K A N N U R U N I V E R S I T Y

(Abstract)

M.Sc Programme in Chemistry (Material Science) under Choice based Credit Semester System– Scheme & Syllabus effective from 2010 Admission- Implemented– Orders issued.

ACADEMIC BRANCH

U.O.No.Acad/C2/14161/2010. Dated, K.U.Campus.P.O,12-04-2011.

Read:1. U.O.No.Acad/C2/028/2003 dated 13-01-2007.

2. Minutes of the meeting of the Curriculum Committee held on 05-06-2010 & 16-08-2010.

3. U.O No Acad/C3/2049/2009 dated 05-04-2011.

4. Letter from the Head, Dept. of Chemistry,SAT Campus, Payyannur.

ORDER

1. As per paper read (1) above, the Scheme and Syllabus of M.Sc Chemistry (Material Science) Programme under Credit and Semester System was implemented in this University with effect from 2006 admission.

2. As per the recommendation of the Curriculum Committee vide paper read (2) above, the regulations for Credit Semester System were revised and Choice based Credit Semester System was implemented in this University with effect from 2010 admission, as per paper read (3) above.

3. As per the paper read (4), the Head of the Department of Chemistry has forwarded the revised scheme and syllabus for M.Sc Programme in Chemistry (Material Science) in line with the revised regulations for Choice based Credit Semester System, for implementation with effect from 2010 admission.

4. The Vice Chancellor, after considering the matter in detail, and in exercise of the powers of the Academic council, conferred under section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction to implement the revised scheme and syllabus of M.Sc Programme in Chemistry (Material Science) under Choice based Credit Semester System with effect from 2010 admission.

5. The following orders are therefore issued on the matter:

(i) ***The revised Scheme and Syllabus of M.Sc Programme in Chemistry (Material Science) under Choice based Credit Semester System are implemented in this University with effect from 2010 admission subject to report to the Academic Council.***

(ii) ***The Regulations for Choice based Credit Semester System implemented for PG Programmes in this University vide paper read (3) above will be applicable for M.Sc Chemistry (Material Science) also.***

6. The revised Scheme and Syllabus of M.Sc Programme in Chemistry (Material Science) effective from 2010 admission are appended.

Sd/-

REGISTRAR

To

1. The HOD, Dept.of Chemistry, SAT Campus, Payyannur.
2. The Examination Branch (through PA to CE).

Copy to:

1. PS to VC/PA to PVC/PA to Registrar.
2. DR/AR-I (Academic).
3. SF/DF/FC.

Forwarded/By Order

SECTION OFFICER

Appendix to U.O No Acad/C2/14161/2010 dated 12-04-2011.

K A N N U R U N I V E R S I T Y

Regulation,Scheme and Syllabus

for

M.Sc PROGRAMME

in

C H E M I S T R Y

(Material Science)

Choice based Credit Semester System
w.e.f. 2010 Admission

I) *Objectives of the Course:*

To acquire knowledge about the contemporary and advanced areas of Material Science in post-graduate level through theory, practical and research project. Awareness about the latest experimental conversion of the technology is also included. It also aims to make the students capable of higher studies.

The M.Sc. degree course in Chemistry (Material Science) shall be equivalent to the M.Sc. degree course in Chemistry conducted by the Kannur University.

The course is offered at the School of Chemical Sciences, Swami Anantha Theertha Campus of Kannur University situated at Edat, Payyanur.

II) *Duration of the Programme*

The course shall be offered in four semesters during a period of two academic years. Each semester will have 17-18 weeks duration. The minimum duration for completion of the course is four semesters. The maximum period for the completion of the course is eight semesters.

III) *Eligibility*

Candidates who have passed and secured at least 55% marks in B.Sc. Chemistry (Main) Degree examination with Mathematics as a compulsory subsidiary subject of Kannur University or an equivalent examination of any other University are eligible to apply for the M.Sc. Chemistry (Material Science) course. Regulations regarding the reservation of the seats are as per the rules of Government of Kerala/ Kannur University. Those who have appeared for the final year examinations can also apply; however, they should produce the mark sheet before the publication of the results of the entrance Examination.

IV) *Admission procedure*

Every year, Kannur University will publish the admission notification. Accordingly, filled-up application with sufficient documents and fee may be submitted to the department. Eligible candidates have to appear for an entrance examination conducted by the School of Chemical Sciences. *Mode of Examination:* 100 objective questions with one mark each. 1/3 mark will be deducted for each wrong answer; *Duration:* Two hours; *Syllabus;* Scheme and syllabus of the examinations decided prior to the examination and will be included in the prospectus. 50% weightage will be given to the marks obtained in the qualifying degree examination and 50% weightage will be given to entrance examination. A total of twelve students are admitted a year. Reservations for eligible candidates at the time of admission will be as per the rules of Kannur University.

V) *Course Structure*

1 The course is choice based on Credit Semester System. The total credit required for the successful completion of the programmee is fixed as 80 out of which 60 credits for core courses and 12 credits for electives. The maximum credit a student can acquire is fixed as 98.

2 The number of periods allotted per week for a topic is considered as its credit. For practical, three hours is considered as one credit. Elective courses will be offered depending on the availability of teaching staff/resource person at that time. At least 6 students have to register for an offered elective course.

3 No student shall register for more than 24 credits and less than 16 credits per semester. The duration of the course shall extend to more than two years (maximum four years) for the students securing less than 12 credits in a semester.

4 The first two semesters will have only core courses. Electives are offered only in third and fourth semesters.

5 During the third semester, the students will have to visit a Research Institute of National repute to have an idea about the current research activities. The report of the same may be submitted to the head of the department for valuation.

6 During the fourth semester, each student shall carry out a project work in any branches of Chemistry/ Material Science for a period of not more than six months. The project can be carried out in a research institute/industry of national repute with guidance from experts there. The departmental council shall make decision regarding the project details.

7 A student will have to present one seminar (one credit) in the second semester. The topics of the seminar will be chosen by the student in concern with his/her tutor. Seminar attendance is compulsory for the students.

8 Attendance is compulsory for each course and the minimum requirement for appearing for the end semester examination shall be as per general regulations of the University.

9 Two hours per week is allotted for tutorial classes. Each student will be assigned to a teaching staff of the department as his/her advisor.

VI) *Indexing of marks*

1 The duration of examination of the course will be equal in hours to the credit offered for the course.

2 The allocation of marks for each component under Continuous Evaluation shall be in the following proportions:

THEORY		PRACTICAL	
a. Assignment	20%	a. Tests	75%
b. Tests	40%	b. Record	25%
c. Seminar/Viva/Quiz, etc	40%		

2 First three semester examinations will be conducted by the department. The fourth semester examinations will be conducted by the University. The consolidated grade card and the degree certificate will be issued by the University.

3 The pattern for the end semester examination consisted of short answers (2 marks), one-paragraph answers (4 marks each) and essays (8 marks). No choice will be given.

4 The concerned teaching faculty will value the internal examinations. The Semester examination papers will be valued combined by the concerned teaching faculty and an

external expert in the field suggested by the departmental council and approved by the Vice Chancellor.

5 The answer papers of internal examinations, after evaluation, shall be kept with the concerned faculty till the end of the semester.

6 Practical examinations will be conducted at the end of the semester. One external examiner in the field suggested by the departmental council and approved by the Vice Chancellor and the concerned teaching faculty will be in-charge for the same. The duration of the practical examination is six hours. Record books will be valued internally and should be made available for the external examiner for reference.

7 Viva in the third semester will be internal. The comprehensive viva in the forth semester will be a combined one for the theory, practical and project. At least two experts suggested by the departmental council and approved by the Vice Chancellor may be present as external examiners.

8 Seminar will be valued internally by the teaching faculty of the department and compiled by the head of the department.

VII) ***In the case of any inconsistency between the implemented regulations of Choice based Credit Semester System and its application to M.Sc. Chemistry (Material Science) programme, the former shall prevail***.

SCHEME

Semester I

Sl. No	Course code	Title of the Course	Contact Hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	CMS C 001	Quantum Chemistry	2	-	-	60	40	100	2
2	CMS C 002	Chemical Bonding	2	-	-	60	40	100	2
3	CMS C 003	Nuclear and Radiochemistry	2	-	-	60	40	100	2
4	CMS C 004	Structural Inorganic Chemistry	2	-	-	60	40	100	2
5	CMS C 005	Theoretical Organic chemistry	2	-	-	60	40	100	2
6	CMS C 006	Heterocycles and Stereochemistry	2	-	-	60	40	100	2
7	CMS C 007	Thermodynamics	2	-	-	60	40	100	2
8	CMS C 008	Electrochemistry and Electrodics	2	-	-	60	40	100	2
9	CMS C 009	Computer Methods in Chemistry	2	-	-	60	40	100	2
10	CMS C 010	Inorganic Chemistry Practical I	-	-	6	60	40	100	2
11	CMS C 011	Organic Chemistry Practical I	-	-	6	60	40	100	2
		Total	31						22

Semester II

Sl No	Course code	Title of the Course	Contact Hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	CMS C 012	Group Theory for Chemistry	2	-	-	60	40	100	2
2	CMS C 013	Theoretical Spectroscopy	2	-	-	60	40	100	2
3	CMS C 014	Coordination Chemistry	2	-	-	60	40	100	2
4	CMS C 015	Complex & Organometallic Chemistry	2	-	-	60	40	100	2
5	CMS C 016	Bioorganic chemistry & Natural Products	2	-	-	60	40	100	2
6	CMS C 017	Reactions & Mechanism in Organic Chemistry	2	-	-	60	40	100	2
7	CMS C 018	Statistical Thermodynamics	2	-	-	60	40	100	2
8	CMS C 019	Solid State Chemistry	2	-	-	60	40	100	2
9	CMS C 020	Analytical Chemistry	2	-	-	60	40	100	2
10	CMS C 021	Inorganic Chemistry Practical II	-	-	6	60	40	100	2
11	CMS C 022	Physical Chemistry Practical I	-	-	6	60	40	100	2
12	CMS C 023	Seminar	-	1	-		100	100	1

13	CMS O 001	Basic concepts in chemistry	3	-	-				3
		Total	31+1						23+3

Semester III

Sl No	Course code	Title of the Course	Contact Hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	CMS C 024	Bioinorganic Chemistry	2	-	-	60	40	100	2
3	CMS C 025	Organic Spectroscopy	2	-	-	60	40	100	2
4	CMS C 026	Synthetic Organic Chemistry	2	-	-	60	40	100	2
5	CMS C 027	Chemical Kinetics & Catalysis	2	-	-	60	40	100	2
6	CMS C 028	Instrumental Methods of Analysis	2	-	-	60	40	100	2
7 8 9	CMS E 001	*Inorganic Materials*	2 x 3 = 6			60	40	100	6
	CMS E 002	*Polymer chemistry*							
	CMS E 003	*Biochemistry*							
	CMS E 004	*Medicinal chemistry*							
	CMS E 005	*Environmental chemistry*							
10	CMS C 029	Organic Chemistry Practical II	-	-	6	60	40	100	2
11	CMS C 030	Physical Chemistry Practical II	-	-	6	60	40	100	2
12	CMS C 031	Viva	-		-	-	100	100	1
13	CMS C 032	Study Tour Report	-		-	-	100	100	2
		Total	31						23

