Estd: 1966

SARASWATHI NARAYANAN COLLEGE
(An Autonomous Institution Affiliated to Madurai Kamaraj University)
(Reaccredited with Grade 'B' by NAAC)
Perungudi, MADURAI – 625 022.
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DEPARTMENT OF CHEMISTRY

Choice Based Credit System (CBCS)
Learning Outcomes-based Curriculum Framework (LOCF)

M.Sc. Chemistry Programme

(For those who join in June 2022)

PRINCIPAL

Dr. M. Kannan M.A., M.Phil., Ph.D.

DEPARTMENT OF CHEMISTRY

1. **Dr. K.K. Mothilal, M.Sc., M.Phil., P.G.D.C.A., Ph.D.**
   - Associate Professor and Head
2. **Dr. P.Mohandass, M.Sc. M.Phil., Ph.D.**
   - Associate Professor
3. **Dr. A. Gubendran, M.Sc., M.Phil., Ph.D**
   - Associate Professor
4. **Dr. S.V. Ganesan, M.Sc., M.Phil., Ph.D**
   - Assistant Professor
5. **Dr. S.Perumal, M.Sc., M.Phil., Ph.D**
   - Assistant Professor
6. **Dr. R.Dhanalakshmi, M.Sc., M.Sc.(Yoga), M.Phil., Ph.D**
   - Assistant Professor
7. **Dr. A.Manivel, M.Sc., M.Phil., P.G.D.C.A., Ph.D.**
   - Assistant Professor
8. **Dr. N.Muniyappan, M.Sc., Ph.D. - Assistant Professor**
9. **Dr. M.Saravanakumar, M.Sc., Ph.D**
   - Assistant Professor
10. **Dr. S. Jeya Sheela, M.Sc., M.Phil.,Ph.D.**
    - Assistant Professor
11. **Dr. N. Arunkumar, M.Sc., Ph.D**
    – Assistant Professor

PROFILE OF THE COLLEGE

Thiru. L. Narayanan Chettiar, a renowned philanthropist founded Saraswathi Narayanan College at Perungudi near Madurai Airport in the year 1966. The college is a prestigious academic powerhouse catering to the educational needs of students hailing from economically weaker and socially oppressed section of our society. It imparts education of the highest quality to students irrespective of caste, creed and religion. The guiding principles of our college are duty, devotion and distinction. The institution has proved an innovative leader and a catalyst in the best educational, cultural and economic interests of students. It is committed to make the students morally upright, intellectually resourceful, socially advantaged and globally competent. It is devoted to teaching, research and extension activities with equal importance.

The college set off its academic journey with Pre-University Courses in the year 1966 – 67. The Institution started offering UG programmes from the academic year 1968 – 69. It was upgraded as Post-Graduate Institution in 1979 – 80 and as Research Institution in 1984 – 85. The co-educational system was introduced for M.Phil. Programmes in the academic year 2001 – 02 and for PG programmes in the year 2002 – 03 with the noble objective of promoting higher education among girls in rural areas. Girls have been enrolled in UG programmes also since the academic year 2010 – 11.

The green campus of 66 acres has a built-up area of 1,70,059 sq.ft. A new library housed at Silver Jubilee building was built at the cost of Rs.25,00,000/- and it was inaugurated by His Excellency Dr. M. Chenna Reddy, then the Governor of Tamilnadu on 04.04.1994. The library was dedicated to the memory of Achi. The major donor of this building was Tmt. Saraswathi Narayanan, the better half of the Founder President Thiru. L. Narayanan Chettiar. Sri Vidhya Ganapathi Temple was built and consecrated on 27.08.2015.

The Departments of Botany, Mathematics, Commerce, English, Economics and Chemistry have been upgraded as university recognized research centres to carryout M.Phil and Ph.D research programmes in the college. NAAC accredited the college with grade B+ in the year 2005. UGC accorded the status of Autonomy to our institution in the year 2007. NAAC re-accredited the college with grade B (CGPA of 2.78) in the year 2016. UGC extended the Status of Autonomy to the institution for another period of five years from the academic year 2016 – 17.

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M.Sc CHEMISTRY- COURSE STRUCTURE

SEMESTER I

Course type	Title of the course	Course Code	Hrs/ Week	Credit	Exam Hrs.	CIA	Ext.
CC-1	Organic Chemistry – I	LPCHCT11	5	4	3	25	75
CC-2	Inorganic Chemistry – I	LPCHCT12	5	4	3	25	75
CC-3	Physical Chemistry – I	LPCHCT13	5	4	3	25	75
CC-4(P)	Organic Chemistry Practical	LPCHCL21	5	-	-	-	-
CC-5(P)	Inorganic Chemistry Practical	LPCHCL22	5	-	-	-	-
DSE-1(T)	Analytical Techniques and Bio-organic Chemistry	LPCHDS11	5	4	3	25	75
	Drug Design	LPCHDS12					
Ad.Cr.Co: MOOC	MOOC-1		-	-	-	-	-
			30	16			

SEMESTER II

Course type	Title of the course	Course Code	Hrs/ Week	Credit	Exam Hrs.	CIA	Ext.
CC-6	Organic Chemistry – II	LPCHCT21	5	4	3	25	75
CC-7	Inorganic Chemistry – II	LPCHCT22	5	4	3	25	75
CC-8	Physical Chemistry – II	LPCHCT23	5	4	3	25	75

CC-4(P)	Organic Chemistry Practical	LPCHCL21	5	4	6	40	60
CC-5(P)	Inorganic Chemistry Practical	LPCHCL22	5	4	6	40	60
DSE-2	Computer applications in Chemistry-Practical	LPCHDL21	3	3	3	40	60
	Computational chemistry and Numerical Analysis	LPCHDS21	3	3	3	25	75
AEC-1	Organic Photochemistry	LPCHAE21	2	2	3	25	75
	Scientific Research and Presentation Skills	LPCHAE22					
SLC-1	Supramolecular Chemistry	LPCHSC11	-	-	3	100	-
	Green Chemistry	LPCHSC12					
Ad.Cr.Co: MOOC	MOOC-1		-	-	-	-	-
			30	25			

SEMESTER III

Course type	Title of the course	Course Code	Hrs/ Week	Credit	Exam Hrs.	CIA	Ext.
CC-9	Organic Chemistry – III	LPCHCT31	5	5	3	25	75
CC-10	Inorganic Chemistry – III	LPCHCT32	5	5	3	25	75
CC-11	Physical Chemistry – III	LPCHCT33	5	5	3	25	75
CC-12(P)	Physical Chemistry Practical	LPCHCL41	4	-	-	-	-
CC-	PROJECT	LPCHPJ41	4	-	-	-	-

13(P)							
GEC-1	Non Major Electives	LPCHNM31	5	4	3	25	75
AEC-2	Chemistry SET/NET/CSIR -UGC	LPCHAE31	2	2	3	25	75
	Medicinal Paramedical Chemistry	LPCHAE32					
SLC-2	Environmental Chemistry	LPCHSC31			3	100	-
	Laboratory Safety Skills	LPCHSC32					
Ad.Cr.Co: MOOC	MOOC-2				-	-	-
			30	21			
SEMESTER IV							
Course type	**Title of the course**	**Course Code**	**Hrs/ Week**	**Credit**	**Exam Hrs.**	**CIA**	**Ext.**
CC-14	Organic Chemistry – IV	LPCHCT41	5	5	3	25	75
CC-15	Inorganic Chemistry – IV	LPCHCT42	5	5	3	25	75
CC-16	Physical Chemistry – IV	LPCHCT43	5	5	3	25	75
CC-12(P)	Physical Chemistry Practical	LPCHCL41	5	4	6	40	60
CC-13	PROJECT	LPCHPJ41	4	4	3	50(p)	50 (vv)
DSE-3	Polymer Chemistry	LPCHDS41	4	3	3	25	75
	Corrosion Science	LPCHDS42					
SEC-1	Nano Chemistry	LPCHSE41	2	2	3	25	75
	Material Chemistry	LPCHSE42					
Ad.Cr.Co: MOOC	MOOC-2		-	-	-	-	
			30	28			

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DEPARTMENT OF CHEMISTRY – PG –CBCS–LOCF

(For those who join in June 2022)

Title of the paper: ORGANIC CHEMISTRY - I	**Semester: I**
Course Code:LPCHCT11 Contact Hours: 5hrs/w	**Credits: 4**

Course Learning Outcomes:

On completion of the course, the students are able to:

- ✓ understand the concept of structure-activity relationship in organic reactions
- ✓ apply different reaction intermediates in explaining reaction mechanism and electron displacement mechanisms in organic chemistry.
- ✓ understand the concept of aromaticity in organic chemistry.
- ✓ gain knowledge on the different methods of determining presence of intermediates and reaction mechanism
- ✓ gain knowledge on the substitution reactions at saturated carbon and aromatic carbon, besides understanding the reaction mechanisms.

Pre-Required Knowledge:

- ✓ Rules for resonance
- ✓ Structure –Activity relationship
- ✓ Limitations of nucleophilic and electrophilic substitution reactions

UNIT-I: REACTIVE INTERMEDIATES AND ELECTRON DISPLACEMENT

Reactive Intermediates: Synthesis, geometry, stability and reactions of carbocations, carbanions, free-radicals, carbenes. Inductive and field effects – Resonance effect - Steric inhibition of resonance – Hyper conjugation – Hydrogen Bonding- Quantitative treatment of the effect of structure on reactivity – LFER - The Hammett relationship – significance of reaction and substituent constants – Application of the Hammett equation in reaction mechanism – Limitations and deviations - Taft equation.

UNIT II: AROMATICITY

Aromatic character in five, six, seven and eight member rings – Huckel's rule and Craig's rule – Concept of homoaromaticity and antiaromaticity – systems with 2,4,8 and 10 π electrons- systems with more than 10 π electrons – Alternant and non-alternant hydrocarbons. Chemistry of cyclopentadienyl anion - Fulvene – Azulene – Tropolones – Sydnones – Annulenes - Aromaticity based on ^{1}H NMR.

UNIT III: INTRODUCTION TO REACTION MECHANISM

Introduction – Principles of microscopic reversibility: Hammond postulate, Curtin-Hammett principle – Reaction Profile diagram – Kinetic vs Thermodynamic control – Kinetic Isotope effect: Primary and Secondary Kinetic Isotope effect – Methods of determining Reaction Mechanism: Identification of the product; Determination of the presence of intermediate by isolation, detection, trapping; isotopic labelling; cross-over experiments; stereochemistry.

UNIT IV: SUBSTITUTION AT SATURATED CARBON

Aliphatic nucleophilic substitution:

The S_N1, S_N2, mixed S_N1 and S_N2, SET, S_Ni mechanism – The neighboring group mechanism: participation by σ, π, and n electrons – Effect of substrate structure, leaving group, reaction medium on nucleophilic substitution reaction – nucleophilic substitution at allylic, trigonal and vinylic carbon – ambident nucleophiles and substrates: regioselectivity.

Aliphatic Electrophilic substitution:

Bimolecular mechanism, S_E2 and S_Ei – effect of leaving group and solvents.

UNIT V: SUBSTITUTION AT AROMATIC CARBON

Aromatic electrophilic substitution

Aromatic electrophilic substitution – Orientation – Reactivity – Partial rate factors – ortho/para ratio – Quantitative treatment of reactivity of the electrophile - the selectivity relationship – orientation in di-substituted benzene – orientation in other ring systems (naphthalene and anthracene only) – Effect of leaving group.

Aromatic nucleophilic substitution

The SN_{Ar}, S_N1, Benzyne and SR_N1 mechanism – Effect of substrate structure, leaving group and attacking nucleophile.

Suggested topics for group discussion/ presentations:

- ✓ Reactive oxygen species (ROS) impact on human beings
- ✓ Recent trends in detection of intermediates
- ✓ Regioselectivity in biological systems
- ✓ Structure- activity relationship in synthesis of drugs
- ✓ Orientation and selectivity of electrophilic substitutions in higher aromatic systems

Suggested Readings:

Text Books:

1. P. Sykes, Guide Book to mechanism in organic chemistry, Pearson, VI Edition, 2003.
2. Jerry March, M.B. Smith, Advanced organic chemistry. John-Wiley, VII Edition. 2015.
3. Jagadamba Singh and L.D.S. Yadav, Advanced Organic synthesis, PragatiPrakashan, II Revised Edition, 2007.
4. N. Tewari, Advanced Organic Reaction Mechanism, II Edition, Books & Allied (P) Ltd., 2007.
5. R.O.C. Norman, J.M. Coxon, “Principles of Organic Synthesis”, CRC Press, 2017.
6. S.M. Mukerji and S.P. Singh, “Reaction Mechanism in Organic Chemistry”, Macmillan India Ltd., Patna, 1990

Reference Books:

1. W. Carruthers and I. Coldham, "Modern Methods of Organic Synthesis", Cambridge University Press, Cambridge, 2015
2. Carey and Sundberg, Advanced Organic Chemistry – Structure & Mechanism Part A,V Edition Springer, 2008.
3. Jonathan Clayden, Nick Greeves, Stuart Warren, "Organic Chemistry" Oxford University Press, 2014.
4. E.S. Gould, Mechanism and structure in organic chemistry. Henry Holt & co, New York. 1959.
5. V.K. Ahluwalia, "Organic Reaction Mechanism", Narosa Publications, 2010.

Web Sources:

1. https://nptel.ac.in/courses/104/101/104101115/ or https://youtu.be/SXZrZNhpxbY
2. https://nptel.ac.in/content/storage2/ courses/ 104101005/downloads/Lecture Notes/chapter%205.pdf
3. https://www.youtube.com/watch?v=tcd2In933ig
4. https://www.youtube.com/watch?v=Z7nq-Dfd0kc
5. https://www.youtube.com/watch?v=ez40OIQrP60
6. https://www.youtube.com/watch?v=n4cIKKI3_eU

Title of the paper: INORGANIC CHEMISTRY – I **Semester: I**

Course code:LPCHCT12 **Contact Hours: 5hrs/w** **Credits: 4**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ understand the concepts of wave equation, operators and probability distribution curves
- ✓ predict the hybridization and geometry of molecules based on VSEPR theory.
- ✓ gain knowledge on the determination of lattice energy
- ✓ appreciate the role of metal ions in biological systems

Pre-Required Knowledge:

- ✓ Electronic configuration of s ,p, and d block elements
- ✓ Metal ions in biology
- ✓ Electrode potentials and electromotive forces

UNIT I: ATOMIC STRUCTURE AND WAVE MECHANICS

Wave mechanical concept of the atom – Wave equation - Operators- eigen function and eigen values- Orthogonality and Normalization of wave function –Hydrogen like atoms – Probability distribution curves - angular and radial wave function –significance of quantum numbers –shape of atomic orbitals – polyelectronic atom – Pauli's exclusion principle , Aufbau principle – Slater's rule and its applications - LS coupling scheme –Russell Saunders method –Term symbols of d^n configuration –Hund's rule –electronic configuration.

