G.T.N. ARTS COLLEGE (AUTONOMOUS)

Affiliated to Madurai Kamaraj University
Old Karur Road, Dindigul, Tamil Nadu - 624005

PG CHEMISTRY SYLLABUS

NON –OBE SYLLABUS (2017 TO 2019)

OBJECTIVES

- To provide mobility and flexibility for students within and outside the parent department as well as to migrate between institutions
- To provide broad-based education
- To help students learn at their own pace
- To provide students scope for acquiring extra credits
- To impart more job oriented skills to students
- To make any course multi-disciplinary in approach

1. QUALIFICATION FOR ADMISSION

Candidate for admission to the M.Sc. (Chemistry) course (Full Time) should posses a B.Sc. Chemistry/ Special Chemistry/ Applied Chemistry degree with Physics as one of the ancillaries and other any one of the ancillaries viz. Maths, Botany or Zoology with 55% of total marks.

2. DURATION OF THE COURSE

The candidates shall undergo the prescribed course of study for a period of two academic years (Four semesters)

3. MEDIUM OF INSTRUCTION

English

4. SUBJECTS OF STUDY

Core Papers

Major Electives, Non Major Elective, Project

5. EVALUATION METHOD UNDER CBCS

Programmes	Theory		Practical	
	Internal (CA)	External (SE)	Internal (CA)	External (SE)
PG	25	75	40	60

CONTINUOUS ASSESSMENT (CA)

INTERNAL ASSESSMENT

- Internal assessment is based on the continuous evaluation of performance of the students in each semester. An internal mark is awarded to each course in accordance with the following guidelines.
- Internal marks for those students (PG) who repeat the Semester (RS) for want of attendance should be marked "AA" in the foil card.
- There is no minimum passing for internal marks.
- No Internal improvement is allowed
- Special Internal Assessment tests may be permitted on genuine reasons with the approval of the HOD, Dean & Principal before the summative examinations.

POSTGRADUATE:

1. Two internal tests are conducted and worked out for a maximum of 15 marks
2. Average of the two tests is taken for the Final Internal Assessment marks.

Allotment of Internal Marks

THEORY		PRACTICAL	
Average of two tests	15	Average of two tests	25
Average of two Seminar / Quiz	5	Record Work	10
Average of two Assignments	5	Seminar / Quiz / Viva	5
Internal Maximum	25	Internal Maximum	40

SUMMATIVE EXAMINATIONS (SE)

1. Summative Semester Examinations for PG is conducted in November and April for the odd and even semesters respectively.
2. Non-semester pattern is followed for all Certificate / Diploma Courses.
3. Question paper setting along with the scheme of valuation is purely external for PG.
4. Panels of Question Setters and External examiners approved by the Board of Studies of the Departments are made available for the use of the office of the COE
5. Practical Examinations will be conducted by the External examiner and the course teacher, who will act as the Internal Examiner. In the absence of course teacher, HOD will act as the Internal Examiner.
6. The marks scored by the candidates in Add-On course final examinations will be worked out for 100.

EXTERNAL

POST GRADUATE

External Maximum - 75

Passing Minimum - 34

COMMON QUESTION PATTERN FOR THEORY PAPER – PG

(With effective from 2017 onwards)

Blue print for External

Max. Marks: 75 **Duration: 3 Hrs**

SECTION – A

1. **Answer All Questions (No Choice)** **10 x 1 = 10 Marks**

   Choose the Correct answer (Objective type)

   (Two Questions from each unit)

SECTION – B

2. **Answer All Questions (either/or pattern)** **5 x 7 = 35 Marks**

(One set from each unit)

SECTION – C

3. **Answer any Three questions out of five questions** **3 x10 = 30 Marks**

(One Question from each unit)

INTERNAL

POST GRADUATE

Internal Maximum - 25

COMMON QUESTION PATTERN FOR THEORY PAPER - PG

(With effective from 2017 onwards)

Blue print for Internal

Max. Marks: 50 **Duration: 2 Hrs**

SECTION – A

1. **Answer All Questions (Multiple Choice)** **9 x 1 = 9 Marks**

   Choose the Correct answer (Objective type)

SECTION – B

2. **Answer any Three questions out of Five questions** **3 x 7 = 21 Marks**

SECTION – C

3. **Answer any Two questions out of Four questions** **2 x10 = 20 Marks**

6. ELIGIBILITY FOR THE DEGREE

i. The candidate will not be eligible for degree without completing the prescribed courses of study, lab work etc., and passing all the prescribed External examinations.

ii. Attendance, progress and conduct certificate from the Head of the Institution will be required for the students to write the examination.

The passing minimum is 50% (50% out of External Marks).

Subject	No. of Papers	Hours	Credits	Marks
Core	**16**	**80**	**71**	**1600**
Major Elective	**3**	**15**	**15**	**300**
Non Major Electives	**1**	**5**	**4**	**100**
Total	**20**	**100**	**90**	**2000**

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Choice Based Credit System for **M.Sc CHEMISTRY.**

SCHEME OF EXAMINATION

(For those who joined in June 2017 and after)

FIRST SEMESTER

Part	Study Chemistry	Course Code	Course Title	Hrs per cycle	Credit	Internal Marks	External Marks	Total Marks
I	Core	17PCHC11	Introduction to Organic Reactions	5	5	25	75	100
I	Core	17PCHC12	Structure and Bonding	5	4	25	75	100
I	Core	17PCHC13	Thermodynamics, Chemical Equilibrium and Electrochemistry	5	4	25	75	100
I	Major Elective	17PCHE11/ 17PCHE12	1.Medicinal and pharmaceutical Chemistry 2.Biochemistry	5	5	25	75	100
I	Core-Practical	17PCHC1P	Inorganic Qualitative, quantitative analysis and Preparations	10	5	40	60	100
			TOTAL	30	23			

SECOND SEMESTER

Part	Study Chemistry	Course Code	Course Title	Hrs per cycle	Credit	Internal Marks	External Marks	Total Marks
I	Core	17PCHC21	Stereochemistry and Organic Reactions	5	4	25	75	100
I	Core	17PCHC22	Coordination and Organometallic Chemistry	5	5	25	75	100
I	Core	17PCHC23	Group Theory and Spectroscopy	5	4	25	75	100
I	Major Elective	17PCHE21/ 17PCHE22	1. Analytical Chemistry 2. Industrial Chemistry	5	5	25	75	100
I	Core-Practical	17PCHC2P	Organic Qualitative, Quantitative Analysis and preparations	10	5	40	60	100
			TOTAL	30	23			

THIRD SEMESTER

Part	Study Chemistry	Course Code	Course Title	Hrs per cycle	Credit	Internal Marks	External Marks	Total Marks
I	Core	17PCHC31	Organic Spectroscopy and Natural Products	5	4	25	75	100
I	Core	17PCHC32	Inorganic Spectroscopy And Coordinated Ligands	5	4	25	75	100
I	Core	17PCHC33	Quantum, Nano and Macromolecular Chemistry	5	5	25	75	100
I	Non Major Elective	17PCHN31 / 17PCHN32	1. Environmental Science 2. Environmental Chemistry And Toxicology	5	4	25	75	100
I	Core-Practical	17PCHC3P	Conductometric, Potentiometric Titrations and Adsorption	10	5	40	60	100
			TOTAL	30	22			

FOURTH SEMESTER

Part	Study Chemistry	Course Code	Course Title	Hrs per cycle	Credit	Internal Marks	External Marks	Total Marks
I	Core	17PCHC41	Biomolecules, Rearrangements and Synthetic methods	5	4	25	75	100
I	Core	17PCHC42	Nuclear and Analytical Chemistry	5	4	25	75	100
I	Core	17PCHC43	Chemical Kinetics, Surface, Biophysical and Photochemistry	5	4	25	75	100
I	Major Elective	17PCHE41/ 17PCHE42	1.Introduction to Nanoscience 2.Green Chemistry	5	5	25	75	100
I	Core-Practical	17PCHC4P	Project/ Review of Recent aspects of Chemistry Project Viva-voce	10	5	40	60	100
			TOTAL	30	22			

G.T.N. ARTS COLLEGE (Autonomous), DINDIGUL

SYLLABUS FOR M.Sc., (Chemistry) UNDER CBCS

(With effect from the academic year 2017 onwards)

Course Title: Introduction to Organic reactions Semester: 1

Course Code: 17PCHC11 Part: III Contact Hours /Week: 5 Credit : 5

Objectives

To Study the concepts of Reaction Mechanism**,** Aliphatic Nucleophilic substitution, and also Stereo Chemistry, Symmetry of elements, Geometrical Isomerism, Aromatic Characters, Novel ring to know about Oxidation and Reduction.

Unit 1 Electron displacement 18 Hours

Inductive and field effects – bond distances – bond energies- delocalized bonds – cross conjugation – rules of resonance – resonance energy – resonance effect – steric inhibition of resonance – Hyper conjugation hydrogen bonding addition compounds EDA complexes – inclusion compounds – effect of structure on the dissociation constants of acids and bases – concept of Hard and Soft acids and bases.

Introduction to reaction mechanisms

Reaction intermediates – free radicals, carbenes, nitrenes, carbanions and carbocation‘s – formation and stability of reaction intermediates – methods of determination of reaction mechanism – kinetic and thermodynamic control of chemical reactions. Principle of microscopic reversibly – Energy profile diagram – Hammond postulate.

Unit 2 Aliphatic Nucleophilic Substitution 18 Hours

Nucleophilicity and basicity – SN1 and SN2 mechanisms – effect of substrate structure – effect of the attacking nucleophiles – effect of the leaving group – effect of the reaction medium – ambident nucleophiles ambident substrates – neighboring group participation of n ,π, and σ electrons – s_ni mechanism –nucleophilic substitution at an allylic carbon – nucleophilic substitution at a vinyl carbon.

