

(For students admitted from 2018 onwards)

Organic Chemistry – I

Objectives
❖ To know the methods of naming and reactive intermediates in organic compounds & reactions ❖ To understand the stereochemistry of aliphatic and aromatic hydrocarbons ❖ To learn the methods of determining the reaction mechanism. ❖ To impart knowledge about chemistry of natural products.
Learning Outcomes
At the completion of this course the student will be able to ❖ Identify ,classify and draw structures of organic molecules ❖ Apply the basic rules of organic nomenclature to interrelate between structures of organic molecules

UNIT - I

Nomenclature of organic compounds- Naming of linear and branched alkanes, alkenes, polynes and alkynes with and without functional groups by IUPAC nomenclature- aromatic and hetero aromatic systems- nomenclature of heterocycles having not more than two hetero atoms such as oxygen, nitrogen and sulphur- nomenclature of alicyclic, bicyclic and tricyclic compounds.

Reactive intermediates: free radicals-carbenes, nitrenes, -carbanions- carbonations and arynes-generation, stability, structure and reactivity-nonclassical carbocations.

Electronic effects: inductive effect, resonance effect, hyperconjugation (Baker-Nathan effect)-hydrogen bonding(inter and intra molecular).

UNIT – II

Organic stereo-chemistry I : Optical isomerism: principles of symmetry- concept of chirality- optical purity - elements of symmetry and chirality- Newmann, Sawhorse, Fisher and flying wedge notations- represntation and inter-conversions.-types of molecules exhibiting optical activity- configurational nomenclature- D and L, & R-S nomenclature- of acyclic and cyclic chiral compounds- stereo chemistry of allenes and spirenes- biphenyls (atropisomerism)- stereochemistry of ansa compounds- cyclophanes and trans cyclo alkenes- definition of terms like prochirality, enantiotopic and diastereotopic groups / faces- asymmetric synthesis-Cram's rule.

UNIT – III

Organic stereochemistry II :Geometrical isomerism: Eand Z nomenclature- determination of configuration of the geometrical isomers.

Configuration of cyclic and bicyclic ring systems: Cis and trans nomenclature of three, four, five six membered substituted cyclic systems-configuration of cyclohexane- mono and di substituted cyclohexanes- decalins.

Dynamic stereo chemistry : Quantitative correlation between conformation and reactivity-Winstein,Eliel equation- Curtin-Hammet principle- conformation, reactivity and mechanism of cyclic systems- saponification of an ester, esterification of an alcohol, chromic acid oxidation of cyclohexanols- neighboring group participation, deammination of 2-amino cyclohexanol- stereo specific and stereoselective reactions.

UNIT – IV

Methods of determing reaction mechanism: Thermodynamic and kinetic aspects of organic reactions-energy profie diagrams- intermediate versus transition states.isotope effects-kinetic and non-kinetic methods of determination of reaction mechanism- product analysis and its importance- cross over experiments- isotopic labeling studies- stereochemical studies ,substituent effects.

Correlation analysis: Linear free energy relations- Hammet equation, significance of sigma and rho- applications- Taft equation- Swain,Scott, Grunwald-Winstein equations- their applications-classification os solvents.

UNIT – V

Natural products: Carbohydrates-polysaccharides-structure of starch, and cellulose, configuration of carbohydrates- photosynthesis.

Peptides and proteins: Naturally occurring amino acids – their classifications – acid-base properties and their importance – primary, secondary, tertiary and quaternary structures of proteins – protection of N-terminal and C-terminal groups of proteins – synthesis of peptides, Merifield's solid state peptide synthesis – structure elucidation of oxytocin, biosynthesis of proteins.

Nucleic acids: chemistry of nucleic acids- structure of DNA, properties, biological implications of DNA, replication of DNA- structure of RNA- types of RNA- their functions – determining the base sequence of DNA.

Antibiotics: structural elucidation and synthesis of penicillin, streptomycin- cephalosporin C and chloramphenicol. Structure activity relationship in chloramphenicol.

References:

1. R. Panico, WH. Powell, L. Jean, C.Richer, A Guide of IUPAC Nomenclature of Organic Compounds, 1993.
2. R.S. Cahn and O.C. Dermer, Introduction to Chemical Nomenclature, 5th Edn., Butterworths, 1997.
3. J. March, "Advanced Organic Chemistry : Reactions, Mechanisms and Structure",4th ed., Wiley, 1992.
4. R.K. Bansal, "Organic Reaction Mechanisms", Tata McGraw Hill, 1975.
5. P. S. Kalsi, "Organic Reactions and their Mechanisms", New Age International Publishers.
6. E.L.Eliel, "Spectrochemistry of Carbon Compounds", McGraw Hill, 1962.
7. D. Nasipuri, Stereochemistry of Organic Compounds.
8. I.L. Finar, "Organic Chemistry", Vol.II, 5 th ed., ELBS 1975.
9. R.T. Morrison and R.N.Boyd, "Organic Chemistry", 6 th ed., Allyn and Eacon,
10. F.A. Carey and R.J. Sunberg, "Advanced Organic Chemistry, Parts A & B, Plenum, 1984.

O.P. Agarwal, Chemistry of Organic Natural Products, Vol. I & II, Goel Publications, 1997.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018– 19

Core Course – III (Major Practical) – CC 3

Credits : 6 **Code: S1PCHP1**

Hours / Week : 10

Medium of Instruction : English

SEMESTER – I

(For students admitted from 2018 onwards)

Inorganic Practical – I

Objectives
❖ To impart knowledge on Qualitative analysis of Inorganic mixture ❖ To gain the depth knowledge in the Colorimetric estimation of different metals.
Learning Outcomes
❖ To understand the procedure of semi micro qualitative analysis and colorimetric analysis

1. **Semi-micro qualitative analysis** of

   A mixture containing two common and two rare cations

2. **Colorimetric estimation** of

   a) Copper,

   b) Ferric,

   c) Nickel,

   d) Chromium,

   e) Manganese using photo electric colorimeter.

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Core Course – IV (Major Practical) – CC 5

Credits : 4 **Code: S1PCHP2**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – I

(For students admitted from 2018 onwards)

Organic Practical – I

Objectives
❖ To impart knowledge on Qualitative analysis of organic mixture ❖ To gain the depth knowledge in Single stage preparation of organic compounds
Learning Outcomes
❖ To understand the procedure of qualitative analysis of organic mixture and single stage and multistage preparation of organic compounds .

1. **Qualitative analysis of organic mixture**

   a) Pilot separation
   b) bulk separation
   c) analysis
   d) derivative
   e) determination of m.p or b.p of derivatives

2. **Single stage preparation of organic compounds**
   a) Nitration : methyl m- nitrobenzoate from methyl benzoate.
   b) Addition : Benzophenone oxime from benzophenone
   c) Chlorination cum diazotization : o-chloro benzoic acid from anthranilic acid
   d) Oxidation: p-benzoquinone from hydroquinone
   e) Diazotisation; Phenly azo 2-naphthol from aniline

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Elective Course – I (Elective Theory) EC 1

Credits : 4 **Code: S1PCHEL1A**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – I

(For students admitted from 2018 onwards)

Analytical Chemistry

Objectives
❖ To study about error analysis. ❖ To learn the various quantitative measurement instruments. ❖ To give an important overview of separation techniques. ❖ To know the various advanced techniques.
Learning Outcomes
At the completion of this course the student will be able to ❖ Understand the principles of analytical chemistry. ❖ Understand the procedures and applications of the analytical techniques. ❖ Use statistical method for evaluating and interpreting data.

UNIT – 1

DATA ANALYSIS

Accuracy and Precision – Significant Figures – Rounding Off – determinate Errors – Indeterminate errors – sways of Expressing accuracy – standard deviation – Propagation of errors – The Confidence Limit – Tests of Significance – Rejection of a Result:The Q Test – Statistics for Small Data Sets – Linear Least squares – The Correlation Coefficients

UNIT – II

ELECTRO ANALYTICAL METHODS

Polarography: Principle, experimental technique – dropping mercury electrode – Residual, migration and diffusion currents – Half-wave potential – Ilkovic equation – Analytical applications of polorography – Differential pulse polorography, cyclic voltametry – principle, experimental setup – application – Amperometric titration – principle and types – Titration between $Pb^{2+}$and $K_2Cr_2O_7$. electrogravimetry – theory of electrolysis, experimental set up diagram- applications – ion selective electrodes: principle and applications – DSC: Principle and applications – TMA: Principle and applications

UNIT – III

THERMALMETHODS OF ANALYSIS

Thermal methods of analysis – Principle – instrumentation –methods of obtaining thermogram- TGA curves for $AgNO_3$, $CuSO_4$, CaC_2O_4,H_2O Differential thermal analysis – Principle – instrumentation – DTA curves for the above compounds. Factors influencing DTA- applications of DTA. Study of Organic reactions, Decomposition of complexes, Thermometric titration.

UNIT – IV

OPTICAL METHODS

Colorimetry - Laws of colorimetry – mono chromators, detectors, instrumentation and applications – Estimation of Cr in steel - Biochemical analysis of urea, sugar and cholesterol.

Flame photometry: Principle, Instrumentation and applications.Turbidimetry and Nephelometry: principle and choice between two techniques – Instrumentation and applications.

Fluorometry and phosphometry: principle, instrumentation and applications - Refractrometry and polarimetry:principle, instrumentation and applications.

UNIT – V

CHROMATOGRAPHY AND SOME ADVANCED TECHNIQUES

Principles, classification (adsorption, partition, column, thin layer and paper chromatographic techniques) and applications - Ion exchange, solvent extraction, GC, HPLC techniques and applications, types of column, detectors applications – GC-MS and HPLC-MS – electrophoresis-Principle, techniques and applications.

AAS, ICP-ES, ICP-MS – electron microscvope: SEM, TEM and AFM – principle and applications.

References:

1. F.W. Fifield and D. Kealey, "Principles and practice of Analytical Chemistry", Blackwell Publishing,Fifthh Edition, 2000.
2. J.S. Fritz and G.H. Scheink, "Quantitative Analytical Chemistry",Allyn and Bacon, Inc., Boston, Fifth Edition, 1987.
3. G.D. Christian,"Analytical Chemistry", John Wiley and Sons, Inc., Fifth Edition, 1994.
4. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, "Fundamentals of Analytical Chemistry", Thomson-Brooks.Cole, Eigth Edition, 2004.
5. H.H. Willard, L.L Merritt, J.A. Dean and F.A. Settle, Jr., CBS Publishers and Distributors, New Delhi, Sixth Edition, 1986.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course – I (Elective Theory) EC 1

Credits : 4 **Code: S1PCHEL1B**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – I

(For students admitted from 2018 onwards)

Solid State Chemistry

OBJECTIVES

1. To learn the crystal structures of few inorganic solids.
2. To study the chemistry of crystallization and vapour phase transport.
3. To learn the applications of magnetic materials.
4. To study the chemistry of organic solids.

UNIT I: Crystal Structure and Crystal Engineering of Organic Solids

Types of close packing – hcp and ccp – packing efficiency – SC, BCC, and FCC, radius ratio rule – applications – polyhedral description of solids – structure types: Na_2O, Cs_2O, rutile, perovskite (ABO_3), ReO_3, K_2NiF_4, spinels and antispinels. Hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudopolymorphism – supramolecular isomorphism, polymorphism and crystal engineering of pharmaceutical phases.

UNIT II: Metallo Organic Frameworks

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

UNIT III: Preparative Methods in Solid State Chemistry

Experimental procedure, coprecipitation as a precursor to solid state reaction, other precursor methods, kinetics of solid state reactions – crystallizations of solutions, melts, glasses and gels, solutions and gels: zeolite synthesis – precipitation from solution or melt: flux method, epitaxial growth of thin layers, verneuil flame fusion method. Graphite intercalation compounds, transition metal dichalcogenide and other intercalation compounds, ion exchange reaction, synthesis of new metastable phases by 'Chimie Douce'. Electrochemical reduction methods – preparation of thin films, chemical and electrochemical methods, physical methods – growth of single crystals, Czochralski method, Bridgman-Stockbarger methods – zone melting. Vapour phase transport, hydrothermal methods, comparison of different methods – high pressure and hydrothermal methods and dry high pressure methods.