UNIT II: COVALENT BONDING

Qualitative treatment of VB and MO theories –symmetry and overlap - sigma and pi bonds - resonance- Hybridization - VSEPR theory – –applications of VB and MO theories to the structure of homo nuclear and hetero nuclear diatomic and linear triatomic molecules (BeH_2) –comparison of VB and MO theory –The concept of multi centre bond as applied to electron deficient molecules: diborane and Metal alkyls – Bonding in xenon compounds.

UNIT III: BOND PROPERTIES AND IONIC BONDING

Bond order- Bond energy- Bond length- Bond polarity – Partial ionic character –Electronegativity –Scales and applications electron affinity –Lattice energy –Born-Haber cycle –Covalent character in ionic compounds (Fajan's rule) – different types of electrostatic interactions – theory of hydrogen bonding.

UNIT IV: ELECTRODE POTENTIALS, ACID–BASE SYSTEMS AND NON-AQUEOUS SOLVENTS

Electrode potentials and electromotive forces –Application of electrode potentials in inorganic chemistry. A generalized acid-base concept –steric effects and solvation effects – Measures of acid-base strength –Hard and soft acids and bases –symbiosis –Theoretical basis of Hardness and softness Classification of solvents –properties of ionizing solvents –typical reactions in non-aqueous solvents: Liq.

NH_3,Liq. SO_2, Liq. HFand anhydrous H_2SO_4 - Molten salts as non –aqueous solvents.

UNIT V: BIO-INORGANIC CHEMISTRY

Metal ions in biology- sodium-potassium ion pump – ionophores – metalloporphyrins- cytochromes - transport and utilization – haemoglobin and myoglobin – dioxygen binding - synthetic oxygen carriers –photosynthesis and chlorophyll – Photosystem I and II – ferridoxins and rubredoxin – blue copper proteins - enzymes- enzymatic action- inhibition and poisoning – vitamin B_{12} and B_{12} coenzyme – nitrogen fixation –in vivo and in-vitro - metal toxicity and detoxification.

SUGGESTED TOPICS FOR GROUP DISCUSSION/PRESENTATIONS

- ✓ Electronic configuration of elements
- ✓ The concept of multi center bond
- ✓ Theory of hydrogen bonding
- ✓ Electrode potentials and electromotive forces
- ✓ Molten salts as non –aqueous solvents
- ✓ Metal toxicity and detoxification

Suggested Readings:

Text Books:

1. J.E. Huheey. E.A. Keiter and R.L. Keiter. Inorganic chemistry principles of structure and reactivity. IV Edn., Addison –Wiley publishing company. New York 1993.
2. D.F.Shriver and P.W. Atkins Inorganic chemistry .III edn. Oxford press. 1999.

Reference Books:

1. J.D. Lee. Concise Inorganic chemistry. V edn, ELBS Chapman and Hall. London 1996.
2. F.A. Cotton and Wilkinson. Advanced inorganic chemistry IV edn. John wiley& sons. New York. 1988.
3. K.F. Purcell and J.C. Kotz. Inorganic chemistry. W.B. Sauders Company. 1997.

4. E. Cartmell& G.W.A. Fowels. Valency and molecular structure. ELBS IV edn..1979.
5. H.H. Sisler. Chemistry in non –aqueous solvents. Chapman and Hall 1961.
6. Asim K Das, Bioinorganic Chemistry, Books and Allied (P) Ltd, Kolkata, 2007.

Web Sources:

1. https://nios.ac.in/media/documents/313courseE/L3.pdf
2. https://www.colby.edu/chemistry/PChem/Lecture2.html
3. http://eclass.bsnvpgcollege.co.in/Admin/WebDoc/pdf/Econtent_Pdf_Inorganic Chemistryfor 4thSemStudents.pdf
4. https://authors.library.caltech.edu/25052/1/BioinCh.pdf
5. https://www.colby.edu/chemistry/PChem/Lecture2.html
6. https://ncert.nic.in/textbook/pdf/kech104.pdf

Title of the paper: PHYSICAL CHEMISTRY - I **Semester: I**

Course code: LPCHCT13 Contact Hours: 5 hrs/w **Credits: 4**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ learn the principles of quantum mechanics of simple systems.
- ✓ know the limitations of classical thermodynamics in the evaluation of macroscopic properties.
- ✓ understand the principles of activity and fugacity.
- ✓ understand the principles of irreversible thermodynamics.
- ✓ know the concept of phase diagram.
- ✓ acquire the knowledge about polymers, mechanism and kinetics of polymerization

Pre-Required Knowledge:

- ✓ Bohr theory of hydrogen atom.
- ✓ Spectrum of the hydrogen atom.

- ✓ Block body radiation
- ✓ Basic concept of entropy

UNIT I: QUANTUM CHEMISTRY I

Birth of quantum mechanics-de Broglie's concept – experimental verification – Heisenberg's uncertainty principle-postulates of quantum mechanics. Methods of getting the following quantum mechanical operators – position, momentum, angular momentum, kinetic energy and total energy. eigen function, eigen value, degeneracy, orthogonality, normalization-derivation of Schrödinger wave equation.

Applications of SWE to simple systems: - free particle moving in 1D box, particle moving in 1D box-particle in 3D box; rectangular box, cubical box - rigid rotator-simple harmonic oscillator. (SWE and energy calculations)

UNIT II: THERMODYNAMICS AND NON-IDEAL SYSTEMS

Systems of variable composition – partial molar quantities – definitions – physical significance – chemical potential – variation of chemical potential with temperature and pressure. Determination of partial molar properties – Gibbs-Duhem equation – fugacity –Definition – determination of fugacity of real gases – variation of fugacity with pressure and temperature - Duhem - Margules equation. Activity and Activity coefficient – Determination of activity and activity coefficients of non-electrolytes (EMF method).

UNIT III: IRREVERSIBLE THERMODYNAMICS AND CHEMICAL EQUILIBRIUM

Third law of thermodynamics – Nernst heat theorem Planck, Lewis and Randall rule – Determination of absolute entropy – unattainability of absolute zero – apparent exceptions of third law. Non-equilibrium thermodynamics - Basic concept - forces and fluxes- Entropy of irreversible process - Entropy production - Phenomenological laws and Onsagar's reciprocal relations and the principle of microscopic reversibility and its Onsagar reciprocal relations.

UNIT IV: PHASE DIAGRAM

Definitions –phases, components and degrees of freedom – thermodynamic derivation of phase rule – One component systems- water system - Two components systems – simple eutectic – Lead-silver system – congruent melting point-Zinc – Magnesium and incongruent melting point-Benzene – Picric acid system. – Three component system – Triangular system – Liquid-liquid equilibria- One, Two and Three pair partially miscible pairs – Double salt formation congruently saturating compound –incongruently saturating compound.

UNIT V: POLYMER CHEMISTRY

Classification of polymers –polymerization mechanism – chemistry and kinetics – step-wise polymerization - kinetics of vinyl polymerization, kinetics of ionic polymerization, polymerization techniques – suspension polymerization and emulsion polymerization –molecular weight of polymers – Determination of molecular weight of polymer by osmometry, viscometry, light scattering and Ultracentrifuge methods.

SUGGESTED TOPICS FOR GROUP DISCUSSION / PRESENTATIONS:

- ✓ Postulates of quantum mechanics
- ✓ Determination of fugacity of real gases
- ✓ Determination of absolute entropy
- ✓ Three component system
- ✓ Determination of molecular weight of polymer

Suggested Readings:

Text Books:

1. A.K.Chandra Introductory quantum chemistry. 3rd edn., Tata Mc Graw Hill Publishing Co. New Delhi, 1988.
2. S. Glasstone, Thermodynamics for chemistry Van Mostrand Co. In. New York, 1969.
3. V.R. Gowariker, N.V. Viswanathan and JayadevSreedhar, Polymer Science, Wiley Eastern Limited, 1986.

Reference Books:

1. I.N. Levine quantum chemistry, Allyn and bacon. Boston. 1983.
2. H.W. Hanna. Quantum Mechanics in chemistry, Benjamin / Cummings Publication, 1985.
4. D.A. McQuarrie. Quantum Mechanics in chemistry. Oxford University Press. 1983.
5. P.W. Atkins. Molecular Quantum Mechanics. Oxford University Press. 2nd edn., 1986.
6. D.A. McQuarrie and J.D. Simon. Physical Chemistry - a molecular approach. Viva Books (P) Ltd., New Delhi,.1998.
7. Kuriacose and Rajaram, Thermodynamics ShohanLal and Co., Delhi, 1986.
8. K.L. Kapoor, Text book Physical Chemistry, Mac Milan India Ltd., Delhi, 1986.
9. S.H. Maran and J.B. Lando fundamentals of physical chemistry, Collien Macmillan International edition, New York, 1974.
10. G.W. Castellan. Physicalchemistry 2nd edition. Addison – wiley. Massachusetts 1980.
11. R.A. Albertyand R.J. Silbey- physical chemistry John-Wiley & Sons Inc-New York, 1992.
12. F.W. Billmeyer Jr. Text Book of polymer science. John wiley& Sons Inc 1971.
13. F.Rodrigeez. Principle of polymer systems. Tata –Mc Graw Hill Publishing Co., Delhi, 1974.

Web Sources:

1. https://nptel.ac.in/courses/104/101/104101126/
2. https://nptel.ac.in/courses/103/101/103101004/
3. https://www.youtube.com/watch?v=0xhUGYDKpGw

Title of the paper: Analytical Techniques and Bio-Organic Chemistry **Semester: I**

Course code: LPCHDS11 **Contact Hours: 5hrs/w** **Credits: 4**

Learning outcomes:

On completion of the course, the students are able to

- ✓ know the principle and applications of ORDand CD

- ✓ understand the basic principle ofvarious chromatography techniques.
- ✓ acquire the basics of drug design, antibiotics and vitamins.
- ✓ explain the various concepts in bio-organic chemistry.
- ✓ understand the concepts of proteins and Amino acids

Pre-Required Knowledge:

- ✓ Column Chromatography
- ✓ Analogues and Prodrugs
- ✓ Molecular adaptation
- ✓ Nucleic acids

UNIT I: ANALYTICAL AND SEPARATION TECHNIQUES

ORD and CD – principle - Cotton effect – type of ORD curves, axial α-haloketone rule – octant rule – application to determine the configuration and conformation of simple monocyclic and bicyclic ketones- comparision of ORD and CD.

Classification of chromatography – principles and techniques of Column Chromatography, Thin Layer Chromatography, and paper chromatography. Principles and applications of HPLC, GC, ion-exchange techniques and Gel permeation chromatography.

UNIT II: MEDICINAL CHEMISTRY AND VITAMINS

Drugs – Introduction – Analogues and Prodrugs – Factors governing drug design – Drug design through Conjunction and Disjunction approach – Factors governing ability of drugs to reach active site – Isosterism and Bio-isosterism.

Antibiotics – Classification – Structure, Structure Activity Relationship (SAR) and Therapeutic uses of Chloramphenicol, Pencillin G, Erythromycin.

Vitamins – Classification – Source, Structure (Elucidation not required), deficiency and therapeutic uses of Vitamin A, B1, B2, B6, C and E.

UNIT III: BIO-ORGANIC CHEMISTRY- I

Chemistry in Biosystems – chirality, molecular asymmetry and prochirality –proximity effect – molecular adaptation - Reversible and irreversible inhibition – transition state analogs

– antibodies as enzymes – suicide enzyme inactivators and affinity labels.

UNIT IV: BIO-ORGANIC CHEMISTRY – II

Classification of proteins – peptides – primary (Ramachandran plot), secondary and tertiary structure of peptides – synthesis of peptides – amino acids – determination of amino acids – structural elucidation of oxytocin and glutathione – biosynthesis of amino acids.

UNIT V: BIO-ORGANIC CHEMISTRY – III

Components of Nucleic acids – Nucleosides - Nucleotides – polynucleotides - laboratory synthesis of nucleotides and nucleosides – Deoxyribonucleic acid – synthesis – Watson-Crick model of the double helical structure of DNA – Ribonucleic acid – synthesis, structure, types of RNA - difference between DNA and RNA.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- Gel permeation chromatography.
- Antibiotics and its classification
- Chemistry in biosystems
- Classification of proteins
- Watson- Crick model of the double helical structure of DNA

Suggested Readings:

Text Books:

1. A. Braithwaite and F.J. Smith, “Chromatographic methods”, Chapman and Hall, IV Edition, 1985.
2. B.K. Sharma, “Instrumental Methods of Chemical Analysis”, Goel Publishing House, Meerut, 1995.
3. D. Nasipuri, “Stereochemistry of organic compounds: Principles and application”, Wiley Eastern II edition, 1994.
4. Herman Dugas and C. Penny, “Bio-organic chemistry: A Chemical approach to enzyme action”, Springer- Verlag, 1995.
5. I.L. Finar, “Organic chemistry, Vol. I & II 5th Edition, ELBS 1975.

References Books:

1. A.L. Lehninger, “Principles of Biochemistry”, Worth *Publishers*, New York, 1982.
2. Ashutoshkar, “Medicinal chemistry”, New Age International Publishers, IV Edition, 2012.
3. Jayashree Gosh, “A Text Book of Pharmaceutical Chemistry”, S. Chand & Co., II Revised Edition, 2003.
4. P.S. Kalsi, J.P. Kalsi, and A. Choudhary,“ Bio-organic, Bio-inorganic and Supra molecular Chemistry”, New Age International Publishers, IV Edition, 2020.

WebSources:

1. https://youtu.be/OIFXMhgKfrA
2. https://youtu.be/XMtmSz_9umk
3. https://youtu.be/OTeXkbJj9bk
4. https://youtu.be/NGwP471sehI
5. https://youtu.be/H5gI_X1tDNQ
6. https://youtu.be/Sl_JDjsssIM
7. https://youtu.be/z2JEDeGkfCc
8. https://youtu.be/J6R8zDAl_vw
9. https://youtu.be/0lZRAShqft0

Title of the paper: DRUG DESIGN **Semester: I**

Course code: LPCHDS12 Contact Hours: 5hrs/w **Credits: 4**

Learning Outcomes:

On completion of the course, the students are able to

- ✓ master the pharmacokinetics and its use in drug design
- ✓ explain the variations in the biological activities of stereoisomers
- ✓ analyse and predict the structure –activity relationship and structureactivity-relationship
- ✓ gain knowledge on the basic concepts and the general technique used in combinatorial synthesis

Pre-Required Knowledge:

- ✓ Pharmacokinetics models
- ✓ The design of combinatorial syntheses

- ✓ History and evolution of chemoinformatics
- ✓ Molecular modeling
- ✓ Bioisoteres

UNIT I: INTRODUCTION TO DRUG DESIGN

a) ADME Properties

The pharmacokinetics phase - Adsorption - Distribution, Metabolism - Elimination - Bioavailability of drug. Intravascular and Extravascular administration. The use of pharmacokinetics in Drug dsign.

b) Pharmacodynamics - Stereoelectronic structure.