Aliphatic electrophilic substitution: Electrophilic substitution at saturated carbon – S_E1, S_E2, and s_ei mechanisms.

Unit 3 Stereochemistry 18 Hours

Symmetry elements and point group classification Concept of chirality, necessary and sufficient conditions for chirality – Relationship between substrate symmetry and chirality. Projection formulae Wedge, Fischer, Sawhorse and Newmann. Optical isomerism due to centre of chirality. Erythro and threo nomenclature. Configuration – determination of configuration. Cahn Ingold and Prelog system of designation of configuration.

Geometrical Isomerism

E-Z nomenclature – determination of configuration of geometrical isomers using physical and chemical methods – stereoisomerism in monocyclic compounds [up to six membered ring].

Unit 4 Aromatic Character **18 Hours**

Aromatic character in benzene, six membered rings, five, seven, eight membered rings-other systems with aromatic sextets – Huckel's rule. Craig's rule - concept of homo aromaticity and anti-aromaticity - systems with 2, 4,8 and 10 electrons - system with more than 10 electron – Alternant and non-alternant hydrocarbons. Chemistry of cyclopentedienyl anion – Fulvene, Azulene and Annulens.

Novel Ring System

Nomenclature of bicyclic and tricyclic systems – chemistry of adamantine, diamantine [congressane], cubane and catenanes.

Unit 5 Oxidation And Reduction **18 Hours**

Elimination of hydrogen and aromatization reactions catalytic dehydrogenation – mechanism, applications and stereochemical aspects of the following oxidation – reduction reactions: Oxidation reaction involving cro3, seo2, oso4, lead tetra acetate – Oppenaver oxidation.

Catalytic Hydrogenation

Reactions involving lithium aluminium hydride tri isobutyl alumino hydride, DIBAL and sodium borohydride – Birch reduction – Meerwein
Pondorf - Verely reduction – Wolff-Kishner reduction – Huang – Minlon modification-hydroboration – selectivity in oxidation and reduction.

Reagents In Organic Synthesis

Gilman's reagent [lithium dimethylcuprate], lithium diisopropylamide [LDA], dicyclohexylcarbodiimide, Woodward and Prevost hydroxylation, DDQ, Merrified resin phase transfer catalysts, Peterson's synthesis, Baker yeast.

Text Book

1 .Jain.M.K and Sharma.S.C, (2017).*"Modern Organic Chemistry"*, Vishal Publishing Co, JALANDHAR - 144 008 (PB.) INDIA. Golden Jubilee Yr. Revised Edition.

Reference Books

1. Nasipuri D, (2012), "*Stereochemistry of Organic Compounds - Principles and Applications"*, New Academic Science Limited. 4th Edition.
2. March J, Smith M.B, (2007), "*Advanced Organic Chemistry: Reactions, Mechanisms and Structure*", Wiley, New York. 6th Edition.
3. Clayden J, N. Greeves, S. Warren, (2012), "*Organic Chemistry"*, Oxford University Press; 2nd Edition
4. Morrison R.T, Boyd R.N, (2001), "*Organic chemistry"*, Prentice-Hall. 6th Edition.
5. Finar I.L (2013) "*Organic Chemistry, Volume-II"*, Pearson Education. 5th Edition.

Course Title: Structure and Bonding Semester: 1

Course Code: 17PCHC12 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To study the nature of chemical bonding, bond properties and also properties of solid state. To understand the concept of inorganic chains, rings, and also solid state structure.

Unit 1 Nature of Chemical Bonds 18 Hours

Covalent bond: Hybridisation-Calculation of s and p characters- Bent‘s rule M.O theory; LCAO approximation-application of MOT to heteronuclear diatom molecules like H2O- Concept of multi centered bond as applied electron deficient molecules like diborane and metal alkyls –VSEPR theory-Walst diagram.

Unit 2 Bond Properties And Ionic Bonding 18 Hours

Ionic radii-covalent radii-van der Waals radius-bond length, bond order, bond polarity-partial ionic character of covalent bonds-electro negativity electron affinity-lattice energy- Born Haber cycle - Covalent character in Iron compounds - Different types of electrostatic interactions – Hydrogen bond.

Unit 3 Solid State Chemistry 18 Hours

Crystal defects point, Non stoichiometry on physical properties- Electronic structure of solids electron and band theories- Types of solids- Electrical Conductivity superconductivity-High temperature superconductors Types of semiconductor-Thermo electric power and Hall effect – Photovoltaic effect Semiconductors in solid energy Conversion.

Unit 4 Inorganic Chains – Rings And Cages 18 Hours

Silicates: Various silicate structures – Structure, property, correlation – Silicones. Poly acids: Classification – isopoly acids like polymolybdate, polyvanadate and polytungstate – their structures – heteropolyacids: 12A, 12B, 9 and 6. Heteropolyacids-preparation andstructures.

Phosphazenes and its polymer – Phosphonitrilic comounds- S_4N_4 - Polymeric sulphur nitride (polythiazyl) Cage compounds: Nomenclature of Boranes and carboranes – Wade‘s rule – preparation and structures of $B_4 H_{10}$, borazine and bonding and bonding.

Unit 5 The Chemistry Of Solid State I 18 Hours

Structure of Solids; Comparison of X-ray and Neutron Diffraction; structure of Pyrovoskite, cadmium iodide and nickel arsenide; spinels; defects in solids, non stoichometeric compounds. Solid state lasers, inorganic phosphors, Ferrites. Reactions solid state and phase transitions, Diffusion, Diffusion coefficient Diffusion mechanisms, Vacancy and Interstitial Diffusion, Formation of spinels.

Text Book

1. Puri B.R, Sharma L.R, and Pathania M.S, (2003), "*Advanced inorganic chemistry*"- Vishal Publishing Co. JALANDHAR - 144 008 (PB.) INDIA

Reference Books

1. Cottonand F.A, Wilkinson G, John Wiley & Sons, (1998), "Advanced Inorganic Chemistry", Singapore. 5th edition.
2. Mackay K.M, and Mackay R.A, (1989), "*Introduction to Modern "Inorganic Chemistry"*, Prentice Hall, New Jersy. 4th edition
3. James E. Huheey, Ellen A. Keitler and Richard L. Keitler, (1993), "*Inorganic Chemistry*", Harper Collins College Publishers, New York. 4th edition

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Course Title: Thermodynamics, Chemical equilibrium and Electrochemistry Semester: 1
Course Code: 17PCHC13 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To learn the concepts of thermodynamics, phase equilibria, and electrochemistry.

Unit 1 Chemical Thermodynamics 18 Hours

Second law of thermodynamics – concept of entropy- Gibbs – Helmholtz equation – Maxwell relations – Thermodynamic equation of state – Thermodynamics of system of variable composition – Partial molar quantities , partial molar volume – Chemical potential, Gibbs – Duhem equation – Experimental determinations of fugasity of real gases and its determination – Third law of thermodynamics – Absolute entropies – Determination of absolute entropies – Exception to third law – Unattainability of absolutezero.

Unit 2 Chemical And Phase Equilibria 18 Hours

Reaction free energy / Reaction potential – Reaction isotherm and direction of spontaneity – Standard reaction free energy – its calculation from thermochemical, electrochemical and equilibrium data – Temperature coefficient of reaction free energy and equilibriumconstant.

Gibbs phase rule – its thermodynamic derivation – Application of phase rule to three – compounds systems – Formations of one pair, two pairs and three pairs of partially miscible liquids – Systems composed of two solids and a liquid.

Unit 3 Statistical Thermodynamics 18 Hours

Aim of statistical thermodynamics – define of state of a system – ensembles (micro , macro and grand canonical)- Boltzmann distribution law and its derivation – Boltzmann – Planck equation – partition function thermodynamic properties from partition functions – partition function and equilibrium constant – Quantum statistics – Fermi – Dirac and Bose – Einstein statistics – photon gas electron gas according to such statistics – population invertion –Einstein‘s and Determination theories of heat capacities of solids. Nuclear spin statistics basis of entropy H_2 at 0K in temperature of ortho-pararatio.

Unit 4 Electro Chemistry I 18 Hours

Theroy of electrolytic conductance – inter – ionic attraction – ionic atmosphere – thickness of ionic atmosphere - The Debye –Huckel – Onsager conductance equation – its derivation and experimental verification – deviations modifications – Debye Falkenhagan and Wein effects – means ionic activity and active coefficients of strong electrolytes.

The role of electrodes – the electrochemical potential- Types of electrodes – gas/ inert metal electrode – ion / insoluble salt / metal electrode – oxidation – reduction electrode – liquid junction potential and membrane potential – Electro chemical cells - Nernst equation – Application of EMF measurements – determination of equilibrium constant, dissociation constant solubility product and potentiometric titrations.

Unit 5 Electrochemistry II **18 Hours**

The electrical double layer and Zeta potential- Perrin, G – Chapmen and Stern models – polarisable and non – polarisable interfaces – electrokin phenomena – dynamic electrochemistry– electrode processes and non equilibrium electron potential – over potential – Butler Volmer equation – Tafel equation – Current – potentio curves – hydrogen over voltage.

Application of electrochemical processes – power generation and storage Fuel cells – storage batteries and dry cells – principles of inhibition of corrosion - voltammetry – photo electerochemistry and electro chemilumunescence.