Semester IV

Sl No	Course code	Title of the Course	Contact Hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	CMS C 033	Research Project			90	100		100	10
2	CMS C 034	Ceramic Materials		2		60	40	100	2
3	CMS E 006	*Composite Materials*	2 x 3 = 6	-	-	60	40	100	6
	CMS E 007	*Advanced Organic Synthesis*							
	CMS E 008	*Photochemistry*							
	CMS E 009	*Nanomaterials chemistry*							
	CMS E 010	*Chemical & Electrochemical energy systems*							
4	CMS C 035	Comprehensive Viva	- -			100	-	100	1
		Total	31						19

Total Credits: 88

Maximum Credits: 98
[75 (core course) + 12 (Elective) + 3 (Open course) + 8 (additional elective)]

SYLLABUS

FIRST SEMESTER

CMS C 001 Quantum Chemistry

Unit 1 *18 hrs*

Max Planck's quantum theory of radiation, Heisenberg's uncertainly principle, complex numbers, Schrodinger wave mechanics, physical meaning of wave function, elements of operator algebra, Eigen functions and eigen values, Hermitian operators, the postulates of quantum mechanics, time dependent and time independent Schrodinger equations.

Quantum mechanics of translational motion, particle in a one and three-dimensional boxes, degeneracy, quantum mechanics of vibrational motion, one-dimensional harmonic oscillator, comparison of classical and quantum mechanical results, quantum mechanics of rotational motion, particle on a ring-rigid rotator, the wave function in spherical polar co-ordinates. Legendre polynomials, spherical harmonics, polar diagrams.

Unit 2 *18 hrs*

Quantum mechanics and potential energy of Hydrogen like atoms, the wave equation in spherical polar co ordinates, solution of the R,θ,Ø equations.

Need of approximate methods in quantum chemistry, variation method, ground states of Hydrogen and Helium atoms, perturbation method, ground state of Helium atom, electron spin and atomic structure, spin functions and operators, Pauli's exclusion principle, Slater determinantal wave functions, spin orbit interactions, angular momentum, Russel-Saunder's terms and coupling schemes, introduction to SCF methods.

References:

1 *Molecular Quantum Mechanics*, P.W. Atkins, R.S. Friedmann, Oxford University Press
2 *Quantum chemistry*, I. N. Levine, Pearson Education
3 *Fundamentals of Quantum chemistry*, R Anantharama, Macmillan
4 *Introductory Quantum chemistry*, A.K. Chandra, Tata McGraw Hill
5 *Quantum chemistry*, D.A. Mc.Quare, University Science Books
6 *Introduction to Quantum Mechanics*, L. Pauling and W.B.Wilson, McGraw Hill
7 Quantum chemistry, R K Prasad, New Age International

CMS C 002 Chemical Bonding

Unit 1 *18 hrs*

Born-Oppenheimer approximation, essential principles of the MO method, MO treatment of Hydrogen molecule and the H_2^+ ion, valence bond treatment of ground state of hydrogen molecule, MO treatment of homonuclear diatomic molecules, Li_2, Be_2, N_2, O_2, O_2^+, O_2^-, F_2 and heteronuclear diatomics, LiH, CO, NO, HF, correlation diagrams, noncrossing rules, spectroscopic term symbols for diatomic molecules. Theorems in chemical bonding: The Viral theorem, The Hellmann – Feymann theorem, electrostatic theorem,

Unit 2 *18 hrs*

Theory of directed valency, localized bonds, hybaridization and geometry of molecules, methane, water, ethane, acetylene, MO theory of conjugated systems, HMO theory of linear conjugated systems, ethane, allyl systems, butadiene. Bond order, charge density and free valency calculations, cyclic conjugated systems and aromaticity.

The directed covalent bond, partial ionic character of covalent bonds, complex bonds orbitals, structure of resonating molecules such as CO and CO_2, introduction to metallic bonding, introduction to hydrogen bonding.

References:

1. *Quantum chemistry*, I. N. Levine, Pearson Education
2. *Chemical Bonding*, L. Pauling, Oxford University Press.
3. *Introductory Quantum chemistry*, A.K. Chandra, Tata McGraw Hill.
4. *Quantum chemistry*, D. A. Mc.Quadre, University Science Books.
5. *Theoretical Inorganic Chemistry*, M. S. Day and J. Selbin,
6. *Quantum chemistry*, R. K. Prasad, New Age International.

CMS C 003 Nuclear and Radiochemistry

Unit 1 *18 hrs*

Nuclear and radiation chemistry: Nuclear structure, mass and charge, Nuclear moments, Binding energy, Semi empirical mass equation, Stability rules, Magic numbers, Nuclear models, Shell, Liquid drop, Fermi gas, Collective and optical models, Equation of radio active decay and growth, half life and average life, Radio active equilibrium, Transient and secular equilibria, Determination of half lives, Nuclear reactions, Energetics of nuclear reactions, Types of nuclear reactions, Spontaneous and induced fission, cross section and critical size, Principle and working of GM, Proportional, Ionization and Scintillation counters, Applications of radioactivity, working of nuclear reactors, Nuclear energy in India.

Unit 2 *18 hrs*

Nuclear materials and materials for aerospace applications, interaction of gamma radiation with matter, effects of radiation on the structure and stability of solids, Detection and measurement of radiations, radiation dosimetry, Fricks dosimeter, Szilard Chalmers effect.

Chemistry of Thorium, Uranium and Plutonium, Study of monazite sand, use and application of thoria in nuclear reactions, Metals and alloys relevant to aerospace applications, Chemistry of Titanium and its alloys, study of ilmenite, Extraction of titanium, its alloys and Shape memory alloys, their applications.

References:

1. *Introduction to Radiochemistry*, G. Friedlander and J.W. Kennedy, John Wiley and Sons.
2. *Source book on Atomic energy*, S. Glaston, Affiliated East West Publications.
3. *Essentials of Nuclear Chemistry*, H. J. Arnikar, New Age International,
4. *Radiochemistry and Nuclear Chemistry*, G.R. Choppin, J-O. Liljenzin and J. Rydberg, British Library Cataloguing series.
5. *Nuclear Chemistry, U.N. Dash*, Sultan Chand and Sons
6. *A Text book of Nuclear Chemistry*, C.V. Shekar, Dominant Publishers

CMS C 004 Structural Inorganic Chemistry

Unit 1 *18 hrs*

Sulphur-nitrogen compounds, tetra sulphur tetranitride, disulphur dinitride and polythiazyl, Sulphur-phosphorus compounds, Molecular sulphides, Phosphorus-nitrogen compounds, Phosphazines, cyclo and linear phosphazines other P-N compounds, Boron-Nitrogen compounds, Borazine, boron nitrides, Boron hydrides, topological approach to Boron hydride structure, Styx number, neutral boron hydrides, icosahedral frame work, Closo, nido and Arachno Structures, Wades rule, Carboranes, metallocarboranes,

Metal-metal bonds and Metal clusters, Metal carbony1 clusters, Anionic and hydrido clusters, LNCC's and HNCC's, Isoelectronic and isolobal relationships, Hetero atoms in metal clusters, Electron counting schemes for HNCC's- Capping rule- Metal clusters as catalysts.

Unit 2 *18 hrs*

Metal ligand equilibria in solutions, stability constants, chelate effect, Irwing-William order of stability, binary formation constants, Energy profile of a reaction, inert and labile complexes, kinetics of octahedral substitution, acid hydrolysis, base hydrolysis, anation reactions. Reactions without M-L bond cleavage, substitution reaction in square planar complexes, trans effect, mechanism of substitution, redox reactions, inner sphere and outer sphere reactions, complimentary and non- complimentary reactions.

References:

1 *Inorganic Chemistry*, Keith F. Purcell and John C. Koltz, Holtz-Saunders International.
2 *Advance Inorganic Chemistry,* F A Cotton, Wilkinson, C A Murillo and M Bochmann, John Wiley and Sons
3 *Inorganic Chemistry – Principles of structure and reactivity*, J. E. Huhee, Pearson Education
4 *Concepts and models of Inorganic Chemistry*, B. Douglas, D.H. Mc Daniel and J.J. Alexander, John Wiley and Sons
5 *Inorganic Chemistry, Shriver and Atkins*, Oxford University Press

CMS C 005 Theoretical Organic chemistry

Unit 1 *18 hrs*

Localized and delocalized chemical bondings, resonance, bond energy, polarizabilty, MOT, HMOT and its applications, Aromaticity, anti, homo, non aromaticities, aromaticity of heterocycle rings, fused rings, charged rings and annulenes. Thermodynamics and kinetics of organic reactions, Hammet plots, limitations of and deviations from Hammet plots. Pericyclic reactions, cycloadditions, electrocyclic, sigmatropic, chelotropic and group transfer reactions, the ene- reactions, applications.

Unit 2 *18 hrs*

Reactive intermediates, formation, detection and application studies of carbenes, nitrenes, arynes, carbon radicals, carbocations, carbanions, and arynes. Photochemical reactions, photo addition, photo oxidation, photo rearrangement, photochemistry of carbonyl compounds, alkenes and dienes, Barton and Hoffman-Lofferty reactions, applications

References:

1 *A Guidebook to Mechanisms in Organic Chemistry*, P. Sykes, Pearson Education
2 *The search of organic reaction pathways, P. Sykes, John Wiley & Sons*
3 *The Chemistry of Free radicals*, R.L. Huang, S.H. Goh and S.H. Ong, Edward Arnold
4 *Organic Chemistry*, Y. Brice, Pearson Education
5 *Reactive Intermediates*, C. J. Moody and W.H. Whitham, Oxford University Press
6 *Principles of organic Synthesis*, R.O.C Norman, J.M.C. Frnsz, ELBS
7 *Advanced Organic Chemistry*, Jerry March, Wiley Editions

CMS C 006 Heterocycles and Stereochemistry

Unit 1 *18 hrs*

Introduction to heterocyclic compounds, uses, criteria of aromaticity in heterocycles, non aromatic heterocycles, bond angle strain, synthesis and general reactions of pyridines, synthesis of quinolines, synthesis and general reactions of pyrans, synthesis of furan, thiophene and indole, general aspects of the chemistry of pyramidines and purines, synthesis of imidazole, pyrazole and oxazole.