UNIT IV: Magnetic Materials and Optical Properties

Selected examples of magnetic materials and their properties – metals and alloys, transition metal oxides, spinels, garnets, ilmenite and perovskites. Magnetoplumbites – applications – structure/property relations – transformer,information storage, magnetic bubble memory devices, permanent magnets. Luminescence, Lasers and phosphors – definitions and general comments, configurational coordinate model, some phosphor materials, anti-Stokes phosphors –lasers – the ruby laser, Neodymium lasers

UNIT V: Organic Solid State Chemistry

Topochemical control of solid state organic reactions – intramolecular reactions – conformational effects – intermolecular reactions – molecular packing effects – photodimerization of 2-ethoxycinnamic acid (α form, β form, γ form) – photopolymerization of 2,5-distyrylpyrazine – photopolymerizations of diacetylenes. Asymmetric syntheses – dimerization of anthracene – control of molecular packing arrangements. Organic reactions within inorganic host structures – electrically conductive organic solids – organic metals, conjugated systems, doped polyacetylene, polyparaphenylene, polypyrrole – organic charge transfer complexes – new superconductors

REFERENCES

1. A. R. West, Solid State Chemistry and Its Applications; 2nd Ed., John Wiley and sons, New York, 2014 (Unit III – V).
2. J. M. Lehn, Supramolecular Chemistry; VCH, Weinheim, 1995.
3. G. R. Desiraju, Crystal Engineering: The Design of Organic Solids; Elsevier, Amsterdam, 1989.
4. G. R. Desiraju, and T. Steiner, The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press: Oxford, 2002.
5. G. A. Jeffrey, Introduction to Hydrogen Bonding; Oxford University Press, New York, 1997.
6. J. M. Lehn, Transition Metals in Supramolecular Chemistry; Vol 5, John Wiley and Sons, New York, 1999.
7. C. N. R. Rao, Current Science, 2001, 81, 1030.
8. Journals:
(i) Crystal Growth and Design.http://www.pubs.acs.org/journals/cgdefu/index.html
(ii) Crystal Engineering Communication, http://www.rsc.org /Publishing/ Journals /ce/ index.asp

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course – I (Elective Theory) EC 1

Credits	: 4	**Code: S1PCHEL1C**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER – I

(For students admitted from 2018 onwards)

Supramolecular Chemistry

OBJECTIVES

1. To know the fundamentals of supramolecules.
2. To learn co-receptor molecules and multiple recognition
3. To study the supramolecular reactivity and catalysis.

UNIT I: Concepts of Supramolecular Chemistry

Concepts and languages of supramolecular chemistry – various types of noncovalent interactions – hydrogen bonds, C-H...X interactions, halogen bonds – π-π interactions, non–bonded interactions – various types of molecular recognition. Crystal engineering of organic solids – hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudopolymorphism – supramolecular isomorphism / polymorphism – crystal engineering of pharmaceutical phases.

UNIT II: Metallo Organic Frameworks

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

UNIT III: Co-receptor Molecules and Multiple Recognition

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

UNIT IV: Supramolecular Reactivity and Catalysis

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

UNIT V: Supramolecular Devices

Supramolecular devices and sensors – various types of supramolecular devices – an overview – supramolecular photochemistry – molecular and supramolecular photonic devices – light conversion and energy transfer devices – molecular and supramolecular electronic devices – electronic conducting devices – molecular wires, modified and switchable molecular wires –
molecular and supramolecular ionic devices – tubular mesophases, molecular protonics – switching devices – electro-photo switch – ion and molecule sensors – role of supramolecular chemistry in the development of nanoscience and technology.

REFERENCES

1. J. M. Lehn, Supramolecular Chemistry; VCH, Weinheim, Germany, 1995.
2. G. R. Desiraju, Crystal Engineering: The Design of Organic Solids; Elsevier, United States, 1989.
3. G. R. Desiraju, and T. Steiner, The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press, Oxford, 1999.
4. G. A Jeffrey, Introduction to Hydrogen Bonding; Oxford University Press: UK, 1997.
5. J. M. Lehn, Transition Metals in Supramolecular Chemistry; John Wiley and Sons: New York, 1999.
6. G. R. Desiraju, Current Science; 2001, 81, 1038.
7. Web source:
(i) Crystal Growth and Design, http://www.pubs.acs.org/journals/cgdefu/index.html
(ii) Crystal Engineering Communicationhttp://www.rsc.org/Publishing/Journals/ce/index.asp

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

SEMESTER - II

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Core Course – V (Major Theory) - CC5

Credits : 4 **Code: S2PCH3**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – II

(For students admitted from 2018 onwards)

Inorganic Chemistry - II

Objectives

- To learn the concepts of CFT and MO theory of complexes
- To interpret the stability of various complexes
- To understand the various concepts of Carbon Π donor complexes in organometallic chemistry.
- To impart knowledge and applications of Bioinorganic chemistry

Learning Outcomes

At the completion of this course the student will be able to

- **Apply the concepts of Inorganic Chemistry to solve a range of different chemical problems.**
- **Basic concept of bio inorganic chemistry**

UNIT-1

Coordination chemistry: Nomenclature of mono and poly nuclear complexes – crystal field theory – shapes of d orbitals – splitting of d orbitals in octahedral symmetry- CFSE-strong field and weak field splitting-calculation of CFSE for dn system- splitting in tetrahedral symmetry-only weak field splitting-reasons- tetragonal symmetry- differences between tetrahedral and tetragonal symmetry- John Teller distortion- splitting pattern in trigonal, squreplanar, trigonal bipyramidal, square pyramidal, cubic symmetries. Factors affecting the magnitude of splitting (10Dq) -oxidation state of the metal ion, nature of the metal ion, number and geometry of the ligands, nature of the ligands – Spectrochemical studies, Jorgenson relation, evidences for CFT. Magnetic properties, computation of lattice energies, enthalpies of hydration, stability of particular oxidation states. Site preferences in sofuels-

M.O. theory -octahedral, tetrahedral and square planar complexes. Pi bonding and M.O theory- ligands having filled and empty pi bonds-effect on 10 Dq.- evidences for Pi bonding.- X-ray crystallography.- IR, Photoelectron spectroscopy, Nephelauxiticeffect.-angular overlap model.

UNIT – II

Stability of coordination compounds : Detection of compound formation in solution. Stability constants—stepwise and overall formation constants—ph metric, polorographic, photometric methods of determining formation constants. Factors affecting stabilities—statistical and chelate effects.

Kinetics and mechanisms of reactions in solutions

Labile and inert complexes - ligand displacement reactions- hydrolysis , aquation in octahedral and square planar complexes – trans effect- electron transfer reactions – complementary and non

complementary types – inner sphere and outer sphere processes – isomerisation and racemisation.- reactions of coordinated ligands temolate effect and synthesis of macrocyclic ligands

UNIT - III

Photochemistry of coordination compounds : Photochemical reactions of coordination and organometallic compounds—photo oxidation-photoreduction-photo substitution-photo isomerisation reactions-complexes of pi acceptor ligands- carbonyls-18 electron rule-application to the structure of carbonyls-(mono and polynuclear)-application of IR to identify the terminal and bridging CO- preparation and properties of carbonyls- $Ni(CO)_4$, $Fe(CO)_9$, $Cr(CO)_6$, $Re_2(CO)_{10}$, - Carbonylate anions-carbonyl hydrides- isolobal fragments-nitrosyl complexes preparation-bridging and terminal nitrosyls-bent and linear nitrosyls,-dinitrogen complexes.

UNIT - IV

Carbon pi-donor complexes : Synthesis, structure and bonding in olefins, acetylenes and allyl complexes-metallocenes-molecular orbitals ofmetallocenes-catalysis by organonetallic compounds –hydrogenation and hydroformylation of olefins-oxidation of olefins to aldehydes and ketones- polymerisation of allenes – cyclo oligomerisation of acetylene-Fischer- Tropsch synthesis.

UNIT - V

Bio-inorganic chemistry : Bio membranes- membrane transport- sodium and potassium pumps – crown ethers , cryptands , spherands , chemotherapy – Pt complexes in cancerotherapy – Cis platin and its mode of action – cytotoxic compounds of other metals – Gold containing drugs as anti Rheumatic agents and their mode of action – Lithium in psycho Pharmacological.

Reference:

1. Shriver, Atkins and Langford Inorganic Chemistry, ELBS, 1994
2. F.A.Cotton and G.Wilkinson, " Advanced Inorganic Chemistry", 4 th ed., A Wiley - Interscience Publication, John –Wiley & Sons, USA.
3. J.E. Huheey, "Inorganic Chemistry" 3 rd . ed., Harper & Row publisher, Singapore. 4.
4. S. Glasstone, "Source Book on Atomic Energy", D.Van Nostrand, New York 1967 (Affiliated East-West Press, New Delhi 1969)
5. Purcell and Kotz, "Inorganic Chemistry", Saunders Golden Sunburst Series, W. B. Saunders Company, Philadelphia
6. W. Kaim and B. Schewederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John Wiley & Sons, New York, USA.
7. R. W. Hay, "Bioinorganic Chemistry".
8. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, Panima Publishing Company, New Delhi, 1997.
9. A.W. Adamson and P. D. Fleischauer, "Concepts of Inorganic Photochemistry", Wiley, New York, 1975.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 –19

Core Course – VI (Major Theory) - CC6

Credits : 5 **Code: S2PCH4**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – II

(For students admitted from 2018 onwards)

Organic Chemistry - II

Objectives
❖ To learn the aspects of aliphatic electrophilic and aromatic electrophilic substitution reactions and its applications. ❖ To study the aspects of aliphatic nucleophilic and aromatic nucleophilic substitution reactions and its applications. To appreciate the principles of addition reactions. ❖ To understand the concept of Terpenes,Alkaloids and Vitamins
Learning Outcomes
At the completion of this course the student will be able to ❖ Recall reagents and predict products for a defined set of organic reactions. ❖ To understand the naming reaction and molecular rearrangement ❖ To have and importance of natural products, Terpenes Alkaloids and Vitamins

UNIT – I

Aliphatic nucleophilic substitution : SN^1, SN^2, and SNi mechanisms-effect of substrate structure, leaving group, attacking nucleophile and solvent-neighboring group participation—substitution in allylic carbons and reactivity-ambident nucleophiles.

Elimination reactions : E_1, E_2, E_1cb and Ei mechanisms- stereo chemistry of eliminations – Hoffman and Saytzeff rules-competition between elimination and substitution reactions-Chugaev reaction-dehydration of alcohols-dehydrohalogenation-Hoffman degradation-cope elimination-Bredt's rule

Aliphatic electrophilic substitution : SE_1,SE_2, and SEi mechanism-effect of substrate structure, leaving groups, attacking electrophiles and solvent-Stark-Enamine reaction-decarboxilation of aliphatic acids- halogenation of aldehydes and ketones.

UNIT – II

Aromatic compounds : Elements of aromaticity-Huckel and Craig's rule-Effects of aromaticity on bond lengths- ring currents-Nonbenzanoid aromatic compounds- aromatic character in three, five,seven and eight membered rings-anti-aromaticity-system with 2,4,6,8 and10 electron system.-annulenes and avonones-alternant and non-alternant hydrocarbons,

Aromatic electrophilic substitution : Aromatic ion mechanism-orientation and reactivity-nitration, halogenation, friedel Craft reaction-Gattermann, Kolbe-Schmidt , Reimer-Tiemann, Hauben-Hoesch reactions.