Text Book

1. Puri B.R, Sharma L.R and Pathania M.S (2003), "*Principles of Physical Chemistry"* (Millennium edition) Vishal Publishing Co.,

Reference Books

1. Glasston S (2007), "*Thermodynamics for Chemists"*, East – West Press Private Ltd., New Delhi.
2. Rajaram J and Kuriakose J.C (1999), "*Thermodynamics"* Shoban Lal Nagin, Chand & Co., Ltd., New Delhi. 3rd Edition.
3. Gurdeep Raj, (2001*), "Advanced Physical Chemistry"*, Goel Publishing Co. 25th Edition

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Course Title: Medicinal and Pharmaceutical Chemistry Semester: 1
Course Code: 17PCHE11 Part: III Contact Hours /Week: 5 Credit : 5

Objectives

To study the Fundamentals of Medicinal Chemistry, synthesis and uses of antibiotics , steroids chemotherapeutic agents and to understand the therapeutic action of SAR Drugs ,CNS stimulant and CNS Depressant Drugs .

Unit 1 Fundamental of Medicinal Chemistry 18 Hours

Definitions of Medicinal Chemistry, Pharmacology and molecular pharmacology – major process involved in drug action – pharmacokinetics phase – Quantitative structure Activity Relationship (QSAR) – Hansch approach – concept of bio isomerism – pharmacodynamics phase – receptors and classification of membrane bound receptors – enzyme inhibitors as drugs (illustrated with oneexample).

Unit 2 Medicinally Useful Antibiotics And Steroids 18 Hours

Structural features and mode of action of the following antibiotics – penicillin G, cephalosphorin and their semisynthetic analogsw (β-lactum), streptomycin (aminoglycoside), terramycine (tetracylin) , erythromycin (macrolide) and chloromphenicol

Physiologically active steroids – their structural features and therapeutic use. Oral contraceptive, anabolic steroids anti – inflammatory steroids.

Unit 3 Chemotherapeutic Agents18 Hours 18 Hours

Antineoplastic agents Classification, synthesis, Assay e.g., Cyclophosphamide, Ifosfamide, Chlorambucil, Busulfan, Decarbazine, Methotrexate, Azathioprine, 6-Mercaptopurine. 5- Fluorouracil, Cisplatin. Carnplatin;

Antitubercular Drugs

Classification, Synthesis, Assay e.g., Isoniazid, Rifampicin, Pyrazinamine, Ethambutol, Thiacetazone, Paraanmino salicylic acid and Ethionamide.

Antimalarial Drugs

Classification,synthesis assay e.g., Chloroquin, Primaguine, Amaodiaquine, Mefloquine, Progunanil Pyrimethamine,

Diuretics

Classification synthesis assay e.g., Furesemide Acetazolamide, Chlorothiazide.

Unit 4 Synthesis And Therapeutic Action And Sar of Certain Drugs 18 Hours

Antihypertensive Drugs

Nifedipine Captopril Hydralazine sodium nitropruside, clonidine methyldopa and guanothidine.

Antihistamines

H1 – Antagonists pheniramine, chlorpheniramine, Diphenylhydramine Mepyramine promethazine, H2 – Antagonists Cimetidine, Ranitidine and Formotidine.

Unit 5 Anti – Inflammatory Drugs **18 Hours**

Antipyrefics & Non- narcotic analgestics : Aspirin, Sodium salicylate, paracetamol, phenylbuttazone, oxyphenlibutaxone, Ibuprofen, Mephenamic acid, Diclofenacsodium.

CNS Stimulant Drugs

Amphetamine, Caffeine, Theobromine, Theophyllino, Bemegride , Nikethamide, Methyl phenidate and peracetum.

CNS Depresent Drugs

Phenelazine, Isocarboxazide, Imipramine, Nortiptyline, Amitriptyline, Desipramine.

Text Book

1. Nagradi.T (2004*), Medicinal Chemistry – A Biochemical Approach*, Oxford University Press.

Reference Books

1. Patrick G.L (2001), "*An introduction to Medicinal Chemistry"* Oxford University Press. 2nd Edition.
2. Taylor J.B and Kennewell P.D. (1985*)," Introductory Medicinal Chemistry"* Ellisworth Publishers.
3. Jyotsana Chaturvedi (2016), *Medicinal Chemistry*, Vishal publishing co.

Course Title: Bio Chemistry Semester: 1
Course Code: 17PCHE12 Part: III Contact Hours /Week: 5 Credit : 5

Objectives

To study the enzymes and enzymes inhibition, concepts of genetic information storage of metabolic energy, bio – inorganic chemistry, bio-physical aspects, storage of Metabolic energy, and also genetic information**.**

Unit 1 Enzymes 18 Hours

Classification , nomenclature properties of enzymes some feature of active sites of enzymes, enzymes kinetics- Michaelis – Menton model – significance of KM and VMax values. Enzymes inhibition – Competitive and non-competitive. Allosteric interaction- Mechanism of enzyme action. Lysozyme and carboxypeptidase.

Unit 2 Generation And Storage of Metabolic Energy 18 Hours

Metabolism – basic concepts and design: Glycolysis – citric acid cycle – oxidative phosphoryiation – pentose pathway and gluoneogenesis.

Glycogen and disaccharide metabolism, fatty acid metabolism – amino acid degration and urea cycle – photosynthesis.

Unit 3 Storage Transmission Expression of Genetic Information 18 Hours

DNA – Genetic role structure and replication; messenger RNA and transcription genetic code and gene protein relationship – protein synthesis control of gene expression – Eucaryotic chromosomes, Recombinant DNA technology and viruses.

Unit 4 Bio – Inorganic Chemistry 18 Hours

Metalloproteins and enzymes – Blue copper proteins – copper proteins as oxidases/ reductases – Nickel containing enzymes – structure of DNA- types of nucleic acid interactions – coordination – intercalation and hydrogen bonding- ineractions of metal ions with nucleic acids – redox chemistry , hydrolytic chemistry – monitoring the DNA binding by UV , IR, NMR and CV spectraltechniques.

Unit 5 Biophysical Aspects 18 Hours

Electron transport and oxidative phosphorylation – Thermodynamic and kinetic aspects – Photosynthesis – An overview – Photosystem II – The light harvesting chlorophyll-protein complexes of photo system II Role of carotenoids in photo synthesis – The primary electron donor of photo system II, P680- The stable primary electron acceptor QA and the secondary electron acceptor QB – The transient intermediate electron acceptor of photo system II, pheophytin – Oxygen evolution – The role of manganese – The electron donor to $P680^{+}$ - Charge recombination in photo system II- Photosystem I Light – harvesting chlorophyll protein complexes of photo system I- The primary electron donor of photo system I, P700 - The primary electron acceptor A0 of photo system I The intermediate electron acceptor A1 of photo system I – Mobile electron carriers plastocyanin and ferredoxin and $NADP^{+}$-reductase.

Text Book

1. Bertini I, Gray H.B., Leppard S.J and Valentine J.S (1998), *"Bioinorganic Chemistry"* Viva Books Pvt., Ltd.,

Reference Books

1. Hames B.D and Hooper N.M (2003), "*Biochemistry"* Viva Books Pvt., Ltd.,
2. M.Berg J, Tymoczko J.L and Stryer L (2002), "*Biochemistry"* Freeman W.H and Company, New York. 5th edition.

Course Title: Inorganic Qualitative and Quantitative Analysis and Preparations Semester: 1
Course Code: 17PCHC1P Part: III Contact Hours /Week: 10 Credit : 5

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1. Qualitative Analysis

Semi-Micro Qualitative Analysis: Analysis of mixtures containing one Familiar and one less familiar cations from following.
W, Pb, Se, Mo, Cu, Bi, Ni, Co, Zn, Ca, Ba, Sr, Li, and Mg

2. Estimation

Estimation of one metal in the presence of another by EDTA (Demonstration).Quantitative analysis: Separation and estimation of Mixture by volumetric and gravimetric methods.
Cu, Ni; Cu, Zn; Ba, Ca.

3. Inorganic Preparation

Preparation of at least 5 Inorganic complexes.

Course Title: Stereochemistry and Organic Reactions Semester: 2
Course Code: 17PCHC21 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To understand the mechanism of nucleophilic, electrophilic substitution reaction, concepts of Terpenes, Vitamins, and also conformational analysis, study of Aromatic electrophilic substitution.

Unit 1 Streochemisty-II **18 Hours**

Prochirality and, prosteroisomerism, enantiotopic and diasterotopic ligands and faces and their nomenclature pro –R and pro-S Re and Si faces. Stereospecific and stereoselective reaction. Asymmetric synthesis Cram and Prolog rules. Optical isomers due axial chriality – biphenyls allenes and spiranes. Molecules with planar chirality – paracyclophanes, Trans cyclooctene, ansacompounds.

Unit 2 Conformational Analysis **18 Hours**

Configurations and conformations – conformations of ethane and n- butane-conformation analysis – stereoelectronic and steric factors- conformation of simple acyclic compounds-conformation of monosubstituted and disubstituted cyclohexanes-conformational free energy – Curtin Hammett principle Quantitative treatment of mobile system– Eliel –Ro equation – conformations and reactivity of cyclohexamones-conformational analysis of aldohexopyranoses.

Unit 3 Addition To Multiple Bonds **18 Hours**

Electrophilic, nucleophilic and free radical addition to conjugated systems – orientation of the addendum – stereochemical factors in reactions like addition of hydrogen, halogens halides and hypohalous acids, hydroboration and hydroxylation – epoxidation.Addition to carbonyl groups – mechanism –Aldol condensation – Perkin reaction –Knoevenagel reaction – Mannion reaction – Cannizaro reaction – Benzoin condensation –Reformatsky reaction – Witting reaction – Grignard reactions.Addition to α,β-unsaturated carbonyl groups – addition of Grignard reagent to α,β-unsaturated carbonyl compounds – Michael addition – Diels –Alder reaction – addition to carbenes and carbeniods to double and triple bonds.

Elimination

A-elimination –β-elimination –E1,E2 and E1cB mechanisms – stereochemistry of elimination – orientation of the double bond – effect of changes in the substrate, base, leaving group and medium on E1,E2 and E1cB reactions – elimination vs substitution – pyrolytic cis elimination – Bredt‘s rule.

