

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
CHEMISTRY

PAPER – II		Subject Code
S. No	Subject	
1	ADVANCES IN ANALYTICAL CHEMISTRY-I	1311101
2	ENVIRONMENTAL CHEMISTRY - I	1311102
3	INORGANIC NANOMATERIALS – I	1311103
4	LIQUID CRYSTALS-I	1311104
5	ORGANIC CHEMISTRY - I	1311105
6	PHYSICAL CHEMISTRY-I	1311106

PAPER – III		Subject Code
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1	ADVANCES IN ANALYTICAL CHEMISTRY-II	1311201
2	ENVIRONMENTAL CHEMISTRY - II	1311202
3	INORGANIC NANOMATERIALS – II	1311203
4	LIQUID CRYSTALS-II	1311204
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6	PHYSICAL CHEMISTRY-II	1311206

PAPER – II

ADVANCES IN ANALYTICAL CHEMISTRY-I

UNIT-I

Mossbaur Spectroscopy: Introduction to Mossbaur effect, recoilless emission & absorption of x-rays, Instrumentation, isomer shift, Quadrupole splitting and hyperfine interactions, Application of Mossbaur effect to the investigations of compounds of iron and tin .

Hyphenated Techniques: GC - MS, LC - MS, MS - MS (Tandem) Spectrometry, ICP - MS.

UNIT-II

Imaging techniques including MRI: Magnetic resonance imaging (MRI) - Principle, instrumentation, magnetic resonance angiography, ¹H-nmr of relevant diamagnetic and paramagnetic compounds, contrast agents and clinical applications.

Atomic Emission Spectrometry (AES): Inductively coupled plasma - ICP / AES and Flame emission spectroscopy (FES). Sources - electrical discharge, dc/ac arcs, spark laser microprobe, Qualitative and quantitative analysis, problems discussion.

UNIT-III

Laser Based Techniques

Atomic fluorescent spectrometry (AFS); Resonant ionization spectroscopy (RIS); Laser enhanced ionization (LEI), Principle - Types of transition tunable laser, Classification of medium pumping and controlling mechanisms, Instrumentation detailing of various gaseous, liquid and solid sources, cell, monochromators, detectors.

UNIT-IV

X-ray diffraction & Neutron diffraction

X-Ray Fluorescence method: - Principals, Characteristics; Instrumentation, X-ray tube, Radioactive sources; Wavelength dispersive instruments; Energy dispersive instruments; Theory of x-ray diffraction; diffraction of x-rays by crystals - determination of crystal Structure (powder as well as single crystals), Instrumentation, determination of lattice parameters, X-ray intensity calculations and application of x-rays.

Neutron diffraction: Introduction to neutron diffraction, theory, Instrumentation and application.

UNIT-V

Chromatography

Supercritical fluid chromatography: Properties of supercritical fluids, instrumentation and Operating variables, comparison of supercritical to other types of chromatography, applications. Supercritical fluid extraction: Advantages of supercritical fluid extraction, instrumentation, supercritical fluid choice, off-line and on-line extractions, typical applications of supercritical fluid extraction.

Elution chromatography: Theories-plate theory; rate theory, band broadening-eddy diffusion, Longitudinal diffusion and resistance to mass transfer, column efficiency-plate theory and rate theory approach, Van Deemter's equation and its modern version, optimization column performance, inter relationships-capacity factor, selectivity factor, column resolution, distribution constant and applications of conventional column chromatography, advantages and limitations.

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UNIT-VI

Further reading

URLs

<http://www.sciencedirect.com/science/article/pii/S0003267008018242>
<http://www.spectroscopyonline.com/spectroscopy/Articles/Optimization-of-an-Analytical-Method-for-the-Deter/ArticleStandard/Article/detail/756904>
[http://www.ijrpc.com/files/v2i1%20\(23\).pdf](http://www.ijrpc.com/files/v2i1%20(23).pdf)
<http://hyper.ahajournals.org/content/36/6/1059.full>
<http://www.sciencedirect.com/science/article/pii/S058485478080070X>
<http://www.cis.rit.edu/htbooks/mri/chap-12/chap-12.htm>
http://pearl1.lanl.gov/external/c-cde/scf/pubs/king/59_analytical_SFC_and_SFE.pdf

REFERENCE BOOKS

1. "Mossbauer Spectroscopy", Greenwood N. N., Gibbs T. C., Chapman Hall, 1971.
2. "Chemical Application of Mossbauer Spectroscopy", Goldanski V. I & Harber R. H., Academic Press 1968.
3. "A textbook of Quantitative Inorganic Analysis", A. I. Vogel, ELBS, London.
4. "Dynamics of Chromatography- Part I"; J. C. Gidding; Dekker, New York.
5. "Vogel's textbook of practical Organic Chemistry", B. S. Furhen et. al. Longman Group
6. "Elements of X-ray diffraction", B. D. Cullity, Addison Wisley, 1967.
7. "Diffraction Method", Wormald, Oxford University, Press, 1973
8. "Standard Method of Chemical Analysis" IIA 6th end.
9. "Neutron Scattering in Chemistry", Baun, G. E. Butleworth, London, 1971.
10. "Spectroscopy in Inorganic Compounds", C. N. R Rao & Ferraro G. R., Academic Press, 1970.
11. "Basic Principles of Spectroscopy", Cheney R. Mac Grows Hill, 1971.
12. "Principles of Instrumental Analysis", Skoog, 1985
13. "MRI : Basic principles and applications", M. A. Brown, R. C. Semelka, 1995.
14. "Fundamental of Analytical Chemistry", D. A. Skoog, D. M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
15. "Modern Analytical Chemistry", David Harvey, McGraw Hill, New Delhi, 2000.

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ENVIRONMENTAL CHEMISTRY - I

UNIT-1: Chemistry of Air Pollution:

Environmental pollution-significance-nomenclature-segments; Atmosphere-composition and its pollution; Air pollutants: C, S, N oxides and hydrocarbons; Acid rain, Green House effect and photochemical smog; ozone effect on environment and health; CFCs; Air pollution: Effect of gasoline, Lead; reducing toxic emissions from the fuel combustion in vehicles, NO emissions and its control; Catalytic control device for automobiles.

UNIT-2: Chemistry of Water pollution:

Water and its role in environment-Hydrological cycle- Water pollutants-DO measurements; Waste chemicals; Oil spills; Waste water treatment-Primary, secondary (Aerobic and Anaerobic) and tertiary treatments. Effect of water pollution; physicochemical, biological, toxic and pathogenic effects.

UNIT-3: Chemistry of Soil pollution:

Classification of soil pollutants; source and classification of solid waste and its disposal on land and sea; techniques of recycling of solid waste.

UNIT-4: Pesticide Pollution

Classification of pesticides; persistence of pesticides; pesticide kinetics in environment and water; Modes of action and toxicity; pesticidal accumulation and its toxicity to aquatic organisms; Environmental implications; Alternate methods of pest control; pesticide pollution and its control

UNIT-5: Heavy metal and Thermal Pollution

Heavy metals and their sources; accumulation of metals in environment; toxicity of metals to organisms; Toxic effects of Pb, Hg, Cd, Cr, As and Cu; Effect of thermal pollution; physical, chemical and biological effects; Thermal pollution – standards and its controls; Beneficial uses of thermal pollutant wastes.