Aromatic Nucleophilic substitution: SN^{Ar}, SN^1, benzyne, SRN1 mechanisms – effect of sustrate structure, leaving groups, attacking nucleophiles and solvents – selected reactions – Zeigler alkylation, Chichibabin reaction- reactions involving diazonium group as leaving group – cine substitution – von Richter reaction.

UNIT – III

Addition reactions : Addition to carbon –carbon multiple bonds-electrophilic addition-nucleophilic free radical additions, orientation and reactivity- Birch reduction,hydroxylation, hydroboration, epoxidation, Diels-Alder reaction, Michael addition, ozonolysis, carbenes and their addition to double bonds.

Addition to carbonyl groups : Mannich , crossed cannizzaro , Stobbe , Benzoin , formation of ketenes , openauer oxidation , MPV reduction , Darzen's glycidic ester condensation , wittig reactions.

UNIT – IV

Molecular rearrangements: Mechanism of the following- wagner Meerwin-Dienone phenol- Wolf-Lozson-Schmidt-Bayer Villiger-Stevens-Wittig-Favoraski rearrangements.

Reagents in Organic Syntheses: Complex metl hydrides – LiAlH4, NaBH4, tri tert-butoxyaluminium hydride, Gilman's reagents, Lithium dimethylcuprate, lithium di-isopropyl amide, dicyclohexylcarbodiimides, 1,3-dithianestrimethyl silyl odide, DDZ, SeO_3 – phase transfer catalyst, Crown ethers and Merrifield resins.

UNIT - V

Natural products : Isolation and detection of natural products – a brief outline to carotenoids, flavonoids and anthocynins with one example each (structural elucidation not needed)

Terpenes: structural elucidation , Medicinal values and synthesis of α-pinene, camphor and zingiberene – biosyntheses of terpenes.

Alkaloids: Structural elucidation, medicinal values and synthesis of quinine, reserpine, morphine, cinchonine and papavarine – biosyntheses of alkaloids.

Vitamins: Physiological importance – structural elucidation of vitamins –B_1, B_2, B_6, E and K.

References:

1. J. March, "Advanced Organic Chemistry : Reactions, Mechanisms and Structure",4th ed., Wiley, 1992.
2. R.K. Bansal, "Organic Reaction Mechanisms", Tata McGraw Hill, 1975.
3. P. S. Kalsi, "Organic Reactions and their Mechanisms", New Age International Publishers.
4 I.L. Finar, "Organic Chemistry", Vol.II, 5 th ed., ELBS 1975.
5. O.P. Agarwal, Chemistry of Organic Natural Products, Vol. I & II, Goel Publications, 1997.
6. F.A. Carey and R.J. Sunberg, "Advanced Organic Chemistry, Parts A & B, Plenum, 1984.
7. T.H. Lowry and K.S.Richardson, "Mechanism and Theory in Organic Chemistry",Harper and Row, 1976.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Core Course – VII (Major Practical) – CC7

Credits : 6 **Code: S2PCHP3**

Hours / Week : 10

Medium of Instruction : English

SEMESTER – II

(For students admitted from 2018 onwards)

Inorganic Practical – II

Objectives
❖ To impart knowledge on Quantitative analysis of inorganic metal mixture using Titrimetry and gravimetry ❖ To gain the depth knowledge in c preparation of Inorganic complexes.
Learning Outcomes
At the completion of this course the student will be able to ➢ To estimate the individual amount of mixture by gravimetric and volumetric ➢ To prepare single stage preparation of inorganic compounds

1. Titrimetry and gravimetry

only mixtures of solutions should be given for estimation.

i. Cu vol, Ni grav
ii. Cu vol, Zn grav
iii. Fe vol, Zn grav
iv. Fe vol, Ni grav
v. Zn vol, Cu grav
vi.

2. Preparation of the following complexes

i. Tetrammine copper(ii) sulphate.
ii. Potassium tri oxalato chromate (iii)
iii. Hexa thiourea Lead (ii) nitrate
iv. Potassium tri oxalato aluminate(iii)
v. Tristhiourea copper(I) chloride
vi. Tris thiourea copper(ii) sulphate

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Core Course – VIII (Major Practical) – CC8

Credits : 4 **Code: S2PCHP4**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – II

(For students admitted from 2018 onwards)

Organic Practical – II

Objectives
❖ To impart knowledge on Quantitative analysis of organic mixture ❖ To gain the depth knowledge in Double stage preparation of different organic compounds
Learning Outcomes
At the completion of this course the student will be able to ❖ Assemble glassware and perform the following techniques as a part of synthetic proceduredistillation, reflux, separation, isolation, and crystallization. ❖ Assemble glassware and perform syntheses requiring special conditions, including reactionsunder the reduced pressure, reactions in the air- and/or water-protectedsystems,microwaveinduced reactions, etc.

1. Quantitative analysis of organic compounds

Phenol, aniline, ketone, glucose,
sapanification value of oils and iodine value of oils

2.**Double stage Preparation:**

a) p- bromo acetanilide from aniline
b) acetyl salycilic acid from methyl salicylate
c) 1,3,5 tribromo benzene from aniline
d) p-nitro aniline from acetanilide
e) benzylic acid from benzoin by rearrangement
f) benzanilde from benzophenone by rearrangement
g) p- amino benzoic acid from p-nitro aniline
p-bromo aniline from acetanilide
h) m- nitro aniline from nitro benzene
i) 1,2,4-triacetoxybenzenefromhydroquinone
(oxidation plus acetylation)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course – II (Elective Theory) – EC2

Credits : 4 **Code: S2PCHEL2A**

Hours / Week : 5

Medium of Instruction : English

SEMESTER - II

(For students admitted from 2018 onwards)

Physical Chemistry - I

Objectives
❖ To study about the quantum concept and atomic and molecular structures. ❖ To study the principle, selection rules and applications of molecular spectroscopy. ❖ To get acquainted with classical thermodynamics ❖ **T**o impart the knowledge on Chemical kinetics.
Learning Outcomes
At the completion of this course the student will be able to ❖ the derivation of rate equations from mechanistic data ❖ the use of simple models for predictive understanding of physical phenomena associated to chemical thermodynamics and kinetics ❖ the limitations and uses of models by applying Quantum Chemistry

UNIT – I

Quantum chemistry I: Time independent Schrödinger's wave eqIIuation (SWE) from classical wave equation and de Broglie relationship – elementary ideas about time dependent SWE – Postulates of Quantum Mechanics - Operator Algebra – linear, non-linear and ladder operators – Hermitian operators(definition and theorems) and their properties – proof of Hermitian nature of linear, angular, position and Hamiltonian operators – eigenfunctions and eigenvalues – normalization and orthogonality – principle of superposition – commutation relations of linear and angular momentum operators – average/expectation values.

Application of SWE to model systems - particle in one and three dimensional boxes – quantum numbers, distortion of the box, zeropoint energy and uncertainty principle – orthogonality and normalization – finite potential barrier and tunneling.

UNIT – II

Molecular Spectroscopy – I :

Microwave spectroscopy : Theory of linear, symmetric and asymmetric top molecules.

Infrared spectroscopy : vibrational spectra – selection rules-harmonic and un-harmonic oscillators – (fundamental absorption, first and second overtones, hot bands etc.) – rotation-vibration spectra of diatomic molecules (P,Q,R branches; breakdown of Born-Oppenheimer approximation), selection rules and transitions for rigid-rotor-harmonic oscillator model – relative intensities –

coupling of rotation and vibration – linear and symmetric top molecules (parallel and perpendicular bands) – influence of rotation on the rotation of polyatomic molecules Fourier Transform IR spectrometry.

Raman spectroscopy: Raman effect-elastic and inelastic scattering- selection rules-pure rotational Raman Spectra (linear, spherical top, symmetric top and asymmetric top molecules) – vibrational Raman spectra – polarization of light and Raman effect – comparison of IR and Raman spectra – simple molecules – mutual exclusion principle – Fermi resonance – laser Raman spectroscopy.

UNIT – III

Classical thermodynamics: thermodynamics of systems of variable composition – partial molar quantities and additive rules – chemical potential –relationship between partial molar quantities – Gibbs-Duhem equation- calculation of partial molar quantities from experimental data – thermodynamic properties of real gases – fugacity - definition, calculation (real gases) – and variation of fugacity with temperature, pressure and composition (Duhem-Margules equation) – activity and activity coefficient definition – standard states – colligative properties and the activity of the solute – experimental determination of activity and activity coefficients of non-electrolytes – activities in electrolytic solutions – determination of activity coefficient of electrolytes by freezing point method.

Phase rule : phase rule to three component systems – systems of three liquids – solid-liquid systems - (eutectic systems and two salts and water.)

UNIT – IV

Chemical kinetics I :

Theories of reaction rates (Bimolecular collision theory, absolute reaction rate theory ARRT) – significance of reaction coordinate – potential energy surfaces – kinetic isotopic effect – opposing, parallel and consecutive reactions – the Hinshelwood theory – Kassel, Rice and Ramsperger (KRR) theory – KRRM method – the Slater treatment – Principle of microscopic reversibility – Steady state approximation – chain reactions – thermal and photochemical reactions between hydrogen and halogens. Gas phase auto-oxidation, explosions and hydrogen- oxygen reaction.

Factors influencing reaction rates in solutions – application of ARRT to solution kinetics – effect of solvents – double and single sphere model – effect of ionic strength – influence of pressure on rates in solution – significance of volume of activation – homogeneous catalysis – acid-base catalysis Brønsted relation.

UNIT – V

Fast reaction techniques : Flow methods (continuous and stopped flow methods) – relaxation methods (T and P jump methods) – pulse techniques (flash photolysis, shock tube method) – molecular beam method – half life time method.

Photochemistry: Photophysical processes in electronically excited molecules – Jablonski diagram – Stern-Volmer Equation and its applications – experimental techniques in photochemistry – chemical actinometers – lasers and their applications. Fluorescence,Quenching- static and dynamic quenching Stern-Volmer Plot – linear and non-linear plots – Reasons fordeviation in stern-volmer plot.

Excited state life time ( ) – definition of life time estimation of life time ( ) by time – correlated single photon counting technique.

Basic aspects of photocatalysis – principle – application of semiconductor nano particles in environmental remediation and solar energy conversion (photo splitting of water and dye sensitized solar cells – basic aspects for both)

References:

1. R.K. Prasad, Quantum Chemistry, New Age International Ltd,
2. A.K. Chandra, " Introductory Quantum Chemistry", 4 th ed,. Tata MCGraw Hill (1994)
3. D.A. Mcquarrie, "Quantum Chemistry", University Science Books (1998)
4. F.L.Pillar."Elementary Quantum Chemistry", McGraw Hill (1968)
5. J.P.Lowe, "Quantum Chemistry", Academic Press (1978).
6. I.N.Levine, "Quantum Chemistry", Allyn and Bacon (1983).
7. P.W.Atkins, "Molecular Quantum mechanics", Clarendon Press New York(1973).
8. K.J. Laidler, "Chemical Kinetics",2 nd ed., Tata McGraw Hill (1975).
9. A.A. Frost and R.G.Pearson, "Kinetics and Mechanisms", John Wiley & Sons, New York, 1953.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Elective Course – II (Major Theory) – EC2

Credits	: 4	**Code: S2PCHEL2B**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER - II

(For students admitted from 2018 onwards)

Pharmaceutical Chemistry

OBJECTIVES

1. To understand the basics of pharmaceutical chemistry.
2. To study the antibiotics and their activity.
3. To learn the analgesic and antipyretic activities.
4. To know the activities of anaesthetics and local anaesthetics.
5. To understand concept of clinical chemistry

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UNIT I: Basics of Pharmaceutical Chemistry

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

UNIT II: Antibiotics

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

UNIT III: Analgesic and Antipyretics

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

UNIT IV: Anaesthetics and Local Anaesthetics

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

UNIT V: Clinical Chemistry

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

REFERENCES

1. Jayashree Ghosh, A Text Book of Pharmaceutical Chemistry; 5th Ed., S.Chand and Company Ltd., New Delhi, 2014.
2. S. Lakshmi; Pharmaceutical Chemistry; 1st Ed., S. Chand and Company Ltd., New Delhi, 1995.
3. Bhagavathi Sundari; Applied Chemistry; 1st Ed., MJP Publishers, Chennai,2006.