Unit 4 Terpenes **18 Hours**

Classification of terpenoids structure stereochemistry and synthesis of α- pinene, camphor, zingiberene, cadinene , α-santinin, abietic acid and squalene.

Vitamins

Structure and synthesis of Vitamins A, B1, B2, B6, B12 [structural features only], C, E, H and K.

Unit 5 - Aromatic Electrophilic substitution **18 Hours**

Aromatic electrophilic substitution- orientation –reactivity – mechanism of nitration,

halogenations , Friedel-Craft‘s reaction and sulphonation – partial rate factors ortho/para ratio – Quantitative treatment of reactivity of the electrophile [the selective relationship] – Aromatic nucleophilic substitution reactions- SnAr, Sn1and benzynemechanisms.

Quantitative treatment of the effect of structure on reactivity – The Hammen relationship – siginficance of reaction and substitutents constants – application of the Hammett equation in reaction mechanism – limitations and deviations.

Text Book

1. Jain M.K, Sharma S.C, (2017), *“Modern Organic Chemistry”*, Vishal Publishing Co, JALANDHAR - 144 008 (PB.) INDIA. Golden Jubilee Yr. Revised Edition.

Reference Books

1. Nasipuri D, (2012), “*Stereochemistry of Organic Compounds - Principles and Applications”*, New Academic Science Limited. 4th Edition.
2. J.March, M.B. Smith, (2007), “*Advanced Organic Chemistry: Reactions, Mechanisms and Structure*”, Wiley, New York. 6th Edition.
3. J. Clayden, N. Greeves, S. Warren, (2012), “*Organic Chemistry”*, Oxford University Press; 2nd Edition.
4. Morrison R.T, Boyd R.N (2001), “*Organic chemistry”*, Prentice-Hall. 6th Edition.
5. Finar I.L, (2013), “*Organic Chemistry, Volume-II”*, Pearson Education. 5th Edition.

Course Title: Coordination and Organometallic Chemistry Semester: 2
Course Code: 17PCHC22 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To study the concept of coordination Chemistry, stability of the complexes, stereochemistry of complexes, Bio-inorganic chemistry, use of Inorganic Compounds in Biological chemistry, and also organo metallic compounds with applications.

Unit 1 Coordination Compounds 18 Hours

IUPAC Nomenclature of coordination compounds – isomerism in coordination compounds- Types of ligands – monodendate, ambidentate and macro cyclic ligands- Stability constsnt- Factors aftecting stability constant in solution- Determination of stability constant spectrophotometry, polarographic and potentiometric methods.Theories of Bonding – VB – CFT – MO theories – Splittion of d-orbitals in Oh, Td, square planar and trigonal bipyramidal geometries. Factors affection crystal field splitting – Spectrochemcal series Magnetic moments – quenching of orbital magnetic – moments.

Unit 2 Reaction Mechanism of Coordination Compounds 18 Hours

Substitution reaction octahedral complexes – labile - inert complexes – mechanism of acid hydrolysis, hydrolysis and anation reactions. Substitution reactions of square planner complexes-. Factors affecting reactivity of square planar complexes – The trans – effect its applications – Electron transfer reactions - complementary and complementary reactions – outer sphere and inner sphere electron trans – mechanisms – Synthesis of coordination compounds using electron transfer substitution reactions.

Unit 3 Bio – Inorganic Chemistry – I 18 Hours

Porphyrin ring system – metalloporphyrins – hemoglobin andmyoglobin-structures and work functions – synthetic oxygen carriers – cytochromes – structure and work functions in respiration chlorophyll – structure – photosynthetic sequence – Iron – sulphur proteins (non – heme iron protein) – Copper containing proteins– blue copper proteins – structure of blue copper electron transferases - copper proteins as oxidases – cytochrome C oxidase – mechanistic studies of C oxidase – Hemocyanin. sodium and potassium ions pumps – chelate therapycis-platin.

Unit 4 Complexes Of Π Acceptor Ligands 18 Hours

Synthesis, structure and bonding in carbonyls nitrosyls, dioxygen complexes and dinitrogen complexes. Synthesis, properties, structure and bonding in Ferrocene, Arene and acetylene and allyl complexes, Alkane, alkyne complexes, carbyne and alkylidyne complexes.

Unit 5 Catalysis Using Organometallic Compounds 18 Hours

Oxidative addition – reduction elimination – insertion reaction – Catalytic mechanism in the following reaction – hydrogenation of olefins (Wilkinson catalyst) – Tolman catalytic low hydroformylation oxo process acetic acid from ethanol – oxidation of alkenes to aldo and ketones (wacker process) – catalysis in the formation of synthesis of gas – polymerization (Ziegler – Natta) – Cyclo oligomerisation of acetylenes (Reppe wilke‘s catalysts) – olefin isomerisation using Ni catalyst.

Text Book

1. Puri.B.R, Sharma.L.R, and Pathania.M.S, (2003), "*Advanced inorganic Chemistry"* - Vishal Publishing Co.

Reference Books

1. James E.Huheey, Ellen A.Keitler and Richard L.Keitler, (1997), 4th edition *"Inorganic Chemistry"*, Harper Collins College Publishers, New York.
2. Addison.W.E, Wiley (1961), "*Structural Principles of Inorganic Chemistry"*.
3. Wells.A.F, (1975*), "Structural Inorganic chemistry"*, 4th edition, Oxford, NewYork
4. Kettle.S.F.A, (1996), "*Coordination Chemistry – An Approach"*, Spectrum Academic Publish Oxford.

Course Title: Group Theory and Spectroscopy Semester: 2
Course Code: 17PCHC23 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To study the elements of group theory, applications of group theory, types of molecular spectroscopy, principles and applications NQR, Raman spectroscopy, spin resonance spectroscopy.

Unit 1 Group Theory **18 Hours**

Molecular symmetry elements and symmetry operations – vector and matrix algebra – symmetry operations and transformation matrices – Group – definition and properties of a group– symmetry point groups- representation of a group – reducible and irreducible representations-Great orthogonality theorem- characters – construction of character tables- C2v, C3v, C4v, C2h and D2d – Direct product concept.

Unit 2 Application Of Group Theory To Spectroscopy And Molecular Problems **18 Hours**

Symmetry of normal modes of vibration, application of group theory to normal modes of vibrations and to normal ,mode analysis – symmetry properties of integrals – application for spectral selection rules of vibration spectra – IR and Raman active fundamentals. Symmetry of molecular orbital and symmetry selection rule for electronic transitions in simple molecules like ethylene, formaldehyde and benzene. Group theory and quantum, mechanics – Wave functions as the basis of irreducible and delocalization energy for cyclopropenyl, butadiene and benzenesystem.

Unit 3 Molecular Spectroscopy I **18 Hours**

Electromagnetic spectrum – Types of molecular energies – Absorption and emission of radiation – Einstein‘s coefficient – induces emission and absorption – Rotational spectra of rigid diatomic molecules – isotope effect in rotational spectra – Microwave spectrometer – Informations derives from rotational spectra.Infrared spectroscopy – vibrational energy of a diatomic molecule – infrared selection rules – diatomic vibration rotator – vibrations of polyatomic molecules – overtone, combination and difference bands – concept of group frequencies – coupling interaction- Fermi resonance Fourier transform infrared spectroscopy.

Unit 4 Molecular Spectroscopy II **18 Hours**

Raman spectroscopy – Theories of Raman scattering – Rotational Raman spectra – Vibrational Raman spectra. Mutual exclusion principle – Laser Raman spectra – Electronic spectra of diatomic and polyatomic molecules- intensity of vibrational electronic spectra – Franck– Condon principle rotation fine structure of electronic vibrational spectra- the Fortrat prapbola – Dissociation and predissociation spectra.NQR – principles and applications – quadrupole moment and electrical field nuclear quadrupole resonace , nuclear quadrupole coupling in atoms and molecules – identification of ionic character and hybridization.

Unit 5 Spin Resonance Spectroscopy **18 Hours**

Magnetic properties of nuclei – Resonance condition – NMR instrumentation – Relaxation processes – Bloch equations – chemical shift – spin – spin splitting , relaxation

times , line shape and line width experimental technique- ENDOR, Overhauser effect , FT-NMR spectroscopy , Lanthanide shift reagents – NMR imaging.ESR – principles of ESR – total Hamiltonian – hyperfine structure – ESR spectra of free radicals in solutions – Anisotropic systems – systems in triplet state Zero field splitting in ESR and Krammers degeneracy.

Text Book

1. Puri B.R, Sharma L.R and Pathania M.S (2003) "*Principles of Physical Chemistry"* (Millennium edition,) Vishal Publishing Co.,

Reference Books

1. Ramakrishnan .V and Gopinath (1991), "*Group Theory in Chemistry"* Vishal Publication, 2nd Edition.
2. Aruldhas .G (2001), –"*Molecular Structure and Spectroscopy"*, Prentice Hall of India Pvt., Ltd New Delhi.
3. Gopinathan M.S and Ramakrishnan V (2013), "*Group Theory Applications to Quantum Chemistry, Spectroscopy & Ligand Field Theory"*

Course Title: Analytical Chemistry Semester: 2
Course Code: 17PCHE21 Part: III Contact Hours /Week: 5 Credit : 5

Objectives

To learn the concepts of precipitation techniques, error analysis, methods and uses of electro analytical, thermo analytical and spectro analytical chemistry.

Unit 1 Precipitation Techniques 18 Hours

Introduction – Properties of precipitates and precipitating reagents – Colloidal precipitates Co-precipitation – Post – precipitation- precipitates from homogeneous solution – surface adsorption – Drying and ignition of precipitates-
Application of gravimetric methods.