UNIT-6: Review of Research Work

1. Air Pollution

http://www.out.ac.tz/avu/images/Chemistry/11_Environmental%20Chemistry/env_comp_readings_20080911/Comp-R-airpollutants.pdf

<http://www.godel.net/environment/smog/Chemistry.htm>

2. Water Pollution:

http://www.environment.gov.pk/PRO_PDF/PositionPaper/Water%20Pollution.pdf

http://www.naho.ca/documents/fnc/english/2011_water_pollution_effects.pdf

<http://www.newagepublishers.com/samplechapter/001754.pdf>

3. Soil Pollution

<http://nsdl.niscair.res.in/bitstream/123456789/990/1/>

<http://www.environmentalpollutioncenters.org/soil/>

4. Pesticide pollution

<http://www.icmr.nic.in/busept01.pdf>

<http://cdn.intechopen.com/pdfs/13220/InTech->

[Pesticide pollution resistance and health hazards.pdf](#)

5. Heavy metal Pollution

<http://www.ncbi.nlm.nih.gov/pubmed/14757716>

<http://pollutioninpeople.org/toxics/metals>

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http://chem-tox-ecotox.org/wp/wp-content/uploads/2010/01/02-Metals-17_01_2010.pdf
Thermal Pollution
<http://www.ukm.my/ahmadukm/images/stories/data/kuliah/manusia/artikel/thermal.htm>
http://agritech.tnau.ac.in/environment/envi_pollution_intro%20-%20thermal.html

REFERENCES:

1. “*Water pollution: Causes, Defects and Control*”, by P.K.goel, New Age International Publishers (P) Ltd., New Delhi (2001)
2. “*Environmental Chemistry*”, by V.P. Kudesia, Pragathi Prakashan, Meerut, (2003).
3. “*Fundamental Concepts of Environmental Chemistry*”, by G.S. Sodhi, Narosa Publishing House Pvt. Ltd., New Delhi, (2002).
4. “*A Text Book in Environmental Science*”, by V. Subramanian, Narosa Publishing House Pvt. Ltd., New Delhi, (2002).
5. “*Environmental Chemistry*”, by A.K. De, New Age International Publishers, New Delhi, (2003).
6. Environmental chemistry by Manahan.
7. Solid Waste Management by B.K.Sharma and H. Kaur, Goel Publishing House, Meerut (1999)

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INORGANIC NANOMATERIALS - I

UNIT-I: Nanomaterials

Introduction, Synthesis routes of nanostructured materials.

Bottom-up approaches: PVD, (Inert gas condensation), CVD, Laser ablation, Electroless displacement method, Sol-gel process, Wet chemical synthesis, Self-assembly, Physical and chemical self - assembly.

Top-Down approaches: Mechanical alloying, Nanolithography, Importance of Nanomaterials in various fields - Novel semiconductors devices, Nanosensors, CNT - based sensors, Nanowire sensors, Polymeric nanofibres and nanocomposites, Nanoparticles, Optical nanosensors, Biosensors, Food and agricultural Industry, Water treatment and environment, Nano-medical applications, Paints, energy, Defence and space applications.

Nanocatalysis: Introduction, Gold nanoparticles, Magnetic nanoparticles.

UNIT II: Electronic, Electric and Optical behavior of Inorganic materials

Metals, Insulators and Semiconductors, Electronic structure of solid, band theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping of semiconductors and conduction mechanism, the band gap, temperature dependence of conductivity, carrier density and carrier mobility in semiconductors, synthesis and purification of semiconducting materials, single crystal growth, zone refining, fractional crystallization, semiconductor devices, rectifier transistors, optical devices, photoconductors, photovoltaic cells, solar batteries.

UNIT III: Role of Nanomaterial's in Fuel Processing and Hydrogen storage

Hydrogen Production: Processing hydrogen from alcohol, hydrocarbons and other sources. Relevant properties of hydrogen, hydrogen as an engine fuel, materials and methods of hydrogen storage. Challenges and opportunities for research in fuel processing.

Solid oxide fuel cells (SOFC): Introduction, Benefits and Limitations - Cell reactions; Cell components-Electrolytes, Zirconia analysis, Ceria-based electrolytes; Perovskite based systems, cathode materials, Anode materials, Reactions taking in SOFC, Configuration and Performance, Environmental impact of solid oxide fuel cells, Applications and future of SOFCS.

UNIT IV: Metal Finishing

Introduction, Essential of metal finishing, Electroplating process-plating bath purpose and application of electroplating, effect of plating variables on the nature of electrodeposits, Surface preparation, Electroplating of chromium and silver, Electroless copper plating on printed circuit board, Electroless nickel plating process.

UNIT V: Functional Nanocomposites

Classification of nanocomposites, Synthetic strategies, Interfacial - harvesting maximum performance; Applications of nanocomposites; Electronic and Optoelectronic devices, Electrochemical energy storage, electro-catalysis magnetic applications.

Characterization of metal nanoparticles: UV - Visible spectroscopy, TEM, STM, FIM, SEM, AFM and XRD.

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UNIT VI: Further Reading

Preparation of metal nanoparticles on solid substrates, Self assembly of molecules on metal surface, surface-enhanced infrared absorption (SEIRA) spectroscopy, surface-enhanced Raman spectroscopy (SERS).

URLs:

http://www.wiley.com/legacy/products/subject/reference/chalmers_toc.html (Volume 1 - Theory and Instrumentation)

<http://www.worldcat.org/title/surface-infrared-and-raman-spectroscopy-methods-and-applications/oclc/246607250>

<http://link.springer.com/article/10.1007%2Fs00216-006-1109-7> (Anal Bioanal Chem, Vol. 388, Issue , pp 109-119 (2007))

<http://link.springer.com/article/10.1007%2Fs00216-011-5378-4> (Anal Bioanal Chem, Vol. 401, Issue , pp 2935-2943 (2011))

<http://www.opticsinfobase.org/as/abstract.cfm?uri=as-64-10-1094> (*Applied Spectroscopy*, Vol. 64, Issue 10, pp. 1094-1099 (2010)).

<http://www.envirocentre.ie/includes/documents/metalfinishing.pdf>

<http://nzic.org.nz/ChemProcesses/metals/8G.pdf>

http://iris.elf.stuba.sk/JEEEC/data/pdf/01-02_104-8.pdf

REFERENCES

1. "Nanomaterials Chemistry: Recent Developments and New Directions", C. N. R. Rao, A. Muller and A. K. Cheema, Wiley- VCH GmbH & Co.
2. "Nanomaterials", J Dutta and H Hofmann
3. "Fuel Cells: Principles and applications", B. Viswanathan, M. A. Scibioh, Universities Press.
4. "Nano Materials", A. K. Bandyopadhyay, New Age International Publishers.
5. "Textbook of Nanoscience and Nanotechnology" B. S. Murthy, P. Shankar, B. Raj, B. B. Rath and J. Murday, Universities Press.
6. "Nanostructured materials processing, properties and applications", Carl C. Koch, Jaico Publishing House.
7. "Functional Materials: A chemist's Perspective", V. K. Pillai, M. Parthasarathy, Universities Press.
8. "Nanotechnology", William Illsey Atkinson, Jaico Publishing House.