Unit 2 *18 hrs*

Introduction to isomerism, Racemization, resolution, asymmetric synthesis, Configuration: Absolute and relative configurations, method of optical comparison and quasi-racemates, synthesis of optically active compounds, Conformation: Reactivity, properties, stability, Atrop isomerism, restricted rotation and asymmetry, reactivity in acylic compounds, non-carbon chiral centers, Introduction to the stereochemistry of cyclohexane, fused rings and bridged compounds, Stereochemistry of organic compounds other than carbon centre, Introduction to the stereochemistry of cholesterol and natural products.

Introduction to optical rotation and optical rotatory dispersion, circular dichroism, Cotton effect and their application in assigning configuration and conformation, octant and axial haloketone rules, conformational analysis of cycloalkanes, decalins and their substituted derivatives,

Stereoselective synthesis

References:

1 *Heterocyclic chemistry,* Thomas L. Gilchrist, Pearson Education
2 *Organic Chemistry, Vol I and II,* I.L. Finar, Pearson Education
3 *Heterocyclic chemistry,* T. A. Jouls and K.Mills
4 *Heterocyclic chemistry,* Bensal Raj, New Age Internationsl
5 *Stereochemistry of organic compounds*, E.L. Eliel, Orient Longman
6 *Stereochemistry of carbon compounds*, E.L. Eliel, Wiley Interscience
7 *Organic chemistry*, Vol. II, I.L. Finar, Pearson Education
8 *Introduction to stereochemistry,* K. Mislow, Dower Publications
9 *Organic stereochemistry,* M.J.T. Robinson, Oxford Publications
10 *Stereochemistry Workbook,* K. –H Helwich, C.D. Siebert, Springer

CMS C 007 Thermodynamics

Unit 1 *18 hrs*

Nernst Heat theorem, apparent exception to third law, application of third law, Absolute entropy, residual entropy, Henry's Law, Maxwell relation and significance, Thermodynamic of partial derivative by Jacobians method, Euler's relation, thermodynamic equation of state, partial molar quantities, chemical potential and other thermodynamic functions, thermodynamics of mixing, Gibbs-Duhem-Margules equation, Lewis-Rrandall rule, fugacity in liquid mixtures, chemical affinity and other thermodynamic functions, excess thermodynamics properties,

Thermodynamics of irreversible process, simple examples, general theory of near equilibrium process, entropy production from heat flow, matter flow and current flow, chemical reaction, Phenomenological relations.

Unit 2 *18 hrs*

Onsagar reciprocal relation, Applications of irreversible thermodynamics to diffusion, thermo-osmosis, thermo-molecular pressure difference, thermo-electricity, Phase equilibria,

criteria, deviation of phase rule, systems with partially miscible solid phase, introduction to three-component system and its graphical representation, thermal evaporation, transition point and double salt formation.

References:

1. *Thermodynamics for chemists*, S. Glasstone, Affiliated East West publication
2. *An Introduction to chemical thermodynamics*, Rastogi and Misra, Vikas publishing.
3. *Thermodynamics*, Lewis and Randall, Mc Graw Hill.
4. *Physical Chemistry,* Daniels and Alberty, John Wiley.
5. *Introduction to Thermodynamics of Irreversible process, I. Pregogine, Interscience.*

CMS C 008 Electrochemistry and Electrodics

Unit 1 *18 hrs*

Ionic nobilities, influence of pressure and temperature on ion conductance, Walden's equation, abnormal ion conductance, Derivation of Debye-Huckel-Onsager equation, validity of Debye-Huckel-Onsager equation for aqueous and nonaqueous solution, conductance ratio and Onsager equation, dispersion of conductance at high frequencies, Debye-Falken effect, Debye-Huckel limiting law and its various forms and qualitative and quantitative tests, osmotic coefficient, ion association and dissociation constant, tripple ion and conductance minima, equilibria in electrolytes, solubility product principle, solubility in presence of common ion, activity coefficient and solubility measurement

Unit 2 *18 hrs*

Electrochemical cell, determination of origin of electrode potential, Liquid junction potential, electrode double layer, electric capillary, Lippmann potential, membrane potential, electrolytic polarization, dissolution and decomposition potential, concentration polarization, theories of over voltage, Hydrogen and Oxygen over voltages, Butler-Volmer equation for simple electron transfer reaction, exchange current density, Tafel equation and its significance.

References:

1 *Introduction to Electrochemistry,* S. Glasstone, D. Van Nostrand.
2 *Theoretical electrochemistry,* L.I. Anthropov, Mir publishers.
3 *Modern Electrochemistry, J.O.M.* Bockris and *A.K.N.* Reddy, Plenum
4 *The Principles of Electrochemistry, D.R. Crow, Chapman and Hall*
5 *The Principles of Electrochemistry, D. A. Mc Innes, Dover Publishers*
6

CMS C 009 Computer Methods in Chemistry

Unit 1 *18 hrs*

Introduction to operating systems (MS-DOS, Windows, Linux), programming languages, machine assembly and high-level languages.

Application of Basic and C language in chemistry: determination of empirical formula of hydrocarbons, molecular weight of organic compounds, delocalizatoon energy of aromatic system, calculation of dipole moments and wavelength maximum, application of Woodward-Hoffman rules, determination of molarity and normality, solubility parameters, half-life and average life, applications to kinetics and spectroscopy, calculations of energies and wave functions of eigen values and eigen vectors of matrices, Huckel theory and applications.

Unit 2 *18 hrs*

Introduction to computation chemistry, molecular simulations, molecular design and use of spectroscopic and structural databases, introduction to bioinformatics.

Introduction to C++ and visual basic to chemistry, use of internet in chemical research, use of software like Chem-draw, ISIS draw, Origin, etc, for chemistry applications

References**:**

1 *Computers and their applications in chemistry*, R. Kumari, Narosa
2 *Essentials of computation chemistry: theories and models*, C.J. Cramer, Wiley
3 *Computers in chemistry*, K.V. Raman, Tata McGraw Hill
4 *Introduction to computers*, P. Norton, Tata McGraw Hill
5 *Computer applications in Chemistry,* K. Arora, Anmol publications
6 *Computer software applications in chemistry,* P. C. Jurs, Wiley Interscience
7 *Computational Methods in the Chemical Sciences,* A.F. Carley and P.H. Morgan, Eillis Horwood

CMS C 010 Inorganic Chemistry Practical I

Separation and identification of four metal ions of which two are rare/less familiar such as T1, W, V, Se, Te, Ti, Ce, Th, Zr, U, Mo and Li. (6 Nos.)

Volumetric estimations, EDTA- Ca, Cu, Fe, Ni, Co, (4 Nos.)

Colorimetric determinations of Cr, Fe, Ni and Mn. (4 Nos.)

References:

1. *Vogel's Textbook of Quantitative Chemical Analysis*, Menham, Pearson Education
2. *Vogel's Qualitative Inorganic Analysis*, Svehla, Pearson Education
3. *Semimicro Qualitative analysis*, Ramanujam.
4. *Quntitative Chemical Analysis,* D. Levie, Tata Mc Graw Hill

CMS C 011 Organic Chemistry Practical I

Analysis of organic binary mixtures: Separation and identification of organic binary Mixtures containing one component with at least two substituents. (5 Nos.)

Double stage preparation and identification of organic compounds: (4Nos.)

Analysis of caffeine, casein and oil, Solvent extraction, Fractional crystallization, Steam distillation and distillation under reduced pressure and Sublimation

References:

1 *A Text Book of Practical Organic Chemistry*, A I Vogel, ELBS.
2 *Practical Organic Chemistry*", F.G. Mann and B C Saunders, Longman.
3 *Systematic identification of Organic Compounds*, Shriner, John Wiley and Sons
4 *Advanced Practical Organic Chemistry*, J. Leonard, B, Lygo and G. Procter, Nelson Thornes

SECOND SEMESTER

CMS C 012 Group Theory for Chemistry

Unit 1 *18 hrs*

Molecular symmetry, groups and matrices: Symmetry elements and symmetry operations in molecules, point groups and their determinations, Schoenflies and their symbols, mathematical group, sub group, Abelian and cyclic group, group multiplication tables, classes in a group, similarity transformations of matrices, addition and multiplication of matrices,

inverse of a matrix, character of a matrix, block diagonalisation, matrix form of symmetry operations, isomorphism.

Theory of molecular symmetry: Matrix representation of symmetry operations, representation of groups, construction of representation using vectors and atomic orbital as basis, representation generated by cartesion co-ordinates positioned on the atoms of a molecule (H_2O and SO_2 as examples)

Unit 2 *18 hrs*

Reducible and irreducible representations, construction of irreducible representation by reduction, Great Orthogonality Theorem (GOT) (without proof), properties of irreducible representations, construction of irreducible representation using GOT, construction of character tables (C_2V, C_3V, C_4V).

Applications of group theory: Applications to molecular vibrations, symmetry aspects of molecular vibrations, vibrations of polyatomic molecules, selection rules for vibrational absorption, complementary character of IR and Raman spectra, determination of the number of active IR and Raman lines, applications to chemical bonding, construction of hybrid orbital (BF_3, CH_4, PCl_5 as examples), transformation properties of atomic orbital.

References:

1 *Chemical Applications of Group Theory,* F A Cotton, Wiley Eastern.
2 *Symmetry in Chemistry*, Jaffe and Archin
3 *Group Theory and Symmetry in Chemistry*, L H Hall, Mc Graww Hill.
4 *Group Theory in Chemistry,* V. Ramakrishnan and M.S. Gopinathan, Vishal Publications
5 *Group Theory: Selected problems*, B. Sury, University Press
6 *Group Theory and Chemistry,* Bishop
7 *A Simple Approach to Group Theory in Chemistry, S Swarnalakshmi, Universities Press*

CMS C 013 Theoretical Spectroscopy

Unit 1 *18 hrs*

Electromagnetic radiation: Regions of the spectrum, interaction of electromagnetic radiation with matter and its effect on the energy of molecules, rotational, vibrational and electronic energy levels and selection rules, transition moment integral, microwave spectroscopy, rotational spectra of diatomic and polyatomic molecules, rigid and non-rigid rotator models, determination of bond lengths, isotope effect on rotation spectra, applications.

Vibrational energies of diatomic molecules: Interaction of radiation with vibrating molecules, anharmonicity of molecular vibrations, fundamental, overtones and hot bands, degrees of freedom of poly atomic molecules and nature of molecular vibrations (CO_2 and H_2O as examples), vibration-rotation spectra of diatomic and polyatomic molecules, selection rules, determination of force constant.