Unit 2 Error Analysis 18 Hours

Error analysis Classification of errors – accuracy and precision – minimization of errors significant figures – significant figures in computation – statistical treatment of data; mean median , standard deviations variance relative standard deviation – spread , errors – standard deviation of computed results- reliability of results – Q test, Tn test – Confidence lime comparison of results – Student‘s t-test – F test comparsion of the means of two samples – correlation and regression; linear regression (least square analysis)

Unit 3 Electro Analytical Methods 18 Hours

Electro analytical Techniques: Electro gravimetry Theory of electrogravimetric analysis electro analytical separation and determination of metal ions. Coulormetry Electrolytic cell-working electrodes – auxiliary electrode and reference electrode coulometric titrations. Voltammetry: Cyclic voltammetry-stripping voltammetry chrono potentiometry, Amperometry; Amperometric titrations.

Unit 4 Thermo Analytical Methods 18 Hours

Thermal analysis: Theory and principles of DTA and TGA – factors affecting the position of DT and TG traces – applications of DTA and TGA to the thermal behavior of the following compounds – crystalline copper sulphate calcium oxalate monohydrate calcium acetate mono hydrate , ammonium nitrate, potassium chlorate with and without catalyst, ammonium Metavanadate zinc hexafluosilicates- complementary nature of DTA and TGA – principle and application of DSC – determination of degree of conversion of high alumina cement – purity determination – phase transition study – in forensic laboratory.

Unit 5 Spectro Analytical Methods 18 Hours

Colorimetry: Beer and Lambert‘s law – terminology – condition for a satisfactory colorimetric analysis – methods of colour measurement of comparison – principles of colorimetric determination of NH3, Cr ,Cu, Fe, Mn- simultaneous spectro photometric determination of Cr and Mn.Nephelometry and turbidimetry: Pinciple – determination of sulphate and phosphate fluorimetry: principle – application of fluorimetry in the determination of Cd, Ca and Zn and determination of codeine and morphine in a mixture, flame spectrometry: theory – interference – AAS – applications in the determination of

Mg^{+2} and Ca^{+2} in tap water V in lubricating oil, trace lead in a Ferrous alloy and trace elements in contaminated soil.

Text Book

1. Willard H.H, Merritt L.L, and Dean J.A, (1988), "*Instrumental Methods of Analysis of East"* – West Press, New Delhi.

Reference Books

1. Skoog D.A, West D.M and Hollar F.J (1996*), "Fundamentals of Analytical Chemistry"* Harcourt College Publishers. 7th Edition.
2. Basset .J et al., Vogel's (1989) Text book of "*Qualitative Inorganic Analysis"* Longman, ELBS Essex. 5th Edition.
3. Dick J.G (1973), "*Analytical Chemistry"*, Tata – McGraw Hill.

Course Title: Industrial Chemistry Semester: 2

Course Code: 17PCHE22 Part: III Contact Hours /Week: 5 Credit : 5

Objectives

To understand the principles of chemical technology, raw materials, energy for chemical industry, water pollution and its control, and to study the small scale chemical industries, large scale chemical industries

Unit 1 Principles of Chemical Technology 18 Hours

Introduction – basic principles of chemical Technology – importance of chemical technology – classification of technological processes – designing and modeling of chemical plants – unit process and unit operations. Basic requirements of industrial reactors – choice and selectivity of reactor basic principles of homogeneous and heterogeneous processes and reactors with examples.

Unit 2 Raw Materials And Energy For Chemical Industry 18 Hours

Raw materials – Characteristics of raw materials and their resources – methods of raw material concentration – integral utilization of raw materials.Energy for chemical industry – power and fuels – classification of fuels – coal – fuel gases and liquid fuels – petroleum – cracking – chemical corrosion – types of corrosion and preventivemeasures.

Unit 3 Water Pollution And Its Control 18 Hours

Water in chemical industry – soft and hard water – softening of water – basic principles of water pollution – water pollutants – pollution parameters – industrial pollution control – waste water treatment methods – pollution control act – water prevention act.

Unit 4 Small Scale Chemical Industries 18 Hours

Electro – thermal and electro – chemical industries: electroplating – surface coating industries – oils, fats and waxes – soaps and detergents – cosmetics. Match industries and fireworks: manufacture of some industrially important chemicals like potassium chlorate, potassium nitrate, barium nitrate and red phosphorus- metal powders.

Unit 5 Large Scale Chemical Industries 18 Hours

Manufacturing process – raw materials – composition and uses of products in Portland cement – ceramics – plastics synthetic fibers – rubber – fertilizers – insecticides and pesticides – photo film industries – commercial aspects of starting an industry.

Text Book

1. Chakrabarthy B.N (1984), "*Industrial Chemistry"*, Oxford and IBH Publ., New Delhi,

Reference Books

1. Mukhlyonov (1979), "*Chemical Technology, Vol.1"*, Mir publication, Moscow, 3rd Edition.
2. De A.K (1989), "*Environmental Chemistry"*, Wiley Eastern Ltd., Meerut. Chs.5-7. 2nd Edition.
3. Goel R.K (1977), *"Process know – how and material of construction for Chemical Industries"*, S.B. Publ., Delhi.
4. Norris Shreve R and Brink J.A (1977), Jr. "*Chemical Process Industries"*, McGrew Hill, Tokyo. 4th Edition.

Course Title: Organic Preparation, Qualitative and Quantitative Analysis Semester: 2
Course Code: 17PCHC2P Part: III Contact Hours /Week: 10 Credit : 5

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1. Quantitativeanalysis

Separation and analysis of two component mixtures. Identification of the components and Preparation of solid derivative.

2. Estimation

a) Estimation of glucose by Lane and Eynon method and Bertrand method.
b) Estimation of glycine.
c) Estimation of methyl ketone.

3. Organic Preparations (only for classwork)

About 5 two – stage preparations:

a) p-Nitroaniline from acetanilidebenzophenone
b) p-Bromoaniline from acetanilideaniline.
c) m-Nitrobenzoic acid from methylbenzoate.
d) Benzanilidefrom
e) Sym-Tribromobenzene from

Course Title: Organic Spectroscopy and Natural Products Semester: 2
Course Code: 17PCHC31 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To understand the concepts of spectral techniques**,** Steroids, Alkaliods, Antibiotics, UV, IR, Mass spectral techniques and also NMR spectral techniques for the quantitative, structural analysis of organic compounds.

Unit 1 Spectroscopy I **18 Hours**

UV Spectroscopy: Principle- absorption spectra of conjugated dienes– α,β-unsaturatedcarbonyl compounds- Woodward – Fieser rules.

IR Spectroscopy: Molecular Vibrations–Vibrational frequency–factors influencinggroup frequencies – quantitative studies and application of IR in identifying the functional groups

Mass Spectroscopy: Principle–type of ions–base peak–parent ion, metastable andisotopic peaks – fragmentation – general rules – pattern of fragmentation for various classes of compounds – McLafferty rearrangement – Retro Diels –Alder reaction.

Unit 2 Spectroscopy II **18 Hours**

^{1}H NMR Spectrocopy Origin of NMR spectra- chemical shift–spin coupling–coupling constant – first and second order spectra – spin – spin splitting- influence of stereochemical factor on chemical shift of protons –simplification of complex spectra deuterium substitution-spin decoupling - double resonance – shift reagents - Nuclear Overhauser Effect– CIDNP – concept of aromaticity.

^{13}C NMR Spectroscopy Basic principle of FT technique–Relaxation time– assignment of signals – Off-resonance decoupling – additivity relationship – calculation of chemical shifts for aromatic and aliphatic compounds – DEPT ^{13} C Spectra – $^{13}C^{13}$ correlation COSY , HETCOR , ROESY and NOESY– Inadequate.

Unit 3 Chiro Optical and Analytical Techniques **18 Hours**

ORD and CD – Principle – Cotton effect – type of ORD curves – α – halo ketone rule– Octant rule – applications to determine the configuration and conformation of simple monocyclic and bicyclic ketones – comparison of ORD and CD.

Chromatographic techniques: Column, TLC, Paper, GLC, HPLC, Exclusion and Ion exchange.

Unit 4 Steroids **18 Hours**

Classification – configuration and conformational aspects of A/B cis and A/B trans steroids – complete chemistry and stereochemistry of cholesterol [includes bile acids], chemistry of ergosterol and Vitamin D2 – male sex harmones – androsterone and testosterone – female sex harmones – oestrone, equilenin and progesterone – A basic idea about adrenocortical harmones – Cortisone [synthesis not included].Prostaglandins. General study of prostaglandins - Structures. Chemistry of PGEL and PGF1 α.

Unit 5 Alkaliods and Antibiotics **18 Hours**

General methods of structural determination – Hofmann, Emde and Von Braun degradations. Structure and synthesis of quinine, papaverine, morphine, reserpine, and lysergic acids.

Antibiotics

Definition, classification of antibiotics, structure, stereochemistry and synthesis of penicillin, chloramphenicol.

Text Book

1. Jain.M.K, Sharma.S.C, (2017), "*Modern Organic Chemistry"*, Vishal Publishing Co, JALANDHAR - 144 008 (PB.) INDIA. Golden Jubilee Yr. Revised Edition.