Question Paper Pattern
Maximum Marks: 75
Exam duration: Three Hours

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Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course – II (Elective Theory) – EC2

Credits	: 4	**Code: S2PCHEL2B**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER - II

(For students admitted from 2018 onwards)

Bio-organic Chemistry

OBJECTIVES

1. To learn the preparation, properties of amino acids and proteins.
2. To study the activity of enzymes and cofactors.
3. To know basics of lipids and nucleic acids.
4. To learn the concept of bioenergetics.
5. To learn the principles of lead and analogue synthesis.

UNIT I: Amino Acids and Proteins

Structure, classification, synthesis and properties of amino acids – biosynthesis of amino acids – peptides – N-terminal and C-terminal residue analysis – solid phase peptide synthesis.
Proteins – classification and properties (denaturation, isoelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins – biological roles of proteins.

UNIT II: Enzymes and Cofactors

Chemical nature of enzymes – characteristics of enzymes – colloidal nature, catalytic nature. Mechanism of enzymes – Michaelis-Menten hypothesis – Fischer's lock and key model – regulation of enzyme activity. Structure and biological functions of coenzyme A, NAD+, FAD and vitamin B12.

UNIT III: Lipids and Nucleic Acids

Lipids – definition – simple lipids – fats and oils – compound lipids – phospholipids, glycolipids – physical properties – solubility, melting point, surface tension, emulsification and geometric isomerism – chemical properties – reaction involving -COOH group, -OH group and double bonds. Nucleic Acid – definition – nucleosides and nucleotides – deoxyribonucleic acid (DNA) – internucleotides linkages – base composition – double helical structure.

UNIT IV: Bioenergetics

Concept of energy – thermodynamic principles – first law, second law, combining the two laws – relationship between standard free energy change and equilibrium constant. Standard free energy values of chemical reactions – Adenosine triphosphate (ATP) as universal currency of free energy in biological systems – ATP hydrolysis and equilibria of coupled reactions – inter conversion of adenine nucleotides.

UNIT V: Lead and Analogue Synthesis

Designing organic synthesis – disconnection approach – synthons and synthetic equivalents – one group disconnections: alcohol, acid and ketone – functional group interconversions. Asymmetric synthesis – basic principles – stereoselective and stereospecific reactions – reagents, catalysts and their applications (wherever applicable) in alkylation and hydrogenation – Jacobsen's catalyst – Evan's catalyst.

REFERENCES

1. J. L. Jain, Fundamentals of Biochemistry; S. Chand and Co., New Delhi, 2007 [Unit- I, II, III, IV].
2. N. C. Price and L. Stevens, Fundamental of Enzymology; Oxford University Press, UK, 1999 [Unit-II].
3. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry: Part-A and Part-B; 5th Ed., Springer, Germany, 2008 [Unit-I, II, III].
4. S. Warren, Designing Organic Synthesis: The Disconnection Approach; 2nd Ed., Wiley, New York, 2008 [Unit-V].
5. H. B. Kagan, Asymmetric Synthesis; Thieme Medical Publishers, Germany, 2009 [Unit – V].

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)
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Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

SEMESTER - III

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 –19

Core Course –IX (Major Theory) – CC9

Credits	: 5	**Code: S3PCH5**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER – III

(For students admitted from 2018 onwards)

Inorganic Chemistry - III

Objectives
❖ To learn the inorganic applications of different types of spectroscopic techniques. ❖ To acquire the knowledge of solid state chemistry. ❖ T**o** impart knowledge in Bio inorganic chemistry
Learning Outcomes
At the completion of this course the student will be able to ❖ To understand the basic concepts of spectroscopy ❖ To understand the applications of bio inorganic chemistry

UNIT- I

Electronic spectroscopy: electron configuration- terms, states and micro states- derivation of term symbols- (p^2,d^2)- arranging various terms according to their energies- spectroscopic terms- effect of inter-electronic repulsion and spin- orbit coupling- Racah parameters, D and RS coupling and ij coupling- selection rules and the breakdown of selection rules- group theoretical explanation- splitting of orbitals in octahedral field –hole formalism- ground states of free ions for dn systems- oh and Td systems and the corresponding energy level diagrams- mixing of orbitals- orgel diagram, characteristics- prediction and assignment of transitions for dn weak field cases. Tanang-Sugano diagrams- characteristics- prediction and assignment of transition for weak field and strong field – d^n systems- band intensity, band width, band shapes- factors affecting these – distortion and spin orbit coupling- calculation of B and 10D for simple complexes- charge transfer spectra.

UNIT – II

NMR spectroscopy; chemical shifts and coupling constants (spin,spin coupling involving different nuclei ^{1}H, ^{31}P, ^{13}C)- interpretations and applications to inorganic compounds- effect of quadrupolar nuclei (^{2}H, ^{10}B, ^{11}B) on the proton nmr.- NMR of paramagnetic molecules-isotopic shifts, contact and pseudo- contact interactions-lanthanide shift reagents- stereo chemistry of non-rigid molecules.

EPR spectroscopy: basic principles- characteristics of the hyperfine splitting selection rules-hyperfine splittings in various structures, bis (salicylaldimine copperII)-factors affecting the magnitude of g values. – g values of transition metal ions-dependence on spin orbit coupling- and crystal field effects- three conditions(I)spin orbit coupling,>> than crystal field (ii)strength of crystal field braking the spin orbit coupling (iii) very large crystal field , Ni II octahedral complexes, Cu II in a tetrahedral field, -zero field splitting- Krammers degeneracy- magnitude of zero field splitting and signal- effective spins mixing of states and zero field splitting- line width, in solid state EPR- spin lattice relaxation- spin, spin relaxation- exchange processes- effect of distortion- T2, Ag, Eg, ground terms- g(parallel) and g(perpendicular) dependence on 10 Dq, ,lamda, k- calculation of g s-alpha^2,beta^2 and G parameters from EPR and information obtained from them.

UNIT - III

IR and Raman spectroscopy: Combined uses of IR and Raman spectroscopy in the structural elucidation of simple molecules likeH_2O, ClF_3, NO_3' ion, ClO_3' ion, - effect of coordination on ligand vibrations- uses of group vibrations in in the structural elcidation of metal complexes of urea, thiourea, cyanide, thiocyanate, nitrate, sulphate, and dimethyl sulphoxid e- effect of isotopic substitution on the vibrational spectra of molecules- vib. Spectra of metal carbonyls with reference to the nature of bonding, geometry, nd number of C-O stretching vibrations- group theoretical treatment.-

Lanthanides : co-ordination compounds of lanthanides-spectral and magnetic properties-

Actinides : synthesis of elements- magnetic and spectral characteristics of actinides.

Transition Metals: Magnetic properties of transition metal compounds

UNIT- IV

Mossbauer Spectroscopy: Mossbauer transition and Dopler effect- isomer shift- quadropole effect of magnetic field on spectra- simple applications – iron and tin compounds.

Solid State-differences between point group and space group- scew axis-glide planes-crystal symmetry elements-crystal classes- crystal systems- unit cell- bravis lattice- asymmetric unit space group- equivalent positions-relationship between molecular symmetry and crystallographic symmetry- basic concepts, the concept of reciprocal lattice and its application- x-ray diffraction by single crystal- structure factor- systematic absence- determination of space groups-heavy atom method- neutron diffraction, elementary treatment- comparison with x-ray diffraction- electron diffraction , basic principles.

UNIT - V

Diagramatic presentation of potential data: Latimer diagrams- Frost diagrams-base latemer diagrams- pour basic diagrams- effect of compound formation on potentials-

Bio-inorganic chemistry: Ion pumps-oxygen transport- enzyme applications, acid catalysis-oxalo acetate decarboxylase,carboxypeptidase-redox catalysis- iron sulphur proteins-nonheme iron-cytochromes of the electron transport chain- cytochrome P-450 enzymes.

Reference:

1. R.S. Drago, "Physical Methods in Inorganic Chemistry", 3 rd Ed., Wiley Eastern, Company
2. Shriver, Atkins and Langford Inorganic Chemistry, ELBS, 1994
3. F.A.Cotton and G.Wilkinson, " Advanced Inorganic Chemistry", 4 th ed., A Wiley - Interscience Publication, John –Wiley & Sons, USA.
4. J.E. Huheey, "Inorganic Chemistry" 3 rd . ed., Harper & Row publisher, Singapore. A.F.A. Kettle, Coordination Compounds, ELBS,
5. B.N. Figgis, Introduction to Ligand Field Theory, Wiley-Eastern, New Delhi.
6. E.A.V.Ebsworth, "Structural Methods in Inorganic Chemistry", 3 rd ed., ELBS, Great Britain, 1987.
7. D.N. Sathyanarayana, Vibrational Spectroscopy, New Age International Publs., 1996.
8. K. Nakamoto, Infrared and raman Spectra of Inorganic and Coordination Compounds,sJohn-Wiley & sons, 1978

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Core Course – X (Major Theory) CC10

Credits : 5 **Code: S3PCH6**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – III

(For students admitted from 2018 onwards)

Organic Chemistry - III

Objectives
❖ To learn the applications of various reaction in organic synthesis. ❖ To study the organic applications of different types of spectroscopic techniques. ❖ To develop the knowledge in the synthesis and bio-synthesis of natural products
Learning Outcomes
At the completion of this course the student will be able to ❖ Predict the physical properties of organic chemicals based on their structures ❖ Analyze the influence of structure and physical properties of organic molecules on their biological properties

UNIT - I

Organic photochemistry: Funtamental concepts- Jablonski diagram- energy transfer characteristics of photo reactions and photo oxidation- photoreactions of ketones and enones- Norrish type I and II- reactions- photo-chemistry of alkenes, dienes and aromatic compounds- photosensitization- photo additions- Barten reaction- Patterno Buchi reaction.

Pericyclic reactions: Concerted reactions- stereochemistry- orbital symmetry and correlation diagram- Frotier molecular orbital approach- Woodward- Hoffmann rules- electrocyclic reactions- cycloaddition reactions- selection rules- zigmatropic rearrangements- selection rules with simple molecules- 1.3 and 1.5 hydrogen shifts- Cope and Claisen rearrangements.

UNIT - II

Ultraviolet and visible Spectroscopy: Basic principles of electronic transitions- correlation of energy change with electronic transitions- instrumentation and sample handling techniques- Applications of UV- visible spectroscopy- Woodward Fishr Scott rules- applications to conjucated dienes, trienes and polyenes- unsaturated carbonyl compounds- conjugated cyclic ketones- actophenones – benzene and its substituted derivatives- othr aromatic hydrocarbons- hetecyclic systems- differentiation of position isomers- stereo-chemical factors affecting electronic spectra of biphenyl and binaphthyls- cis trans isomers- angular distortion- cross conjugation.

Infrared Spectroscopy : Instrumentation and sampling techniques- types of stretching and bending vibrations- characteristic group frequencies- both internal and external- quantitative studies- organic structure determination, finger print region - identification of functional groups- hydrogen bonding, intermolecular and intra molecular-conformational aspects in cyclic 1,2 diols and 1,3 diols- transannular interactions in UV and IR – determination of reaction rates and mechanisms of reactions involving IR and UV spectroscopy- (basic aspects)

UNIT - III

Proton nmr spectrometry: Chemical and magnetic non-equivalence- chemical shift- coupling constant- first and second order proton spin- spin interaction- dependence of j on dihedral angles- vicinal and geminal coupling constants- karplus equation- long range coupling constants- influence of stereo chemical factors on chemical shift of protons- simplification of complex spectra- double resonance techniques- shift reagents- chemical spin decoupling of rapidly exchangeable protons- OH, COOH, SH, NH 2- an elementary treatment of NOE phenomenon- to techniques- COSY- MOSCY,- RGSY.