UNIT II: DRUG DISCOVERY BY DESIGN

Streochemistry and Drug Design: Structurally rigid Groups – procaine, Acetylcholine. Conformation - Syn and Anti Acetylcholine, Phenyl ethanoate, methiodides. Configuration-Variations in the biological activities of stereoisomers

UNIT III: STRUCTURE–ACTIVITY –RELATIONSHIP (SAR)

Changing the size and shape - Changing the degree of unsaturation - Introduction or removal of ring system - Introduction of new substituents: methyl group, Halogens, hydroxyl groups, Basic groups, carboxylic and sulphonic acid groups - Changing the existing substituents of lead – isosteres.

UNIT IV: QUANTITATIVE-STRUCTURE ACTIVITY-RELATIONSHIP (QSAR)

Partition parameters - partition coefficients(p), Lipophilic subtituents constants (π) Electronic parameters - The Hammett constants - Steric parameters - The Taft Steric parameters (Es), Molar refractivity (MR), Hansch analysis-craig plots - Computer – aided drug design - Modelling Drug - Receptor Interaction.

UNIT V: COMBINATORIAL CHEMISTRY

Basic concepts - The general technique used in combinatorial synthesis i) Solid support method - parallel synthesis – Furka's mix and spilt techniques - sequential chemical tagging methods - Still's binary code Tag system

computerised tagging - ii) Combinaterial synthesis in solution iii) Screening and deconvolution

SUGGESTED TOPICS FOR GROUP DISCUSSION / PRESENTATIONS:

- ✓ Drug Metabolism
- ✓ Structural Activity Relationship
- ✓ The Hammett constants
- ✓ Polymers in drug delivery systems.
- ✓ Nanomedicines

Suggested readings:

Text Books:

1. Gringuage, Introduction to Medical Chemistry, Wiley – VCH, 2004.
2. Jayashree Ghosh, *Pharmaceutical Chemistry*, S. Chand and Company Ltd., New Delhi, 2006.
3. Ashutoshkar, *Medicinal Chemistry*, Wiley Eastern Ltd., New Delhi. 1993.

Reference Books:

1. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed., Robert F.Dorge, 2003.
2. S.S.Pandeya and J.R.Dimmock, An Introduction to Drug Design, New Age International, 2006.
    1. Burger's Medicinal Chemistry and Drug Discovery,Vol-1 (Chapter-9 and Ch-14) Ed., M.E.Wolff, John Wiley, 2005.
    2. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill, 2006.
    3. The Organic Chemistry of Drug Design and Drug Action by Silverman R. B., 2nd Edn., Academic Press. 2012.
    4. D. Lednicer, Strategies for Organic Drug Synthesis and Design, John Wiley. M.L Gangwal Medicinal chem. istry Lectures on Drug design and Synthetic Drugs, Student Publishing House, 2007.Academic Press, 2006

5. Jürgen,B.(2004),Chemoinformatics Concepts, Methods, and Tools for Drug Discovery,
6. SpringerA. Gringauz, Introduction to Medicinal Chemistry, How Drugs Act and Why?, John Wiley and Sons, 1997.

Web Sources:

1. https://jcpjaipur.com/wp-content/uploads/2020/05/ Medicinal-Chemistry-Unit-I.pdf
2. https://www.fpharm.uniba.sk/uploads/media/Seminar_ 1_from_ Pharmaceutical_chemistry_I_02. pdf
3. https://www.oecd.org/chemicalsafety/risk-assessment/introductiontoquantitativestructureactivityrelationships.htm
4. https://www.youtube.com/watch?v=x0UqTZcuFdE
5. https://www.youtube.com/watch?v=lUxkcEoGkVg
6. https://www.youtube.com/watch?v=UHEXXGiegd0
7. https://www.youtube.com/watch?v=4-4HIPjAs-M&t=49s

Title of the paper: Organic Chemistry Practical		**Semester: I & II**
Course Code: LPCHCL21	**Contact Hours: 5+5hrs/w**	**Credit: 4**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ separate and analyse the organic compounds in the two-component organic mixture
- ✓ prepare derivatives for the analysed compounds and detect its melting point.
- ✓ carryout two stage organic preparations
- ✓ techniques involved in the estimation of glucose, glycine and ketone group.
- ✓ Analyse the spectrum of synthesized compounds using FT-IR, NMR, LC-MS.

EXPERIMENTS

1. Qualitative analysis: Separation and analysis of two component mixtures. Identification of components and preparation of solid derivative.

2 Two-stage organic preparations (Structures drawing using ChemDraw for the two stage preparations):
   a) p-Nitroaniline from acetanilide
   b) p-Bromoaniline from acetanilide
   c) m-Nitrobenzoic acid from methyl benzoate
   d) Benzanilide from benzophenone
   e) sym-Tribromobenzene from aniline
3. Quantitative analysis
   a) Estimation of glucose by Lane and Eynon's method
   b) Estimation of glucose by Bertrand's method.
   c) Estimation of ethyl methyl ketone or acetone
   d) Estimation of glycine
   e) Determination of unsaturation
4. Spectral analysis of synthesized compounds using FT-IR, NMR, LC-MS etc., (Optional)

   Note: Any one of the above estimations and any one two stage organic preparation / qualitative analysis will be given in the external examination.

Question Pattern:

1. a). Estimation of an organic compound (glucose, ethyl methyl ketone, HCHO and glycine)
   b). Two stage organic preparation.
   (Or)
2. a). Estimation of an organic compound (glucose, ethyl methyl ketone, HCHO and glycine)
   b). Separation and analysis of two component mixture

Suggested Readings

Text Books:

1. Basic Principles of Practical Chemistry, Kulandaivelu A.R., VeeraswamyR.Venkateswaran, Sultan Chand & Sons, 2017.
2. Vogel's Text book of Practical Organic Chemistry, Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith, Fifth Edition, Bath Press, Great Britan, 1989

Reference Books:

1. Practical Chemistry, Pandey D.N., Sultan Chand Publishers, 2018.

2. Vogel's Textbook of Quantitative Chemical Analysis, G H Jeffery, J Bassett, J Mendham, R C Denney, Fifth Edition, Bath Press, Great Britan, 1989

Web Sources:

1. https://nptel.ac.in/courses/104/106/104106108/
2. https://nptel.ac.in/courses/104/106/104106108/#

Title of the paper: Inorganic Chemistry Practical **Semester: I & II**

Course code: LPCHCL22 **Contact Hours: 5+5hrs/w** **Credits: 4**

Course Learning Outcomes:

On the completion of the course the student will be able to

- ✓ perform Semi micro qualitative analysis of inorganic mixture containing four cations
- ✓ estimate one metal ion in the presence of Pb impurity by complexometric titration.
- ✓ understand the techniques involved in Inorganic complex preparations
- ✓ carryout the separation and estimation of mixtures by volumetric and gravimetric methods
- ✓ understand the thermal and spectroscopic characterization of the prepared inorganic complexes using like UV and IR spectroscopic techniques.

Semi micro qualitative analysis:

1. Analysis of mixtures containing two familiar and two less familiar cations from the following:
   Less familiar: W, Mo, Se, Te, Ce, Th, Zr, V, U, Li
   Familiar:Pb, Cu, Bi, Cd, Mn, Zn, Co, Ni, Ca, Sr, Mg
   (Insoluble and interfering anions may be avoided)
2. Estimation of one metal ion (Cu, Ca, Zn and Mg) in the In the presence of Pb impurity by complexometric titration.
3. Inorganic preparations Preparation of at least any 5 inorganic complexes

1	$VO(acac)_2$	9	$[Ni\ (DMG)_2]$
2	$K_3[Fe(C_2O_4)_3]$	10	$[Cu(NH_3)_4]SO_4.H_2O$
3	Prussian Blue, Turnbull's Blue	11	$K_3[Cr(C_2O_4)_3]$
4	Cis-$[Co(trien)(NO_2)_2]Cl.\ H_2O$	12	$[Cu(thiourea)_3]Cl$
5	$Na[Cr(NH_3)_2(SCN)_4]$	13	$[Co(NH_3)_5]\ (NO_2).(NO_3)_2$
6	$Hg[Co(SCN)_4]$	14	$[Mg(C_9H_6ON)_2].\ 2H_2O$
7	$[Fe(acac)_3]$		
8	$[Ni\ (NH_3)_6]Cl_2$		

4. Inorganic Quantitative analysis: Separation and estimation of mixtures by volumetric and gravimetric methods. Some typical recommended mixtures are Cu and Ni, Cu and Zn, Cu and Fe, Ca and Ba, Ni and Zn.
5. Spectral characterization of any two inorganic complexes – class work (Demonstration only)

a). Evaluation of 10 Dq, β' and β from UV-Visible spectrum.

b). Evaluation of IR frequencies of stretching and bending vibration of selected inorganic complexes.

c). Calculation of g and A values from EPR spectrum evaluation.

d). Evaluation of thermal stability of inorganic complexes by TGA, DTA and DSC studies.

QUESTION PATTERN

1. Analyse systematically the given inorganic mixture containing two familiar and two less familiar cations.
2. Estimation of the amount of any one metal ion (Cu or Zn or Mg) by complexometric titration.

   (Or)
3. a). Estimate the amount of two metal ions present in a mixture, one by volumetrically and another by gravimetrically

   b). Preparation of any one inorganic complex

Suggested Readings:

Text books:

1. V.V. Ramanujam, Inorganic Semi-micro Qualitative Analysis, 3rd edn., The National Publishing Company, Chennai, 2004.
2. D.V. Jahagirdar, Experiments in Chemistry, Himalaya Publishing House, 2nd Edition, Reprint 2018
3. V. Venkateswaran, R. Veeraswamy, & A.R. Kulandaivelu, Basic Principles of Practical Chemistry, 2nd Edition, New Delhi: S. Chand Publications, 2004.

Reference Book:

1. Vogels Text book of Qualitative Inorganic Analysis, Addition Wesley Longman, 7thedn., 2001.

Web Sources:

1. https://www.iitg.ac.in/juba/CH425.pdf
2. http://wwwchem.uwimona.edu.jm/lab_manuals/c21 jexpt. html

Title of the paper: ORGANIC CHEMISTRY – II		**Semester: II**
Subject Code: LPCHCT21	**Contact Hours: 5hrs/ w**	**Credits: 4**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ master the stereochemistry and conformational analysis
- ✓ explain the reaction mechanism and summarize rearrangement reactions
- ✓ develop skill to analyze and predict the structure of organic molecules using spectral techniques
- ✓ gain knowledge on the synthesis and characteristics of novel ring system.
- ✓ elucidate the structure and properties of carbohydrates

Pre-Required Knowledge:

- ✓ Introduction of isomerism and confirmation
- ✓ Principles of spectroscopy

✓ Nomenclature of organic compounds

UNIT I: STEREOCHEMISTRY

Optical isomerism – Conditions for optical activity - concept of chirality - The Cahn-Ingold-Prelog system of nomenclature – Enantiotopic and diastereotopic atoms, groups and faces – Molecules with more than one chiral centre – Molecular dissymmetry – Optical activity of biphenyls, allenes and spirans – Stereo-specific and stereo-selective synthesis – Asymmetric synthesis – enantioselectivity – diastereoselectivity - Cram's rule – Prelog's rule and Felkin-Anh model.

Geometrical Isomerism: Determination of configuration of geometrical isomers using physical and chemical methods – Stereoisomerism in monocyclic compounds (upto six – membered ring)

UNIT II: CONFORMATIONAL ANALYSIS

Configuration and conformation - conformations of ethane and *n*-butane – conformational analysis – stereoelectronic and steric factors – conformation of simple alicyclic compounds - conformation of mono-substituted and disubstituted cyclohexane –conformations of decalins and perhydrophenanthrene – correlation of the conformation of acyclic and cyclic systems with their physical and chemical properties – conformational free energy difference and its determination - quantitative treatment of mobile system - Eliel-Rho equation – conformation and reactivity of cyclohexanones.

UNIT III: REARRANGEMENT REACTIONS

Detailed Mechanism and applications of the following rearrangement reactions: Rearrangement at electron deficient centre:

i) Carbon: Wagner - Meerwein rearrangement, Pinacol – Pinacolone rearrangement and Demjanov rearrangement.
ii) Nitrogen: Hofmann rearrangement, Beckmann rearrangement andCurtius rearrangement.
iii) Oxygen; Baeyer-Villeger oxidation and Dakin reaction
iv) Rearrangement at electron rich centre:

a) Favorskii rearrangement, Steven rearrangement andSommelet-Hauser rearrangements.

b) Aromatic rearrangements: Fries, Claisen and Benzidine rearrangements.

UNIT IV: UV, IR AND MASS SPECTROSCOPY

UV Spectroscopy – Woodward-Fieser rules - absorption spectra of conjugated dienes - α,β-unsaturated carbonyl compounds - effect of solvent.

IR Spectroscopy- Diatomic molecules – selection rules – Polyatomic molecules – IR vs Raman spectrum – Band shapes and intensity – DRS - Identification of functional groups by IR analysis - factors influencing group frequencies – Interpretation of IR Spectra – Finger print region.

Mass spectroscopy– type of ions – base peak – parent ion – nitrogen rule - metastable ions and isotopic ions - fragmentation – general rules - pattern of fragmentation for various classes of compounds – Mc Lafferty rearrangement and Retro –Diels Alder reaction – Applications: GC-MS, and LC-MS.

UNIT V: NOVEL RING SYSTEM AND CARBOHYDRATES

Novel ring System:

Nomenclature of bicyclic and tricyclic systems – Structure, synthesis and reactivity of Adamantane, Structure and synthesis of Cubane, Bullvalene (Fluxional molecule), Catenanes and Rotoxanes.

Carbohydrates:

Ring structure of the monosaccharide – Methods for determining the size of sugar rings – Structural elucidation of sucrose, maltose - Configuration and Conformation of lactose and cellobiose – Structure, preparation, properties and uses of starch, cellulose and amino-sugars.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- ✓ Asymmetric synthesis
- ✓ Configuration and conformation of organic compounds
- ✓ Mechanism and applications of the rearrangement reactions

- ✓ Spectroscopy
- ✓ Carbohydrate Chemistry

Suggested Readings

Text Books:

1. R.S.Dhillion, I.P.Singh, C.Baskar, “Stereochemistry”, Narosa Publishing House, 2014
2. D. Nasipuri, Stereochemistry of organic compounds:Principles and application Wilev Eastern II Edition 1994.
3. P.S. Kalsi, Stereochemistry. Conformation and mechanism Wilev Eastern, 1991.
4. Jagadamba Singh and L.D.S. Yadav, Advanced Organic synthesis, PragatiPrakashan, II Revised Edition, 2007.
5. V.K. Ahluwalia, “Organic Reaction Mechanism”, Narosa Publications, 2010.
6. Kemp, Organic spectroscopy,ELBS with Macmillan, 1975.
7. B.M Silverstein. G.C. Bassler and T.C. Morrill, Spectrometric identification of organic compounds John Wiley & Sons, New York, V Edition, 1991.
8. L. Pavia, Introduction to Spectroscopy, Amazon.ca, 1999.
9. S.K. Dewan, Organic Spectroscopy,CBS Publishers, I Edition, 2010.
10. V.K. Ahluwalia, R. Aggarwal, “Alicyclic Chemistry”, Ane Books Pvt. Ltd., I Edition, 2009.
11. S.C. Pal, “Nomenclature of Organic Compounds”, Narosa Publishing House, I Edition, 2006.