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LIQUID CRYSTALS-I

UNIT I

Chemical constitution - Thermotropic Liquid Crystals - Nematics, Smectics, Cholesterics and Disc like molecules - Achiral and Chiral molecules - Occurrence of Ferroelectricity - Supra-molecular Design of molecules - Banana Molecules, Lyotropic Liquid Crystals - Monolayer and Bilayer arrangements - Monotropic and Enantiotropic Liquid Crystals - Bridging Groups - Chemical Moieties and their influence for mesomorphism.

UNIT II

Microscopic investigations including basic concepts - Phenomenology and Morphology - Polymorphism - Boundary effects - Textures - Homogeneous and Homeotropic textures of Nematic and Smectic phases.

UNIT III

Theories of Liquid Crystalline state - Swarm theory - Continuum theory -Maier Saupe theory (Mean field) - Landu de Gennes theory - Pre-transitional Effects - McMillan theory of smectic-A phase and its developments.

UNIT IV

Electric and Magnetic field effects - Elastic Deformation (Frederick's deformation) - Magnetic field effects (temperature) on Nematic and Smectics -Electric field effects - Domains - DSM - Loops - Electro Hydrodynamics instabilities.

UNIT V

Hydrogen bonding and supramolecular liquid crystals: Chemical moieties - shape based classification of LCs - Metallo - Mesogens - Bent liquid crystals - Hydrogen bonding liquid crystals - chemical moieties and interaction effect on physical properties - types of HB LCs - Polycatenar liquid crystals

Text Books & References:

1. 'The Physics of Liquid Crystals' by P.G.de Gennes, Ed: Marshall and Wilkinson, Clarendon Press, Oxford, U.K.
2. 'Introduction to Liquid Crystals' by E.B.Priestley, Plenum Press.
3. 'Liquid Crystals' by S.Chandrasekh Cambridge Univ. Press.
- 4.'The Molecular Physics of Liquid Crystals' by G.R.Luckhurst and G.W.Gray, Academic Press, New York, U.S.A
- 5.'Hand Book of Liquid Crystals' by T.Kato, Ed: D.Demus, J.Goodby, G.W.Gray, Ed: H.W.Spiess and v.vn (Weinheim: Wiley-VCH). 1998.

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6. 'Thermotropic Liquid Crystals - Recent Advances' Ed: ARamamoorthy. Springer Press.
7. 'Alignment Technology and Applications of Liquid Crystal Devices' by Kohki Takatoh, Masaki Hasegawa et al, Taylor & Francis press.
8. 'Ferroelectric Liquid Crystals - Principles, Properties and Applications' by J.W.Goodby, R.Blink, N.A.Clark, S.T.Lagerwall et al.
9. 'Ferroelectric Liquid Crystals' by B.Zeks and R.Blink, Gordon & Breach.
10. H.Kihara, T.Kato, T.Uryu, S.Ujiie, U.Kumar, J.M.J.Frechet, D.W.Bruce and D.J.Price, Liq. Cryst., **21**, (1996) 25; Z.Siderotou, D.Tsiourvas, C.M.Paleos and ASkoulios, Liq. Cryst., **22**, (1997) 51; C.M.Paleos and D.Tsiourvas, Liq. Cryst., **28**, (2001) 1127.
11. T.C.Lubensky and L.Radzihovsky, Phy. Rev. E., **66**, (2002) 031704.

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ORGANIC CHEMISTRY - I

UNIT-I: Stereochemistry (Optical – Geometrical and Conformational Isomerism)

Significance and Classification of Isomers; Optical Isomerism - Elements of symmetry and Chirality; Configuration of optically active molecules; DL, RS – notation; Relative and absolute configurations; Resolution of racemic mixtures; Absolute asymmetric synthesis; Stereospecific and regiospecific synthesis; Cram's rule-Dynamic enantiomerism; Cis- and trans isomerism; E-Z configuration; Interconversion of geometrical isomers; Beckmann rearrangement, conformational analysis of ethane, n-butane and cyclohexane

UNIT-II: Neighboring group effects- Catalysis by transition Metal complexes:

Neighbouring group effects; stereochemistry; Intramolecular nucleophilic attack; rate of reaction – anchimeric assistance; homogeneous hydrogenation – transition metal complexes, stereochemistry of homogeneous hydrogenation – diastereo selectivity, enantio selectivity, the oxo process, enzyme reactions. Catalytic role of Organometallic Compounds: Oxidative addition and Reductive Elimination : Stereochemistry and Mechanism of Oxidative Addition – Insertion Reactions – Hydrogenation of Olefins – Transfer Hydrogenation – Hydrosilation of Olefins – Isomerisation of Olefins – Ziegler – Natta Polymerization of Olefins – Oligomerization of Butadiene . Alkene Metathesis. Oxidation of Olefins to Carbonyl Compounds – Oxidation of Hydrocarbons to Alcohols and Acids

UNIT- III: Enzyme catalyzed organic reactions

Enzymes as Catalysts- Specificity of Enzyme catalyzed reactions; Enzyme Kinetics; Ionic Interactions; Ion dipole; Dipole-Dipole Interactions ; Charge transfer Complexes; Mechanism of Enzyme Catalysis- Approximation, Covalent Catalysis ; Desolvation ; Strain or Distortion; Group Transfer reactions by Enzymes - Amination and Phosphorylation; Reduction and Oxidation- Redox without a Coenzyme; Monooxygenation – Oxidative decarboxylation reaction; O₂ activation

UNIT- IV: Pericyclic Reactions & Photorearrangements

Diels-Alder Cycloaddition reaction: Regiochemistry, Stereochemistry, Intramolecular, Retro, Asymmetric, 1,3 Dipolar reactions, Electrocyclic reactions, Sigmatropic rearrangements.

Photorearrangements: Rearrangements of Enones, Dienones, Epoxy ketones, in aromatic compounds, by alkenes.

Photoreduction and Photooxidation: Photoreduction of carbonyl compounds, aromatic hydrocarbons, Photochemical oxidation and Photooxidation of alkenes and polyenes.

UNIT – V: Addition to Carbon – Heteroatom Multiple bonds

Addition reactions of carbonyl compounds: Aldehydes and Ketones; Addition of water, Alcohol, cyanide, thiols. Ammonia, amine and 2,4- DNP; Addition of hydride ion; Reduction

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with NaBH_4 and LiAlH_4 and reduction of compounds with $\text{C}=\text{N}$ linkages, Tollen's reaction; Dieckmann and Knoevenagel condensation

UNIT- VI: Review of Research Work

1. Stereochemistry

<http://research.cm.utexas.edu/nbault/teach/stereo.html>
<http://www.mz-at.de/pdf/RegisChiralReview.pdf>
<http://www.wiredchemist.com/chemistry/instructional/an-introduction-to-chemistry/structure/geometric-and-optical-isomers>
<http://www.creative-chemistry.org.uk/molecules/optical.htm>
<http://www.britannica.com/EBchecked/topic/296365/isomerism/279762/Conformational-isomers>

2. Neighboring group effects- Catalysis by transition Metal complexes:

<https://www.jyu.fi/kemia/tutkimus/orgaaninen/en/research/Pihko/gm/02.02.2010-Hasibur.pdf>
<http://euch6f.chem.emory.edu/neighboring.html>
<http://research.cm.utexas.edu/nbault/Anchimeric.htm>
<http://www.britannica.com/EBchecked/topic/432186/organometallic-compound>
<http://www.ncbi.nlm.nih.gov/pubmed/22287209>