^{13}C NMR spectroscopy: Basic principles- ft.nmr- explanation- broad band decoupling- off resonance decoupling- calculation of chemical shifts for simple aliphatic and aromatic compounds- conformation and chemical shift correlation- peak assignments- importance of NOE phenomenon in 13c nmr spectroscopy.

UNIT - IV

Mass spectroscopy: Basic principles- resolutions- EI and CI methods- base peak- isotopic peaks- metastable peaks- parent peaks- determination of molecular formula- recognition of molecular ion peak- fragmentation - general rules- nitrogen rule- pattern of fragmentation of various classes of compounds- Mc Lafferty rearrangement- importance of metastable peeks.

Electron spin resonance spectroscopy: Basic principles- comparison between esr and nmr spectra- hyperfine splitting- factors affecting the magnitude of G- values- calculation of unpaired electron density on an atom in a delocalised system- applications to organic free radicals.

Optical rotatory dispersion and circular dichroism: Introduction to theory and terminology- cotton effect- ORD curves- axial haloketone rule and its applications- octant rule- its applications- applications of ORD to determine absolute configuration of monocyclic ketones- comparison between ORD and CD -their inter relationships.

UNIT - V

Steroids: Classification- structural elucidation and synthesis of cholesterol(synthesis not required) vitamin D,progesterone, stigmasterol. Structure and biological activity of ergosterol, , equilenin, androsterone, oestrone and cortisone. classification and functions of prostoglandins- conformations of steroids- biosynthesis of cholesterol.

Heterocyclics: Synthesis and reactions of azoles- pyrazole, imidazole, oxazole, and thiazloe- synthesis and reactions of azepine, oxazine, thiazine, pyridazine pyrimidine, and pyrazine.

Reference:

i P.M. Silverstein, F. X. Wester, "Spectroscopic Identification of Organic Compounds", 6 th ed., Wiley 1998.

i. J.R.Dyer, "Applications of Absorption Spectroscopy of Organic Compounds", Prentice Hall, 1965.

ii. W.Kemp, Organic Spectroscopy, ELBS, 1991.

iii. Y.R.Sharma, Elementary Organic Spectroscopy- Principles and Chemical Applications, S.Chand, 1992

iv. P.S. Kalsi, Spectroscopy of Organic Compounds,

v. C.H.Depuy and O.S.Chapman, Molecular Reactions and Photochemistry, Prentice Hall, 1975.

vi. M.G.Arora, Organic Photochemistry and Pericyclic Reactions.

vii. I.L.Finar, Organic Chemistry Vol II, ELBS, 5th Edn., 1975

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Core Course – XI (Major Theory) – CC11

Credits : 4 **Code: S3PCH7**

Hours / Week : 5

Medium of Instruction : English

SEMESTER - III

(For students admitted from 2018 onwards)

Physical Chemistry - II

Objectives
❖ To understand the elements of group theory and the application of group theory. ❖ To study the fundamental principles of Quantum chemistry, Schrodinger wave equation and its applications. ❖ To develop the Surface Phenomena and Role of surfaces in catalysis in chemical kinetics ❖ To gain the depth knowledge in Statistical Mechanics and Partition Functions .
Learning Outcomes
At the completion of this course the student will be able to ❖ Recall the basics of thermodynamics, photochemistry and electrochemistry ❖ Differentiate the classical and quantum approaches. ❖ recognize the quantum nanostructures. ❖ understand the principles of Molecular Spectroscopy

UNIT-I

Group theory : Elements of Group theory – properties of group and subgroup – classes – group multiplication tables – isomorphism groups – symmetry elements and symmetry operations – inter relations among symmetry operations – generators – point groups of molecules – matrix representation theory – consequences of great orthogonality theorem and construction of character tables(C_{2v} and C_{3v}) – characters, reducible and irreducble representations – direct products and correlation tables.

Application of group theory: to IR, Raman (for non-linear molecules; polarization ratio – number of Raman polarized lines) and Electronic spectra – projection operators – SALC procedure – evaluation of energies and HMO calculations for systems like ethylene butadiene and planar monocyclic aromatic compounds – hybridization schemes of sigma orbitals.

UNIT - II

Quantum Chemistry – II

Application os SWE to: Simple Harmonic Oscillator (SHO) – Hermite polynomial, Eigenfunctions and Eigenvalues – rigid rotator with free axis (SWE in polar coordinates, separation of angular functions and their solutions, Legendre and associated Legendre polynomials, degeneracy of rotational states) – selection rules for rotational and vibrational transitions – Bohr correspondence principle – hydrogen and hydrogen like atoms (separation of angular and radial wave equations and solution to radial equation, Lagurre and associated Lagurrre polynomials, quantum numbers, shapes and nodal properties of orbitals, space quantization and electron spin) – SWE to many electron atoms and molecules – Born-Oppenheimer approximation – one electron orbitals – the antisymmetry or Pauli's exclusion principle and Slater Determinant (ground state helium atom)

UNIT – III

Molecular spectroscopy I: Introductory aspects : Interaction of radiation with molecules – Einstein and transition probabilities – basics of selection rules – epresentation of spectra – the width and intensity of spectral transitions – oscillator strength – Fourier Transform spectroscopy.

Photoelectron Spectroscopy: Basic Principles – Koopman's theorem – UPES, XPES (ESCA and Auger Spectrosciopy) – valence and core binding analysis, examples and applications of ESCA with two examples

UNIT – IV

Statistical Mechanics I:

Calculation of thermodynamic probability of a system – difference between thermodynamic and statistical probability – ensembles, phase space – ergodic hypothesis – definition of micro and macro states – different methods of counting micro and macro states – distinguishable and indistinguishable particles – classical statistics – derivation of Boltzmann distribution law.

Partition Functions : Translational, rotational, vibrational and electronic partition functions – calculation of internal energy, enthalpy, entropy and other thermodynamic functions – application of partition function to mono and diatomic molecules.

UNIT – V

Chemical Kinetics - II

Surface Phenomena: Adsorption and free energy reaction relation at inter-phase – physisorption and chemisorption – potential energy diagram – Lannard- Jones plot – BET isotherm – surface area determination – adsorption from solution – Gibbs adsorption isotherm- solid liquid inter face- wetting and contact angle- solid gas interfaces- soluble and insoluble films.

Electrical phenomenon at interfaces including Electro kinetic – micelles and reverse micelles – solublisation – micro-emulsion or micelliar emulsions.

Role of surfaces in catalysis: semiconductor catalysis – n and p type surfaces – kinetic s of surface reactions involving adsorbed species – Langmuir- Hinshelwood mechanism of bimolecular reaction – Langmuir-Rideal mechanism of bimolecular reaction – Rideal-Eler mechanism.

References:

i. R.K. Prasad, Quantum Chemistry, New Age International Ltd,
ii. A.K. Chandra, " Introductory Quantum Chemistry", 4 th ed,. Tata MCGraw Hill (1994)
iii. D.A. Mcquarrie, "Quantum Chemistry", University Science Books (1998)
iv. F.L.Pillar."Elementary Quantum Chemistry", McGraw Hill (1968)
v. J.P.Lowe, "Quantum Chemistry", Academic Press (1978).
vi. I.N.Levine, "Quantum Chemistry", Allyn and Bacon (1983).
vii. P.W.Atkins, "Molecular Quantum mechanics", Clarendon Press New York (1973).
viii. K.J. Laidler, "Chemical Kinetics",2 nd ed., Tata McGraw Hill (1975).
ix. A.A. Frost and R.G.Pearson, "Kinetics and Mechanisms", John Wiley & Sons, New York, 1953.
x. I.Amdur and G.G. Hammes, "Chemical Kinetics Principles and Selected Topics", McGraw Hill, New York, (1966).
xi. 1K.K. Rohatgi Mukherjee ,"Fundamentals of Photochemistry", Wiley Eastern Ltd, New Delhi (1978).
xii. G. Hughes, "Radiation Chemistry", Oxford Chemistry Series, Clarendon Press, (1973).

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018– 19

Core Course – XII (Major Practical) – CC12

Credits : 6 **Code: S3PCHP5**
Hours / Week : 10
Medium of Instruction : English

SEMESTER – III

(For students admitted from 2018 onwards)

Physical Practical - I (Non – Electrical)

Objectives
❖ To impart knowledge on kinetics experiments to determine rate, order, Ea. ❖ To gain the depth knowledge in phase rule through two and three components system
Learning Outcomes
At the completion of this course the student will be able to ❖ Basic principle of kinetics,partition,CST,TT and Phase diagram

Non-electrical – Practical – I

1. Kinetics – Acid Hydrolysis of Ester – Comparison of strengths of acids.
2. Kinetics – Acid Hydrolysis of Ester – Determination of Energy of Activation (Ea).
3. Kinetics – Saponification of Ester .
4. Kinetics – Persulphate – Iodide Reaction – Determination of order, effect of Ionic strength on rate constant.
5. Distribution Law – Study of iodine – Iodide equilibrium.
6. Distribution Law – Study of Association of Benzoic Acid in Benzene.
7. Adsorption – oxalic Acid\ Acetic Acid on charcoal using Freundlich isotherm.
8. Determination of molecular weight of substances by cryoscopy.
9. Determination of Molecular weight of substances by Transition Temperature method.
10. Determination of molecular weight of substances by Rast method.
11. Determination of critical solution temperature(CST) of phenol water system and effect of impurity on SCT.
12. Determination of integral and differential heat of solutions by colorimetry.
13. Study of phase diagram of two components forming simple eutectic.
14. Study of phase diagram of two components forming a compound.
15. Study of phase diagram of three components system (Acetic acid, Benzene, and water.

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Elective Course – III (Elective Theory) – EC3

Credits : 4 **Code: S3PCHEL3A**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – III

(For students admitted from 2018 onwards)

Industrial Chemistry

Objectives
❖ To give an important overview of chemical industries and the various water purification techniques.
❖ To understand the details about cement and glass.
❖ To study about various cleaning agents.
❖ To learn the importance of under earth chemicals
Learning Outcomes
At the completion of this course the student will be able to ❖ Basic application of chemistry In industries like water,cement ,sugar,rubber,plastics etc.

UNIT – I

Basic ideas about chemical industries: Flow charts- chemical conversion – Batch versus continuous processing – chemical process economics – market survey – plant location – Research and development and its role in chemical industries.

Water in industry: pollution of water by ertilizer, detergent and pesticide industries – BOD, COD – water treatment – ion exchange, reverse osmosis and softening of hard water.

UNIT – II

Cement: Manufacture, Hot process and dry process – types – analysis of major constituents – setting of cement – reinforced concrete – cement industries in India.

Glass: types – composition – manufacture of optical glass, coloured glass and neuron absorbing glass – Fertilizers: Fertiliser industries in India – manufacture of ammonia – ammonia saltd, urea, super phosphate, triple super phosphate and potassium salts.

UNIT – III

Sugar: sugar manufacture, recovery of sugar from molasses, sugar industries in India.

Cleaning agents: Preparation of toilet and washing soaps- synthetic detergents – alkyl, aryl sulphonates, builders, additives and corrosion inhibitors – Paints and Varnishes: Primary constituents of paints – dispersion medium (solvent) – binders' pigments- oil based paints – latex paints – requirements of a good paint.

UNIT – IV

Rubber industries: Natural rubber – synthetic rubber – monomer production – synthetic rubber polymerization – butadiene, styrene co polymers – neoprene – urethane rubber.

Plastics: Manufacture – resin – manufacturing process – condensation, polymerization – polyamides – nylon 66, polyester and terelene.

UNIT – V

Coal : Origin and imporatance of coal – types – composition – coal gasification – carbonization – coal tar based chemical manufacture – coal mines in India.

Petroleum : Origin – refining – cracking – knocking – and octane number – LPG – synthetic gas and synthetic petrol.