Reference Books:

1. K. Mislow, Introduction to Stereochemistry. Benjamin 1966.
2. E.L. Eliel, Stereochemistry of carbon compounds, McGraw-Hill, New York, 1962.
3. I.L Finar, Organic chemistry, Vol. 2, V Edition ElBS 1975.
4. R.O.C. Norman, Organic synthesis III Edition 1993.
5. W.Carruthers, Some modern methods of organic synthesis Cambridge University Press II Edition, 1982.
6. J.R. Dyer, Application of adsorption spectroscopy. Prentice Hall, 1965.

7. I.Howe. D.H. Williams and R.D. bowen, Mass spectroscopy Principles and applications Mcgraw Hill, II Edition 1981.
8. F.J.McQuillin and M.S.Baird, Alicyclic Chemistry, II Edition, Cambridge Univ. Press. 1983.

Web Sources:

1. https://onlinecourses.nptel.ac.in/noc19_cy25/preview
2. https://www.youtube.com/watch?v=FFqfM1cN89w
3. https://www.youtube.com/channel/UCo-V97xlCS5VmGnkhLjGTfg/playlists
4. https://www.youtube.com/watch?v=4CjTT5CQ-Jw
5. https://nptel.ac.in/courses/104/106/104106108/#
6. https://www.youtube.com/watch?v=mC3QKnkovaY
7. https://www.youtube.com/embed/Q2xXlJfYHdg
8. https://www.youtube.com/watch?v=iuW3nk5EADg

Title of the paper: Inorganic Chemistry -II		**Semester: II**
Course code:LPCHCT22	**Contact Hours: 5hrs/w**	**Credits: 4**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ evaluate various unit cell parameters like density, Avagadro number.
- ✓ acquire the knowledge of stability constant and isomerism of coordination compounds.
- ✓ understand the concepts and applications of VBT and CFT of coordination compounds
- ✓ study the structure and stability of nitrosyls, dioxygen and dinitrogen complexes
- ✓ gain knowledge on bonding on iso-polyacids and hetero polyacids

Pre-Required Knowledge:

- ✓ Double salt, Complex salt and Werner's theory of coordination complexes
- ✓ Types of solid forces

- ✓ History & common notation used in organometallic chemistry

UNIT I: SOLID STATE CHEMISTRY – I

Symmetry in crystal – space lattice – Unit cells – Crystal system – Bragg's equation - Rotating crystal method and powder method of X-ray diffraction - Neutron diffraction: (Elementary treatment) - Miller indices Screw axis and Glide plane – Evaluation of Unit cell dimensions (density, Avogadro number etc.) – Packed arrangement of atoms – Radius ratio rule – Structure of crystal lattices such as AB type (CsCl, ZnS), AB_2type (CaF_2, TiO_2, CaC_2, CdI_2), nickel arsenide-structure of graphite, diamond andpervoskite.

UNIT II: COORDINATION CHEMISTRY-I

Nomenclature mononuclear and dinuclear complexes – types of ligands – monodentate, Polydentate, ambidentate and macrocyclic ligands – Isomerism and Types of Isomerism - chelates effect and its applications- stability constant-Definition and types– factors affecting stability constant - determination of stability constant - Job's method. Sidgwick theory, EAN and formation of metal-metal bond in dimers - Valence bond theory: hybridization, geometry, magnetism, drawbacks of VBT.

UNIT III: COORDINATION CHEMISTRY-II

Crystal field theory: crystal field effects, assumptions of crystal field theory, crystal field splitting in octahedral and tetrahedral geometries, qualitative crystal field splitting diagrams-high-spin and low-spin complexes, factors affecting the magnitude of Δ, calculation of CFSE- spectrochemical series, Nephelauxetic series -Jahn Teller Theorem and its applications-Dynamic and Static Jahn Teller. Effect-, crystal field splitting in tetragonally distorted octahedral geometry and in square planar geometry. Applications of CFT-Spinal and inverse spinal- Molecular orbital theory: Molecular orbital approach to bonding in octahedral complexes, ML_6 -π Donor Ligands (L→M) and π Acceptor Ligands (M→L)

UNIT IV: ORGANOMETALLIC CHEMISTRY – I

Introduction and stability – 16 and 18 electron rule isolobal fragments– metal carbonyls complexes – IR studies – metal carbonyl hydrides - nitrosyls, dioxygen and dinitrogen complexes – application of EAN rule – synthesis , properties, structure and bonding in ferrocene, arene, olefine, acytelene, cyclopentadienyl complexes – metallocenes of Rh,Os and Ni.

UNIT V: INORGANIC CHAINS, RINGS AND CAGES

Polyacids - Isopoly and heteropoly acids – Structure and bonding of 6- and 12 – isopoly and heteropoly anions.- P-N compounds (phosphonitrilic chlorides)-S-N compounds – S_4N_4, $(SN)_x$.- borazines- -boranes- styx number and Wade's rule. Carboranes - Types of carboranes such as nido, closo, arachno – preaprtion, properties and structure. A general study of Metallocarborane.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- ✓ Normal and Inverse Spinels
- ✓ Quazi crystals
- ✓ Metallocarboranes
- ✓ Structure and bonding of ferrocene
- ✓ STYX number and wade's rule

Suggested Readings:

Text Books:

1. Gary L Miessler and DolnaldATarr, Inorganic Chemistry, 3rd edition, Peason education, 2009
2. R S Drago, Physical methods in inorganic chemistry, Affiliated East-west press Pvt Ltd, New Delhi,1993.
3. J.E. Huheey ,E.A . Kaiter and R. L .Keiter Inorganic chemistry: Principle of structure and reactivity, Harper Collins college publishers, IV edition, 1993.

Reference Books:

1. F.A. Cotton and Wilkinson, Advanced inorganic chemistry, Vledn., John wiley& Sons, New York, 2007.

2. K. F. Purcell and J.C Kotz Inorganic chemistry, Hottsaundersinternational edition, 1987
3. F. Basolo and R.G. Pearson, Mechanism of inorganic chemistry, Wiley eastern limited 1967.
4. R S Drago, Physical methods in inorganic chemistry, Affiliated East-west press Pvt Ltd, New Delhi,1993.
5. D. Sutten – Electronic spectra of transition metal complexes, McGraw-Hill, 1968.
6. E.A.B. Ebsworth D.W.H Rankin and S. Gadock, Structural methods in inorganic Chemistry, Blackwell Scientific Publication, 1987.
7. L.M Jackmann and E.A Cotton, Dynamic nuclear magnetic resonance spectroscopy, Academic Press, New York, 1975

Web Sources:

1. http://nptel.ac.in
2. http://swayam.gov.in
3. mooc.org
4. https://www.coursera.org
5. https://edurev.in/studytube/Introduction-Coordination-Chemistry--Inorganic-Che/707fd345-3c3b-476e-8977-988cafbf1120_t
6. https://www.youtube.com/watch?v=iT0PpN7y64M
7. https://www.youtube.com/watch?v=_59hmlZ9CuI
8. https://www.youtube.com/watch?v=s5b3Ot0qEig
9. https://www.youtube.com/watch?v=yxBCh7T67Yk

Title of the paper: Physical Chemistry – II		**Semester: II**
Course code:LPCHCT23	**Contact Hours: 5hrs/w**	**Credits: 4**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ understand the quantum theory and wave mechanical concept
- ✓ learn the Collision theory and the theory of unimolecular reactions with chain reactions
- ✓ understand the Debye-Huckeltheory, conductmetric titrations and its applications, EMF applications.

- ✓ understand the types of over voltage with theories-Types of Corrosion, polarography, storage battery, and Fuel cells.
- ✓ learn the Boltzmann distribution law and its derivation-Quantum Statistics, thermodynamics properties from partition function and Debye's theories of heat capacities of solids.

Pre-Required Knowledge:

- ✓ VBT and MOT for hydrogen molecule and H_2^+
- ✓ Zeta potential - electro osmosis- electrophoresis-streaming potential
- ✓ Iron-Nickel Oxide Cells, Zinc-Nickel Oxide Cells, Zinc-Silver Oxide Cells.

UNIT I: QUANTUM CHEMISTRY–II

SWE for Hydrogen atom problem-separation of variables-Radial distribution Probability and shapes of atomic orbitals – Need for approximation method – SWE for Helium atom and many electron atoms – Perturbation theory (first order only) – Variation method - Tunneling effect – Secular equation – Secular determinant – HarteeFock SCF Method for many electron systems and its application to He atom – Pauli asymmetric principle-Born Oppenheimer approximation – MO treatment for hetero and homo nuclear atomic molecules.

UNIT II: CHEMICAL KINETICS

Simple collision theory- ARR theory- potential energy surfaces- Theory of unimolecular reactions – Lindemann – Hinshelwood - RRKM and slater treatment – kinetic isotopic effect- chain reactions – study of oxygen hydrogen explosive reactions- Decomposition of acetaldehyde – decomposition of N_2O_5 – reaction in solution- significance of volume of activation primary and secondary salt effects.

UNIT III: ELECTRO CHEMISTRY–I

Debye- Huckel theory – Derivation of Debye- Huckel Onsagar equation – Experimental verification- Wien Effect – Debye falken hagen effect- Debye – Huckel limiting law - Conductometry –types of conduct metric titrations and its

applications (Determination of solubility product, degree of dissociation of weak acid). Standard Electrode Potential and EMF – Concentration cells with and without transference –- Determination of equilibrium constant, dissociation constant and solubility product.

UNIT IV: ELECTRO CHEMISTRY–II

Over voltage-Hydrogen , oxygen over voltage- Theories of over voltage – Corrosion – Types of corrosion – Prevention of corrosion – Butler –Volmer equation. Tafel equation- voltametry- polarography- half wave potential- application of polarography-coulometric analysis, primary and secondary coulometric titrations-storage battery- Lead acid storage battery – Nickel– cadmium cell - Fuel cells - H_2-O_2 fuel cell - Hydrocarbon – O_2 cell.

UNIT V: STATISTICAL THERMODYNAMICS

Definition- state of a system- Ensembles- (microcanonical, canonical and grand)- Boltzmann distribution law and its derivation- Quantum Statistics - Bose-Einstein - Fermi- dirac statistics- derivation- Boltzmann-planck equation- partition function- thermodynamics properties from partition function- partition function and equilibrium constant- translational, rotational and vibrational partition function - negative Kelvin temperature. Einstein's and Debye's theories of heat capacities of solids.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- ✓ Shapes of atomic orbitals
- ✓ Lindemann theory of unimolecular reactions
- ✓ Debye – Huckel limiting law
- ✓ Fuel cells
- ✓ Einstein's and Debye's theories of heat capacities of solids

Suggested Readings

Text Books:

1. A.K.ChandraIntiductory quantum chemistry. 3re edn.. Tata Mc Graw Hill Publishing Co.. New Delhi. 1988.

2. K.J. Laider. Chemical Kinetics. McGraw—Hill, New York, 2nd edn., 1965.
3. B.Viswanathan, S.Sundaram, R.Venkataraman, K.Rengarajan and P.S.Raghavan; Principles and Application of electrochemistry,1st edition S.Viswanathan(Printers & Publishers) PVT; LTD.2007
4. S. Glasstone. Thermodynamics for chemists, D. Van Nostrand Company, Incorporated, 1947.

Reference Books:

1. I.N.Levine quantum chemistry, Allyn and bacon. Boston.1983
2. M.W. Hanna. Quantum Mechanics in chemistry, Benjamin.
3. D.A. McQuarrie. Quantum Mechanics in chemistry. Oxford University Press.1983.
4. P.W. Atkins. Molecular Quantum Mechanics. Oxford University Press. 2nd edn.. 1986.
5. D.A. McQuarrie and J.D. Simon. Physical Chemistry- a molecular approach. Viva Books (P) Ltd.. New Delhi.1998.
6. K.J. Laider. Theories of chemical reaction rates, McGraw-Hill, 1969.
7. F. Wilkinson. Chemical Kinetics and Reaction Mechanism. Van Nostrandreinhold Co., New York. 1980
8. S. Galsstone. An Introduction to Electrochemistry. Van Nostrand Co. Inc., New York,1942.
9. L. Antropov. Theoretical electrochemistry. MIR Publications. Moscow.1972.
10. J.O.M. Bockris and A.K.N. Reddy. Modern Electrochemistry Vol.I and II. Springer, 2000
11. D.R. Crow. Principles and Application of electrochemistry. Chapman and Hall. 1988.
12. F.W Sears and G.L. salinger. Thermodynamic. Kinetic theory and Statistical Thermodynamics, Narosa Publishing House, New Delhi, 3rd edition, 1998.

Web Sources:

1. https://nptel.ac.in/courses/104/105/104105041/
2. https://nptel.ac.in/courses/104/101/104101126/
3. https://www.youtube.com/watch?v=6oeN9VDFLig

4. https://nptel.ac.in/courses/104/108/104108057/
5.https://nptel.ac.in/content/storage2/courses/115106057/STiAP_Unit_4_Hartree_Fock_L19_to_L23.pdf
6. https://www.youtube.com/watch?v=W8FhlGNnMkg
7. https://www.youtube.com/watch?v=wbGgIfHsx-I
8. https://www.youtube.com/watch?v=gtbS1h75Pxo
9. https://nptel.ac.in/content/storage2/courses/108103009/download/M9.pdf
10. https://nptel.ac.in/courses/104/103/104103112/

Title of the paper: Computer Applications in Chemistry – Practical		**Semester: II**
Course code: LPCHDL21	**Contact Hours: 3 hrs/w**	**Credits: 3**

Learning Outcomes:

On the completion of the course the student will be able to

- ✓ perform literature survey in chemistry
- ✓ understand the concept of internet and their applications such as email, sending and receiving files
- ✓ draw chemical structure using Chemdraw.
- ✓ analyze the given data and correlate the data and curve fitting using MS Excel and origin
- ✓ compute simple chemistry problems using Visual Basic programs.