3. Enzyme catalyzed organic reactions:

<http://books.google.co.in/books?id=toy5IMAVswkC&printsec=frontcover&dq=subject:%22Organic+reaction+mechanisms%22&hl=en&sa=X&ei=zUBcUYynI4PxrQeA54CQBA&ved=0CDwQ6AEwAg#v=onepage&q&f=false>

4. Pericyclic Reactions & Photorearrangements

<http://carolinevictoriarose.com/wp-includes/rearrangement-reactions-pdf>
<http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/pericycl.htm>
<http://courses.chem.psu.edu/chem39/Slides/Section11.pdf>
<http://www.newagepublishers.com/samplechapter/001120.pdf>

5. Addition to Carbon hetero atoms multiple bonds

<http://link.springer.com/article/10.1023%2FA%3A1019064627386?LI=true#page-1>
<http://chemistry2.csudh.edu/rpendarvis/AlkeneAddn.html>
http://chemwiki.ucdavis.edu/Organic_Chemistry/Hydrocarbons/Alkenes/Catalytic_Hydrogenation_of_Alkenes
<http://books.google.co.in/books?id=wPas7FgmZ8C&pg=PA73&lpg=PA73&dq=addition+to+carbon+nitrogen+multiple+bonds&source=bl&ots=kLR7QWBMdO&sig=XX7gSymPmRBwHRoI1dC6CyKvcw&hl=en&sa=X&ei=7rdWUaeuH4KurAeK4oCoBw&sqi=2&ved=0CHUQ6AEwCQ#v=onepage&q=addition%20to%20carbon%20nitrogen%20multiple%20bonds&f=false>

REFERENCES:

- 1) "*Stereochemistry of Carbon Compounds*" by Ernest L. Eliel, Tata-Mc Graw Hill Co., New Delhi (1975).
- 2) "*Stereochemistry- Conformation and Mechanism*", by P.S. Kalsi, Wiley Eastern Ltd., New Delhi, Hyd. (1991).
- 3) "*Advanced Organic Chemistry*", by Jerry March, John Wiley & Sons, New York, London. (2001).
- 4) "*Organic Chemistry*", by R.T. Morison and R.N. Boyd, Allyn & Bacon Inc., (printed in Singapore) (2001).

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- 5) “*Organic Chemistry*”, by Paula Yurkanis Bruice, Pearson Education (Singapore) Pvt. Ltd., Delhi (2001).
- 6) “*A Guide-book to Mechanism in Organic Chemistry*”, by Peter Sykes Orient Longmans Ltd., New Delhi (1976).
- 7) “*Mechanism and Theory in Organic Chemistry*”, by T.H. Lowry and K.S. Richardson, Harper & Row Publishers, London (1988).
- 8) “*Carbocyclic Non-Benzenoid Aromatic Compounds*”, by Douglas Lloyd, Elsevier Publishing Company, Amsterdam, London, New York (1996).
- 9) “*University Chemistry*”, Vols II & III by C.P. Murthy, S.F Mehidi Ali and P.K. Dubey, New Age International (P) Ltd., New Delhi, Hyderabad(1996).
- 10) “*Organic Chemistry*”. Vol. I. by S.M. Mukherji, S.P.Singh and H.P. Kapoor, Wiley Eastern Ltd., New Delhi, Hyderabad.(1985)
- 11) “*Organic Reaction Mechanisms*”, by Raj K. Bansal, Tata-Mc Graw Hill Co., New Delhi (1998)
- 12) “*Organic Stereo Chemistry*” by Henri Kagan, Edward Arnold Publishers, London (1988).
- 13) “*Advanced Organic Chemistry*” by Maya Shankar Singh, Pearson Education (Singapore) (P) Ltd., Delhi (2005)
- 14) “*A Text Book of Organic Chemistry*” by Arun Bahal and B.S Bahl. S.Chand & Company., New Delhi (2005).
- 15) “*Organic Reaction Mechanism*” by V.K.Ahluvalia, Narose Publishing House, New Delhi (2010)
- 16) “Name Reactions- A collection of Detailed Reaction Mechanisms” by Jie Jack Li, Springer
- 17) “*Organic Name Reactions and Molecular Rearrangements*” by Gurudeep Raj, Krishna Prakashan Media (P) Ltd., Meerut, (2011)
- 18) The Organic Chemistry of Enzyme catalyzed reactions, Revised addition by Richard B. Silverman, Academic Press, Elsevier Science
- 19) “*Organometallics-A Concise Introduction*”, Ch.Eischeinbroich and Salzer-VCH
- 20) “*Organotransition Metal Chemistry Fundamental Concepts and Applications*”, John Akio Yamamoto, Wiley & Sons.
- 21) “*Homogeneous Catalysis by Metal Complexes*”, M M Taqui Khan and A E Martel
- 22) “*Applied Homogenous Catalysis with Organo Metallic Compounds Vol I & II*”, Boy Cornills and W A Herrmann – VCH
- 23) “*Homogenous catalysis*”, G W Parshall, John Wiley & Sons, New York
24. Modern methods of Organic Synthesis, W. Carruthers and Iain Coldham, Cambridge University Press

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PHYSICAL CHEMISTRY-I

Unit -I: Thermo dynamics

Basic concepts of thermodynamics, Zeroth law of thermodynamics, First law of thermodynamics - limitations, Spontaneous process, Second law of thermodynamics, Carnot theorem, Entropy free energies {Gibbs, Gibbs-Helmholtz}, Kirchhoff's equation, Vant-Hoff's equation, Maxwell equation, Clapeyron equation, Clausius Clapeyron equation, Nernst heat theorem, chemical potential, Gibbs- Duhem equation, Gibbs - Margules equation, applications of these concepts, concept of fugacity of gases.

Unit -II: photochemistry

Types of photo chemical reactions, laws of absorption, quantum yield and quantum efficiency, Jablonsky diagram, fluorescence, phosphorescence, ISC, IC, vibrational cascade, chemical luminescence, delayed fluorescence Franck-Condon principle kinetics of the reactions: dissociation of HI, HBr, HCl, Photo sensitized process, flash photolysis.

Unit-III: Quantum Mechanics

Postulates of quantum mechanics, Schrodinger wave equation (Time dependent and independent), Eigen value, Eigen function, normalization, orthogonality, different operators, particle in one dimensional box, tunneling effect, particle in three dimensional box, rigid rotator, Schrodinger wave equation of H-like atoms, approximation methods: time independent perturbation theory, variation theory, chemical applications of group theory- basic principles.

Unit-IV: Electro Chemistry

Basic concepts of electro chemistry, Kohlrausch's law, Arrhenius theory of electrolyte dissociation and limitations, Debye-Huckel- Onsager's equation, transport number, Hittorf's method, Nernst equation, reference electrode, electrochemical series, reversible cells and irreversible cells, concentration cell with and without transference, Complexation effect, electron transfer processes involving organic and inorganic compounds.

Unit- V: Chemical Kinetics

Basic concepts of kinetics, kinetics of complex reactions: opposing reactions, parallel reactions, consecutive reactions, chain reactions, Arrhenius equation, theories of reaction rates – collision theory, transition state theory, Lindeman's theory, RRK & RRKM theories, reactions in solutions: influence of solvent, primary and secondary salt effect, effect of dielectric constant of solvent, ion-ion interactions, single sphere model, double sphere model, Hammett equation, Taft equation, Enzyme catalysis.