Fuel gases : Large scale production – storage – hazards and uses of coal gas, water gas and producer gas and oil gas.

References:

1. B.N. Chakrabarthy, Industrial chemistry , Oxford & IBH publishing Co.,New delhi, 1981
2. B.K elvin industrial chemistry, geol publishing House, Meerut.
3. P.P. Singh, T.M. Joseph and R.G.Dhavale, College Industrial chemistry, Himalaya publishing House, Bombay ,4th Ed., 1983
4. R. Norrish sherve and Joseph A.Brink Jr., Chemical Process industries, Mcgraw Hill Industriak Book Company, London
5. A.C.S. Brain , Production and properties if industrial Chemicals, Reinhold, NY.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type –Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Elective Course – III (Elective Theory) – EC3

Credits	: 4	**Code: S3PCHEL3B**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER – III

(For students admitted from 2018 onwards)

Elective Course – III (Elective Chemistry)

Green Chemistry

OBJECTIVES

1. To learn the green chemistry and their principles.
2. To learn the importance of greener reactions.
3. To understand the phase-transfer catalyst in green chemistry.

UNIT I: Introduction to Green Chemistry

Introduction to green chemistry – twelve principles of green chemistry – planning a green synthesis in a chemical laboratory – evaluating the type of reaction involved – rearrangement, addition, substitution, elimination and pericyclic reactions. Selection of appropriate solvent – aqueous phase reaction – reactions in ionic liquids – organic synthesis in solid state – solid supported organic synthesis – selection of starting materials – use of protecting group – use of catalyst – use of microwaves and sonication.

UNIT II: Addition and Condensation Reactions

Addition reactions – Michael addition in [aqueous medium and solid state] – Diels- Alder reactions in aqueous phase. Condensation reactions – Aldol condensation of aldehydes with nitroalkanes and nitriles – Aldol condensation in solid phase – benzoin condensation under catalytic conditions – applications.

UNIT III: Oxidation and Reduction Reactions

Oxidation reactions – Baeyer-Villiger oxidation in aqueous phase and solid state – enzymatic Baeyer-Villiger oxidation. Reduction reactions – Clemmensen reduction – mechanism – limitations – applications

UNIT IV: Phase-Transfer Catalyst Reactions

Phase-transfer catalyst reactions – Heck reaction – Michael addition reaction – oxidation of toluene to benzoic acid – Reimer-Tiemann reaction – Baker-Venkataraman synthesis – Williamson ether synthesis – Dozen reaction.

UNIT - V: Sonication Reactions

Sonication reactions – Barbier reaction – Reformatsky reaction – Simmons-Smith reaction – Strecker synthesis – Ullmann coupling reaction – Wurtz reaction – Bouveault reaction.

REFERENCES

1. V. K. Ahluwalia, Green Chemistry; 2nd Ed., Ane Books Pvt Ltd., New Delhi, 2016. [UNIT-I, II, III, IV, V]
2. P. T. Anastas and J. C. Warner, Green chemistry Theory and Practice; Oxford University Press, New York, 2005. [Unit-I]
3. V. K. Ahluwalia and K. Agarwal, Organic Synthesis, Special Techniques; 2nd Ed., Narosa Publishing House, New Delhi, 2007. [Unit-I]

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type –Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018– 19
Elective Course – III (Elective Theory) – EC3

Credits	: 4	**Code: S3PCHEL3C**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER – III

(For students admitted from 2018 onwards)

Catalysis

Objectives

1. To understand the basic concepts of catalysis
2. To know the different methods of catalysis
3. To learn the various techniques and mechanisms involved in catalysis.

Unit -1: Introduction to catalysis

1.1 Activity, selectivity, promoters, stabilisers and poisons, Catalysts deactivation, Turn overnumber, inhibitors.

1.2 *Thermodynamic consideration in catalysis:* Energy factor, significance of activationparameters and application to kinetic systems.

1.3 *Physical adsorption-Unimolecular adsorption-* types of adsorption isotherms, Multimolecular adsorption-BET method, Harkins-Jura equation.Chemisorption of gases onmetals and oxides

Unit -2:Homogeneous and Heterogeneous Catalysis

2.1 Acid-base catalytic reactions, protolytic and protropic mechanisms, activation energy of theprocesses, catalytic activity and acid-base strength, acidity functions: Hammett-Zuckertreatments, linear free energy relationships.

2.2 Homogeneous catalysts for the polymerization of olefins, oxidative dehydrogenation, Ethylbenzene to styrene, Ziegler-Natta polymerization.

2.3 Partial oxidation: n- butane to maleic anhydride, propylene to acrolene, Fisher-Tropschsynthesis, catalytic reaction of cracking, shape selective catalysis: Zeolites-Alkylation of aniline with alcohols.

2.4 Catalysts for the production of petrochemicals- production of aromatics, para-xylene,cumene, linear alkylbenzenes and methanol.

2.5 Phase transfer catalysis – Rhodium water soluble catalyst systems with carboxylated and sulfonatedphsphines for hydroformylation reactions.

Unit - 3:PhotocatalysisandElectrocatalysis

3.1 Thermal and photochemical reactions between H2-Cl2 and H2-Br2 and H2- I2 reactions,fluorescence, phosphorescence and quenching-Stern-Volmer equation.

3.2 Photocatalytic studies using non-stiochiometric oxides such as n-type and p-type semiconductors (TiO2, ZnO, Cr2O3, doped and coupled semiconductors for the degradationof dyes)

3.3 Solar energy conversion, electrochemical cells, photoelectrolysis of water and photocatalyticreactions

3.4 Photocatalytic reduction of dinitrogen, photocatalysis for organic reactions oxidation,reduction, polymerization, substitution and isomerization reaction using TiO2.

Unit -4: Biocatalysis: Mechanism and Application

4.1 *Mechanisms*: Covalent catalysis, acid-base and metal-ion catalysis, entropy and geometric effects, structural complementary of the active site to the transition state, prevention of the side reactions, the size of the enzymes

4.2 *Applications of enzymes in organic synthesis*:Oxidoreductase: Oxidation - Alcohols, epoxides, sulfoxides, amino acids, lactones, Oxidoreductase: Reduction-α-hydroxyaminoacid, Transferase: Amino acids, amines.

Unit -5: Techniques in Catalysis

5.1. Structural characterization-BET surface area method, pore volume, and pore size distribution-BJH method, t-plot method, XRD, SEM, TEM, AFM, STM, TPR and TPD.

5.2 Special relevance to metal oxides with different structures

Text Books

1. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy, *Catalysis*: *Principles and Applications*, Narosa Publishing House, New Delhi, 2004
2. G.C. Bond, *Heterogeneous catalysis: Principles and applications*, Oxford University Press,Ely House, London W.I, 1974.
3.

References

1. V. Murugesan, A. Banumathi and M. Palanichamy, *Recent Trends in Catalysis*, Narosa Publishing House, New Delhi, 1999.
2. K.J. Laidler, *Chemical Kinetics*, Tata Mcgraw-Hill Publishing Company Ltd, New Delhi,1973.
3. D.K. Chakrabarty, *Adsorption and Catalysis by solids*, Wiley Eastern Limited, New Delhi,1991.
4. J.M Thomas, W.J. Thomas, *Principles and practice of Heterogeneous Catalysis*, Wiley-VCH, New York, 1996.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type –Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

SEMESTER – IV

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Core Course – XIII (Major Theory) CC13

Credits : 4 **Code: S4PCH8**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – IV

(For students admitted from 2018 onwards)

Physical Chemistry – III

Objectives
❖ To study the fundamental principles and concepts of Quantum chemistry ❖ To impart knowledge on molecular spectroscopy ❖ To learn about Transport and Activity of ions and Electrolyte equilibrium in a solutions. ❖ To gain the depth knowledge in Elect kinetic phenomena.
At the completion of this course the student will be able to ❖ Ability to interpret spectroscopic data for compound identification.

UNIT – I

Quantum Chemistry – III

Need for approximation methods – variation method (statement, proof, sewcular equation, applications to hydrogen and helium atoms) perturnbation method for non-degenerate systems(first order corrections to eigenvalues and eigenfunctions, applications to helium atom)

Angular momentum in many electron systems (spin orbit interaction, L_S, j-j cvoupling scxhemes) – elementary idea of Hartree-Fock self-consistent field method

MO and VB treatment of hydrogen molecule (electron density, forces and their role in chemical binding) – hybridization, solving wave equation for sp, sp2 and sp3 hybrid orbitals – Huckel's molecular orbital theory and its application to ethylewne and butadiene (charge density, pi-bond order and free valence).

UNIT-II

Molecular Spectroscopy III: NMR: spin and applied magnetic field-Larmor precession-relaxation precession- PMR chemical shift- spin spin interaction (AX and A2 – spin systems in terms of spin Hamiltonian and spin product functions)- Fourier transformation NMR- multiple pulse nmr (effect of pulses, the rotating frame of reference, free induction decay FID, multiple pulse spin-spin and spin-lattice relaxation, inversion recovery) - C13 nmr- chemical exchange- evaluation of thermodynamic parameters in simple system.

ESR- spectroscopy : basic principles, zero field splitting and Kramer's degeneracy, Factors affecting the g-values - presentation of spectra-hyperfine splitting- isotopic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnel'srelationships, measurement techniques and applications.

UNIT – III

Quantum statistics: Bose- Einstein, Femi-Dirac distribution functions - comparision of them with M- statistics- Application of BE statistics to photon gas- superfluidity of liquid helium- application of FD statistics to electron gas and thermionic emission.

Heat capacities of solids- Einstein and Debye's treatments- concept of negative elvin temperature.

Non-equilibrium thermodynamics: Theremodynamics of irreversible processes – entropy production and entropy flow in open systems – Onsagar's theory – phenomenological relations – Onsagar reciprocal relation - steady state condition – L12 = L21 with respect to (i)thermoelectricity, (ii)electro kinetic effect (iii)thermo molecular pressure difference (iv) transference number methoed

UNIT – IV

Ionics: Transport of ions in solution- Debye-Huckel theory- radius of ionic atmoshphere and its calculation – Debye-Huckel-Onsagar equation modification – asymmetry and electrphoretic effect – evidences for ionic atmosphere – Falkenhegen and Wien's effects.- extension to Debye Huckel Onsager theory-

Activity of ions in solution- Experimental determination- Debye-Huckel limiting law (derivation, verification and modification) – activity coefficient at higher conc- Bjerrum model.

Electrode- Electrolyte equilibrium- Nernst equation- and its limitations- equilibrium electrode potentials- classification of electrodes- concentration cells- liquid junction potentials- thermodynamic quantities from EMF data.

Electrochemical energy- Storage systems- primary and secondary batteries- fuel cells.

UNIT V

Electokinetic phenomena: Theories of electrical double layer – Electrical double layer potential- theory of multiple layers at electrode electrolyte interface- double layer capacity- ectrokinetic phenomena- zeta potential- electro osmosis- sedimentation potential

Processes at the electrodes- the rate of charge transfer- exchange current density- Butler-Volmer equation- Tafel equation-

Principles of corrosion electrochemical corrosion- construction and use of pourbaix and Evans diagram and prevention of corrosion- electrochemical oxidation and reduction.

Cyclic voltametry – principles and applications.