Reference Books

1. J. Mohan, (2004), "*Organic Spectroscopy Principles and Applications"*, CRC. 2nd Editon
2. J.March, M.B. Smith, (2007), "*Advanced Organic Chemistry: Reactions, Mechanisms and Structure*", Wiley, New York. 6th Edition
3. J. Clayden, N. Greeves, S. Warren, (2012), "*Organic Chemistry"*, Oxford University Press; 2nd Edition.
4. W. Kemp, (1994), "*Organic Spectroscopy"*, MacMillon. 3rd Edition.
5. I.L.Finar, (2013), "*Organic Chemistry, Volume-II"*, Pearson Education. 5th Edition

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Course Title: Inorganic Spectroscopy and Coordinated Ligands Semester: 3
Course Code: 17PCHC32 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To study the concept of transition metal complexes, spectral techniques , IR, PES, XPS, Mossbaier spectral techniques, NMR, ESR spectral techniques for the quantitative , structural analysis of Inorganic compounds and also Molecular rearrangements and reactions of coordinated ligands

Unit 1 Electronic Spectra of Transition Metal Complexes 18 Hours

Electronic spectra of transition metal complexes and Photochemistry – d- d transition – charge transfer transition – selection rules – mechanism of breakdown of selection rules – bandwidths and shapes – Jahn Teller effect – Tanabe – Sugano diagram – evaluation of 10Dq and β for octahedral and tetrahedral complexes of d^3, d6, d7 and d^8 configurations - photochemistry – photo redox and substitution reaction occurring in Co (III) and Cr (III) complexes – photochemistry of ruthenium polypyridyls.

Unit 2 Application of Spectroscopy To The Study Of Inorganic Compounds I 18 Hours

Application of IR and Raman spectra in the study of coordination compounds – detection of inter and intramolecular hydrogen bonding – stretching mode analysis of meta carbonyls.Mossbauer effect resonance absorption – Doppler effect – Doppler velocity – Experimental technique of measuring resonance absorption – isomer shift – magnetic hyperfine splittings – application of Mossbauer spectroscopy in the study of iron and tin complexes.

Photoelectron Spectroscopy

Theory – XPS. UV-PES – instrumentation evaluation of Ionisation potential – Chemical identification of elements – Koopmann's theorem – chemical shift – UPS – XPES of N2, O2 and HCL- evaluation of vibrational constants from UPS – spin orbit coupling – Auger spectroscopy– Principle and its application.

Unit 3 - Application of Spectroscopy to the Study of Inorganic Compounds II 18 Hours

NMR Spectroscopy: ^{31}P,^{19}F, and ^{15}N – NMR – introduction - applications in structural problem – evaluation of rate constants – monitoring the course of reaction – NMR of fluxional molecules – NMR of paramagnetic molecules – contact shifts and shift reagents.

ESR Spectroscopy

Principles – presentation of the spectrum – hyperfine splitting – evaluation of g- and Atinsors – factors affecting the magnitude of g- values –zero field splitting – Kramer's degeneracy – ESR of d^3 octahedral – complexes – anisotropy and hyperfine splitting constant – Application of ESR in the study of transition metal complexes.

Unit 4 Principles of Coordination Chemistry 18 Hours

Studies of coordination compounds in solution – detection of complex formation in solution – stability constants – stepwise and overall formation constants. Simple methods (potentiometric, pH metric and photometric methods) of determining the formation constants.Factors affecting stability – statistical and chelate effects – forced configurations.

Unit 5 Molecular Rearrangements and Reactions of Coordinated Ligands 18 Hours

Molecular rearrangement of four coordinate complexes – six coordinated complexes – reaction – Coordination ligands – reaction due to metal ion polarization of coordinatinated ligands – hydrolysis of acid esters and amides and of peptides – Aldol condensation – imine formation, hydrolysis and sub exchange – the template effect and macrocylic ligands.

Text Book

1. Puri B.R, Sharma L.R, and Pathania M.S, (2003), "*Advanced inorganic chemistry"*- Vishal Publishing Co.

Reference Books

1. Adamson, (1975), "*Concept of Inorganic Photochemistry"*, Wiley, New York.
2. Basalo F, and Pearson R.G, 1967, "*Mechanism of Inorganic reaction"*,Wiley, New York. 2nd Edition.
3. Bertini.I et al, (1998), "*Bio inorganic Chemistry"*, Viva Books Private Ltd, Chennai.
4. Drago.R.S,(1977), "*Physical Methods in Chemistry"*, Saunders Golden Sunburst W.B.Saunders Company, London.
5. Kettle.S.F.A ,(1996), "*Coordination Chemistry – An Approach"*,Spectrum Academic Publish Oxford.

Course Title: Quantum, Nano and Macromolecular Chemistry Semester: 3
Course Code: 17PCHC33 Part: III Contact Hours /Week: 5 Credit : 5

Objectives

To study the fundamental principles of Quantum Chemistry, Schrodinger wave equation application of Quantum Chemistry to chemical bonding, concepts of nano chemistry and Macromolecules of Polymers.

Unit 1 The Birth of Quantum Chemistry 18 Hours

Planck's explanation about black-body radiation – de – Broglie's concept of matter waves, Compton Effect. Heisenberg's uncertainty principle and complementarity. Operators – Linear operators – Method of getting the following quantum mechanical operators – Position, momentum, kinetic energy , potential energy, total energy, angular momentum, raising and lowering and spin angular momentum.

Postulates of quantum mechanics – Hermicity and proving the quantum mechanical operators are Hermitian – Commutator algebra – evaluation of commutators – vanishing and non-vanishing commutators – Eigen function and Eigen value – Introduction Dirac notation – Expansion theorem. Orthogonality and normalisation of wave functions.

Unit 2 Application of Quantum Chemistry in Simple Systems 18 Hours

Derivation of Schrodinger wave equation – Application of SWE to simple systems – Free particle moving in one dimensional box – Physical interpretation of the one dimensional problem- characteristics of wave function – average momentum of a particle in a box is zero – Particle moving 3-D box – Degeneracy – distortion – Particle moving in a ring – Rigid rotator – Spherical harmonics – Simple harmonic oscillator – Hermite polynomials –Hydrogen atom problem –Radial wave function – Radial probability distribution – Shapes of various atomic orbitals – Term symbols – L-S coupling scheme –Spectroscopic states.

Unit 3 Approximation Methods in Quantum Chemistry 18 Hours

Variation theorem – Application to hydrogen and He atom – Hartee – Fock Self Consistent Field (HFSCF) method of many electron system and its application to He atom – Electron spin and Pauli principle – Anti symmetric nature of the wave functions – Slater determinants approximation – VB and MO treatment of hetero nuclear and homo nuclear diatomic molecules. Need for approximation methods – Schrodinger equation for He atom and other many electron system – the time independent Perturbation theory (First order only) – Application to hydrogen atom.

Unit 4 Instrumentation in Nano chemistry 18 Hours

Microscopic techniques for the characterization of nanomaterials – UV and fluorescence spectroscopy AFM, SEM, TEM, X-ray diffraction and microanalysis.

Unit 5 Macromolecules Overview of Polymers 18 Hours

Types and properties of polymers Kinetics and mechanism of free radical, ionic condensation and Zeigler- Natta polymerization processes. Emulation and suspension polymerization techniques – Polymer molecular weight and its distribution – Molecular weight determination – osmatic pressure method – light scattering method – ultracentrifuge method and viscosity method. New polymers in material science – conducting polymers and polymer electrodes.

Text Book

1. Puri B.R, Sharma L.R and Pathania M.S (2003), "*Principles of Physical Chemistry"* Vishal Publishing Co. Millennium Edition.

Reference Books

1. Atkins P.W (1986), "*Molecular Quantum Mechanics"*, Oxford University Press. 2nd Edition,
2. Chandra A.K (1998) , *"Introductory Quantum Chemistry"* , 3rd edition., Tata McGraw Hill Publishing Co., New Delhi. 3rd Edition,
3. Hanna M.W (1969*), "Quantum Mechanics in Chemistry"*, The Benjamin/ Cummings Publishing Co., London. 2nd Edition,

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Course Title: Environmental Science Semester: 3
Course Code: 17PCHN31 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To learn the various types of pollutions, concepts of air pollution, Water pollution, soil pollution, and also analysis of pollutants and it's classification, To study the effects and control of air pollution, Water pollution, soil pollution.

Unit 1 Introduction and Classification 18 Hours

Introduction – Environmental science – Environmental chemistry – Ecology - Definition-Eco – System – Cycling of mineral elements and gases – Phosphate cycle-carbon cycle Hydrogen cycle – Nitrogen cycle – Hydrological cycle Environmental segments – pollution and its types: Air pollution –water pollution – soil pollution – radioactive pollution thermal pollution – noise pollution – marine pollution other types of pollution – and its effects and control – remedial measures.

Unit 2 Air Pollution 18 Hours

Introduction- sources of air pollution – air pollutants – classification and effects of air pollutants – Oxides of nitrogen, sulphur and carbon – acid rain –effects and control – hydrogen sulphide – effects and control – carbon mono oxide effects and control- photo chemical smog-effects and control fly ash- effects and control – green house effect – global warming- effects and control – ozone layer – ozone depletion – chlorofluroro carbons – effects and control.

Unit 3 Water Pollution 18 Hours

Introduction – types of water – water pollution – water pollutants – classification – physical , chemical and biological inorganic pollutants and toxic metals – organic pollutants – radioactive pollutants in water – pesticides and fertilizers – suspended particles – water , quality – water quality index – ill effects of water pollutants fluorosis – water pollution control –water treatment – primary , secondary and tertiary treatment – desalination – reverse osmosis – sewage and industrial waste water treatment.

Unit 4 Soil Pollution 18 Hours

Introduction- types of soil- soil pollution – types – indicators of soil pollution – plants as indicators of pollution – sources of soil pollution – fertilizers and pesticides – radioactive pollutants – solid wastes – soil sediments as pollutant – soil erosion – treatment of soil pollutants –solid wastes – thermal methods – land filling composting – land protection – remedial measure for soil pollution.

Unit 5 Analysis of Pollutants 18 Hours

Introduction analysis of air pollutants – units – sampling –devices and methods for sampling – measurements: UV –visible spectrometry IR spectrometry – emission spectrometry – turbidimetry nephelometry – gas chromatography – HPLC – chemi-luminescence of nitrogen oxides –IR photometry – conductometry – analysis of water pollutants units sampling – devices and methods for sampling measurement : UV –Visible spectrometry titration – analysis of different water quality parameters – BOD-COD – analysis and monitoring of pesticides carcinogens and industrial pollutants.