Theory of Raman spectra (classical and quantum mechanical theory): Pure rotational vibrational Raman spectra, vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, applications of Raman and IR spectroscopy in elucidation of molecular structure (H_2O, N_2O and CO_2 molecules as examples).

Unit 2 *18 hrs*

Electronic spectra of diatomic molecules: Vibrational coarse structure and rotational fine structure of electronic spectrum, Franck-Condon principle, types of electronic transitions, Fortrat diagram, dissociation and pre dissociation, calculation of heat of dissociation.

Nuclear Magnetic Resonance Spectroscopy: Magnetic properties of nuclei, theory and measurement techniques, population of energy levels, solvents used, chemical shift and its measurement, factors affecting chemical shift, nuclear resonance, relaxation methods,

integration of NMR signals, spin-spin coupling, coupling constant 'j' and factors affecting it, shielding and de shielding, chemical shift assignment of major functional groups, classification (ABX, AMX, ABC, A_2B_2 as examples), spin decoupling, applications of spin decoupling (with simple molecules as examples),

NMR studies of nuclei other than Proton: ^{13}C Chemical shift and factors affecting it, ^{19}F and ^{31}P NMR.

References:

1 *Fundamentals of Molecular Spectroscopy*, Banwell and Mc Cash, Tata McGraw Hill
2 *Molecular Structure and Spectroscopy*, G Aruldas, Prentice Hall.
3 *Atomic Structure and Chemical Bonding including Molecular Spectroscopy,* Manas Chanda, Tata McGraw Hill,
4 *Molecular Spectroscopy,* Barrow, Mc Graw Hill.
5 *Theory of Atomic Spectra*, Sobelman, Alpha
6 *Molecular Spectroscopy*, K.V. Raman,
7 *Fundamentals of Molecular Spectroscopy*, P.S. Sindhu
8 *Vibrational Spectroscopy,* S. Narayana
9 *Atomic and Molecular Spectroscopy,* Gupta

CMS C 014 Coordination Chemistry

Unit 1 *18 hrs*

Limitations of VB theory, Crystal field theory of coordination compounds, d-orbital splitting in octahedral, tetrahedral and square planar fields, Jahn-Teller effect, crystal field effect on ionic radii and lattice energies, evidence of M-L covalency, structural and thermodynamic evidences for ligand field splitting, hydration and ligation, MOT in coordination compounds, MO energy level diagrams for octahedral, tetrahedral and square planar configuration with and without π bonding, MOT: a group theoretical approach, angular overlap model of bonding in complexes, effect of π bond in stability, Nephelauxetic series, critical comparison of the three theories as applied to metal complexes.

Unit 2 *18 hrs*

Optical activity in coordination complexes, ORD and CD, cotton effect and applications, changes in band positions in IR, band intensities and band splitting for assigning proper geometry for complexes (illustrations with proper examples), Nuclear Magnetic Resonance, Nuclear Quadrupole Resonance, Mossbauer and Electron Spin Resonance Spectroscopy for structural studies of complexes, importance of molar conductance studies in coordination chemistry.

References:

1 *Concepts and Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel, J. Alexander, Wiley Student Edn*
2 *Concise Inorganic Chemistry J.D. Lee, Blackwell*
3 *Inorganic Chemistry- Principles of structure and reactivity,* J E Huhee, Pearson Education
4 *Inorganic Chemistry, Shriver & Atkins, Oxford*
5 *Inorganic Chemistry, A.G.* Sharpe, Pearson Education
6 *Coordination Chemistry*, S. F. A. Kettle, Longman.
7 *Chemistry of Coordination compounds*, J C Bailar, Reinhold.
8 *Coordination Chemistry,* F Basolo R Johnson, Benjamin Inc.
9 *Coordination Chemistry,* D Banergea, Tata McGraw Hill.
10 *Electronic Absorption Spectroscopy and Related Techniques,* D N Sathynarayana, Universities Press.

CMS C 015 Complex & Organometallic Chemistry

Unit 1 *18 hrs*

Magnetic susceptibility measurements, Gouy method, diamagnetic corrections, spin only value, orbital contribution, spin orbit coupling, ferro and antiferro magnetic coupling, spin cross over systems, application of magnetic measurements to structure determinations of transition metal complexes.

Term symbol for d^n ions, spectroscopic ground states, selection rules for d-d transitions, Orgel diagrams for transition metal complexes (d^1 to d^9 configuration), Tanabe-Sugano diagrams, interpretation of spectra of spin paired and spin free octahedral, distorted octahedral, tetrahedral and square planar complexes, charge transfer transitions.

Unit 2 *18 hrs*

Transition metal alkyls and aryls, routes of synthesis, stability and decomposition pathways, organo copper in organic synthesis, transition metal to carbon multiple bonded compounds, alkylidenes, alkylidynes, low valent carbenes and carbynes synthesis, nature of bond, structural characteristics and reactivity (electrophilic and nucleophilic reactions on the ligands).

Transition metal-π complexes with unsaturated organic molecules: alkenes, alkynes, allyl, diene, dienyl, arene, and trienyl complexes, fluxionality and dynamic equilibria in compounds such as η^2 – olefin, η^3 – allyl and dienyl complexes, catalysis by organometallic compounds: hydrogenation, hydro formylation and polymerization reactions.

References:

1. *Advanced Inorganic Chemistry, Cotton and Wilkinson*
2. *Concise Coordination Chemistry*, R Gopalan and V N Ramalingam, Vikas Publishers
3. *Theoretical Inorganic Chemistry,* M C Day and J Selbin, Affiliated East West Press.
4. *Elements of magneto Chemistry,* R L Dutta and A Syamal, S Chand & Company Ltd.
5. *Organometallic Chemistry,* R C Mehrotra and A Singh, New Age International.
6. *Concepts and Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel, J. Alexander, Wiley Student Edn.*
7. *Inorganic Chemistry, A.G.* Sharpe, Pearson Education

CMS C 016 Bioorganic Chemistry & Natural Products

Unit 1 *18 hrs*

Biomolecules: nomenclature, reactivity and stereochemistry, nucleic acids, DNA, RNA, peptide bond formation, structure organization of proteins, chemistry of nucleic acid bases A, G, C, T and U and their synthesis, synthesis of adenosine and ATP, polymer supported peptide synthesis, protein biosynthesis, applications of DNA hybridization in agriculture and medicine.

Chemistry of natural products: Hofmann, Emde and von Braun degradations in alkaloid chemistry, introduction and classification of Terpenoids, isoprene rules, general methods of determining the structure of terpenoids, introduction and nomenclature of steroids, Blanc's rule, Barbier-Wieland degradation.

Unit 2 *18 hrs*

Oppenuer oxidation, Diel's hydrocarbon, biosynthesis of terpenes and alkaloids, flavours and fragrance, introduction to cosmetics chemistry.

Organic medicinal chemistry: Introduction, general principle of drug action, physico-chemical properties of organic medicinal agents, chemistry of prodrugs, drugs metabolism,

chemistry of sedatives, hypnotic drugs (barbiturates and non-barbiturates, introduction to psycho active drugs. Introduction to the chemistry of antibiotics

References:

1. *Medicinal chemistry,* W. Kar, Wiley Eastern
2. *Chemistry of natural products,* O.P. Agarwal, Goel Publ.
3. *Chemistry of natural products,* H.M. Chawla, B. Prakash, S. Chand
4. *Chemistry of natural products,* S.V. Bhat, A. Nagasampagi, M. Sivakumar, Narosa
5. *Organic Chemistry, Vol 2*, I. L Finar, Longman.
6. *Chemistry of Natural Products*, Ahluwalia, Ane books
7. *Introduction to Medicinal chemistry,* Patrick, Oxford
8. *Principles of organic medicinal chemistry,* Rama rao nadendla, New Age International
9. *Fundamentals of Medicinal chemistry,* Thomas, Wiley
10. *Oral drug delivery technology,* A Jithin, Pharma

CMS C 017 Reactions & Mechanism in Organic Chemistry

Unit 1 *18 hrs*

Mechanisms, reactivity and reactions of electrophilic and nucleophilic substitutions, effect of solvent, leaving group and substrate structure, neighboring group participation,

Mechanism and rectivities of Carbon-Carbon and Carbon-Hetero multiple bonds (Michael addition, Stobbe, Knoevenagal, Darzen, Reformatsky and Benzoin condensations, Wittig-Horner and Darkin reactions).

Unit 2 *18 hrs*

Mechanism, orientation and reactivity of elimination reactions, mechanism and applications of rearrangement reactions (Wagner-Meerwein, Demjanov, Beckmann, Hoffmann, Curtius, Schmidt, Lossen, Wolff, Fries, Arylazo, Fischer-Hepp, Hofmann-Martius, Von Richter, Orton, Bamberger, Smiles, Dienone-Phsenol, Benzilic acid, Favorskii, Stevens, Wittig, Sommelet-Hauser, Baeyer-Villiger, Hydroperoxide and borane rearrangements).

Mechanism and reactivity of oxidation and reduction reactions.

References:

1 *Advanced Organic Chemistry*, Jerry March, Wiley Editions
2 *Organic Chemistry,* Louden, McGraw Hill
3 *Advanced Organic Chemistry,* F.A. Carey and R. S. Sundberg, Springer
4 *Principles of organic Synthesis,* R.O.C Norman, J.M.C. Frsnz, ELBS
5 *Advanced Organic Chemistry*, B. Miller, Pearson Education
6 *Advanced Organic Chemistry*, M.S. Singh, Pearson Education
7 *Named Reactions*, J.J. Li, Springer

CMS C 018 Statistical Thermodynamics

Unit 1 *18 hrs*

Basic principles, permutation, probability concept, thermodynamic probability, macrostates and microstates, derivation of Boltzman distribution law, partition function, physical significance, different ensembles, distinguishable and Indistinguishable molecules, partition function and thermodynamic function, separation of partition functions, translational, rotational, vibrational and electronic partition functions, calculations of thermodynamic functions and equilibrium constants, equation of state, Sackur-Tetrode equation, statistical formulation of third law of thermodynamics.

Unit 2 *18 hrs*

Basic idea of phase-space, heat capacity of gases, heat capacity of Hydrogen, ortho and para Hydrogens.The atomic crystals: Einstein's theory of atomic crystal, Debye's modification of Einstein's model, The virial expression and virial coefficient, relation between virial coefficient and the cluster integrals, need for quantum statistics, Bose-Einstein statistics, Bose-Einstein distribution, theory of paramagnetism, Bose-Einstein condensation, liquid Helium, super cooled liquids, Fermi-Dirac distribution, application of free electron gas, thermionic emission, comparison of three statistics.