Reference:

1. P.W. Atkins, "Physical Chemistry", ELBS and Oxford University Press, Oxford,1983.
2. F.W. Sears, "Thermodynamics, Kinetic theory of Gases and Statistical Mechanics", 2 nd Ed., Addision Wesley, (1972).
3. S.Glasstone, "Introduction to Electrochemistry", Affiliated East-West Press, (1968).
4. J.Albery, "Electrode Kinetics", Clarendon Press, Oxford Chemical Series, (1979)
5. J.O.Bockris and A.K.N. Reddy, "Modern Electrochemistry", Vol. I & II, Plenum (1970).
6. L.I. Anthrapov, "Theroretical Electrochemistry", Mir Publishers, Moscow, (1972).
7. Glasstone, "Theoretical Chemistry", Affiliated East-West Press.
8. Gupta, Statistical Thermodynamics
9. Lee, Sears and Salinger, Kinetic Theory of Gases and Statististical Thermodynamics,

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type –Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Core Course – XIV (Major Practical) CC14

Credits : 3 **Code: S4PCHP6**

Hours / Week : 10

Medium of Instruction : English

SEMESTER – IV

(For students admitted from 2018 onwards)

Physical Practical – II (Electrical)

Objectives
❖ To gain the depth knowledge in electrical physical chemistry practicals through conductometry, potentiometry and pH meters.
Learning outcomes
❖ To understand the principle electro chemistry Vs Conductrometric,Potentiometry and pH meter

Electrical – Practical – II

1. Conductometry – Acid – alkali titrations.
2. Conductometry – precipitation titrations.
3. Conductometry - Displacement titrations.
4. Conductometry – Determination of dissociation constant of weak acids.
5. Conductometry – Solubility product of sparingly soluble silver salts.
6. Verification of Onsager equation – conductivity method.
7. Determination of degree of hydrolysis and hydrolysis constant of a substance.
8. Potentiometric titrations – Acid alkali titrations.
9. Potentiometric titrations – precipitation titration.
10. Potentiometric titrations – Redox Titrations.
11. Potentiometry – Determination of dissociation constant of week acids.
12. Potentiometroy – Determination of solubility of silver salts.
13. Potentiometry – Determination of activity and activity coefficients of Ions.
14. pH titration of ortho-phosphoric acid.

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Core Course – XV (Major Project Work) CC15

Credits : 3 **Code: S4PCSPW**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – IV

(For students admitted from 2018 onwards)

PROJECT WORK

Objectives
❖ To gain the depth knowledge in laboratory Field (Chemical handling) ❖ To gain the basic principles of research ❖ To apply the various spectra to analyze the compounds
Learning outcomes
❖ To understand the principles of research ❖ To understand the concepts of laboratory instruments and techniques

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course – IV (Elective Theory) EC 4

Credits : 4 **Code: S4PCHEL4A**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – IV

(For students admitted from 2018 onwards)

Applied Chemistry

Objectives
❖ To learn the reactions under sono chemistry. ❖ To impart knowledge in the various concepts and applications of Supramolecular Chemistry ❖ To study the importance of polymers and emphasize the applications of polymers. ❖ To understand the different methods involved in water treatment.
Learning Outcomes
At the completion of this course the student will be able to ❖ Demonstrate skills in sampling , processing, preservation of environmental samples, quality assurance and quality control procedures in performance of analytical instruments ❖ use of analytical instruments in environmental pollution analysis and in the field of selected industries critically analyse and interpret scientific data

UNIT – I : Sono Chemistry

Introduction – Instrumentation – The physical aspects – Types of Sonochemical reactions – Homogeneous reactions – Heterogeneous liquid – liquid reactions – Heterogeneous solid – liquid reactions – Synthetic Application – Esterification – Saponification – Hydrolysis / Solvolysis – Substitutions – Addition reactions – Alkylations – Oxidation – Reduction – Hydroboration – Hydrosilation and hydroalkylation – Coupling reactions – Dichlorocarbene – Other Reactions – Bourgveault reaction – Cannizzaro reaction – Strecker synthesis – The Reformatsky reaction – The barbier reaction of carbonyl compounds – Condensations – Carbohydrates – formation of acetals and benzylidene derivatives of alkylaglycopyranosides

UNIT- II Chem Informatics:

Introduction – Evaluation – History and uses – molecular elvin i using computer –Basic idea – chemical information data base design and their management – data base concepts – structural languages chemical data base design Chemical information sources – chemical information researches formula searching.

UNIT- III Supramolecular Chemistry:

Introduction – molecular forces, molecular recognition – basic concepts of host – guest complexation with examples from ionophore chemistry – non-covalent interactions and organic host – guest complexes, molecular receptors for different types of molecules, design and synthesis of co receptor molecules, triangular square, rectangular supramolecules.

UNIT- IV

Polymer Chemistry

Introduction – structure, classification of polymers, elvin ization methods, Importance of polymers,Molecular weight of polymers – Number average and weight average, Determination of molecular weight by osmometry, light scattering, viscosity and sedimentation methods, Kinetics of elvin ization reactions,polycondensation reactions, ionic and free radical elvin ization, copolymersation – coordination polymers,Conducting polymers.

UNIT – V – Water Treatment

Water in industry: Pollution of water by fertilizer, detergent and pesticide industries – BOD, COD – water treatment – ion exchange, reverse osmosis and softening of hard water. Treatment of water for municipal purposes – Chemical methods of sterilization – Physical methods of sterilization – Sea water as a source of drinking water – Desalting. Electro dialysis method. Reverse osmosis method

References :

Chemoinformatics- A text book Johann Gasteiger, Thomas Engel Wiley – VCH Gmbh & Co., Germany

1. P.S. Kalsi & J.P Kalsi – Bioinorganic, Bioorganic & supra molecular chemistry – New Age International Publishers – 2010
2. V.R.Gowariker, N.V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age Publishers,New Delhi, 1986.
3. Charles E. Carraher, Polymer chemistry, 6th edn, Marcel Dckker, Brijbasi Art Pvt.Ltd, 2003
4. B.K. Sharma, Engineering Chemistry, Krishna Prakasan Media (P) Ltd.,1997
5. W.Kemp, Organic Spectroscopy, ELBS, 1991.
6. Y.R.Sharma, Elementary Organic Spectroscopy- Principles and Chemical Applications, S.Chand, 1992
7. P.S. Kalsi, Spectroscopy of Organic Compounds,

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type –Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course – IV (Elective Theory) EC 4

Credits	: 4	**Code: S4PCHEL4B**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER - IV

(For students admitted from 2018 onwards)

Scientific Research Methodology

Objectives

1. To introduce the purpose and importance of research for future development.
2. To know the various indexes and abstracts in science and technology.
3. To learn literature search for current awareness and for retrospective survey.
4. To know the classical and comprehensive reference works and general treatises in chemistry.
5. To know the methodology of writing thesis and journal articles.

UNIT 1:Meaning of Research

1.1 The search for knowledge, purpose of research, nature of scientific knowledge, scientific method, role of theory, characteristics of research.

1.2 Types of research: fundamental or pure research, applied research, action research, historical research, experimental research. 1.3 Assessment and evualation-purpose and general methodology.

UNIT 2:The Chemical Literature

2.1 Sources of chemical information: primary, secondary and tertiary sources.

2.2 Indexes and abstracts in science and technology: applied science and technology index, biological abstracts, chemical abstracts, chemical titles, current chemical reactions, current contents, engineering index, index chemicus, index medicus, physics abstracts, science citation index.

2.3 Classical and comprehensive reference works in chemistry: Beilstein's Handbook of Organic Chemistry, Dictionary of Organic Compounds, Merck Index, Handbook of Chemistry and physics, Lange's Handbook of Chemistry, Atlas of Spectral Data and Physical Constants for Organic Compounds

2.4 General Treatises: Organic Syntheses, Reagents for Organic Synthesis, Compendium of Organic Synthetic Methods, Organic Reactions, Theilheimer's Synthetic Methods of organic Chemistry.

2.5 Reviews: Annual and quarterly reviews, general reviews.

UNIT 3:The Chemical Abstracts

3.1 Current awareness searching: CA weekly issues, CA issue indexes.

3.2 Retrospective searching: CA volume indexes-general subject index, chemical substance index, formula index, index of ring systems, author index, patent index.

3.3 CA Collective indexes: Collective index (CI), decennial index (DI).

3.4 Access points for searching CA indexes: index guide, general subject terms, chemical substance names, molecular formula, ring systems, author names, patent numbers.

3.5 Locating the reference: finding the abstract, finding the original document, chemical abstract service source index.

UNIT 4:The Scientific Writing

4.1 Scientific writings: research reports, thesis, and journal articles.

4.2 Requirement of technical communications: eliminating wordiness and jargon-tautology, redundancy, imprecise words, superfluous phrases.

4.3 Steps to publishing scientific articles in journals: types of publications-communications, articles, reviews; where to publish, specific format required for submission, organization of the material.

4.4 Documenting: abstracts-indicative or descriptive abstract, informative abstract, footnotes, end notes, referencing styles, bibliography-journal abbreviations (CASSI), abbreviations used in scientific writing.

UNIT 5:Computer Searches of Literature

5.1 ASAP Alerts, CA Alerts, SciFinder, ChemPort, ScienceDirect, STN International. Google scholar, Scopus.

5.2 Journal home pages.

Text Books :

1. B. E. Cain, The Basis of Technical Communicating, ACS.,Washington, D.C., 1988.
2. J. W.Best, Research in Education, 4th ed. Prentice Hall of India, New Delhi, 1981.
3. H. F. Ebel, C. Bliefert and W.E. Russey, The Art of Scientific Writing, VCH, Weinheim, 1988.
4. J. Gibaldi, and W.S. Achtert, Handbook for writers of Research Papers; 2nd ed.; Wiley Eastern, 1987.
5. A. Joseph, .Methodology for Research; Theological Publications, Bangalore, 1986

References :

1. R. L. Dominoswki, Research Methods, Prentice Hall, 1981.
2. H. M. Kanare, Writing the Laboratory Notebook; American Chemical Society: Washington, DC, 1985.
3. J. S. Dodd, Ed., The ACS Style Guide: A Manual for Authors and Editors; American Chemical Society: Washington, DC, 1985.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type –Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course – IV (Elective Theory) EC 4

Credits	: 4	**Code: S4PCHEL4C**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER - IV

(For students admitted from 2018 onwards)

Heterocyclic chemistry

OBJECTIVES

1. To rationalize the reactivity of hetero aromatic compounds.
2. To learn the preparations of five and six membered fused rings.
3. To learn the nomenclature of Heterocycles.
4. To understand the reaction mechanism of heterocyclic compounds.

UNIT-I: NOMENCLATURE OF HETEROCYCLES

Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic fused and bridged heterocycles.Aromatic Heterocycles General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations).Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

UNIT-II: NON-AROMATIC HETEROCYCLES

Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversino and 1,3-diaxial interaction. Stereo-electronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic, ectrophilic interactions. Heterocyclic Synthesis. Principles of heterocyclic synthesis involing cyclization reactions and cycloaddition reactions.

UNIT-III: SMALL RING HETEROCYCLES

Three-membered and four-membered heterocycles-synthesis and reactions of azirodines, oxiranes, thiranes, azetidines, oxetanes and thietanes.Benzo-Fused Five-Membered HeterocyclesSynthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes.

UNIT-IV: MESO-IONIC HETEROCYCLES

General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. Six-membered Heterocycles with one Heteroatom. Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and phridones. Synthesis and reactions of quionlizinium and benzopyrylium salts, coumarins and chromones.

UNIT-V: HIGHER HETEROCYCLES

Six membered Heterocycles with two or more Heteroatoms. Synthesis and reactions of diazones, triazines, tetrazines and thiazines. Seven-and Large-membered Heterocycles. Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines.

Suggested References:

Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
Heterocyclic chemistry J.A. Joule, K. Mills and g.F. Smith, Chapman and Hall.
Heterocyclic Chemistry, T.L. Gilchrist, Longman Scietific Techinal.
Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley-Inter Science.
An Introductiion to the Heterocyclic Compounds, R.M. Acheson, Johnwiely.
Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type –Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course – V (Elective Theory) EC 5

Credits : 4 **Code: S4PCHEL5A**

Hours / Week : 5

Medium of Instruction : English

SEMESTER – IV

(For students admitted from 2018 onwards)

NANO AND COMPUTATIONAL CHEMISTRY

Objectives
❖ To learn the fundamental concepts of nano science and technology ❖ To gain the depth knowledge in computer with chemistry. ❖ To impart knowledge on green chemistry.
Learning Outcomes
At the completion of this course the student will be able to ❖ Appreciate the importance of nanoscience ❖ recognize the different types of nanomaterials. ❖ Explain the principle for the various compujtational techniques.