EXPERIMENTS

1. To learn creating, receiving and sending e-mail
2. Drawing chemical structure and predicting NMR spectrum in ChemDraw
3. To search a particular topic in chemical literature sources for physical data, reactions, syntheses, techniques or concepts.
4. To learn the data analysis correlation and curve fitting using MS Excel
5. To learn the data analysis correlation and curve fitting using Origin

6. Data interpretations of some physical chemistry experiments like CST, Ester hydrolysis, Phase Diagram
7. To develop a visual basic application for displaying the contents of the selected file using the file list box, directory list box and drive list box.
8. To learn the integrated development environment – the menu bar, tool bar, the project explorer, the tool box, Different types of window
9. Form designer, the Message box and Input box
10. To develop VB Program for the calculation of Half-life period
11. To develop VB Program for the calculation of temperature conversion
12. To develop VB Program for the calculation of Average rate constant of first order reaction
13. To develop VB Program for the calculation of Molarity, molality and normality of a solution
14. To develop VB Program for the calculation of Different velocities of gases
15. To develop VB Program for the calculation of Empirical formula of an organic compound containing C,H and O
16. To develop VB Program for the calculation of Thermodynamic parameters like enthalpy, entropy and free energy.
17. To learn thesis and paper (Journal) typing using latex software.

Suggested Readings:

Reference Books:

1. D.S. Sehawat and Sanjay Sharma, Visual Programming, S.K.Katania & sons, 1st Edition, 2006, New Delhi.
2. Gary Cornell, Visual Basic 6, Tata-McGraw Hill Publishing Company, 1998, New Delhi.

Web Sources:

1. https://www.tutlane.com/tutorial/visual-basic
2. https://www.vbtutor.net/lesson1.html

Title of the paper: Computational Chemistry and Numerical Analysis		Semester: II
Course code: LPCHDS21	Contact Hours: 3hrs/w	Credits: 3

Learning Outcomes:

On completion of the course, the students are able to

- ✓ know essential theoretical background of computational chemistry and programming skills.
- ✓ gain knowledge on research to perform scientific computations to solve chemical problems.
- ✓ perform computational methods to specific problems in chemistry and successfully apply appropriate computational techniques.
- ✓ get handson training in the context of currently available computational chemistry software and high-performance computer hardware.

Pre-Required Knowledge:

- ✓ Computational Strategies
- ✓ Density Functional Theory (DFT)
- ✓ Principle of polynomial functions.

UNIT I: INTRODUCTION TO COMPUTATIONAL CHEMISTRY

The promise of computational chemistry, Potential Energy Surfaces,-Coordinate systems, Geometry optimization, Local and Global minima, Conformational Analysis, Transition State Optimization, saddle point, vibrational frequencies, and normal mode analysis, Intrinsic Reaction Coordinate (IRC) analysis.

UNIT II: COMPUTATIONAL CHEMISTRY METHODS-I

Molecular Mechanics-Force field methods, Semi-empirical methods, Variational method, Roothaan-Hall equations, self-consistent field approach, electron spin and Pauli principle, antisymmetric wave functions and Slater determinants.

UNIT III: COMPUTATIONAL CHEMISTRY METHODS-II

Ab initio methods- Basis sets, Slater and Gaussian functions, polarization and diffuse functions, split-valence

sets, correlation-consistent sets, Born-Oppenheimer approximation, Hartree-Fock theory, electron correlation problem, Perturbation theory, Koopmans theorem. Density Functional Theory (DFT) and methods.

UNIT IV: NUMERICAL ANALYSIS

Errors, different type of errors. Representation of numbers in computer, computer arithmetic, zero in floating point number. Operators – finite differences, average, differential, etc., their inter-relations. Difference of polynomials.

UNIT V: DIFFERENCE EQUATION. APPROXIMATION OF FUNCTION. LEAST SQUARE METHOD.

Use of orthogonal polynomials. Approximation by Chebyshev polynomials, Max-min principle. Economization of power series. Solution of non-linear equation containing one variable. Newton's methods. Modified Newton-Raphson method. Birge-Vieta method, Bairstow method. System of non-linear equations-iteration and Newton Raphson methods. Eigenvalues and eigenvectors of matrix. Leverrier-Faddeev method. Power method. Jacobi's method, Givens method, Householder's method. Comparisons.

SUGGESTED TOPICS FOR GROUP DISCUSSION / PRESENTATIONS:

- ✓ Coordinate systems and Geometry optimization.
- ✓ Molecular Mechanics and Force field methods and Semi-empirical methods
- ✓ Ab initio methods - Basis sets, Slater and Gaussian functions
- ✓ Errors, different type of errors and Representation of numbers in computer.
- ✓ Use of orthogonal polynomials and Approximation by Chebyshev polynomials.

Suggested readings:

Text Books:

1. Physical Chemistry: A Molecular Approach, D. A. McQuarrie, and J. D. Simon,Viva Books, 2011.

2. F. Jensen, Introduction to Computational Chemistry, 3rd Edition, John Wiley & Sons Ltd, UK, 2017.
3. Introduction to Computational Chemistry, F. Jensen, 2nd edition, Wiley-Blackwell (2006)
4. Numerical Methods for Ordinary Differential Systems-The Initial Value Problem,J. D. Lambert ISBN-13: 978-0471929901, 1991,John Wiley & Sons Ltd,

References Books:

1. Norman S. Clerman and Walter Spector, Modern Fortran: Style and Usage, Cambridge University Press, New York, USA, 2012.
2. Errol G. Lewars, Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics, 2nd Edition, Springer, 2011.

Web Sources:

1. http://expchem3.com/
2. http://www.sci.umanitoba.ca/chemistry/wp-content/uploads/sites/2/2019/04/CHEM-3260.pdf
3. https://www.youtube.com/watch?v=KjBCjVAobVs
4. https://www.youtube.com/watch?v=ukNbG7muKho
5. https://www.ch.ic.ac.uk/marshall/4I10/4I101.pdf

Title of the paper: Photochemistry and Pericyclic Reactions **Semester: II**
Subject Code:LPCHAE21 **Contact Hours: 2hrs/w** **Credits: 2**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ understand the concept thermal and photochemical reactions.
- ✓ gain knowledge on various photophysical processes and explain Jablonski diagram
- ✓ explain mechanism of various important photochemical reactions involving n-π*, π-π* transitions

- ✓ explain different approach like Huckel Mobius concept, FMO approach for feasibility of different photochemical processes.

Pre-Required Knowledge:

- ✓ Wave function and atomic orbital symmetry
- ✓ LCAO approach
- ✓ Photochemistry of vision.
- ✓ Applications of photochemistry

UNIT I: INTRODUCTION TO PHOTOCHEMISTRY

Introduction - Thermal vs Photochemical reactions – Excitations and electronic transitions –Forbidden transitions – Nomenclature and properties of the excited states –Jablonski diagram – Photophysical processes: fluorescence, phosphorescence, internal conversion, intersystem crossing - Photo sensitization.

UNIT II: PHOTOCHEMICAL REACTIONS OF CARBONYL COMPOUNDS

Photochemical reactions of ketones - reactivity of n-π* - α-cleavage: Norrish type I reaction - β-cleavage – intramolecular hydrogen abstraction: Norrish Type II reaction (γ-hydrogen transfer) – Paterno-Buchi reaction: [2+2]-cycloaddition reaction of excited carbonyl compound with olefin, acetylenes.

UNIT III: PHOTOCHEMICAL REACTIONS INVOLVING π BONDS

Photochemistry of olefins and conjugated olefins – Photochemical reactions of 1,4–dienes: di-π - methane rearrangement - photo oxidation: Type I Photooxidation and Type II Photooxidation - Photochemistry of arenes: oxidative coupling – photoreduction

UNIT IV: PERICYCLIC REACTIONS

Pericyclic reactions – conservation of orbital symmetry – Electrocyclic reactions – sigmatropic reactions - cyclo-addition reactions: Diels-Alder reaction – Ene reactions – 1,3- Dipolar cycloadditions — chelotropic reactions.

UNIT V: ANALYSIS OF PERICYCLIC REACTIONS

Analysis of electrocyclic reaction, cycloaddition reactions, sigmatropic reactions by FMO approach using Woodward-Hoffmann rules – Correlation diagram approach for electrocyclic reactions, cycloaddition reactions, and sigmatropic reactions – Huckel-Mobius approach for analysis of electrocyclic reactions, cycloaddition reactions, and sigmatropic reactions.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS:

- ✓ Artificial photosynthesis
- ✓ Photodynamic therapy
- ✓ Photodriven molecular switches
- ✓ Dye-sensitized solar cells
- ✓ OLED devices

Suggested Readings:

Text Books:

1. Jagadamba Singh, Photochemistry and Pericyclic Reactions, New Age, III Edition, 2012.
2. S.M. Mukerjee and S.P. Singh, “Pericyclic reactions”, Macmillan, 1976.
3. J.M. Coxon, B. Halton, Organic Photochemistry, Cambridge University Press, Cambridge, 2011

Reference Books:

1. J.R. Dyer, Application of adsorption spectroscopy. Prentice Hall, 1965.
2. C.H. Depuy and O.L. Chapman, Molecular reactions and Photochemistry. Prentice Hall. 1972.
3. R.B. Woodward & R. Hoffmann, Conversation of Orbital Symmetry. VChGmBH (1971)

Web Sources:

1. https://nptel.ac.in/courses/104/105/104105038/
2. https://nptel.ac.in/courses/104/106/104106077/
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy15/

Title of the paper: Scientific Research Methodology **Semester: II**

Course code: LPCHAE22 **Contact Hours: 2hrs/w** **Credits: 2**

Course Learning outcome:

On completion of the course, the students are able to

- ✓ understand the significance of research
- ✓ gain the importance of literature survey
- ✓ apply error analysis in their own work
- ✓ know the style of the conventions of writing thesis
- ✓ learnstatistical treatment.

Pre-Required Knowledge:

- ✓ Crystallization
- ✓ Sublimation
- ✓ Types of Error

UNIT I: INTRODUCTION TO METHODOLOGY

Nature and importance of research - aims, objective, principles and problems - selection of research problem - survey of scientific literature - primary and secondary sources - citation index for scientific papers and journals - patents.

UNITII: CONDUCT OF RESEARCH WORK

Physical properties useful in analysis and methods of separation prior to analysis - Isolation techniques - extraction - Soxhlet extraction, crystallization, sublimation - methods for vacuum sublimation and distillation under reduced pressure.

Chemistry of working with hazardous materials - acid / base / water sensitive, corrosive, toxic, explosive and radioactive materials.

UNITIII: EVALUATION OF ANALYTICAL DATA

Precision and accuracy - Reliability - determinate and random errors - distribution of random errors - normal distribution curve.

UNITIV: STATISTICAL TREATMENT OF ANALYTICAL DATA

Statistical treatment of finite samples - the students test and F test - criteria for rejection of an observation - the Q test, significant figures and computation rules - data plotting - least square analysis.

UNITV: THESIS AND ASSIGNMENT WRITING

Conventions of writing - the general format - page and chapter format - use of quotations and footnotes - preparation of tables and figures - referencing - appendices - revising editing and evaluating the final product - proof reading - meanings and examples of commonly used abbreviations.

SUGGESTED TOPICS FOR GROUP DISCUSSION / PRESENTATIONS:

- ✓ Citation index for scientific papers
- ✓ Crystallization and sublimation
- ✓ Reliability
- ✓ Computation rules
- ✓ Preparation of tables and figures

Suggested Readings:

Text books:

1. Douglas A. Skoog and Donald, M. West, Fundamental of analytical chemistry, Halt Saundersons International Edition.
2. J. Anderson, H.M. Durston and M.Poole, Thesis and assignment writing - Wiley Eastern Ltd., (1970).
3. J. March, Advanced organic chemistry - reactions, Mechanism & Structure. McGraw Hill Student Edition.

Reference books:

1. Vogel's Textbook of quantitative chemical analysis, ELBS edition.
2. Rajammal P. Devados, Research Methodolgy.

Web Sources:

1. https://youtu.be/og8_CaDQgVU
2. https://youtu.be/LmOXcrD6o_o

3. https://youtu.be/hRAFPdDppzs
4. https://youtu.be/rtZYbwgy83o
5. https://youtu.be/vyX4xZlYBZQ

Title of the paper: Supramolecular Chemistry		Semester: II
Course code:LPCHSC11	Contact Hours: 2hrs/w	Credits: 2

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ understand the concepts of bonding in supramolecular structure
- ✓ gain knowledge in molecular recognition and nature of bindings involved in biological systems
- ✓ know the Structure of supramolecules of various types in solution and solid state
- ✓ familiarize the applications of supramolecules in miniaturization of molecular devices
- ✓ get knowledge of types of supramolecules, structures their applications as organic materials, sensors and devices

Pre-Required Knowledge:

- ✓ Structure of crown ether
- ✓ Covalent andnon-covalent interactions
- ✓ Enzyme and their types

Unit I: Introduction:

Concepts and development, Nature of binding interactions in supramolecular structures: ion-ion, ion-dipole, dipole-dipole, H-bonding, cation-π, anion-π, π-π and vanderwaal interactions.

Unit II: Supramolecular Chemistry in Life:

Supramolecular Chemistry in Life, Ionophores, Porphyrin and other tetrapyrrollic macrocycles, Coenzymes, Neurotransmitters, DNA and biochemical self-assembly.

Unit III: Host–guest Chemistry:

Synthesis and structures of crown ethers, Lariat ethers, Podands, Cryptands, Spherands, Calixarene, Cyclodextrins, Cyclophanes, Cryptophanes, Carcerands and hemicarcerands, Host-guest interactions, Preorganisation and

complimentarity, Lock and key analogy, Binding of cationic, Anionic, Ion pair and neutral guest molecules.

Unit IV: Supramolecular Polymers

Self-assembly molecules: Design, Synthesis and Properties of the molecules, Self assembly by H-bonding, Catenanes, Rotaxanes, Dendrimers and Supramolecular gels. Relevance of supramolecular chemistry to mimic biological system.

Unit V: Molecular Devices

Molecular Electronic devices, Molecular wires, Molecular rectifiers, Molecular switches and Molecular logic gates. Examples of recent developments in supramolecular chemistry from current literature.

Suggested Readings:

Text Book:

P.S.kalsi.,Bioorganic, Bioinorganic and Supramolecular Chemistry,4th edition, New Age International (P) Ltd., Publisher, New Delhi,2020.

Reference Books:

1. Lehn, J. M., Supramolecular Chemistry-Concepts and Perspectives, Wiley –VCH 1995.
2. Beer, P.D., Gale, P. A., and Smith, D. K., Supramolecular Chemistry, Oxford University Press 1999.
3. Steed, J. W., and Atwood, J. L., Supramolecular Chemistry, Wiley 2000.