References:

1 *Elements of statistical Thermodynamics*, M.C.Gupta- New age international.
2 *Elements of statistical Thermodynamics*, L.K. Nash- Addision Wesley Publishing
3 *A course on statistical thermodynamic*, Kistin and Dorfuran- Academic 1971.
4 *Statistical thermodynamic,* D.A.Mc Quarrie- Harper and Row

CMS C 019 Solid State Chemistry

Unit 1 *18 hrs*

Classification of solids, preparation, properties and industrial importance of semiconductors, imperfection in solids, point, line and plane defects, electrons and holes, non-stoichiometry, imperfection and physical properties of solids (brief survey). Electrical properties of solids: electrical conductivity, Hall Effect. Dielectric properties: piezo electricity, ferro electricity and conductivity. Optical properties of solids: photo conductivity, luminescence, color centers, lasers, refraction, birefringence. Magnetic properties of solids: diamagnetism, paramagnetism, ferro, antiferro and ferri, magnetisms, calculation of magnetic moments, mechanical and thermal properties. Solid state reactions: general principles, Wagner's theory, order-disorder transitions in solids, factors influencing the solid state reactions.

Unit 2 *18 hrs*

Ionic Conductors, mechanism of ionic conduction, diffusion, superionic conductors, phase transitions and mechanism of conduction in superionic conductors, Superconductivity, Meisner effects; Type I and II superconductors, high T_c materials.

Liquid Crystals: Types, examples and applications, theories of liquid crystals, photoconductivity of liquid crystals, mesomorphic behaviour, thermotropic liquid crystals, nematic and smectic mesophases, smectic – nematic transition and clearing temperature, homeotropic, planar and schlieren textures, twisted nematics chiral nematics, molecular arrangements in smectic A and smectic C phases, optical properties of liquid crystals.

References:

1 *Solid state chemistry,* D.K.Chakraharthy, New Age publication
2 *Introduction to solids*, I.V.Azaroof, Mc Graw Hill.
3 *Principles of the solid state*, H.V. Keer, Wiley Eastern
4 *Solid state chemistry and its applications*, A.R. West, Wiley
5 *Liquid Crystals*, S. Chandrasekhar, Cambridge University Press

CMS C 020 Analytical Chemistry

Unit 1 *18 hrs*

Introduction to analytical and instrumental methods, Classification of analytical techniques, nature and origin of errors, accuracy and precision, statistical evaluation of data, tests of significance, Students 't' test, 'F' test, significant figures and computation rules, Types of

analysis based on sample size : macro, meso, micro, sub-micro and ultra-micro estimations, nano level detections.

Precipitation phenomena, organic precipitants in inorganic analysis, extraction of metal ions, nature and types of extractants and its applications, chelometric titration, masking and de masking techniques, industrial applications of masking.

Separation techniques: Solvent extraction, batch and continuous extractions, countercurrent distribution, extraction of metal ions, nature and types of extractants and its applications.

Unit 2 *18 hrs*

Introduction to chromatography, classification of chromatographic methods, theory, techniques and applications of Paper chromatography, Column chromatography, Thin layer chromatography (TLC), High performance liquid chromatography (HPLC), Gas chromatography (GC).

Radio analytical methods: Introduction, principle and application of neutron activation analysis (NAA), isotope dilution analysis and radiometric titrations.

Electro analytical methods: Principles and applications of Voltammetry, Cyclic voltammetry (CV), Polarography, Stripping voltammetry, Conductometry, Amperometry, Potentiometry and Electrogravimetry.

References:

1 *Principles and practice of Analytical Chemistry*, F.W. Fifield and D. Kealeg, Blackwell publications
2 *Vogel's Qualiitative Inorganic Analysis*, Pearson Education
3 *Modern Analytical Chemistry*, Harvey, Tata Mc Graw Hill
4 *Instrumental methods of chemical analysis*, Willard, Dean and Merrit, Affiliated East West Press
5 *Vogel's quantitative chemical analysis,* Pearson Education
6 *Principles of quantitative chemical analysis,* de Levine, Mc Graw Hill
7 *Fundamentals of Analytical Chemistry,* Skoog, West, Holler, Croach, Thomson Brooks/Cole
8 *Organic Analytical Chemistry,* Jagmohan, Narosa Publications

CMS C 021 Inorganic Chemistry Practical II

15 Units *90 hrs*

Estimation of binary mixtures of metal ions in solution by volumetric, gravimetric, colorimetric and electro analytical methods for the following Cu, Ni, Fe, ZnMg, Ca, Ba, Cr_20_7 etc.,

1. Analysis of some typical ores and alloys.
2. Ion exchange separation of binary mixtures of metal ions, NPK estimation and pH determination of soil and fertilizer
3. Preparation of some colloids: Nano technological methods, (i) Synthesis of Bohemite ($AI(OH)_3$ from aluminium nitrate and (ii) Preparation of mixed oxide nano crystals, Aluminium nitrate, ($TiC1_4$ (titanium salt), $SiC1_4$, Titanium isopropoxide)
4. Thin film fabrication – electrode deposition and CVD.
5. Determination of dia magnetism and paramagnetism.

Reference:

1 *A Text Book of Quantitative Inorganic Analysis*, A.I.Vogel, Longman
2 *Analysis of Minerals and Ores of Rare Elements,* W.R.Schoder and A.R.Powell
3 *Quantitative Chemical Analysis,* I.M.Kolthoff and E.M. Sanderson
4 *Experimental Inorganic Chemistry*, W.G. Palmer.

5 *Preparative Inorganic Reactions* N.L. Jolly (Ed)
6 *Hand Book of Preparative Inorganic Chemistry* –Vol I & II, G. Brauer
7 *Hand Book of Thin Films*, Meissil and Glang (Ed.)

CMS C 022 Physical Chemistry Practical I

15 Units *90 hrs*

Distribution law: Partition of iodine between water and carbon tetrachloride, Equilibrium constant of simple reaction, concentration of unknown KI, partition studies, determination of equilibrium constant, hydrolysis constant, association studies.

Solid and liquid equilibria: Construction of phase diagram of simple eutectics, systems with congruent melting points and solid solutions, determination of composition of unknown mixtures, analytical and synthetic methods for the determination of solubilities and heat of solution.

Partially miscible liquids: Critical solution temperature, influence of impurities on the miscibility temperature, determination of composition of unknown mixtures, completely miscible liquid systems: Construction of phase diagrams of two component liquid systems, Zeotropic and azeotropic. Three component systems: With one pair of partially miscible liquids, construction of phase diagrams and tie lines, compositions of homogenous mixtures, heat of solution from solubility data, analytical and graphical method.

Molecular Weight Determination, Rast and transition temperature method, molecular weight of a solid using a solid solvent by cooling curve method, molecular weight determination by study of depression in transition temperature, cryoscopic study,

Refractometry: Determination of molar refractions of pure liquids, determination of composition of mixtures.

Viscosity: Determination of viscosity of pure liquids, composition of binary liquid mixtures determination of molecular weight of a polymer.

Potentiometry: Electrode potentials of Zn and Ag electrodes, determination of standard potentials, determination of mean activity co-efficient of an electrolyte at different molalities by EMF method, dissociation constant measurement, determination of strength of a given solution, potentiometric titration.

References:

1. *Practical Physical Chemistry*, A. Findlay and J A Kitchener, Longman
2. *Experimental Physical Chemistry*, F Daniels and J H Mathews, Longman
3. *Practical Physical Chemistry* A M James, J A Churchil
4. *Instrumental Methods of Analysis* H H Willard, L L Merritt and J A Dean, Affiliated East West Press.
5. *Practical Physical Chemistry*, D.M. James and F.E. Prichard, Longman
6. *Experimental Physical Chemistry*, V.d. Ahuwale and parul, New age International.

CMS C 023 Seminar

Each students has to present a seminar on atopic related to chemistry/ material science of recent trends with power point for 25-30 minutes.

CMS O 001 Basic Concepts in Chemistry

Unit 1 *18 hrs*

Some basic concepts in chemistry: Importance of studying chemistry-Laws of chemical combinations- Daltons atomic theory- Mole concept- atomic, molecular and molar masses-chemical equations.

Atomic structure: Fundamental properties, Rutherford model of atom-Nature of electromagnetic radiation-emission spectrum of hydrogen atom-Bohr's model of hydrogen atom-draw back of Bohr model-Concept of orbital Quantum numbers

Classification of elements

Mendeleev's periodic table: Atomic number and modern periodic law – long form of periodic table-electronic configuration of elements and position in the periodic table-s,p,d and f block elements periodic properties-ionisation energy, electron affinity, atomic radii, valancy,electro negativity.

Solid State: Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, points defects, electrical and magnetic properties.

Unit 2 *18 hrs*

Solutions: Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties - relative lowering of vapour pressure, elevation of B.P., depression of freezing point, osmotic pressure, determination of molecularmasses using colligative properties, abnormal molecular mass.

Chemical Kinetics: Rate of a reacation (average and instantaneous), factors affecting rates of reaction; concentration, temperature, catalyst; order and molecularity of a reaction; rate law and specific rate constant, intergrated rate equations and half life (only for zero and first order reactions); concept of collision theory (elementary idea, no mathematical treatment)

Surface Chemistry: Adsorption - physisorption and chemisorption; factors affecting adsorption of gases on solids; catalysis; homogenous and heterogeneous, activity and selectivity; enzyme catalysis; colloidal state: distinction between true solutions, colloids and suspensions; lyophilic, lyophobic, multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brounian movenment, electrophoresia, coagulation; emulsion types of emulsions.

General Principles and Processes of Isolation of Elements; Principles and methods of extraction - concentration, oxidation, reduction electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and Iron.

Unit 3 *18 hrs*

General principles of organic chemistry: hydrocarbons, reaction mechanisms, alcohols, carbonyl compounds and amines.

Biomolecules: Carbohydrates - Classification (aldoses and keloses), monosaccahrides (glucose and fructose), oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); importance. Proteins - Elementary idea of α-amino acids, peptide bond, polypeptides proteins, primary structure, secondary structure, teritary structure and quaternary structure, denaturation of proteins; enzymes, Vitamins - Classification and functions, Nucleic Acids: DNA & RNA.

Polymers; Classification - natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some importance polymers; natural and synthetic like polythene, nylon, polyesters, bakelite, rubber.

Chemistry in everyday life; Chemicals in medicines - annalgesica, tranquilizers, antisecptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines, Chemicals in food- preservatives, artificial sweetening agents, Cleansing agents - soaps and detergents and dyes.