UNIT –I

What is nano –Why nano –Nanomaterials characteristic differences over bulk materials –Synthesis of nanomaterials, Bottom – up vs. top – down approaches – RF Plasma, Chemical methods, Thermolysis, Pulse laser methods- Micro Electro Mechanical Systems[MEMS] & Nano Electro Mechanical System(NEMS)

UNIT-II

Different classes of nanomaterials- Metal and Semicondutor Nanomaterials. Quantum Dots, Wells and Wires, Characterization – Crystallography(XRD),Transmission Electron Microscopy(TEM), Scanning Microscopy (SEM,STM&AFM)

UNIT-III

Computational Chemistry – What you can do with computational chemistry, The tools of computational chemistry,Putting it all together, The philosophy of computational chemistry. The concept of the Potential Energy Surface-Perspective,Stationry Points, The Born-Oppenheimer approximation, Geometry optimization,Stationary points and normal- mode vibrations:ZPE, Symmetry.

UNIT-IV

Introduction to computers and computing- basic organization of a computer-CPU- main memory-secondary storage-I /Odevices- software- system and application software-high and low level languages- computers- algorithms and flowcharts.

Introduction to networking- computer networks-network components-hubs, switches, repeaters, routers, bridges-routers and gateways- network topologies- star, bus and ring-LAN, WAN,Intranet and Internet- worldwideweb-internet for chemists-online search of chemistry data bases- search engines for chemistry-chemweb-e-journals**.**

UNIT-V

Green chemistry- Need for green chemistry-12 principles-concept of atom economy: Illustration for Rearrangement, Subsitution, Addition and Elimination reactions-concept of selectivity :Chemo,Regio,Enatio and Diastereio selectivity-Green solvents :Super critical CO2, Ionic liquids, water- Solvent less processes . Green Synthesis: Adipic acid, Ibuprofen, Urethane Micro wave assisted reactions in water: Hydrolysis of benzyl chloride to benzyl alcohol, oxidation of toluene to benzoic acid. Ultro sound assisted reaction: Esterfication, limitation of green chemistry.

References

1. Introduction to Nanotechnology, charles P.Poole,Jr. and Frank J. Owens,Wiley,2003
2. I.N Levine "Quantum chemistry" 5th edition.Prentice Hall, Upper Saddle River, NJ,2000
3. K.N. Houk,Y.Li, and J.D. Evanseck, Angew, chem..Int.Ed,Engi.1992,31,682.
4. P. Atkins, "Physical chemistry",6th edition, Freeman,New York,1998,PP.830-844.
5. K.V. Raman,Computers in Chemistry,TMH,1993.
6. M. Born and J.R. Oppenheimer, Ann. Physik., 1927,84,457.
7. A.P. Scott and L. Radom, J.Phys.chem.,1996,100,16502.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005

M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19

Elective Course –V (Elective Theory) EC 5

Credits	: 4	**Code: S4PCHEL5B**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER – IV

(For students admitted from 2018 onwards)

Chemistry of Nanoscience and Nanotechnology

OBJECTIVES

1. To know the synthetic methods of nanomaterials.
2. To understand the characterization of nanomaterials.
3. To understand carbon clusters and nanostructures.
4. To learn nanotechnology and nanodevices.

UNIT I: Synthetic Methods

Definition of nanodimensional materials – historical milestones – unique properties due to nanosize, quantum dots, classification of nanomaterials.General methods of synthesis of nanomaterials – hydrothermal synthesis,solvothermal synthesis – microwave irradiation– sol-gel and precipitation technologies– combustion flame – chemical vapour condensation process – gas-phase condensation synthesis – reverse micelle synthesis – polymer-mediated synthesis – protein microtubule-mediated synthesis – synthesis of nanomaterials using microorganisms and other biological agents – sonochemical synthesis – hydrodynamic cavitation.Inorganic nanomaterials – typical examples – nano TiO2/ZnO/CdO/CdS, organic nanomaterials – examples – rotaxanes and catenanes

UNIT II: Characterisation of Nanoscale Materials

Principles of Atomic Force Microscopy (AFM) – Transmission Electron Microscopy(TEM) Resolution and Scanning Transmission Electron Microscopy (STEM) – Scanning Tunneling Microscopy (STM) – Scanning Nearfield Optical Microscopy (SNOM).Scanning ion conductance microscope, scanning thermal microscope, scanning probe microscopes and surface plasmon spectroscopy.

UNIT III: Reactions in Nanoparticles

Reactions in nanospace – nanoconfinement – nanocapsules Cavitands, cucurbiturils, zeolites, M.O.Fs, porous silicon, nanocatalysis.

UNIT IV: Carbon Clusters and Nanostructures

Nature of carbon bond − new carbon structures − carbon clusters – discovery of C60−alkali doped C60−superconductivity in C60−larger and smaller fullerenes.Carbon nanotubes – synthesis − single walled carbon nanotubes − structure and characterization − mechanism of formation − chemically modified carbon nanotubes −doping − functionalizing nanotubes − applications of carbon nanotubes. Nanowires −synthetic strategies − gas phase and solution phase growth − growth control − properties.

UNIT V: Nanotechnology and Nanodevices

DNA as a nanomaterial – DNA – knots and junctions, DNA – nanomechanical device designed by Seeman.Force measurements in simple protein molecules and polymerase – DNA complexes– molecular recognition and DNA based sensor.Protein nanoarray, nanopipettes, molecular diodes, self-assembled nanotransistors,nanoparticle mediated transfection.

REFERENCES

1. C. N. R. Rao, A. Muller and A. K. Cheetham (Eds), The Chemistry of Nanomaterials: Vol. 1 and 2; Wiley-VCH;Germany, Weinheim, 2004.
2. C. P. Poole, Jr: and F. J. Owens, Introduction to Nanotechnology; Wiley Interscience, New Jersey, 2003.
3. K. J. Klabunde (Ed), Nanoscale Materials in Chemistry; 2nd Ed., Wiley- Interscience, New York, 2009.
4. T. Pradeep, Nano: The Essentials in Understanding Nanoscience and Nanotechnology; 1st Ed., Tata McGraw Hill, New York, 2007.
5. H. Fujita (Ed.), Micromachines as Tools in Nanotechnology; Springer-Verlag, Berlin, 2003.
6. Bengt Nolting, Methods in Modern Biophysics; 3rd Ed., Springer-Verlarg, Berlin, 2009.
7. H. Gleiter, Nanostructured Materials: Basic Concepts, Microstructure and Properties, Elsevier, Chennai, 2000.
8. W. Kain and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2nd Ed., John-Wiley R Sons, New York, 2013.
9. T. Tang and P. Sheng (Eds), Nanoscience and Technology, Novel Structures and Phenomena; Taylor andFrancis, New York, 2003.
10. A. Nabok, Organic and Inorganic Nanostructures; Artech House, Boston, 2005.
11. E. A. Rietman, Molecular Engineering of Nanosystems; Springer-Verlag, New York,2001.
12. Home page of Prof. Ned Seeman - http://seemanlab4.chem.nyu.edu/
13. Nanoletters - http://pubs.acs.org/journals/nalefd/index.html
14. Nanotation - http://www.acsnanotation.org/

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)
Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)
Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD

Rajah Serfoji Govt. College (Autonomous), Thanjavur – 613 005
M.Sc., Chemistry – CBCS Pattern (From the academic year 2018 – 19
Elective Course –V (Elective Theory) EC 5

Credits	: 4	**Code: S4PCHEL5C**
Hours / Week	: 5	
Medium of Instruction	: English	

SEMESTER – IV

(For students admitted from 2018 onwards)

Applied Organic chemistry

Objectives

1. To understand the elements of chemical engineering in organic synthesis
2. To understand the techniques involved in modern organic synthesis
3. To apply the knowledge of chemical reactions in solvent free organic synthesis

UNIT 1: Organic Chemical Technology

1.1 Unit operations in chemical engineering: Fluid flow: Reynold's number; Bernoullis' equation, Turbulent flow.Heat transfer: Heat transfer coefficient, Corrosion and scale formation in heat exchangers and condensers. Mass transfer: Distillation - two and three component systems. Leaching & extraction; Stirrers and driers.

1.2 Energy balance over a flow system, heat of reaction, Chemical equilibrium, entropy changes, vapour phase and liquid phase catalytic reactions.

1.3 Factors affecting chemical process kinetics, scaling up of reactions from laboratory to pilot plant to main plant; Materials of construction; Study of industrial scale nitration, sulphonation, halogenations reactions; Preparation of a dye and a drug.

1.4 Quality control, R & D, standardization.

UNIT 2: Organometallic Compounds

2.1 Synthesis and reactions involving organolithium (n-BuLi, PhLi}, organocadmium, organomagnesium, organoselenium, organo aluminium, and organocopper.

2.2 Reactions promoted by samarium diiodide and dicyclopentadienyl samarium – Barbier type reaction, ketyl-alkene coupling reactions, pinacolic coupling reactions, acyl anion reactions and McMurray olefination

UNIT 3: Green Chemistry

3.1 The need for green chemistry and eco-efficiency, challenges and green chemistry, Challenges and green methods, green products, recycling waste.

3.2 Twelve principles of green chemistry, inception of green chemistry, awards for green chemistry and international organizations promoting green chemistry

3.3 Designing green synthesis-choice of starting materials, choice of reagents, choice of catalysis-biocatalysts, polymer supported catalysts(examples),choice of solvents.

UNIT 4: Microwave Assisted Synthesis and Sonochemistry

4.1 Introduction, Importance

4.2 Microwave assisted synthesis: Principle, instrumentation, types, limitations and precautions.

4.3 Applications: Esterification, deprotection of esters and ethers, C- and N-alkylation and condensation of active methylene compounds, rearrangement reactions, synthesis of enamino-ketones and electrophilic alkenes.

4.4 Sonochemistry: Principle, instrumentation, types and precautions.

4.5 Applications: Esterification, hydrolysis, substitution and addition reactions, oxidation and reduction reactions, coupling reactions.

UNIT 5: Phase Transfer Catalysts in Organic synthesis

5.1 Types of PTC, Mechanism and Advantages

5.2 Preparation of quartenary ammonium salts and macrocyclic ethers.

5.3 Application: Substitution, esterification, addition, condensation and polymerization reactions.

Text books

1. W.L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7 th Edn., McGraw-Hill, New Delhi,2005.

2. J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall, 1974.

3. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi, 2001.

4. K. Tanaka, Solvent Free Organic Synthesis, Wiley VCH, Weinheim, 2003.

References

1. P. H. Groggins, Unit Processes in Organic Synthesis, 5thEdn., Tata McGraw Hill, New York, 1995.,

2. C. E. Dridens, Outlines of Chemical Technology, Affiliated East-West Press Pvt.Ltd, 2001.

3. C. A. Clausen and G. Matson, Principles of Industrial Chemistry, John Willey & Sons, New York, 1978.

4. M.Larhed, and K.Olofsson, Topics in current chemistry, Springer,266,2006

5. R.Sanghi and M.M. Srivastava, Green chemistry, Environment Friendly Alternatives, Narosa Publishing House, 2007.

6. V. K. Ahluwalia, Green Chemistry, Ane Books Pvt. Ltd., 2006.

7. B. Michael Smith, Organic synthesis, McGraw Hill International Edition 1994. 8. Methods and Reagents in Green Chemistry, Edited by P. Tundo, A. Perosa and F. Zacchini, Wiley-Interscience, 2007.

Question Paper Pattern

Maximum Marks: 75

Exam duration: Three Hours

Part A – 10 X 2 = 20 Answer All Questions (Two questions from each unit)

Part B – 5 X 5 = 25Answer All Questions (Either 0r type -Two questions from each unit)

Part C – 3 X 10 = 30 Answer Any THREE (One question from each unit)

Signature of the HOD