Web Sources:

1. https://www.youtube.com/watch?v=jGDYUKCNOdk
2. http://nptel.ac.in
3. http://swayam.gov.in
4. mooc.org
5. https://www.coursera.org
6. http://www.powershow.com/view/3debe0-ZGRlO
7. https://vtechworks.lib.vt.edu/bitstream/handle/10919/28741/ch1.pdf
8. https://www.youtube.com/watch?v=WfFhaU9LoVw

Title of the paper: Organic Chemistry - III		Semester: III
Subject Code: LPCHCT31	Contact Hours: 5hrs/w	Credits: 5

Course Learning Outcomes:

On completion of the course, the students are able to:

- ✓ gain knowledge on the various aspects of oxidation and reduction.
- ✓ explain the various aspects ofelimination and addition reactions.
- ✓ understand the principles and are able to apply NMR spectra for structural analysis of simple organic molecules.
- ✓ learn in detail the 2-D NMR techniques
- ✓ elucidate the structure and synthesis of alkaloids and terpenoids.

Pre-Required Knowledge:

- ✓ Oxidizing and reducing agents
- ✓ Free Induction Decay
- ✓ Fourier-Transform
- ✓ Isoprene rule

UNIT I: CARBONYL CHEMISTRY ADDITION AND ELIMINATION REACTIONS

Addition Reactions:

Michael addition – addition of Grignard reagent to α, β – unsaturated carbonyl compounds – Diels – Alder reaction.

Mechanism – Aldol condensation – Perkin reaction – Knovenagel reaction – Mannich reaction – Cannizaro reaction –Benzoin condensation –Claisen ester condensation - Darzen's reaction – Reformatsky reaction – Esterification of acids and hydrolysis of esters.

Elimination Reactions:

α-Elimination, β-elimination – E1 , E2 and E1$_C$B mechanism – stereochemistry of elimination – orientation of the double bond – Hofmann and Saytzeff rule, – effect of the substrate , base, leaving group and medium on E1 , E2 and E1CBreaction. Elimination vs Substitution.

UNIT II: OXIDATION AND REDUCTION REACTIONS AND REAGENTS

Oxidation reactions using DMSO – HIO_4 – $Pb(OAc)_4$, Woodward-Prevost hydroxylation. Peroxides – Sharpless asymmetric epoxidation and peracids, PCC (Corey's reagent), PDC, Etards reagent, MnO_2, OsO_4, DDQ, SeO_2 and Jones reagent.

Reductions involving:

i) Complex metal hydrides like $LiAlH_4$, $NaBH_4$, $NaBH_3(CN)$,
ii) Dissolving metals like alkali metals, Mg and zinc
iii) H_2/Ni, Pt, Pdetc,

UNIT III: ^{1}H NMR &^{13}C NMR SPECTROSCOPY

^{1}H-NMR Spectroscopy

Introduction – relaxation processes - chemical shift, factors influencing chemical shift - spin – spin coupling, coupling constant, Karplus equation, first order and second order spin-spin splitting – influence of stereochemical factors on chemical shift of protons – Nuclear Overhauser Effect (NOE) - simplification of complex spectra – deuterium substitution – spin decoupling, double resonance, shift reagent – proton exchange phenomena.

^{13}C-NMR Spectroscopy

Basic principles, Chemical shift, FT technique – assignment of signals – Broad band decoupling and off resonance decoupling - gauche effect – additivity relationship – calculation of chemical shifts for aromatic and aliphatic compounds.

UNIT IV: ADVANCED NMR SPECTROSCOPY AND STRUCTURAL ELUCIDATION BY SPECTRAL TECHNIQUES

2-D NMR Techniques

Basic aspects ofCorrelation spectroscopy (COSY) - HOMO COSY (HOMCORR: ^{1}H-^{1}H connectivity, ^{13}C-^{13}C connectivity) - HETERO COSY (HETCORR: ^{13}C-^{1}H connectivity) – HSQC, HMQC, HMBC - 2D NOE Correlation Spectroscopy (NOESY).

Application of the spectral techniques (UV, IR, MASS, ^{1}H NMR, ^{13}C NMR) to structural elucidation of simple molecules and interpretation of spectral data of simple organic molecules.

UNIT V: NATURAL PRODUCTS CHEMISTRY

Alkaloids**:** General methods of determining the structure – structure and synthesis of quinine, morphine, lysergic acid (structural elucidation not required) – biosynthesis of alkaloids.

Terpenes:Structural elucidation of α- pinene, camphor, zingiberene and α-cadinene – biosynthesis of terpenoids.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- ✓ NMR spectra for simple protein molecules
- ✓ Extraction of alkaloids
- ✓ Structure-activity relationship in natural products
- ✓ Novel reagents in organic synthesis
- ✓ MRI Technique

Suggested Readings:

Text Books:

1. Jerry March, Advanced organic chemistry Wiley 4th edition 1992.
2. Jagadamba Singh and L.D.S. Yadav, Organic synthesis, PragatiPrakashan, 2007.
3. Carey and Sundberg, Advanced Organic Chemistry – Structure & Mechanism Part A, V Edition Springer, 2008
4. Kemp, Organic spectroscopy,*ELBS* with Macmillan, 1975
5. B.M Silverstein. G.C. Bassler and T.C. Morrill, Spectrometric identification of organic compounds John Wiley & Sons, New York, V Edition, 1991.
6. L. Pavia, Introduction to Spectroscopy, Amazon.ca, 1999.
7. S.K. Dewan, Organic Spectroscopy,CBS Publishers, I Edition, 2010.
8. O.P. Agarwal, Chemistry of Organic Natural Products, Goel Pub. House, 1981.

9. S.V. Bhatt., Chemistry of Natural Products, Narosa Publishing House, 2005

Reference Books:

1. J.M. Harris C.C. Wamser, Fundamentals of organic reaction mechanisms John Wiley and sons Inc.1976.
2. W. Carruthers and I. Coldham, Modern Methods of Organic Synthesis, Cambridge, 2005
3. I.L. Finar, Organic chemistry. Vol. I & II 5thedn.. ELBS 1975.
4. K.W. Bentley, The chemistry of natural products. Vol. I, *Interscience Publishers*, Inc., New York, *1957*.
5. S.W. *Pelletier*, *Alkaloids*: *Chemical* and Biological Perspectives, Vol. 13, I Edition, 1988.
6. A.A. Newman, *Chemistry of Terpenes* and *Terpenoids*, *Academic Press*. *Vols.1 and 2*, Wiley, New York, 1981.

Web Sources:

1. https://nptel.ac.in/content/storage2/courses/104101005/ downloads /Lecture Notes/chapter%207.pdf
2. https://nptel.ac.in/content/storage2/courses/104101005/ downloads/Lecture Notes/chapter%208.pdf
3. https://nptel.ac.in/content/storage2/courses/104101006/ downloads/ lecture-notes/mod10/lec1.pdf
4. https://nptel.ac.in/content/storage2/courses/104101006/ downloads/ lecture-notes/mod10/lec2.pdf
5. https://nptel.ac.in/content/storage2/courses/104108062/ module4.pdf
6. https://nptel.ac.in/content/storage2/courses/104101005/ downloads/LectureNotes/ chapter%2013.pdf
7. https://nptel.ac.in/content/storage2/courses/104103067/ pdf/mod5.pdf
8. https://nptel.ac.in/courses/104/101/104101117/
9. https://nptel.ac.in/courses/104/108/104108078/

Title of the paper: Inorganic Chemistry – III **Semester: III**

Course code:LPCHCT32 **Contact Hours: 5hrs/w** **Credits: 5**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ understand consequences of various defects in ionic crystals
- ✓ know the applications of organometallic compounds in catalysis
- ✓ gain knowledge on combined application of IR and Raman spectra in inorganic compounds
- ✓ understand the mechanism of substitution reactions in coordination compounds
- ✓ apply the concepts of NMR and ESR spectral methods to metal complexes

Pre-Required Knowledge:

- ✓ Photovoltaic effect
- ✓ ESR – principle
- ✓ Jahn-Teller distortion

UNIT I: SOLID STATE CHEMISTRY- II

Crystal defects – point, line and plane defects – colour centers- non-stoichiometry - electronic structure of solids – free electron and band theories - electrical conductivity and superconductivity- high temperature super conductors, types of semiconductors- Hall effect – transistors- photovoltaic effect- semiconductors in solar energy conversion

UNIT II: ORGANOMETALLIC CHEMISTRY- II

Catalysis using organometallics – oxidative addition – reductive elimination – insertion reaction- - Catalytic mechanisms in the following reactions: Hydrogenation reactions of olefins -Wilkinson catalyst – Hydroformylation - oxo process – acetic acid from methanol and ethylene to acetaldehyde - Wacker - Schimdt process - Olefin metathesis - and Heterogeneous catalysis –Ziegler Natta polymerization - cyclo-oligomerisation of acetylene - Reppe's and Wilkies catalysis – carbonylation of alcohols

UNIT III: INORGANIC PHOTOCHEMISTRY AND PHYSICAL METHODS IN INORGANIC CHEMISTRY- I

i) Photo-redox, photo-substitution and photo-racemisation reactions – Ruthenium bipyridyl in the conversation of solar energy.

ii) Electronic spectra of transition metal complexes - selection rules micro states – Term symbols– splitting of terms – Orgel diagram and Tanabe-Sugano diagrams - Evaluation of Δ_o and β for d^2& d^8 systems and Jahn-Teller distortion - charge transfer spectra.

iii) Applications of IR and Raman spectra in the study of coordination compounds such as metal carbonyls and nitrosyls.

UNIT IV: PHYSICAL METHODS IN INORGANIC CHEMISTRY- II

^{1}H, ^{15}P ,^{19}F and ^{11}B - NMR – Introduction – applications in structural determination - evaluation of rate constants – hindered rotation – NMR of fluxional molecules – NMR of paramagnetic complexes – contact shift – pseudo contact shift – use of shift reagent in NMR

ESR – principle – presentation of the spectrum – hyperfine splitting – evaluation of g and A tensors – factors affecting the magnitude of g values – zero field splitting – Kramer's degeneracy –anisotropy and hyperfine coupling constant – application of ESR in the structure of transition metal complexes Cu(II) and Mn(II)

Mössbauer spectroscopy – principle – Doppler effect – isomer shift – magnetic hyperfine splitting - quadrupole splitting – applications of Mössbauer spectroscopy in the study of iron and tin complexes

UNIT V: REACTION MECHANISMS OF COORDINATION COMPOUNDS

Substitution reactions of octahedral complexes – labile and inert complexes – mechanism of acid hydrolysis – base hydrolysis and anation reactions. Substitution reactions of square planar complexes- factors affecting reactivity of square planar complexes – Trans effect - theory and its applications – electron transfer reactions – complementary and non –

complementary reaction-outer sphere and inner sphere electron transfer mechanisms- synthesis of coordination compounds using electron transfer and substitution reactions.

SUGGESTED TOPICS FOR GROUP DISCUSSION/PRESENTATIONS

- ✓ Semiconductors in solar energy conversion
- ✓ Oxidative addition – reductive elimination
- ✓ Ruthenium bipyridyl in the conversation of solar energy.
- ✓ Zero field splitting – Kramer's degeneracy
- ✓ Theories of Trans effect
- ✓ contact shift – pseudo contact shift in ESR

Suggested Readings:

Text Books:

1. Gary L Miessler and Dolnald A Tarr, Inorganic Chemistry, 3rd edition, Peasoneducation, 2009
2. J.E. Huheey ,E.A . Kaiter and R. L .Keiter Inorganic chemistry: Principle of structure and reactivity, Harper Collins college publishers, IV edition, 1993

Reference Books:

1. F.A. Cotton and Wilkinson, Advanced inorganic chemistry, IV edn., John wiley& Sons, New York, 1988.
2. K. F. Purcell and J.C Kotz Inorganic chemistry, Hottsaundersinternational edition, 1987
3. F. Basolo and R.G. Pearson, Mechanism of inorganic chemistry, Wiley eastern limited 1967.
4. R S Drago, Physical methods in inorganic chemistry, Affiliated East-west press Pvt Ltd, New Delhi,1993.
5. D. Sutten – Electronic spectra of transition metal complexes, McGraw-Hill, 1968.
6. E.A.B. Ebsworth D.W.H Rankin and S. Gadock, Structural methods in inorganic Chemistry, Blackwell Scientific Publication, 1987.
7. L.M Jackmann and E.A Cotton, Dynamic nuclear magnetic resonance spectroscopy, Academic Press, New York, 1975

Web Sources:

1. http://alpha.chem.umb.edu/chemistry/ch611/documents/Lec21 OrganometalliccatalysisII_001.pdf
2. https://nptel.ac.in/courses/104/108/104108062/
3. http://www1.udel.edu/theopold/CHEM652.html
4. https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/CHEM/Sem-II.pdf
5. http://chemistry.du.ac.in/study_material/ 4101-B/EPR%20Spectroscopy.pdf
6. https://www.adichemistry.com/

Title of the paper: Physical Chemistry – III **Semester: III**

Course code:LPCHCT33 **Contact Hours: 5hrs/w** **Credits: 5**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ understand the concepts of group theory.
- ✓ determine the selection rules for spectral transitions, energies and molecular orbitals.
- ✓ know the principles and applications of microwave and IR.
- ✓ know the principles and applications of Raman, Electronic and PES.
- ✓ know the principles and applications of NMR, ESR and NQR.

Pre-Required Knowledge:

- ✓ Concept of LASER
- ✓ Resonance Raman spectroscopy
- ✓ Applications of NMR spectroscopy

UNIT I: GROUP THEORY-I

Symmetry elements – symmetry operations- groups - sub group, cyclic group, and abelian group - definition and properties – group multiplication table – similarity transformations and classes.Matrices for reflection, rotation, inversion and identity operations –point group classification-great orthogonality theorem- reducible, irreducible

representation- construction of character table-C_{2v}, C_{3v}, C_{4v},C_{2h},D_{2d} and D_4 only- direct product representations.

UNIT II: GROUP THEORY-II

Symmetry of normal mode of vibrations – application for spectral selection rules of vibrational spectra – IR, Raman active fundamentals (water, BF_3 and NH_3). Group theory and hybridization – BF_3 and methane – symmetry of molecular orbital and symmetry selection rule for electronic transition in ethylene and formaldehyde molecules. Wave function as basis of irreducible representation – HMO theory – HMO calculation and delocalization energy for butadiene and benzene.

UNIT III: MOLECULAR SPECTROSCOPY- I

Einstein's coefficient- oscillator strength – microwave spectroscopy – Effect of isotopic substitution – rigid rotor - calculation of various parameters using microwave spectroscopy- vibrational spectra of diatomic molecules- rotational and vibrational of diatomic molecules vibrational spectra of polyatomic molecules – overtones, combination bands, concept of group frequencies- basic concept of FT-IR

UNIT IV: MOLECULAR SPECTROSCOPY- II

Classical and quantum theories of Raman Effect – rotational and vibrational Raman spectroscopy- laser Raman spectroscopy- electronic spectra of diatomic and polyatomic molecules – break down of Born-Oppenheimer approximations. Franck – Condon principle dissociation energy – rotational fine structure and fortrat diagram.

Photoelectron spectra – basic principles – instrumentation X-ray photoelectron and UV photoelectron spectra- core energy level studies- applications of ESCA.