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Unit-VI: URI

Thermodynamics:

- i) www.emc.maricopa.edu/faculty/sarvee/biobk/biobookener/.html
- ii) www.chegg.com
- iii) www.ekayasolutions.com/ech256/.../GibbsDuhemEqn.pdf

photo chemistry:

- i) www2.chemistry.msu.edu/faculty/reusch/virttxtjml/photchem.html
- ii) www.photophysics.com/.../laser-flash-photolysis - United Kingdom

Quantum Mechanics:

- i) <http://ebooks.cambridge.org/ebook.jsf>
- ii) www.ecse.rpi.edu/.../Ch10%20Time-independent%20perturb.pdf

electro chemistry:

- i) www.chem.missouri.edu/GatesGroup/Hammett-wikipedia.pdf
- ii) http://www.cheml.com/acad/web_text/elchem/ec4.html

chemical kinetics:

- i) web.chem.ucsb.edu/~kaljulcatalysis.html
- ii) cmcd.hms.harvard.edu/activities/_media/bcmp201/lecture10.pdf

Recommended Books:

1. Advanced Physical chemistry by Gurudeep Raj, 24th Edition, Gael Publishing house, Meerut (1999)
2. G.A.Somorjai, Y.Li, Introduction to Surface Chemistry and Catalysis (2nd ed.), 2010.
3. "Physical Chemistry" by Peter Atkins and J.D. Paula, 7th edition, ELBS, Low Price Edition (2002).
4. "Chemical Kinetics" by K.J.Laidler 3rd edition, Benzamin-Cummings. Indian reprint edition (2004).
5. "Quantum chemistry "by A.K.Chandra, 3rd edition Tata Mc Graw-Hill Publishing Pvt. Ltd., New Delhi(1988).
6. "Electro chemistry" by Glass stone. 2nd edition, Mc Millan India Ltd. New Delhi (1984).
7. Fundamentals of Photo Chemistry, K.K.Rohatgi - Mukherjee, New Age International (P) Ltd., New Delhi, 1986.

PAPER – III

ADVANCES IN ANALYTICAL CHEMISTRY-II

Unit-I

Green Chemistry

Basic principles of Green Chemistry, Application of non-conventional techniques in organic synthesis (ultrasonic, microwave and grinding etc.), Solid state synthesis and synthesis under solvent free conditions, Use of ionic liquids.

Unit-II

Non conventional sources of energy

Solar sources - Photochemical methods, Thermodynamic efficiency of energy conversion, energy from solar radiations, Transition metal complexes for energy production, Solar hydrogen system, Photochemical processes at semiconductors electrodes, Photo galvanic and Photovoltaic cells based on Inorganic photochemical systems; Geothermal energy; Energy from biogas sources; Tidal wind sources; Energy from fission and fusion reaction.

UNIT-III

Fuel Cells & Nanotechnology

Fuel cell: History and background, Principle of fuel cells, Alkaline fuel cells, Phosphoric acid fuel cells, Solid oxide fuel cell (SOFCs), Fuel processing, Applications of Fuel cells.

Nano: Carbon nanotubes: Single and multiwall carbon nanotubes, Fullerenes, One dimensional nanostructures, Nano wires and nano rods, Chemical Vapour Deposition (CVD), Applications to Fuel-cells, Nano-electromechanical systems (NEMS), Nano-optoelectronic materials and devices, Medicine and pharmacology applications, thin-films, nanoscale devices: Transistors, FETs, quantum dots lasers, Methods of characterization of nanomaterials

UNIT-IV

Metal Analysis

Sampling, Analysis of steel and ferrous alloy: Carbon, silicon, manganese, phosphorous, sulphur, selenium, copper, nickel, chromium, vanadium, tungsten, molybdenum, cobalt, aluminium, titanium, nitrogen, lead, niobium, iron.

Section A: Surfactants and Detergents: Classification, Methods of Analysis.

Section B: Soil and fertilizer analysis: Classification, Methods of Analysis.

UNIT-V

Effluent Analysis & Drug Analysis

Effluent Analysis: Effluent treatment and legislation, characterization of waste water, classification of effluents, waste water treatment processes and recycling, analysis of waste water, Physical methods of characterization, Analysis of organic and inorganic pollutants, automation in effluents analysis.

Drug Analysis: Narcotics, Types-natural,semi-synthetic,synthetic; Anaesthetics, classification of drugs according to their effect, Methods of analysis using fluorimetry, UV spectroscopy, Photocolorimetric, TLC, GC,GC-MS

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UNIT-VI

Further Reading

URLs:

<http://www.sciencedirect.com/science/article/pii/S1878535212002298>
<http://www.sciencedirect.com/science/article/pii/S187853521200295X>
<http://www.understandingnano.com/fuel-cells.html>
<http://www.sciencedirect.com/science/article/pii/S2212670812001534>
http://www.tn.gov.in/spc/tenthplan/CH_11_2.PDF
<http://www.newagepublishers.com/samplechapter/000329.pdf>
<http://www.sciencedirect.com/science/article/pii/S2212670812001534>

REFERENCES:

1. "Green Chemistry" by M. Kidwai and V. K. Ahluwalia.
2. "Solar energy Principles of thermal collections and storage", Sukhatme S. P., Tata Macgrow Hill New Delhi 1984.
3. "Fuel Cells", J. O. M. Bockeris, S. Srinivasan, Macgrow Hills 1969.
4. "Solar Energy" C. D. Rai.
5. "Energy Resources", Simon A.L. 1975.
6. "Direct Energy Conversion", Addison Wesley, 1970, All M and Kottani.
7. "Fuel Cell, Principles and Applications", B. Viswanathan and M. Aulice Scibioh, University Press.
8. "Analytical Chemistry", Gurdeep R Chatwal, Himalaya Publications.
9. "Encyclopedia of Analytical Chemistry", Volume 3, Academic Press, 1995.
10. "Nano Materials", A. K. Bandopadhyaya, New Age International Publications.

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ENVIRONMENTAL CHEMISTRY - II

UNIT-I : Organic Pollution

Sources of organic matter, Degradation of carbon, Nitrogen, sulphur and phosphorous compounds; Effects of organic pollution; Aesthetic effects, effect on oxygen balance, physico chemical characteristics, primary production, species diversity, organism; organic pollution parameters and their measurements: BOD, COD, TOC and TOD; biological indices of organic pollution.

UNIT-II: Oil Pollution

Characteristics and composition of oil: Sources of petroleum oils in the environment; fate and movement of oil in marine environment; effects of oils on organisms; oil pollution and its control.

UNIT-III: Pollutants from industry

Polymers and Plastics; Paper and Pulp; Drugs and Pharmaceuticals; Sugar and Distillery Asbestos: characteristics, sources in the environment, Applications; Effects of asbestos pollution and its mitigation; Polychlorinated Biphenyls: The need and fate of poly chlorinated biphenyls in environment; environment implications of poly chlorinated biphenyls, Abatement procedures for polychlorinated biphenyls pollution; Food Additives: The need and the classification- specific additives & their risk analysis. Mining operation: Types of mining operations and steps involved; environmental effects of mining operation.

UNIT-IV: Radioactive Pollution

Isotopes and nature of radiations; Sources of radio activity in environment, nature and manmade sources; Atomic explosions, nuclear power plants, nuclear fuel cycle; other waste from nuclear power plants, distribution of manmade radioactivity in environment, radio activity in environment; biological effects of radiation; control of radioactive pollution.