THIRD SEMESTER

CMS C 024 Bioinorganic Chemistry

Unit 1 *18 hrs*

Metal ions in biology: their vital role in the active-site structure and function of metallo-proteins and enzymes especially those containing Mg, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo and W ions. Both heme and non-heme systems with one-, two- or multi-metal centers (e.g., Fe: Hb, Mb, Hr, RNR, CCO, P-450, MMO, ferridoxins, Fe-S clusters: Cu: hemocyanin, tyrosinase, DBH, galactose oxidase lactase, SOD, Mn: photosynthesis and photosystem II; vitamin B12; Zn: CPA, CA, AP, Ni: urease. Peptide and nucleotide (phosphate) hydrolytic enzymes (metallohydrolases) will also be heighlighted.

Metalloproteins as enzymes, carboxy peptidase, carbonic anhydrase, alcohol dehydrogenase, catalases, peroxidases, cytochrome P 450, superoxide dismutase, copper oxidases, vitamin B_{12} coenzyme.

Unit 2 *18 hrs*

Metal storage and transport: Transport and storage of dioxygen, heme proteins, oxygen uptake, functions of haemoglobin, myoglobin, hemerythrin and hemocyanins, synthetic oxygen carriers. ferritin, transferring and ceruloplasmin. Electron transfer proteins: cytochromes, iron-sulphur proteins.Biological nitrogen fixation, nitrogenase.

Metals in medicine- metal deficiency, metal toxicity, metal complexes as drugs Metal based drugs (e.g., technetium in heart imaging, cisplatin as antitumor agent, MRI agents), environmental applications and toxic effects (Cd, Hg, Cr) of metal ions. Metal ions in biological systems, essential and trace metals, ion transport across membranes, active transport of ions, ionophores,

References:

1 *Principles of Bioinorganic Chemistry*, S.J. Lippard, and J.M. Berg, , Univ. Science Books.
2 *Biocoordination Chemistry,* D.E. Fenton, (Chemistry Primer 26), Oxford Univ. Press.
3 *Bioinorganic Chemistry,* L. Bertini, H. B. Gray, S. J. Lippard, and J. S. Valentine, Univ. Science Books.
4 *Metal ions of Biological Systems*, H. Siegel and T. G. Spiro, , Marcel-Dekker, 1980.
5 *Principles of Biochemistry*, A. L. Lehninger, D. L. Nelson and M. M. Cox, CBS Publishers and Distributors, 1993.

CMS C 025 Organic Spectroscopy

Unit 1 *18 hrs*

Ultraviolet and visible spectroscopy: sampling, solvent effects, applications to dienes, carbonyl compounds and benzenoid compounds. Stereochemical factors, quantitative studies.

Infrared spectroscopy: modes of vibrations, factors influencing vibrational frequencies, sample techniques, solvents, group frequencies, applications, quantitative infrared analysis, Attenuated Total Reflectance and Multiple Internal Reflectance spectroscopy

Proton NMR spectroscopy: Chemical shift, spin-spin splitting and coupling constants, applications to organic compounds, coupling of proton to other nuclei (^{19}F, D, ^{31}P, ^{29}Si)

Unit 2 *18 hrs*

Carbon-13 NMR spectroscopy: off-resonance and proton decoupling, Nuclear Overhauser Effect, applications

Mass spectroscopy: Theory and instrumentation, Fragmentations, application studies, Introduction to combined instrumental techniques (GC-MS, HPLC-MS, TG-MS)

Introduction to ESR and EPR spectroscopy

Structural elucidation of organic compounds based on UV, IR, NMRs and MS data.

References:

1 *Spectrometric Identification of Organic Compounds,* R.M. Silverstein, G.C. Bassler, T.C. Morril, John Wiley
2 *Organic Spectroscopy* W. Kemp, Palgrave
3 *Organic structural spectroscopy*, J.B. Lambert, H.F. Shurvell, D.A. Lightner and R.G. Cooks, Prentice hall
4 *Application of absorption spectroscopy of organic compounds,* J.R. Dyer, Eastern Economy edition
5 *Introduction to Organic Spectroscopy,* Pavia, Lampman and Krinz, Thomson

CMS C 026 Synthetic Organic Chemistry

Unit 1 *18 hrs*

Reagents in organic synthesis: reactions based on the reagents:Complex metal hydrides, Gilaman's reagent, lithiumdimethyl cuprate, LDA, dicyclohexyl carbodimide, 1,3-Dithane (reactivity umpolung) trimethyl silyliodide, tri-n-butyl tinhydride, osmium tetroxide, DDQ, selenium dioxide .

Phase transfer catalysis, Synthesis and synthetic applications of crown ethers and Merrifieldresin, Peterson's synthesis, Baker yeast.

Unit 2 *18 hrs*

Introduction to Microwave organic synthesis, Introduction to green chemistry-environment friendly organic synthesis- electron transfers reactions, molecular transformations in organic synthesis, protective groups in organic synthesis.

The disconnection approach: introduction, one and two group discussions, use of acetyls and ketenes in synthesis, strategy in ring synthesis for five and six membered rings.

Applications of Transition metals in organic synthesis, applications of heterogeneous catalysts in organic synthesis, application of polymer supported reagents in organic synthesis.

References:

1 *Organic synthesis,* M.B. Smith, McGraw Hill
2 *Modern methods of organic synthesis,* Carruthers, Cambridge
3 *Organic synthesis, the disconnection approach,* S. Warren, John Wiley
4 *Protective groups in organic synthesis,* T.W. Greene and P.G.M. Wuts, John Wiley
5 *Heterocyclic chemistry*, Gillchrist, Pearson education
6 *Heterocyclic chemistry*, J.A. Joule and K. Mills, Oxford
7 *Organic synthesis: special techniques,* V.K. Ahluwalia and R. Agagrwal, Narosa

CMS C 027 Chemical Kinetics and Catalysis

Unit 1 *18 hrs*

Rate law equation: significance, determination of order of a reaction: differential, integral, isolation and half-life methods, true and false orders, determination of rate coefficient of a first order reaction by Guggenheim's methods, reversible, parallel and consecutive first order reactions, unimolecular reactions: Lindman theory, steady state approximation principles, reaction involving free radicals and reactive atoms, thermal decomposition of organic compounds, Rice-Herzfeld mechanism.

Collision theory, transition state theory, comparison of the two theories for reaction between atoms, The HI formation, Arrhenius equation and its temperature dependence of frequency factor, salt effect,

Unit 2 *18 hrs*

Calculation of the kinetic and thermodynamic parameters: Significance of entropy of activation, calculation of thermodynamic parameters, chain reaction, branching chains, explosion and explosion limits, study of kinetics by stopped flow technique, relaxation method, flash photolysis and magnetic resonance method

Homogeneous and heterogeneous catalysis, autocatalytic reactions, inhibitor, Michaleis-Menten equation, catalytic species and catalyzed reactions, acid base catalysis, acid functions, catalytic promoters.

Enzyme catalysis: single substrate and two substrate reactions, inhibition, kinetics, effects of *p*H, temperature, etc., on enzyme catalyzed reactions and its applications, examples of coupled reaction.

References:

1 *Chemical Kinetics*, K.J. Laidler, Pearson Education
2 *Reaction Kinetics,* M.J. Pilling and P.W. Seakins, Oxford Univ. Press
3 *Kinetics and Mechanisms of Chemical Transformations*, J. Rajaram and J.C. Kuriacose, Macmillan
4 *Introduction to Molecular Dynamics and Chemical Kinetics* G.D. Billing and K.V. Mikkelsen, John Wiley
5 *Fundamentals of Photochemistry*, K.K. Rohatgi - Mukkerjee, Wiley Eastern Ltd.
6 *Chemical Kinetic Methods: Principles of Relaxation Techniques and applications* C. Kalidas, New Age International
7 *Molecular Reaction Dynamics and Chemical Reactivity*, R.D. Levine, R.B. Bernstein Oxford

CMS C 028 Instrumental Methods of Analysis

Unit 1 *18 hrs*

Introduction to instrumentation, method of samplings, data analysis and applications to chemistry of the followings: Low Energy Electron Diffraction, Attenuated Total Reflection Spectroscopy, X-Ray Fluorescence, Electronic Spectroscopy for Chemical Analysis, Ion Scattering Spectroscopy, Secondary Ion Mass Spectroscopy, X-ray Photo Electron Spectroscopy, UV-Photo Electron Spectroscopy, Auger Electron Spectroscopy.

Principles, general instrumentation and applications of Scanning Electron Microscopy, Scanning Tunneling Electron Microscopy, Atomic Absorption Spectroscopy, Neutron Activation Analysis and X-ray crystallography.

Unit 2 *18 hrs*

Principles, instrumentation and applications of thermogravimetry (TGA-DTA), Differential Scanning Calorimetry, Dynamic Mechanical Analyzer, Dynamic Chemical Analyzer, Direct injection enthalpymetry and thermometric titrimetry.

Principles and applications of voltammetry, cyclic voltammetry, polarography, stripping Voltammetry, conductometry, amperometry and potentiometry.

Instrumentations of NMR, IR, UV-Visible and Mass spectrometry,

References:

1 *Instrumental methods of chemical analysis*, Willard, Dean and Merrit, Affiliated East West Press
2 Vogel's *Quantitative chemical analysis,* Pearson Education
3 *Principles of quantitative chemical analysis,* de Levine, Mc Graw Hill
4 *Modern analytical chemistry*, Harvey, Mc Graw Hill
5 *Principle and practice of analytical chemistry,* Fifield and Kealey, Blackie

CMS E 001 Inorganic Materials

Unit 1 *18 hrs*

Nuclear materials and materials for aerospace application, metals and alloys relevant to aerospace applications, Structure and technological importance of silicates, cement and ceramics, chemistry of metallocycles, cages and clusters of elements, cryptands and calixeranes, biological significances.

Structural variety properties and implications of borides, carbides, silicides, nitrides, phosphides, oxides and sulfides of transition elements, multiple bonds and cluster variety of transition metals, higher boranes, carboranes and metalloboranes.

Methods of reduction of oxide ores, Ellingham diagram, chemical and electrolytic reductions, reduction potentials, Latimer and Frost diagrams, effect of complexation on potential.

Unit 2 *18 hrs*

Lanthanide and actinides: electronic structure, oxidation states, extraction and separation of lanthanides, stereochemistry of complexes, spectral and magnetic properties.

Industrial Chemicals: Urea and polyphosphates- production, structure, property analyses and uses.

Introduction to inorganic polymers containing boron and sulfur.