UNIT V: ESR, NMR AND NQR SPECTROSCOPY

NMR – chemical shift – spin-spin splitting. Relaxation times. Line shape and line width- experimental technique- double resonance techniques. INDOR. Nuclear Over-Hauser effect.

ESR principles- hyperfine splitting. Factors affecting the magnitude of g value – rate of electron exchange reactions.

Fine structure and hyperfine structures. Electron density from ESR and applications.

NQR – principles and applications – quadrupole moment and electrical field. Nuclear Quadra pole resonance. Nuclear quadrupole coupling in atoms and in molecules-ionic character and hybridization.

SUGGESTED TOPICS FOR GROUP DISCUSSION / PRESENTATIONS:

- ✓ Group multiplication table
- ✓ HMO calculation and delocalization energy
- ✓ Basic concept of FT-IR
- ✓ Rotational fine structure and fortrat diagram
- ✓ Fine structure and hyperfine structures

Suggested Readings:

Text Books:

1. F.A. Cotton, Chemical Applications of Group Theory, 3rd edition, Wiley-Interscience, 1990.
2. R.S. Drago, Physical methods in Chemistry, Saunders, 1999.
3. C.N. Banwell and E.M. McCash, Molecular Spectroscopy, Tata McGraw Hill. 4th edn, 1996.

Reference Books:

1. G. Davidson, “Group theory for chemists”, MacMillan Education Ltd (London), 1991.
2. G.M. Barrow, Introduction to Molecular spectroscopy, McGraw Hill, 1962.
3. A. Streitweiseer, Molecular Orbital Theory for organic chemistry. John Wiley & Sons, Inc., New York-London 1961.
4. V. Ramakrishna and Gopinath, Group theory in chemistry, 2nd edn, Vishal publications, 1991.
5. K.V.Raman, Group theory and its application to chemistry, Tata McGraw Hill. 1990.
6. R. Chang. Basic Principles of Molecular spectroscopy. McGraw Hill, 1971.
7. B.F. Straughan and Walker spectroscopy; Vol. 1, 2 and 3 Chapman Hall, 1976.

8. P.W. Atkins. Physical Chemistry, 6th edn, ELBS and Oxford University press. 1996.
9. E.B. Becker. High resolution NMR. 2nd edn, Academic press. 1990.

Web Sources:

1. https://nptel.ac.in/courses/104/106/104106075/
2. https://ocw.mit.edu/courses/chemistry/5-80-small-molecule-spectroscopy-and-dynamics-fall-2008/
3. http://ocw.uci.edu/lectures/chem_203_lecture_01_organic spectroscopy_infrared_spectroscopy_ introduction_theory_instrumentation_and_sample_preparation.html
4. https://nptel.ac.in/courses/104/101/104101094/
5. https://nptel.ac.in/courses/104/108/104108078/

Title of the paper: Chemistry Set/Net/CSIR-UGC paper Semester: IV

Course code: LPCHAE31 Contact Hours:2 hrs/w Credits: 2

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ know the essential topics required for students to appear for competitive examinations –GATE, CSIR-UCC, SET, TIFR, UPSC, TNPSC etc.
- ✓ learn additional knowledge to pursue a PhD course with stipend
- ✓ get recruitments in Government and Private sectors – Public service commissions –Pharmaceutical-chemical industries etc.
- ✓ provide an opportunity to get familiarized with question pattern as well as difficulty level of the question papers
- ✓ improve the learning skills and self-confidence among PG chemistry students
- ✓ allay the psychological fear of students to attend competitive exams in chemistry

Pre-Required Knowledge:

- ✓ Collection of previous years questions of SET, CSIR and GATE
- ✓ Working out problems asked in various competitive exams
- ✓ Attending online mode exams

Unit I:INORGANIC CHEMISTRY:

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
10. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Unit II: PHYSICAL CHEMISTRY:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactlysolvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom,

including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.

2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
6. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
7. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.
8. Electrochemistry: Nernst equation, redox systems, electrochemical cells; DebyeHuckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
9. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

10. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
11. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.
12. Polymer chemistry: Molar masses; kinetics of polymerization.
13. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Unit III: ORGANIC CHEMISTRY:

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.

8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst-controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.
10. Pericyclic reactions – electrocyclization, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.

Unit IV:ANALYTICAL TECHNIQUES

1. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
2. Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
3. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
4. Structure determination of organic compounds by IR, UV-Vis, ^{1}H &^{13}C NMR and Mass spectroscopic techniques
5. Chromatographic Techniques: Column, Thin layer, Paper, GC-MS and HPLC techniques

Unit V: INTERDISCIPLINARY TOPICS

1. Chemistry in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry.

Suggested Readings:

Reference Books:

A. PHYSICAL CHEMISTRY

1. Atkins' Physical ChemistryJulio de Paula, Peter Atkins, James Keeler
2. Physical Chemistry Third Edition Robert G. Mortimer
3. Physical Chemistry – Thomas Engel & Philip Reid
4. Physical Chemistry. David W. Ball.
5. Principles of Physical Chemistry – Puri, Sharma &Pathania
6. A text book of Physical Chemistry (Vol-II) – K. L. Kapoor
7. Chemical Kinetics and Catalysis – Richard Mishel
8. Chemical Kinetics – Keith J Laidler
9. A text book of Physical Chemistry (Vol-V) – K. L. Kapoor
10. An Introduction to Electrochemistry – Samuel Glasstone
11. Electrochemistry – Philip H. Rieger
12. A book of Physical Chemistry (Vol-III) – K L Kapoor
13. Quantum Chemistry through Problems and Solutions – R.K. Prasad
14. Quantum Chemistry – Donald A. McQuarrie
15. Fundamentals of Molecular Spectroscopy – Colin N. Banwell
16. Physical Methods – Russel S. Drago
17. Chemical Applications of Group Theory – F. Albert Cotton

18. Symmetry and Spectroscopy of Molecules- K .Veera Reddy
19. Molecular Symmetry and Group Theory R. C. Maurya and J.M. Mir
20. Introductory Group Theory for Chemists George Davidson
21. Molecular symmetry and group theory by Robert L. Carter
22. Physical Chemistry through Problems; S. K. Dogra.

B. ORGANIC CHEMISTRY

1. Organic chemistry I.L. Finar V- 1 &2
2. Part-A: Structure and Mechanism – Francis A. Carey, Richard J. Sundberg
3. Part-B: Reactions and Synthesis - Francis A. Carey, Richard J. Sundberg Reagents in
4. Organic Chemistry - by Jonathan Clayden , Nick Greeves), Stuart Warren
5. March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure
6. Modern Methods of Organic Synthesis – William Carruthers, Iain Coldham Organic Synthesis
7. Organic Synthesis the disconnection approach – Stuart Warren
8. Stereochemistry Conformation and Mechanism -P.S. Kalsi
9. Stereochemistry of Organic Compounds - E. L. Eliel
10. A Guidebook to Mechanism in Organic Chemistry – Peter Sykes
11. Spectrometric Identification of Org. Compounds – R. M. Silverstein, F. X. Webster
12. Organic Spectroscopy – William Kemp
13. Photochemistry and Pericycle Reaction ByJagdamba Singh
14. Organic Photochemistry – James H. Coxon, B. Halton
15. Photochemistry by Charles Dupey and O. Chapman

C: INORGANIC CHEMISTRY

1. Concise Inorganic Chemistry - J. D. Lee
2. Inorganic Chemistry -Meissler&Tarr
3. Mechanism of Inorganic Reactions – Fred Basolo, Ralph G. Pearson
4. Concept and Models of Inorganic Chemistry – Bodie Douglas, Darl McDaniel, John Alexander
5. Inorganic Chemistry – Catherine E. Housecraft, Alan G. Sharpe
6. Inorganic Chemistry – Shriver & Atkins
7. Inorganic Chemistry – James E. Huheey, E.A. Keiter, R. L. Keiter, O. K. Medhi
8. Advanced Inorganic Chemistry by Cotton, Wilkinson, Murillo and Bochmann
9. Inorganic Chemistry by Asim K. Das 1-7 Volumes
10. Principles of inorganic Chemistry purisharmakalia

D: ANALYTICAL CHEMISTRY

1. Instrumental Method – Skoog, Holler & Crouch
2. Analytical Chemistry 7e by Gary D. Christian (1).pdf
3. Analytical Chemistry – Skoog, Holler & Crouch
4. Quantitative Chemical Analysis Daniel C. Harris; Charles A. Lucy
5. Vogel's Textbook of Quantitative Chemical Analysis

Web Sources:

1. https://csirhrdg.res.in/
2. https://careerendeavour.com/net-question-paper/
3. https://ifasonline.com/csir-net-chemical-science/previous-year-question-papers.jsp
4. https://www.dalalinstitute.com/books/csir-ugc-net-jrf-chemical-science-solved-papers/
5. https://examprep.vpmclasses.com/
6. https://scoop.eduncle.com/csir-net-question-paper-free-download
7. https://career.aglasem.com/csir-ugc-net-question-paper-chemical-science/

Title of the paper: Medicinal and Pharmaceutical Chemistry Semester: III
Course code: LPCHAE32 Contact Hours: 2rs/wh Credits: 2

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ understand the fundamental in the field of medicinal and Pharmaceutical chemistry
- ✓ understand the common body ailments
- ✓ gain knowledge on important classification of drugs.
- ✓ getexpertise in the synthesis and mechanism of medicinal drugs.

Pre-Required Knowledge:

- ✓ Drug discovery, design and development
- ✓ Health hazards and safety measures in Pharmaceutical Industry
- ✓ Introduction on Material Safety Data Sheet
- ✓ Latest development in drug discovery of selected diseases

UNIT 1: INTRODUCTION

History of medicinal chemistry, Methods of classification of drugs based on structure and biological activity, Concept of acidity and basicity of drugs and pKa values. Origin of drugs – pharmacologically active constituents in plants – classification of drugs – biological and chemical – general mechanism of drug action on lipids, carbohydrates, proteins and nuleic acids.

Common diseases – infective disease – Insect-borne, air-borne and water-borne – hereditary disease

Common body ailments – Diabetes, blood pressure – systolic & diastolic, – CNS depressants and stimulants, lipid profile – HDL, LDL cholesterol.

UNIT 2: CHEMOTHERAPY

Classification, Alkylating agents, Antimetabolics, Anticancer antibiotics, Hormones and their antagonists, Anticancer plant producsts, Prevention, treatment – cancer

and neoplastic agents. Recent development in cancer chemotherapy.

UNIT3: CARDIOVASCULAR DRUGS

Cardiovascular diseases, arteriolar dilators, diuretics, adrenergic receptor blockers, synthesis mode of action, uses and side effects of cardiovascular drugs, esters of nitrous and nitric acid-amyl nitrate, calcium channel blockers, anti-adrenergic drugs methyldopa, sodium channel blockers - quinidine, -adrenergic blockers– atenolol, oxprenolol.

UNIT4: ANTIVIRAL

Replication and transformation, Substance that inhibit early stages of viral replication-Amantidine hydrochloride. Substance that interfere with viral nucleic acid replication-Idoxuridine, Acyclovir. Anti-HIV agent, Anti-Herps Simple Virus agent.

UNIT5: ANTIHYPERTENSIVE AGENTS

Classification, Pheripheral Anti-Adrenergic drugs, centrally acting antihypertensive drugs, Calcium channel blockers, Angiotensin-Converting Enzyme (ACE) inhibitors, β-Adrenergic blockers.

SUGGESTED TOPICS FOR GROUP DISCUSSION / PRESENTATIONS

1. Intelligent molecules in biomedical applications
2. Common diseases
3. Cardiovascular diseases
4. Anti-HIV agent
5. Calcium channel blockers

Suggested Readings:

Text Books:

1. AshutoshKar, (2000). *Medicinal Chemistry*. New Delhi: New Age International Publishers.
2. Jayashree Ghosh, *Pharmaceutical Chemistry*, S. Chand and Company Ltd., New Delhi, 2006.
3. Lakshmi S, *Pharmaceutical Chemistry*, S. Chand & Sons, New Delhi, 1995.

4. Sriram. D and Yogeswari.P, *Medicinal Chemistry*, Dorling Kindersley Pvt. Ltd. 2010.

Reference Books:

1. William O. Foye, Thomas L., Lemke, David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi.
2. A. Burger, Medicinal Chemistry, Wiley Interscience, New York, Vol. I and II, 1970.
3. G. L. Patrick, Introduction to Medicinal Chemistry, Oxford Univeristy Press, 2001.
4. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed., Robert F.Dorge, 2003.

Web Sources:

https://jcpjaipur.com/wp-content/uploads/2020/05/Medicinal-Chemistry-Unit-I.pdf
https://www.youtube.com/watch?v=x0UqTZcuFdE
https://www.youtube.com/watch?v=lUxkcEoGkVg
https://baranlab.org/wp-content/uploads/2018/10/Final-Slides-1.pdf
https://www.slideshare.net/crisbertc/cardiovascular-drugs
https://www.youtube.com/watch?v=UHEXXGiegd0
https://www.youtube.com/watch?v=UVFcTLJPEMo
https://www.youtube.com/watch?v=nXcB8idDoZA

Title of the paper: Green Chemistry	Semester: III
Course code: LPCHSC12	Credits: 2

Course Learning Outcomes

On completion of the course, the students are able to

- ✓ gain clear idea of greener methodologies using ultrasound and microwave methodologies.
- ✓ know the solventless and aquatic phase reactions.
- ✓ understand the application of biocatalysts in organic synthesis
- ✓ gain knowledge on chemical products and processes that reduce or eliminate the use and generation of hazardous substances.

Pre-Required Knowledge

- ✓ Basic principles of green chemistry
- ✓ Phase Transfer Catalysts
- ✓ Various extraction Process

Unit I: Principles of Green Chemistry and Designing a Chemical synthesis

Evaluating the effects of chemistry. Waste minimization, solvent-free and aqueous phase reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity risk = (function) hazard exposure; waste or pollution prevention hierarchy.

Unit II: Green Chemical Approach in Conventional Synthesis

Introduction-Diels alder-Aldol condensation-Heck, oxidation and reduction-photochemical reactions. Alternative solvents- designing a green synthesis. Industrial applications-synthesis of Ibuprofen, Sertraline and Adipic acid. Sonochemistry - Introduction, types of sonochemical reactions, a few synthetic applications - substitution, addition, elimination, hydrolysis, esterification, oxidation, reduction.

Unit III: Phase Transfer Catalysts

Definition, mechanisms, reaction, preparation, advantages and types of PTC. Green Chemical Approach in Conventional Synthesis with PTC - Synthesis of nitriles, alkyl halides, elimination reactions, C-alkylation, N-alkylation,

oxidation using hydrogen peroxide, dihalocarbenes, heterocyclic synthesis, β-lactams synthesis, crown ethers.