Text Book

1. A.K. De, (1994), "*Environmental Chemistry"*, Wiley Eastern Ltd., Meerut,

Reference Books

1. Mukherjee.A.K, (1986), "*Environmental pollution and health hazards – Causes and Control"* Galgotia Press, New Delhi.
2. Manivasakam.N, (1985), "*Physical and chemical examination of water sewage and Industrial effluents",* Pragati Prakashan Publ., Meerut.
3. SharmaB.K, and Kaur.H, (1997), "*Environmental Chemistry"* Krishna Prakashan, Meerut.

Course Title: Environmental Chemistry and Toxicology Semester: 3
Course Code: 17PCHN32 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To understand the sources, distribution, transport, chemo dynamics, and to acquire broad knowledge of Environmental Chemistry, development of methods for ultra-trace analysis of pollutants in air, water, soil and biological matrices.

Unit 1 Fundamentals of Environmental Chemistry 18 Hours

Stoichiometry, Gibb's energy, chemical potential, chemical equilibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radionuclides.

Unit 2 Chemical Composition of Air 18 Hours

Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry. Chemistry of air pollutants. Photochemical smog and acid rain.

Unit 3 Water Chemistry 18 Hours

Physio-Chemical parameters of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential, hydrological cycle, sampling techniques.

Unit 4 Soil Chemistry 18 Hours

Structure of lithosphere, nature of soil - physical properties of soil – soil water - soil air - soil temperature - mechanical composition- structure and texture. Chemical properties of soil: Minerals of soil - colloids in soil; ion exchange reactions in soil. Soil fertility and evaluation - organic matter in soil and their transformation - soil pH.

Unit 5 Environmental Toxicology and Toxic genomics 18 Hours

Introduction to toxicology, toxicity evaluation methods-LD50, LC50, etc. Toxic chemicals in the environment -Teratogens, mutagens and carcinogens. Pollutant uptake, biotransformation, accumulation, detoxification and elimination by organisms. Toxicant effects – molecular effects and biomarkers, sub lethal, acute and chronic effects. Impact of toxic chemicals on enzymes and hormones - Biochemical effects of arsenic, lead, mercury, pesticides, PCBs, flame retardants, Environmental toxicology of nanoparticles/materials.

Text Book

1. Bhatia S.C, (2002). "*Environmental chemistry"*. CBS publishers and Distributors, New Delhi

Reference Books

1. Banerji S.K, (2002). "*Environmental chemistry"*. Prentice-Hall of India, New Delhi
2. Chatwal A, (1999). "*Instrumental methods of chemical analysis"*. Himalaya Publishing House, Mumbai
3. Cunningham P, Cooper H, Eville G, and Hepworth M.T, (1999)."*Environmental Encyclopedia"*. Jaico Publishing House, Mumbai
4. De AK, (1990). "*Environmental Chemistry"*. Wiley Eastern Ltd., New Delhi

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Course Title: Conductometric, Potentiometric Titrations and Adsorption Semester: 3

Course Code: 17PCHC3P Part: III Contact Hours /Week: 10 Credit : 5

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1. Conductometric Experiments

i) NH_4Cl—NaOH – Mixture of NH_4Cl & HCl.

ii) CH_3 COOH —NaOH --- Mixture of CH_3COOH & HCl

iii) Na_2CO_3 —$Pb(NO_3)_2$ — Na_2CO_3

iv) K_2SO_4 —$BaCl_2$ —K_2SO_4

2. Adsorption Experiments

Adsorption of oxalic acid/Acetic acid on Charcoal

3. Potentiometric Methods

i) Precipitations titration Ag+ vs Halide mixture

ii) Redox titrations ceric ammonium sulphate vs ferrous ion

iii) Permanganate vs iodide ion

iv) Determination of dissociation constant of weak acids and pH of buffer solution

v) Determination of solubility product of sparingly soluble salts.

vi) Determination of dissociation constant of weak acids.

Course Title: Bio Molecules, Rearrangement and Synthetic Methods Semester: 4
Course Code: 17PCHC41 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To learn the concepts of Carbohydrates, Amino acids ,Nucleic acids, mechanism of Molecular rearrangements, Green Chemistry, Synthetic methods, Photochemistry & Free radicals. To learn the Green Chemistry and applications, Techniques of Green Chemistry.

Unit 1 Carbohydrates, Amino Acids and Nucleic Acids 18 Hours

Classification of proteins- peptides- structure of peptides – synthesis of pept – chemistry of glutathione and oxytocin – an elementary treatment of enzymes, coenzy and nucleic acids – biosynthesis of amino acids – RNA and protein synthesis – Gen code – DNA and determining the base sequence of DNA.

Pyronose and furanose, forms of aldohexoses and keto hexoses – methods used determination of ring size – conformations of aldohexopyronoses.

Unit 2 Organic Photochemistry & Free Radicals 18 Hours

Conservation of orbital symmetry – electrocyclic reaction – cyclo addition reaction and sigmatropic rearrangements – applications of correlation diagram apporch. Frontier molecular orbital approach, Huckel- Mobius approach and Perturbation molecular orbital approach to the above reactions.

Photochemical reactions of ketones – photosensitization – Norrish I and Norrish type-II reactions- Paterno Buchi reaction – photooxidation – photoreduction photochemistry of arenes.

Free radicals: Formation, deterction and stability of free radicals – free radicals reaction halogenations, addition, oxidation, reduction, and rearrangement reactions – sandmeyer, Gomberg, Bachmann, Ullmann, Pschorr and Hundsdiecker reactions.

Unit 3 Molecular Rearrangements 18 Hours

Mechanism of the following rearrangement reactions: Wagner – Meerwein, Pinacol, Demzanov, Beckmann, Hofmann, Curtius, Wolff, Baeyer- Villeger, Stevens, Sommelet-Hauser, Favorskii, Banzil-benzilic acid, Claisen, cope Fries, Dienone-phenol, di-pi methane, and Benzidine rearrangement – Photochemical rearrangements.

Unit 4 Green Chemistry I 18 Hours

Principles of green chemistry – planning a green synthesis in a laboratory – general interest for solvent free processes – solvent free techniques – Microwave synthesis: Introduction and Characteristics of microwave heating – interaction of microwave radiation with the material – difference between conventional heating and microwave heating. Dielectric polarization – diapolar polarization – applications and advantages of microwave heating over conventional heating.

Unit 5 Synthetic Methods 18 Hours

Planning a synthesis – Relay approach and convergent approach to total synthesis – Retrosynthetic analysis of simple organic compounds – functional group interconversions – use of activating and blocking groups in synthesis – stereo selective problems of geometrical and optical isomerism – steric crowding – Transition metal complexes in organic chemistry – Homogeneous hydrogenation –Umpolung synthesis – Robinson annelation – A schematic analysis of the total synthesis of the following compounds: 2,4 –dimethyl- 1,2 – hydroxypentanoic acids, trans- 9-metyl -1-decalone and isonootkatone.

Text Book

1. Jain.M.K, Sharma.S.C, (2017), Golden Jubilee Yr. Revised Ed. *Modern Organic Chemistry,* Vishal Publishing Co, JALANDHAR - 144 008 (PB.) INDIA

Reference Books

1. Desai K.R, (2005), "*Green Chemistry (Microwave Synthesis*)" Himalaya Publishing House, Mumbai.
2. March J, Smith M.B, (2007), "*Advanced Organic Chemistry: Reactions, Mechanisms And Structure*", Wiley, New York. 6th Edition.
3. Clayden J, Greeves N, Warren S, (2012), "*Organic Chemistry"*, Oxford University Press; 2nd Edition.
4. Kumar S, Kumar V, Singh S.P, (2016), "*Pericyclic Reactions: A Mechanistic and Problem- Solving Approach"*; Academic Press: New York.
5. Finar I.L, (2013), "*Organic Chemistry*", *Volume-II*, Pearson Education. 5th Edition.

Course Title: Nuclear and Analytical Chemistry Semester: 4
Course Code: 17PCHC42 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To study the theories of Nuclear Chemistry and its applications, concepts of Actinides and Lanthanides. To study the analytical methods, and also to learn the concepts of computer in chemistry.

Unit 1 Structure of Nucleus and Radioactive Decay 18 Hours

Composition of the nucleus – nuclear size, shape and density – principal, radial and magnetic quantum numbers – magnetic and electric properties of nucleus – elementary treatment of shell (independent particle) model – nuclear configuration – parity and its conservation – mass defect and binding energy – nuclear forces theory.

Radioactive decay: decay series – rate of disintegration - - half life – average life – units of radioactivity – secular and transient equilibria – theories of alpha decay, beta decay, gamma emission, position decay, nuclear isomerism, internal conversion and electron capture – Auger effect.

Unit 2 Nuclear Fission and Fusion and Application of Radioactive Isotopes 18 Hours

Bethe's notation of nuclear process - nuclear reaction energies (Q value) – fission – energy release in nuclear fission – mass distribution of fission products – theory of nuclear fission fissile and fertile isotopes – energy from nuclear fusion – thermonuclear reaction in stars – classification of reactors – power nuclear reactor – brecder reactor – nuclear reactions in India.

Application of radioactive isotopes: characteristics of tracer isotopes – chemical investigation – age determination medical field – agriculture - industry – analytical application biological effects of radiation – waste disposal management.

Unit 3 Actinides and Lanthanides 18 Hours

Chemistry of Lanthanides and Actinides: Lanthanides – Occurrence, extraction from ores– Separation procedure – ion exchange method – solvent extraction method. Physical and chemical properties – Electronic configuration – common oxidation state – lanthanide contraction and its consequences – colour of lanthanide ions – magnetic properties of lanthanides – separation of actinide elements – electronic configuration – oxidation state – Comparison of lanthanides and actinides – Position in the periodic table.