References:

1 *Inorganic Chemistry,* .J.E Huheey, E.A. Keiter and R.L. Keiter, Pearson Education
2 *Inorganic Chemistry,* Shriver, Atkins and Langford, Oxford University Press
3 *Concise Inorganic Chemistry,* J.D. Lee, ELBS
4 *Concepts and Models of Inorganic Chemistry*, B.E. Douglas, D. McDaniel and A Alexander, John Wiley & Sons
5 *Inorganic chemistry – A Unified Approach*, W.W. Porterfield, Elsevier,
6 *Introduction to Cluster Chemistry*, *D.M.P. Mingos and D.J. Wales, Prentice Hall*
7 *Chemistry of Elements,* N.N. Greenwood and E.A. Earnshaw, Pergaman Press
8 *Advanced Inorganic Chemistry,* F.A. Cotton and G. Wilkinson, John Wiley**.**

CMS E 002 Polymer chemistry

Unit 1 *18 hrs*

Basic concepts: classification, nomenclature, molecular weight and distribution, glass transition, morphology, viscosity vs. molecular weight and mechanical property vs. molecular weight relationships, Chain structure and configuration.

Methods of determination of molecular weight, distribution, size and shape of polymers, Intrinsic viscosity, Mark-Houwink relationship, Thermodynamics of polymer solutions, self-diffusion, reptation, Rouse-Bueche theory and de Gennes reptation model.

Polymerization techniques: condensation polymerization, kinetic and thermodynamic considerations, molecular weight distribution, chain polymerization: effect of substituents, factors affecting polymerization, methods of polymerization: living polymerization, transfer-radical-polymerization.

Unit 2 *18 hrs*

Cationic chain polymerization, kinetics and energetics, anionic polymerization: chain copolymerization, determination of composition, ring-opening polymerization.

Ziegler-Natta catalyst, control of stereochemistry of polyolefins and polycyclo-olefins. Metathesis polymerization: mechanisms, synthesis of polyacetylenes, synthesis block, graft copolymers.

Glass transition temperature and its methods of determination Mechanical properties of polymers and methods of determination.

Characterization techniques of polymers: thermal, mechanical and structural characterizations

Speciality polymers: fire retardant polymers, liquid crystalline polymers, biodegradable polymers, high temperature polymers, optic fibers.

References:

1. *Introduction to Physical Polymer Science* L. H. Sperling, , Wiley- Interscience
2. *Principles of Polymerization* G. Odian, , Third edition, Wiley-Interscience.
3. *Principles of Polymer Chemistry*, P. J. Flory, , Cornell University Press, 1953.
4. F. W. Billmeyer, Textbook of Polymer Science, 3rd Edition, John Wiley, 1994.
5. Gowariker et al, Polymer Science. Wiley Eastern, 1990.
6. K. J. Ivin and J. C. Mol, Olefin Metathesis, 2nd edition, Academic Press, 1996.

CMS E 003 Biochemistry

Unit 1 *18 hrs*

Cell structure: Chemistry of biomolecules, basic aspects of structure and classification of carbohydrates, lipids, aminoacids, proteins and nucleic acids. Supramolecular assemblies, biomembranes, lipo and glycoproteins.

Biocatalysis, concept of enzyme catalysis, role of vitamins and metals as cofactors, enzyme kinetics, Michaelis-Menten equation, inhibition of enzyme action, regulatory aspects.

Metabolism: Overview and important relationships between-glycolysis, TCA cycle, HMP shunt, oxidation of fatty acids, amino acids and urea cycle. Flow of genetic information, nature of genetic code, replication of DNA, transcription and translation, regulation of gene expression.

Unit 2 *18 hrs*

Bioactive and biodegradable polymers: bioactive ceramics. Biocompatibility, toxicity, cytotoxicity, hypersensitivity, Protein interaction with synthetic materials. Immunological responses to biomaterials, blood compatibility, platelet adhetion and aggregation, coagulation.

Assessment of blood: compatibility, sterility and infection. Interactions of bacteria with biomaterials, methods for sterilization, assessment of sterility.

Cardiovascular applications: grafts, catheters, stents, valves, embolic agents, orthopedic applications-joint prostheses, fracture fixation devices, ophthalmologic applications, contact lenses, corneal implants, Dental materials and implants.

References:

1 *Principles of Biochemistry* Albert L. Lehninger, David L. Nelson, Michael M. Cox., CBS Publishers and Distributors.
2 *Biochemistry,* Lubert Stryer, W. H. Freeman and Company, 4th edition.
3 *Biochemistry*, Christopher K. Mathews and K. E. Von Holder, Benjamin/Cummings.
4 *Biomaterial Science- An introduction to Materials in Medicine*, B.D. Ratner, A.S. Hoffman, F.J. Schoen and J.E. Lemons, Academic press
5 *Biomaterials: Principles and applications*, J.B. Park, J.D. Bronzino, CRC Press
6 *Design Engineering of Biomaterials for Medical Devices,* David Hill, John Wiley and Sons

CMS E 004 Medicinal chemistry

Unit 1 *18 hrs*

Introduction, different classes of drugs, drug action, Drug discovery and design, stereochemistry, solubility, salt formation, SAR and QSAR, physicochemical parameters,

Hansch analysis, Craig plot, Free Wilson analysis, drug delivery systems, Enzyme inhibitors in medicine

Pharacokinetics, drug absorption, distribution, metabolism and excretion, the role of nitric oxide in physiological states,

Unit 1 *18 hrs*

General methods of drug synthesis (with paracetamol as eg.), synthesis and action of antibiotics (with penicillin as eg), antiviral agents, general anesthetics

Applications of Electrophoresis, ultra-filtration, ultracentrifugation in purification, separation and isolation.

Introduction to herbal medicine, Introduction the chemistry of homeopathy, Introduction to nanomedicine.

Reference:

1 Principals of Organic Medicinal Chemistry, R.R. Nadendla, New Age
2 Medicinal Chemistry, An introduction, G. Thomas, Wiley
3 Introduction to Medicinal Chemistry, G.L. Patrick, Oxford
4 Medicinal Chemistry, A. Kar, New Age
5 Medicinal Chemistry, D. Sriram, P. Yogeeswari, Pearson, Education
6 Fundamentals of Medicinal Chemistry, G. Thomas, Wiley

CMS E 005 Environmental Chemistry

Unit 1 *18 hrs*

Introduction, public health, public awareness, waste treatment, internal and incidental pollution, pollution control, control management, environmental policies, nature and natural process, natural resources, eco systems.

Air pollution: chemistry, analysis, control, effect of pollution, acid rain, insecticides and pesticides, thermal pollution.

Noise pollution: automobiles, factories, household pollution.

Water pollution: soluble metals, soaps and detergents, marine pollution.

Unit 1 *18 hrs*

Soil pollution: ground water, heavy metal poisoning, industrial pollution, agriculture pollution,

Biodiversity, social issues and the environmental pollution, environmental law and regulations.

Instrumental methods in environmental chemical analysis, solid and liquid samples.

References:

1 *Environmental Chemistry*, Ian Williams, John Wiley & Sons
2 *Environmental Chemistry a global perspective,* G.W. vanLoon and S.J. Duffy, Oxford University Press.
3 *Environmental chemistry,* Peter O'Neill, Blackie Academics
4 *Fundamental concepts of Environmental chemistry* G.S. Sodhi, Narosa publications

CMS C 029 Organic Chemistry Practical II

1 Organic Estimations
   a) Estimation of phenol
   b) Estimation of aniline
   c) Estimation of glucose

2 Organic synthesis: Synthesis of the following organic compounds, purification and characterization.
   a) *m*-Nitrochlorobenzene from *m*-nitroaniline (Sandmayer's Reaction)
   b) Benzophenone oxime and its rearrangement to benzanilide (Beckmann Rearrangement)
   c) Benzalacetone from benzaldehyde (Clasen-Schmidt Reaction)
3 Analysis of natural products:
   a) Determination of saponification value and iodine value of an oil
   b) Isolation of lycopene from tomato/ β-carotene from carrot
   c) Isolation of caffeine from tea/coffee
   d) Isolation of lactose and casein from milk

References:

1 *Lab experiments in organic chemistry*, A. Sethi, New Age international
2 *Vogel's Text book of practical organic chemistry*, B.S. Furniss, A.J. Hannaford, Pearson Education
3 *Advanced practical organic chemistry,* J. Leonard, B. Lygo and G. Procter, Nelson-Thornes
4 *Systematic identification of organic compounds,* Shriner, Hermann, Morrill, Curtin and Fuson, John Wiley
5 *Structural determination of organic compounds,* E. Pretsch, P. Buhlmann and C. Affolter, Springer

CMS C 030 Physical Chemistry Practical II

1 Flame photometry: quantitative determination of Na^+, K^+, Li^+ and Ca^{2+} ions
2 Polarography: determination of number of components and concentration (Cd^{2+}, Zn^{2+}, Pb^{2+}, Cu^{2+}, etc.)
3 Determination of molecular weight and cryoscopic constants
4 Kinetics of salt effect
5 Determination of Transport number
6 Conductance study of saponification reaction
7 Phase equilibria studies
8 Distribution method: determination of the equilibrium constant
9 Potentiometry: determination of stability constant of Cu^{2+} and ethelenediamine
10 UV-Vis. Spectrophotometer: determination of the order of a reaction
11 Colorimetry: quantitative determination of the components of a binary mixture
12 Computer applications in chemistry
   a) Chem draw/ ISIS sketches for reaction and mechanism (minimum 3 Nos)
   b) C^{++} programming for the calculation of thermodynamic parameters

References:

1. *Practical Physical Chemistry,* A. Finlay and J. Akitchener, Longman
2. *Experimental Physical Chemistry,* F. Daniels and J.H. Mathews, Longman.
3. *Instrumental Methods of Analysis,* H.H. Willard, L.L. Merritt and J.A. Dean, AEWt Press.
4. *Experimental Physical Chemistry,* D.P. Shoemaker and C.W. Garland, McGraw-Hill.
5. *A Text Book of Quantitative Inorganic Analysis,* A.I. Vogel, Pearson Education
6. *A Text Book of Qualitative Inorganic Analysis,* A.I. Vogel, Pearson Education
7. *Experimental Inorganic Chemistry*, W.G. Palmer, Cambridge University Press.

CMS C 031 Viva

A viva is conducted at the end of the Semester by the faculty members of the department.

CMS C 032 Study Tour Report

Students will have to visit a Research Institute of National repute to have an idea about the current research activities. The report of the same may be submitted to the head of the department for valuation

FORTH SEMESTER

CMS C 033 Research Project

Each student shall carry out a project work in any branches of Chemistry/ Material Science for a period of not more than six months. The project can be carried out in a research institute/industry of national repute with guidance from experts there.

CMS C 034 Ceramic Materials

Unit 1 *18 hrs*

Ceramic materials: Introduction, bonding, structure and its effects on physical properties, thermodynamics and kinetic considerations, sintering, defects of ceramics, diffusion, phase equilibria in ceramic systems (one component, binary and ternary systems), chemical reactions at high temperatures and processing of ceramics, thermal properties of ceramics, high temperature materials.