UNIT-V: Chemistry of Solid waste

Chemistry of composting, mechanism involved in the decomposition of organic materials like hemicelluloses proteins, carbohydrates, food material, organic insecticides and farm wastes (by aerobic & anaerobic process), Chemistry of Incineration and pyrolysis: Incineration of solid waste; combustion characteristics, of Inorganic & Organic materials- Determination of heating values of combustible solid waste; Pyrolysis: chemical changes in organic and inorganic materials during pyrolysis, Importance of Pyrolysis in solid waste disposal. Chemistry of recycling of solid wastes – recycling and reuse of materials such as paper, plastic and glass

UNIT-VI: Review of Research Work

1. Organic Pollution

<http://www.chem.unep.ch/pops/>

<http://www.chem.unep.ch/pops/pdf/invsrce/inventpopscomb.pdf>

<http://www.lenntech.com/aquatic/organic-pollution.htm>

<http://www.who.int/iomc/groups/pop/en/>

<http://www.greenpeace.to/publications/Riacheulo%20report%202000.pdf>

2. Oil Pollution

<http://oils.gpa.unep.org/facts/sources.htm>

<http://jj49z6.vc.c3.catn.com/oilpollution.html>

<http://library.thinkquest.org/C004218/OilEffects.htm>

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3. Pollutants from Industry
<http://www.infoplease.com/encyclopedia/science/water-pollution-industrial-pollution.html>
http://web.mit.edu/12.000/www/m2015/2015/solutions_for_industrial_pollution.html
<http://www.rfu.org/cacw/pollution.html>
<http://www.nwfpa.org/nwfpa.info/component/content/article/55-waste-reduction/368-food-industry-pollution-prevention-and-waste-reduction>
[http://www.sphinxesai.com/Oct_dec_2010_vol2_no.4/PharmTech_vol2_no.4_1_pdf/PT=24%20\(2265-2270\).pdf](http://www.sphinxesai.com/Oct_dec_2010_vol2_no.4/PharmTech_vol2_no.4_1_pdf/PT=24%20(2265-2270).pdf)
<http://www.eng.buffalo.edu/Courses/ce435/PvsP1/PvsP.html>
4. Radioactive Pollution
http://agritech.tnau.ac.in/environment/envi_pollution_intro%20-%20radioactive.html
<http://lifeofearth.org/pollution/air-pollution/radioactive-pollution>
<http://www.environmentabout.com/799/radioactive-pollution-and-its-effects-on-human-beings>
[http://whqlibdoc.who.int/monograph/WHO_MONO_46_\(p381\).pdf](http://whqlibdoc.who.int/monograph/WHO_MONO_46_(p381).pdf)
5. Chemistry of Solid Waste
http://envis.maharashtra.gov.in/envis_data/files/MSW_.pdf
<http://www.newagepublishers.com/samplechapter/001164.pdf>
http://www.who.int/water_sanitation_health/hygiene/settings/hvchap6.pdf

REFERENCES:

1. P.K.goel., 'Water pollution: Causes, Defects and Control', by New Age International Publishers (P) Ltd., New Delhi (2001)
2. Stumm, W. And J.J Morgan, 'Aquatic Chemistry', Wiley Interscience 1972.
3. Hagerty, D.J., J.L. Pavoni and J. E. Heer, J.R., 'Solid waste Management', Van Nostrand Reinhold Co., Newyork, 1973.
4. Wilson, D.G., Hand Book of Solid waste Management, v.R.nostrand., Reinhold, New Yark, 1977
5. De, A.K., Environmental Chemistry, New Age International Publishers Private Limited., New Delhi, Fifth Edition, 2008
6. Dara, S.S., Environmental Pollution and Control, S. Chand & Co., New Delhi, First Edition, 1993
7. Sodhi, G.S., Fundamental Concepts of Environmental Chemistry, Narosa Publishing House Pvt. Ltd., New Delhi, Third Edition, 2009

INORGANIC NANOMATERIALS – II

Unit-I: Lattice Defects

Introduction to types of Solids, Perfect & imperfect crystals, Point defects, Line defect and plane

defect (definition & explanation of meaning) order & disorder phenomena, Thermodynamics of Schottky & Frenkel defect formation, Determination of defect, Non-stoichiometric defect (structural and thermodynamic aspects), incorporation of Stoichiometric excess of defects, Thermodynamics of Non-stoichiometric phases. Synthesis of Inorganic materials, Synthesis of solid state materials using different techniques: ceramic techniques, Co-precipitation techniques, sol-gel techniques, precursor techniques, high temperature & high pressure synthesis.

Unit- II: Magnetic Materials

Structure and Properties of i) Metal and Alloys ii) Transition metal Oxides iii) Spinel iv) Ilmenites v) Perovskite and vi) Magneto-plumbites. Hard and Soft magnetic materials, hysteresis loop and their application in transformer cores, magnetic bubble memory devices for information storage and permanent magnets, Spin glasses: Formation and characteristics.

Unit- III: Transition metal complexes

Electronic absorption spectra of transition metal complexes: Introduction, Selection rules, Electronic - dipole transitions, Magnetic - dipole transitions, Term symbols for d^n ions, Effects of spin orbit coupling, Energy level diagrams, Orgel and Tanabe-Sugano diagrams, Charge transfer transitions.

Magnetic properties of transition metal complexes: Introduction, magnetic susceptibility and its measurements, spin cross over systems, ferromagnetism and antiferro magnetism.

Metal-metal bonding: Evidences and factors favoring of M-M bonding, bi, tri, tetra, penta and hexa nuclear metal clusters.

Unit- IV: Ionic Conductors

Types of ionic conductors, Mechanism of ionic conduction, Interstitial jumps, Vacancy mechanism, diffusion, super ionic conductors, phase transition & mechanism of conduction in super ionic conductors, examples and applications of ionic conductors. Electronic properties of materials

a) Organic semiconductors, examples, properties and applications.

b) Superconductivity, superconductivity in metals, alloys and ceramics materials (mixed oxides) BCS theory, Meissner effect, Type I & II superconductors, Applications. Fullerenes as superconductors.

c) Dielectric polarization: Piezoelectricity and Ferro electricity.

d) Lasers and Masers actions, Laser production and application.

Unit-V: Bonding involving π -donor ligands

Concept of back-bonding; Transition metal to Carbon multiple bonded compounds (Carbenes & Carbynes); Synthesis, structure and bonding, Organometallic reagents in organic synthesis and in homogeneous catalytic reactions (hydrogenation, hydroformylation, isomerization and polymerization); π -acid metal complexes. Activation of small molecules by co-ordination.

UNIT –VI: Further Reading

Catalysis: Inorganic Materials as Catalysts for Photochemical Splitting of Water, Coordination Complexes as Catalysts, Nanoparticles and catalysis.