Unit 4 Electroanalytical & Thermo analytical Methods and Spectro analytical Methods 18 Hours

Electrogravimetry: Theory of electrogravimetric analysis – electrolytic separation and determination of metal ions -coulometric titrations. Voltammetry: Cyclic voltammetry – stripping voltammetry. Amperometry: Amperometric titrations.

Thermo analytical Methods: Instrumentation and applications of thermogravimetry– Differential Thermal Analysis and Differential Scanning calorimetry.

Spectro analytical Methods: Spectro analytical methods: Laws of absorption quantitative law of luminescence – principles and applications of colorimetric spectrophotometry, fluorimetry, nepheleometry and turbidimetry – flame spectroscopy – atomic absorption, atomic emission atomic fluorescence spectroscopy.

Unit 5 Non Aqueous Solvents **18 Hours**

Preparation, properties and applications of liquid ammonia,liquid nitrogen dioxide,hydrogen cyanide, hydrogen fluoride, and acetic acid.

Text Book

1. Friedlander G, Kannedy J.W, Macias E.S, and Miller J.M, (1987), "*Nuclear and Radiochemistry"*, John Wiley & Sons Inc., New York.

Reference Books

1. Arnidar H.I, (1987), "*Essentials of Nuclear Chemistry"*, Wiley Eastern Ltd., New Delhi. 3rd Edition.
2. Basset J et al, (1989), Longmann edn, "*Vogel's Text book of Quantitative Inorganic Analysis"*, ELBS, and Essex.
3. Dash. U.N, Sultan Chand and Sons, (1991), *"Nuclear Chemistry"*, New Delhi.
4. Glasstone S, (1967), "*Source Book on Atomic energy"*, Van Nostrand Reld Company, New York. 3rd Edition.

Course Title: Nuclear and Analytical Chemistry Semester: 4
Course Code: 17PCHC43 Part: III Contact Hours /Week: 5 Credit : 4

Objectives

To study the concepts of kinetics reaction, enzyme catalysis, kinetics of complex reactions and also surface chemistry. To understand the concepts of biophysical, photo chemistry.

Unit 1 Chemical Kinetics I **18 Hours**

Potentialenergy surface. Chain reactions – general characteristics Steady state approximations – study of kinetics of chain reactions like H2-Br2 reaction – decomposition of acetaldehyde and N2O5 – study of H2-O2 explosive reactions.

Unimolecular reaction rate theories – the simple Lindermann treatment – Hishelwood's theory – Rice, Ramsperer and Kassel (RRK) theory – Advanced unimolecular theory - Marcus theory or Rice, Ramsperger, Kassel and Marcus (RRKM) theory – Slater's theory. Principle of mictroscopic reversibility and detailed balancing – Kinetic isotope effect – Reactions in solution influence of solvent dielectric constant, ionic strength (Bronsted- Bjerrum – equation – primary and secondary salt effects) and pressure on reaction rates in solution – significance of volume of activation.

Unit 2 Chemical Kinetics II and Catalysis **18 Hours**

Fast reactions techniques – chemical relaxation methods, temperature and pressure jump methods, ultrasonic absorption technique, reactions in flow system, continuous and stopped flow, shock wave tube methods; chemical kinetics in crossed molecular beams – Flash photolysis – Spin resonance technique in the study of reaction kinetics.

Catalysis in biological systems – Enzyme catalysis – Michaelis – Menten kinetics – Lineweaver and Burk plot – Eadie's plot – influence of pH on the enzyme catalysis. Heterogeneous catalysis – chemical reaction on solid surfaces – kinetics, and mechanism of unimolecular and biomolecular – reactions – Langmuir – Heinshelwood and Langmuir – Rideal – mechanism – ARRT of surface reactions – NH3 synthesis , hydrogenation of C2H4 and cracking of hydrocarbons.

Unit 3 Surface Chemistry **18 Hours**

Introduction – Adsorption of gases on solids – physisorption and chemisorptions isotherms – Freundlish – Langmuir – BET – Temkin adsorption isotherms. Adorption on liquid surface – surface tension – Gibbs adsorption isotherm – Surface area determination – Electrokinetic phenomena at interfaces- including electro-osmosis and electrophoresis – Spreading of a liquid on another surfactant – monolayers – preparation of LB films – Micelles – Critical micellar concentration (CMC) – structure – biomolecular reaction occurring in a micellar solution – reverse micelles – micro emulsion – Application of photoelectron spectroscopy – ESCA and Auger spectroscopy to the study of surfaces.

Unit 4 Biophysical Chemistry **18 Hours**

Basic concept of non – equilibrium thermodynamics – Onsager reciprocal relationship – Its application to biological systems – High energy metabolies – ATP and its role in bioenergetics- transfer of potential and coupled reaction – Biological energy conversion in catabolism and anabolism – Role of singlet oxygen in biology – Biophysical applications of Mosshauer recognition – An introduction to super – molecular chemistry and photochemistry.

Unit 5 Photo and Radiation Chemistry **18 Hours**

Basic of Photo Chemistry- Jablonsky Diagram Fluorescence phosphoiescence and other deactivating processes. Stern – Volmer equation and its applications – electronic energy transfer mechanisms – photosensitiation and chemiluminescence. Experimental techniques in photochemistry – light sources – chemical actinometry – Elementary aspects of photosynthesis, photochemical conversion and storage of solar energy.

Radiation chemistry – source energy – interaction of high energy radiation with matter – radiolysis of water – definition of G-value – mode of reaction of hydrated electrons OH and H Experimental techniques of radiation chemistry – Dosimetry - Elementary aspects of radiation chemistry in biology and industry.

Text Book

1. Puri B.R, Sharma L.R. and M.S.Pathania (2003), "*Principles of Physical Chemistry"* (Millennium Edition,) Vishal Publishing Co.

Reference Books

1. Laidler K.J (1987), "*Chemical Kinetics"* Harper International edition. London. 3rd Edition.
2. Laidler K.J (1969) "*Theories of Chemical Reaction Rates"*, McGraw Hill Book Co., London.
3. Kalidas .C (1996), "*Chemical Kinetics Methods"* New Age International

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Course Title: Introduction to Nano Science Semester: 4
Course Code: 17PCHE41 Part: III Contact Hours /Week: 5 Credit : 5

Objectives

To study the concepts of nanoscience, instrumentations, analyze characterization of nanomaterials, biological Nanomaterials, synthesis, and properties of nanomaterials.

Unit 1 General Introduction 18 Hours

Forms of Matter – Crystal structures – Electronic properties of atoms and solids Surface energy and surface tension – Defining nano dimensional materials 0D, 1D and 2D nanostructures – size dependence of properties – special properties resulting from nano dimensionality - Potential uses of nanomaterials.

Unit 2 Synthesis of Nanomaterials 18 Hours

General approaches – Nucleation process – size of the crystal – Influence of nucleation rate on the size of the crystal – Chemical methods – Sol- gel techniques – Control of grain size – Co-precipitation – Hydrolysis – Sono chemical method – colloidal precipitation- Bottom up and top down approaches – Kinetically confined synthesis of nanoparticles.

Unit 3 Principle and Instrumentation 18 Hours

Spectrophotometry, XRD, EXAFS, XPS, SEM, TEM, AFM – Application to nanomaterials characterization.

Unit 4 Optical Properties of Nanomaterials 18 Hours

UV-Vis IR absorption – Photoluminescence and stimulated emission – Nonlinear optical mixing – photoconductivity.

Magnetic Properties: Concepts of dia-, para-, and ferro-magnetism– Exchangecorrelation – Exchange interaction

Electrical Properties: Electrical conductivity–Hall Effect–Charge carrier density– Activation energy; Electronic properties – Field emission properties.

Unit 5 Biological Nanomaterials 18 Hours

Sizes of building blocks – Proteins – DNA double nanowire Enzymes – Protein synthesis– Micelles and Vesicles – Biomimetic nanostructures – Worm micelles and Vesicles from block copolymers.

Text Book

1. Ventra M.D, Evoy S, Heflin J.R (2004), Jr., "*Introduction to Nanoscale Science and Technology"*, Kluwer Academic,

References Books

1. Knauth .P, Schoonman J, (2002), (Eds), "*Nano structured Materials: Selected Synthesism Methods, Properties and Applications"*, Kluwer Academic,
2. Cao. G (2009), "*Nanostructures & nanomaterials synthesis, properties and applications"*, Imperial College Press.

Course Title: Green Chemistry Semester: 4
Course Code: 17PCHE42 Part: III Contact Hours /Week: 5 Credit : 5

Objectives

To learn the concept of green chemistry and their principles, importance of greener reactions, and also the phase-transfer catalyst in green chemistry.

Unit 1 - Introduction to Green Chemistry 18 Hours

Introduction to green chemistry – twelve principles of green chemistry – planning agreen 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 ofstarting materials – use of protecting group – use of catalyst – use of microwaves and sonication.

Unit 2 - Addition and Condensation Reactions 18 Hours

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

Unit 3 - Oxidation and Reduction Reactions 18 Hours

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

Unit 4 - Phase-Transfer Catalyst Reactions 18 Hours

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 5 - Sonication Reactions 18 Hours

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

Text Book

1. Ahluwalia .V. K 2016, "*Green Chemistry"*; 2nd Ed., Ane Books Pvt Ltd., New Delhi,

Reference Books

1. Anastas P. T. And. Warner J. C, (2005), "*Green chemistry Theory and Practice*"; Oxford University Press, New York,
2. Narosa (2007), "*Green chemistry"*, Publishing House, New Delhi.

Course Title: Project			Semester: 4
Course Code: 17PCHC4P	Part: III	Contact Hours /Week: 10	Credit : 5

Objectives

1. To study about the different field in the chemistry with help of the project works.