Mechanical properties, creep, fatigue, crack growth, electrical conductivity, magnetic properties, Hysteresis curves, magnetic ceramics and their applications, optical properties, scattering, opacity.

Unit 2 *18 hrs*

Crystalline ceramic materials: oxide, carbide, nitride, graphite and clay materials and their structures, polymorphism, non-crystalline ceramic materials: structure and structural requirements for stability, mode of formation, silicate and non silicate glasses, hydrogen bonded structures, applications.

Ceramic glasses and their applications, Introduction to bioceramic materials and their applications.

Reference:

1. Introduction to ceramics, W.D. Kingery, H.K. Dowen and R.D. Uhlman, John Wiley.
2. Elements of Ceramics, F.H. Nortion.
3. Fundamentals of Ceramics, M.W. Barsoum, McGraw Hill.
4. Material Science and Engineering, S.K. Hajra Choudhury, Indian Book Dist.

CMS E 006 Composite Materials

Unit 1 *18 hrs*

Polymer matrix composites, reinforcements, types of composites, design of high temperature matrix design, reinforcements, fiberes, glass fibers, carbon fibers, high strength poly olefin fibers, boron fibers, alumina fibers, quartz and silica fibers.

Design and properties of composites and composite systems, preparation, properties and applications of reinforced composites, fibre composites, laminar composites, reinforcing mechanisms, failure mechanism in composites, composite fabrication techniques, applications.

Unit 2 *18 hrs*

Hydrogels: introduction, classification, water-soluble hydrogels, formation, structure, characterization, applications in organic and inorganic spacers.

Carbon-Carbon composites – fabrication and applications, fabrication and applications, fabrication of polymer composites, wet lay up, preparation methods, autoclave molding, processing and quality assurance of composites

Environmental effects of composites, intelligent and smart composites. Applications of composite materials in electronic devices.

References:

1. Inorganic Polymers J.E. Mark, H.R. Alock and R West, Prientice Hall.
2. *Text Book of Polymer Science*, F.W. Billmeyer. Jr., Wiley Interscience
3. *Inorganic and Organic polymers,* V. Chandrasekhar, Springer
4. *Text book of polymer science*, F.W. Bilmayer, Wiley Interscience
5. Speciality polymers, R.W. Dyson, Blackie
6. *Contemporary polymer chemistry*, Allcock, Lampe and Marle, Pearson education
7. *Polymer composites*, M.C. Gupta and A.P. Gupta, New Age International
8. *Introduction to polymers,* Young and Lowell, Viva Publications

CMS E 007 Advanced Organic Synthesis

Unit 1 *18 hrs*

Retrosynthetic analysis, methodology for four and five group synthesis: terminology associated with, prostereoisomerism, homo, enantio, diastereo ligands and faces, stereoselective synthesis.

Organometallic reagents of lithium, magnesium, copper, chromium and iron, ylides of sulfur and nitrogen, Tebbe's reagent. Protecting groups, protection of hydroxyl, carboxyl, carbonyl, amino groups. Protection of carbon-carbon multiple bonds. Illustration of protection and deprotection in synthesis.

Metal carbenes, synthesis, reactivity, analogy with ester groups for oxy carbenes, cycloaddition reactions of metal carbenes, synthesis of fused ring systems, Dotz reaction, mechanism of ring formation, application in targetted organic synthesis. Application of cobalt carbonyls in organic synthesis, Pauson Khand reaction and cyclopentenone synthesis, Vollhardt reaction.

Unit 2 *18 hrs*

Pearson reaction, use of organoiron complexes for stereospecific synthesis of substituted cyclic compounds. Use of arene chromium tricarbonyl complexes in organic synthesis, the stereo effect of piano-stool structure, enhancement of arene electrophilicity and acidity of side chain. Chirality of arene chromium complexes and asymmetric synthesis. Palladium in organic synthesis, addition of organopalladium to unsaturated compounds, application to organic synthesis, stereochemical implications, Heck reaction, applications in synthesis.

Use of zirconium and other late transition metals in addition to enyne type compounds, metallacycle formation and synthetic utility.

References**:**

1 F. A. Carey and R. I. Sundberg, Advanced Organic Chemistry, Part A and B, 3rd edition, Plenum Press
2 S. Warren, Designing Organic Synthesis, John Wiley, 1978.
3 S. G. Davies, Organotransition Metal Chemistry, Application to Organic Synthesis, Pergamon Press.
4 R. K. Mackie and D. M. Smith, Guidebook to Organic Synthesis, ELBS.
5 Michael B. Smith, Organic Synthesis, McGraw Hill, 1994
6 J. P. Collman, L. S. Hegedus, J. R. Norton, and R. G. Finke, Principles and Applications of Organotransition Metal Chemistry, University Science Books
7 Barry Trost and Ian Fleming, (editors), Comprehensive Organic Synthesis, Pergamon.

CMS E 008 Photochemistry

Unit 1 *18 hrs*

Electromagnetic spectrum, Photochemical region and energy associated with UV-Visible region, laws of photochemistry, absorption and emission, shape and intensity of absorption and emission bands.

Jablonski diagram, Franck-Condon principle, Kasha's rule, spin states and their interconversion, spin orbit coupling, photophysics of radiative and nonraadiative transitions, energy transfer processes, excimers and exciplexes, static and dynamic quenching, Stern-Volmer analysis.

Experimental methods, fluorescence and photophoresence measurement, quantum yield and life time measurement, steady state quantum yield and chemical actinometry, detection of reactive intermediates by time resolved spectroscopy.

Unit 2 *18 hrs*

Photoinduced electron transfer reactions (PET), sensitization and charge transfer, control and back electron transfer, synthetic applications of PET reactions with examples, application to solar energy conversion and artificial photosynthetic systems. Photochemical substitution in transition metal complexes, organometallic photochemistry, substitution of metal carbonyls.

Introduction to lasers, Lasers in photochemical kinetics, Photophysical Reactions, A brief introduction to some current topics in photochemistry - Applications in synthesis, solar energy utilization and atmospheric chemistry

References:

1. K. K. Rohatgi Mukherjee, Fundamentals of Photochemistry, Wiley Eastern Ltd.,
2. N. J. Turro, Modern Molecular Photochemistry, The Benjamin Cummings Publishing Co.
3. J. Calvert and J. Pitts, Photochemistry, John Wiley,
4. D. O. Cowan and R. L. Drisko, Elements or Organic Photochemistry Plenum Press,
5. I. Ninomiya and T. Naito, Photochemistry Synthesis, Academic Press,
6. D. C. Neckers, Mechanistic Organic Photochemistry, Reinhold,
7. G. L. Geoffrey and M. S. Wrighton, Organometallic Photochemistry, Academic Press,

CMS E 009 Nanomaterials Chemistry

Unit 1 *18 hrs*

Nanoscience an introduction, nanomaterials and nanocomposites, surface energy, thermodynamics, phase transformations. Structure of nanomaterials:- tubes, fibers, wires, bricks and building blocks. Synthesis:- condensation, vapour synthesis, laser ablation, microwave plasma and flame aerosol processes. Nanostructure formation: lithography, self-assembly, molecular synthesis, crystal growth and polymerization.

Properties of nanomaterials:- magnetic, optical, electrical and mechanical properties, superparamagnetic materials, transparent matrices, photochromic and electrochromic materials.

Unit 2 *18 hrs*

Measurement of nanostructure:- specific surface area, X-ray and electron diffraction, electron microscopy, STEM

Nano CAD, Material study: nanocomposites, consumer goods, 'smart materials', Applications to various fields: optics, telecommunication, electronics, digital technology and environment, Biomedical applications: diagnosation, protean engineering, mapping of genes, drug delivery, biomimetics, quantum dots.

Reference:

1. Nanochemistry, G.A. Ozin, A.C. Arsenault, RSC

2. Nanocomposites, diwan, Bharadwaj, Pentagon
3. Nanotechnology, W. Kannangara, Smith, Chapman and hall
4. Nanomaterials, bandyopadhyay, New age international
5. Nnaomaterials, D. Vollath, Wiley-Vch

CMS E 010 Chemical and Electrochemical Energy Systems

Unit 1 *18 hrs*

Available energy options, their advantages and disadvantages. Environmental effects, comparative evaluation of energy options and energy needs. Fossil fuels: petroleum, natural gas and coal - Origin, processing and production of value added products - available current conversion technologies.

Nuclear Energy: Principles of Fission - Fission reactors, U enrichment and processing of spent fuels. Nuclear reactor kinetics and control - nuclear fusion - magnetic and other confinement - evaluation of the option of nuclear energy.

Electrochemical power sources - theoretical background on the basis of thermodynamic and kinetic considerations. Primary electrolyte cells - various types, especially magnesium and aluminium based cells - magnesium reserve batteries. Secondary electrolyte cells: classification based on electrolyte type, temperature of operation on the basis of electrodes - chemistry of the main secondary batteries - Batteries for electric vehicles - present status.

Unit 2 *18 hrs*

Fuel cells - classification - chemistry of fuel cells - detailed description of hydrogen/ oxygen fuel cells - methanol - molten carbonate, solid polymer electrolyte and biochemical fuel cells.

Solar energy conversion devices - photovoltaic cells - photoelectrochemical cells - semiconductor electrolyte junctions photocatalytic modes for fuel conversion process - photobiochemical options.

Hydrogen as a fuel production (thermal, electrolysis, photolysis and photo-electrochemical) storage and applications of hydrogen storage.

Other methods of energy conversion: processes especially in the form of storage as chemical energy.

References:

1 C. A. Vincent Modern Batteries, Edward Arnold,
2 R. Narayanan and B. Viswanathan, Chemical and Electrochemical energy systems, Orient Longmans.
3 K. Sriram, Basic Nuclear Engineering, Wiley Eastern
4 A. S. J. Appleby and F. K. Foulkes, Fuel cell Hand Book, Von Nostrand Reinhold
5 D. Linden, Hand book of batteries and Fuel cells, McGraw Hill Book Company
6 T. Ohta, Solar Hydrogen energy systems, Peragamon Press
7 M. Gratzel, Energy Resources through phtochemistry and catalysis, Academic Press
8 T. Ohta, Energy Technology, Sources, Systems and Frontiers conversions, Pergamon
9 J. G. Speight, The chemistry and technology of petroleum, Marcel Dekker Inc. (1980).

CMS C 035 **Comprehensive Viva**

A Comprehensive viva is conducted at the end of the Semester by external experts from other University/Research institutions suggested by the Head of the Department and approved by the Vice Chancellor.

Sd/-
Dr.K.R.Haridas,
Head,School of Chemical Sciences
SAT Campus, Payyannur.