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URLs

<http://pubs.acs.org/doi/pdf/10.1021/cm7024203> (Chem. Mater., 2008, 20 (1), pp 35–54)
<http://www.mendeley.com/research/calcium-niobate-semiconductor-nanosheets-catalysts-photochemical-hydrogen-evolution-water-1/>
<http://lic.leidenuniv.nl/research/metals-in-catalysis-biomimetics-inorganic-materials>
<http://pubs.acs.org/doi/abs/10.1021/ed100843a>
<http://www.sciencedirect.com/science/article/pii/S0010854511002402>
<http://www.platinummetalsreview.com/article/48/3/101-104/>
http://books.google.co.in/books/about/Nanoparticles_and_Catalysis.html?id=UE6cz32PME8C
<http://onlinelibrary.wiley.com/book/10.1002/9783527621323>
http://research.che.tamu.edu/groups/Seminario/materials/G02_nanoCatalyst.pdf

REFERENCES:

1. “Solid State Chemistry”, C. N. R. Rao: Dekker.
2. “Solid State Chemistry”, A. H. Hanny.
3. “Electronic Processes in Materials”, L. V. Azoroff and J. J. Brophy: MacGraw Hills.
4. “Preparation and Properties of Solid State Materials”, Vol I & II, Wilcox: Dekker.
5. “The Structure and Properties of Materials Vol. IV, Electronic Properties”, LohnWulff: Wiley Eastern.
6. “Ionic Crystals, Lattice Defects and Nonstoichiometry”, N. N. Greenwood: Butterworth's.
7. “The Defect Solid State”, T. J. Rey et al: Interscience.
8. “Chemistry of Imperfect Crystals”, E. A. Kroger: Holland.
9. “Solid State Chemistry”, A. R. West.
10. “Advanced Inorganic Chemistry”, 5th edition, F. A. Cotton and G. Wilkinson: John Wiley and Sons, 1988.
11. “Inorganic Chemistry”, 3rd edition, J. E. Huheey: Harper and N.Y. Row, 1983.
12. “Modern aspects of Inorganic Chemistry”, 4th edition, H. J. Emeleus and A. G. Sharpe: UBS 1989.23

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Liquid Crystals-II

UNIT-I

Thermodynamic properties - Theory of phase transitions - Pre-transitional phenomena - Calorimetric measurements - Molar heat - Transition entropy and Enthalpy.

UNIT-II

Optical properties - Birefringence - Rayleigh's Scattering - UV and visible absorption spectroscopy - IR spectroscopy.

UNIT-III

Liquid Crystal displays - Electro-optic phenomena - Field induced Birefringence - Twisted Nematics - Guest Host effect - Cholesteric to Nematic transition - Storage mode - Display life - Alignment of Liquid Crystal - Homogeneous and Homeotropic.

UNIT-IV

Technical applications - Thermography - Electro-optic display devices - Holography - Interferometry and other applications

UNIT-V

Electro-optic Modulators with liquid crystals - Ferroelectricity in smectic liquid crystals - surface Stabilized Switching mechanism in- Liquid Crystals - Polarization switching - Threshold less switching - V-shaped switching.

Text Books & References:

1. *'The Physics of Liquid Crystals'* by P.G.de Gennes, Ed: Marshall and Wilkinson, Clarendon Press, Oxford, U.K.
2. *'Introduction to Liquid Crystals'* by E.B.Priestley, Plenum Press.
3. *'Liquid Crystals'* by S.Chandrasekh Cambridge Univ. Press.
4. *'The Molecular Physics of Liquid Crystals'* by G.R.Luckhurst and G.W.Gray, Academic Press, New York, U.S.A
5. *'Hand Book of Liquid Crystals'* by T.Kato, Ed: D.Demus, J.Goodby, G.W.Gray, Ed: H.W.Spiess and v.vn (Weinheim: Wiley-VCH). 1998.
6. *'Thermotropic Liquid Crystals - Recent Advances'* Ed: ARamamoorthy. Springer Press.
7. *'Alignment Technology and Applications of Liquid Crystal Devices'* by Kohki Takatoh, Masaki Hasegawa et al, Taylor & Francis press.
8. *'Ferroelectric Liquid Crystals - Principles, Properties and Applications'* by J.W.Goodby, R.Blink, N.A.Clark, S.T.Lagerwall et al.
9. *'Ferroelectric Liquid Crystals'* by B.Zeks and R.Blink, Gordon & Breach.
10. H.Kihara, T.Kato, T.Uryu, S.Ujiie, U.Kumar, J.M.J.Frechet, D.W.Bruce and D.J.Price, *Liq. Cryst.*, **21**, (1996) 25; Z.Siderotou, D.Tsiourvas, C.M.Paleos and ASkoulios, *Liq. Cryst.*, **22**, (1997) 51; C.M.Paleos and D.Tsiourvas, *Liq. Cryst.*, **28**, (2001) 1127.
11. T.C.Lubensky and L.Radzihovsky, *Phy. Rev. E.*, **66**, (2002) 031704.

ORGANIC CHEMISTRY - II

UNIT- I: Heterocyclic Synthesis and Characteristics

Structure and reactivity of Pyridine, Quinoline, Benzofuran, Benzothiophene, Coumarins, Pyrazole, Oxazoles, Isoxazoles, Thiozoles, Isothiozoles, Pyridazine, Pyrimidine and pyrazine.

UNIT- II: Molecular Rearrangements and Named Reactions

Nucleophilic, Electrophilic and free radical rearrangements: wagner-Merwin, Pinacol, Benzil-Benzilic acid, Favorski, Fries, Nebe, Hoffmann Curtius, Beckmann, Schmidt, Bayer – Villiger, Stevens rearrangements; Wittig, Suzuki, Sonogashira reaction, Michael addition, Mannich reaction, Diels Alder reaction, Hydroboration, Clemenson and Birch reductions

Functionalization of alkenes: Epo-oxidation and aziridination, Dihydroxylation, Reduction by hydride transfer reagents

UNIT- III: Organic Synthesis

Synthetic Applications of Organoboranes and Organosilanes; Organic transformations and reagents: Functional group interconversions including Oxidation and reduction; Chemo, regio and stereoselective transformations; Asymmetric synthesis: Chiral auxiliaries, Methods of asymmetric induction substrate, reagent and catalyst controlled reactions; Determination of enantiomeric diastereomeric excess; enantio- discrimination

UNIT – IV: Retro synthetic Analysis and Green Chemistry

Retro synthetic Analysis: Synthons, Guidelines for choosing disconnection-Study with examples; Linear and divergent synthesis; Natural reactivity and Umpoulung; Green Chemistry- Need, Principles and Planning of green chemistry; Green reactions: Arndt – Eistert synthesis & Mechanisms; Barbier reaction under Sonication and Applications; Baker-Venkatraman Rearrangement; Phase Transfer catalyzed synthesis of Flavones and its Applications; Bouveault reaction; Dakin reaction; Darzen reaction in the presence of PTC; Dickmann condensation; Mukaiyama reaction in aqueous phase; Ullmann reaction and its application; Photo chemical reaction- Benzopinacol; conversion of Trans azobenzene to cis azobenzene; PTC catalyzed reactions: Oxidation of toluene to Benzoic Acid; Benzonitrile from Benzamide; Microwave induced reactions- Anthracene- Maleic anhydride adduct, 3-Methyl – 1-Phenyl – 5-Pyrazole; Sonication reaction; Butaraldehyde; 2-Chloro-N- aryl anthranilic acid; Reaction in ionic liquids: 1-Acetylnaphthalene and Ethyl 4- methyl-3-cyclohexene carboxylate.

UNIT – V: Natural Products and Bio Molecules

Structural elucidation and synthesis of Alkaloids: Ephedrine, Cocaine and Cinchonine; Terpenes: Citral, Borneol and Phytol; Steroids: Cholesterol, Testosterone and β -amyrin, DNA and RNA

UNIT-VI: Review of Research work

1. Heterocyclic Synthesis:

<http://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/heterocy.htm>

http://www.uku.fi/~tanevala/LASY/5_heterocyclic.pdf

2. Molecular Rearrangements & Named reactions

http://www.uoi.gr/cerp/2002_February/pdf/05Moulay.pdf

<http://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/rearrang.htm>

http://matematicas.udea.edu.co/~carlopez/Organic_Name_Reactions_Merck_Index.pdf

<http://www.organic-chemistry.org/namedreactions/>

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3. Organic Synthesis

<http://msmith.chem.ox.ac.uk/OS%20HO2FULL.pdf>

<http://ezinearticles.com/?Properties-of-Organosilane&id=2691976>

https://gupea.ub.gu.se/bitstream/2077/21897/1/gupea_2077_21897_1.pdf

4. Retro synthetic Analysis & Green Chemistry

<http://www.cs.moravian.edu/~rdlibby/211-212Chem-PDF/Laboratory/Experiments/212-10Lab/Expt-4-Org-Syn/Retrosynthetic-Analysis/212-09Retrosyn-Anal-1.pdf>

<http://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/Questions/Match/synth10.htm>

<http://www.umsi.edu/~orglab/pdffiles/multistp.pdf>

<http://www.organic-chemistry.org/books/reviews/352730715X.shtm>

<http://www.ias.ac.in/resonance/November2008/p1041-1048.pdf>

<http://www.organicchemistry.org/topics/greenchemistry.shtm>

<http://www.newreka.co.in/pdf/Green%20Chemistry%20-%20Challenges%20%20Opportunities.pdf>

5. Natural Products and Bio Molecules

http://esa.ipb.pt/pdf/Refmush_3.pdf

<https://workspace.imperial.ac.uk/outreach/Public/Presentations/Natural%20Product%20Chemistry.pdf>

<http://nsdl.niscair.res.in/bitstream/123456789/561/1/Lipids.pdf>

http://www.coledavid.com/downloads/datadownloads/chapter_1_biomolecules.pdf

REFERENCES:

1. Modern methods of Organic Synthesis, 3rd edition, Cambridge Low price Edition by W. Carruthers (1996)
2. Advanced organic chemistry by reaction mechanism and structure (McGraw Hill and Kogakush) by Jerry March.
3. Molecular reactions and photochemistry (Prentice Hall) by Charles Dupey and O.Chapman.
4. Organic Chemistry, 5th edition (Prentice Hall of India) by R.T.Morrison and R.N.Boyd.
5. Organic chemistry vol. I & II (ELBS Longmann group Ltd., London) by I.L.Finar.
6. Chemistry of Organic Natural Products Vol-I by O.P.Agarwal, Goel Publishing House, Meerut
7. Organic chemistry, 5th edition, (John Wiley and Sons, New York, 1992) by T.W.Graham Solomons.
8. Green Chemistry (Environmentally Benign reaction) by V.K. Ahluwalia, Ane Books, Pvt. Ltd., New Delhi (2009).
9. Organic Reaction Mechanism” by V.K.Ahluwalia, Narose Publishing House, New Delhi (2010)
10. Name Reactions - A collection of Detailed Reaction Mechanisms” by Jie Jack Li, Springer
11. Organic Name Reactions and Molecular Rearrangements” by Gurudeep Raj, Krishna Prakashan Media (P) Ltd., Meerut, (2011)
12. Heterocyclic Chemistry by J.A. Joule and G.F.Smith, Van Nostrand Reinhold Company, London

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PHYSICAL CHEMISTRY-II

Unit -I: Solid State

Basic concepts, Bravais lattice, crystal systems, symmetry in crystals, X-ray diffraction method, Bragg's equation, determination of crystal structure by Bragg's method and powder method, Miller indices, Weiss indices, structures of NaCl, KCl, CsCl, perovskite; stoichiometric and non-stoichiometric defects, closed packed structures, voids, band theory of semiconductors. Characterization by thermal analysis-TGA, DTA, DSC.

Unit-II: Surface Phenomenon

solid surfaces ; Solid -gas interface. factors influencing adsorption, surface area measurements, adsorption isotherm curves: Freundlich, Langmuir, BFT, Gibbs; negative and positive adsorptions, chemisorptions, physisorption, catalytic activity of surfaces - Types of dispersions, surfactants, micelle and critical micellation concentration, macro and micro emulsions, types of emulsion.

Unit III: Modern methods of characterization of solid materials or surfaces

Physical chemistry of nano materials, Study of the solid materials and surfaces by techniques like Low Energy Electron Diffraction technique, Scanning Electron microscopy, Scanning Tunneling Microscopy, Proton Emission Spectroscopy, Atomic Force microscopy. Laser-based techniques

Unit IV: A) Fuel cells and B) Corrosion

Fuel cells: principle, difference between fuel cell and Carnot cycle technologies, William grove fuel cell, stack of fuel cell, different fuel cell: solid, oxygen-hydrogen, hydrocarbon-oxygen, alkaline, phosphoric acid, molten carbonate, solid polymer fuel cells. Corrosion: EMF, Galvanic series, classification of corrosion, theories of corrosion, kinetics of corrosion, theories of passivity, high temperature corrosion, different forms of corrosion, controlling methods, factors influencing atmospheric corrosion, marine corrosion- controlling methods.

Unit- V:

Separation methods (chromatographic techniques): Column chromatography, Gas Chromatography, TLC, HPLC. Spectroscopy techniques: Nuclear Magnetic Resonance spectroscopy, Infra red spectroscopy, Electron Spin Resonance spectroscopy, Mass Spectroscopy.

Unit- VI: URI

Solid state:

- i) www.seas.upenn.edu/~chem101/sschem/solidstatechem.html
- ii) www.journals.elsevier.com/journal-of-solid-state-chemistry/uqu.edu.sa/files2/tiny_mce/.../solid%20state%20chemistry.pdf

Surface phenomenon:

- i) www.chem.utas.edu.au/staff/stack/teaching/.../sld019.html
- ii) www.mpikg.mpg.de/pdf/KolloidChemie/Scripte/Mizellbildung.pdf

Modern methods of characterization of solid materials or surfaces:

- i) www.chem.qmul.ac.uk/surfaces/scc/scat62.html
- ii) www.columbia.edu/~jcc2161/documents/ChemJVST88.pdf

Fuel cells and Corrosion:

- i) americanhistory.si.edu/fuelcells/basics.html

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- ii) www.britannica.com/EBchecked/.../solid-polymer-electrolyte-fuel-cell
- iii) www.sciencedirect.com
- iv) Corrosion.ksc.nasa.gov/corr-fundamentals.html

Chromatographic techniques and spectroscopy:

- i) www.umsi.edu/~orglab/documents/ir/ir2.html
- ii) www.cis.rit.edu/htbooks/nmr/inside.html
- iii) Masspec.scripps.edu/mshistory
- iv) davisson.nat.uni-magdeburg.de/Downoads/Chromatographie.pdf
- v) [lib.njutcm.edu.cn/... methods ... methods/2.2.46.%20Chromatographic%20separation%20techniques.pdf](http://lib.njutcm.edu.cn/...methods...methods/2.2.46.%20Chromatographic%20separation%20techniques.pdf)

Recommended Books:

1. Advanced Physical chemistry by Gurudeep Raj, 24th Edition, Goel Publishing house, Meerut (1999).
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