Unit IV: Green Approach in Solid Phase

Introduction– solid phase organic synthesis without using any solvent- halogenation, Micheal addition, aldol condensation, Grignard reagent, Reformatsky reaction, Witting reaction, aromatic substitution reactions-nuclear bromination and nitration by Green synthetic methods. Biochemical oxidations-biochemical reduction-enzyme catalyzed reactions in organic synthesis.

Unit V: Green Approach in Extraction Process

Extraction and separation of phyto-constituents: hydro extraction, wet steam and dry extraction, head space extraction, super critical fluid extraction, pressurized liquid extraction, Microwave assisted methods, Ultrasonication assisted extraction and simulated moving bed technology.

Suggested Readings

Text books:

1. V. K. Ahluwalia and M. Kidwai, New Trends in Green Chemistry, Anamlaya Publishers, New Delhi, 2012.
2. Mike Lancaster, Green Chemistry: An Introductory Text: Edition 3, RSC, ISBN: 978-1-78262-294-9, 2016.
3. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry - Theory and Practical, University Press, 1998

References Books:

1. Albert S. Matlack, “Introduction to Green Chemistry” CRC press, 2010.
2. Introduction to Renewable Energy, Solar Energy International, 2012
3. Sunita Dhingra & VK Ahluwalia, Green Chemistry in 21st Century and Beyond, Manakin Press, ISBN-13: 978-9384370480, 2017.

Web Sources:

1. http://igs.chem.cmu.edu/index.php?option=com_content&view=article&id=88&Itemid=276

2. https://www.youtube.com/watch?v=GI8g6x179t0
3. https://www.youtube.com/watch?v=C0K1XRT1myg
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3430255/
5. https://www.ch.ic.ac.uk/marshall/4I10/4I101.pdf
6. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/05.organic_chemistry-ii/21.phase_transfer_catalysis/et/5550_et_et.pdf

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Title of the paper: Environmentalchemistry **Semester: III**
Course code:LPCHSC31 **Credits: 2**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ understand the importance of environmental protection
- ✓ gain the importance of biodiversity
- ✓ learn various type of ecosystem
- ✓ learn the environmental pollution and its consequences
- ✓ gain the knowledge on the natural resources
- ✓ understand the social issues

Pre-Required Knowledge:

- ✓ Structure of Ecosystems
- ✓ Hazardous effects of Air pollution
- ✓ family welfare programme

UNIT I :ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

Definition, scope and importance of environment. Need for public awareness. Concept of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposer, Energy flow in the ecosystem, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Introduction to biodiversity definition: genetic, species and ecosystem diversity, Bio geographical

classification of India. Biodiversity at global, national and local levels. In-situ and ex-situ conservation of biodiversity.

UNIT II: ENVIRONMENTAL POLLUTION

Definition, causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards. Soil waste management: causes, effects and control measures of municipal solid wastes . Role of an individual in prevention of pollution. Disaster management: floods, earthquake, cyclone and landslides.

UNIT III :NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

Unsustainable to sustainable development – urban problems related to energy. Water conservation, rain water harvesting, watershed management-climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wastelandreclamation,consumerism and waste products, Environment protection act – Air (Prevention and Control of Pollution) act ,Water (Prevention and control of Pollution) act , Wildlife protection act, Forest conservation act.

Enforcement machinery involved in environmental legislation, central and state pollution control boards, Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations , population explosion , family welfare programme, environment and human health , human rights , value education , HIV / AIDS. Women and child welfare.

Suggested Readings

Text books:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers (2018).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2016).
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

Reference books:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
5. ErachBharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient BlackswanPvt Ltd. 2013. AS5401 DRILLING OPERA

Web Sources:

1. https://youtu.be/7y2XfEXRKfg
2. https://youtu.be/Om42Lppkd9w
3. https://youtu.be/n3VTOwqT_RI

4. https://youtu.be/PqxMzKLYrZ4
5. https://youtu.be/dnpAbB-tsOY
6. https://youtu.be/c15hy8dXSps
7. https://youtu.be/RlPr5UC5QP4

Title of the paper: Laboratory Safety Skills **Semester: III**
Course code: LPCHSC32 **Credits: 2**

Course Learning Outcomes:

At the end of the course, Students are able to

- ✓ accustomed to good laboratory practices
- ✓ handle laboratory chemicals in safety manner
- ✓ know the safety the disposal of chemicals
- ✓ understand the use of safety apparels

Pre-Required Knowledge:

- ✓ Material safety data sheet
- ✓ Safety culture
- ✓ Emergency response

Unit 1: BASIC LABORATORY SAFETY PRACTICES

Working Alone, Prevention of chemical Exposure, inhalation of chemicals, ingestion of chemicals, Washing Hands, Emergency Exits, Laboratory Signs, Emergency procedure for laboratory.

Unit 2: INTRODUCTIONS TO LABORATORY TECHNIQUES

Sample preparation, stoichiometric calculations, gravimetric, volumetric techniques, standardization methods and analysis of samples by various procedures and the use of glassware.

Use and maintenance of analytical balance, potentiometers, pH meters, conductivity meters, mechanical shakers, melting point apparatus, water heaters, water deionisers, magnetic stirrers and hot plates.

Unit 3: ENVIRONMENTAL SETTINGS AND LABORATORY FACILITIES

Laboratory Footprint, Laboratory Ventiliation, Eyewash and Safety Shower, Safety Shields, Fire Blanket, Electrical Safety Controls, Fire suppression using fire extinguisher.

Fume Hood, Glove box, Refrigerators, stirring and mixing equipment, Vacuum systems.

Unit 4: PRUDENT WORK PRACTICES

Student Behaviour, Chemical Spill Control, Clothing/Hair, Cold/Heat Protection, Eyewash/Shower, Food, Drink and Cosmetics, Laboratory water, Glassware, Labelling. Safety Data Sheets, Personal Protective Equipment, incident reporting, Waste Disposal (Items to Be Recycled).

Unit 5: CHEMICAL SAFETY AND ETHICAL HANDLING OF CHEMICALS

Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, transportation of hazardous chemicals.

Suggested Readings:

Text Book:

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Laboratory Waste Management: A Guidebook by ACS Task Force on Laboratory Waste Management, ACS Miscellaneous, 1994.

Reference Books:

1. Halpern, A. M.; McBane, G. C. Experimental Physical Chemistry: A Laboratory edition, 2006.
2. Hein, M; Peisen, J.P, Miner, R. L, Foundations of College Chemistry in the Laboratory, John Wiley and Sons, 2011

3. Margaret-Ann Armour, Hazardous Laboratory Chemicals Disposal Guide, 2 nd Edition, 1996
4. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

Web Sources:

1. https://www.shutterstock.com/search/laboratory+safety+symbols
2. https://portal.ct.gov/SDE/Publications/Connecticut-Middle-School-Science-Safety/5-General-Science-Laboratory-Safety-Specifications
3. https://www.carolina.com/teacher-resources/Interactive/lab-safety-and-techniques-101-introducing-your-students-to-the-chemistry-lab/tr28304.tr
4. https://www.uregina.ca/hr/hsw/assets/docs/pdf/Laboratory-Safety/Material-Safety-Data-Sheet.pdf
5. https://www.youtube.com/watch?v=gi3DeFY0cfw

DEPARTMENT OF ENGLISH - PG-CBCS -LOCF

Title of the Course: English For Career Development (NME) Semester: III
Course code: LPENNM31 Contact hours: 5hrs/w Credits: 2

Course Learning Outcomes:

On completion of the course, the students are able to

- have the comprehensive understanding of the language ability required in the competitive examination
- effectively use the vocabulary for the fluent and accurate communication
- exercise their grammatical competence in their communications
- confidently meet the job interview requirements
- practise the proficient language skills in all Professional and social interactions

Pre-required knowledge:

- Use of Basic Grammar for Job
- Communicative English for Career
- Writing Skills for Job Purposes

Unit I

Situational Grammar, Tenses, Voices, Prepositions, Articles

Unit II

Sentence Completion
One word Substitution
Homonyms
Phrasal Verbs

Unit III

Reading Comprehension
Analogy
Jumbled Sentence
Errors and How to avoid them

Unit IV

Job Application and Preparing a CV
Expansion of Idea
Report Writing
Essay Writing

Unit V

Interview
Group Discussion
Tips for taking Exam

Suggested Topics for presentation:

- Application process for various jobs
- Providing strategies for identifying the jobs
- Preparing resume for professional jobs
- Writing a clear and concise formal letter
- Developing interview skills

Suggested Readings:

i) Text Book:

Bhatnagar,R.P.*English for Competitive Examinations,* Madras: Laxmi Publication, 2009.

ii) Reference Books:

1. Sharma,Manish.ITI*Employability Skills*.Neelkand publishers,2016.
2. Dixit,Shilpi.*EmployabilitySkills.*BFC Publications,2021.
3. Dhanavel,S.P.*English and Soft Skills.*Orient Blackswan,2011.

iii) Web Source:

1. https://www.coursera.org/learn/careerdevelopment
2. https://www.my.mooc.com/en/mooc/english-for-careerdevelopment
3. https://www.naukri.com/learning/english-for-careerdevelopmentcourse-couri202

DEPARTMENT OF HISTORY – PG - CBCS – LOCF

Course Title : Indian History for Competitive Exams(NME)		**Semester: III**
Course code: LPHSNM31	**Contact Hours: 5**	**Credits: 4**

Course Learning Outcomes:

On completion of this course, the students are able to

- understand the Indus Valley Civilisation.
- explain the administration of Mughals.
- analyse the causes and result of 1857 Mutiny.
- describe the salient features of Constitution of India.
- asses the current events in India and abroad.

Pre- required knowledge:

- Topics of competitive exams.
- Need of General Knowledge.
- Importance of Competitive exams.

Unit I : Ancient Indian History

Sources, - Indus Valley Civilization- Vedic Period - Mauryan Dynasty Buddhism and Jainism- Guptas.

Unite II: Medieval Indian History

Advent of Islam- Establishment of Delhi Sultanate – Mughals and Marathas- Advent of Europeans-Expansion and consolidation of British Rule- Social Reforms-Religious Movements.

Unite III: Indian National Movement

1857 Revolt - Indian National Congress -– Gandhian Era – Role of Tamil Nadu in Freedom Struggle.

Unit IV: Indian Polity

Constitution of India-Preamble- Salient Features - Fundamental Rights and Duties - Panjayat Raj - Center and State Relation- Emergency Provisions- Election Commission- Amendments.

Unit V: Current Events

Profile of States - Defense - National Security and Terrorism, NGO - Eminent Persons and Places- Sports - Books and Authors-Cultural Panorama – Historical Events in India – Covid 19 .

Suggested topics for group discussion and presentation:

- Mauriyan Administration.
- Establishment of Delhi Sultanate.
- Indian National Movement.
- Emergency Provisions.
- Covid 19

Suggested Readings:

Text Books:

1. Ishwari Prasad, History of Medieval India, The Indian Press Ltd., Calcutta, 2006.
2. BipinCandra, History of Modern India, Orient Blackswan Publication, Hydrabad, 2009.

Reference Books:

1. NilakandaSastri, K. A. History of South India, Oxford Publication, Calcutta, 1982.
2. Basham, A.L. Wonder that was India, Rupa and Co Publisher, Delhi, 1967.
3. Bipan Chandra, Modern India, NCERT, New Delhi, 2005.
4. India and the contemporary World- I and II, NCERT, New Delhi.2000
5. Indian History, Part I,II, and III, NCERT, New Delhi,2007.

Web Sources:

- www.clearIAS.com
- www.jagranJosh.com
- www.UPSC.gov.in

DEPARTMENT OF ECONOMICS – PG – LOCF

Title of the Course: Economics for Competitive Examinations (NME)		**Semester: III**
Course Code: LPECNM31	**Contact Hours: 5hrs/w**	**Credits: 4**

Course Learning Outcomes

On completion of the course, the students are able to Grasp the measures of Economic development and role of NITI Aayog Acquire the Skill of analysing the Government policies on poverty and population growth.

Evaluate India's trade policy and gain knowledge on IMF, IBRD and ADB.

Analyse the working of Indian Money Market.

Understand the issues in the Indian Federal system and competently appear for Competitive examinations.

Pre- required Knowledge

Economic growth, Economic development and Economic Planning.

Absolute Poverty Vs Relative Poverty.

Internal trade Vs International trade.

Indian Financial Market:Meaning and Structure.

Direct tax, Indirect tax and Non-tax Revenue.

Unit I: Economic Development and Planning

National Income – Various Committees on National Income estimation – Measures of Economic Development(PQLI, HDI, HPI and GDI) – National Income as a measure of welfare – Green Revolution and agriculture development- History of Economic Planning in India – Planning Commission Vs NITI Aayog – India's role in BRICS.

Unit II: Population and Poverty

Population growth in India – Demographic features of India - India's Population Policy – Report of Lakdawala, Tendulkar and Rangarajan Committees on Poverty (Salient Points only) – Poverty Eradication Programme (IRDP, PMGAY, MGNREGA).

Unit III: International Trade Policy and Institutions

India's Trade Policy – Special Economic Zones – Foreign Investment Policy – Foreign Exchange Rate Policy – FEMA – Globalisation and WTO – International Financial Institutions: IMF, IBRD and ADB.

Unit IV: Indian Money Market

Money Market: Features and instruments – Banking Sector Reforms – Primary Market Reforms – Inflation and controlling measures in India

Unit V: Federal Financial System in India

Federal Structure – Consolidated and Contingency Funds of India – Public Account – Centre – State Financial Relation – Finance Commission – GST and GST Council - Fiscal Sector reforms in India – State Finances – Fiscal Responsibility and Budget Management (FRBM) Act - Local Finances.

Suggested topics for group discussion/ Presentation

NITI Aayog differs from Planning Commission in terms of composition and powers.

Poverty estimation suffers from various methodological issues.

International Monetary Fund (IMF) provides international liquidity.

Indian Banking Sector reform measures are based on Basel-III norms.

State governments are suspicious of the motives of the government of India in raising and sharing of tax revenues with them.

Suggested Readings

Text Books

1. Ramesh Singh(2019), Indian Economy for Civil services, Universities and other Examinations, McGraw Hill Education, New Delhi.
2. Misra and Puri, (2019), Sectoral Problems Of Indian, Economy, Himalayas Publishing House.
3. Rudder Datt and Sundaram, (2018), Indian Economy, S. Chand, New Delhi.

Reference Books

1. Francis Cherunilam, (2019) International Trade and Export Management, Himalaya Publishing House.
2. Uma kapila (Ed.) (2018), Indian Economy since independence, Academic Foundation, New Delhi, 29 th edition.
3. Gupta. K. R and Manoranjansharma (2018) , Indian Economic Policies and Data McGraw Hill Publications.
4. Abhijit, V. Banerjee et al. (2017), poverty and income distribution I India, juggernaut, New Delhi.
5. Prakash B.A (2009) , The Indian Economy since 1991, Edited Book, Pearson Education New Delhi.
6. Iswar C. Dhinkara, (2009) , The Indian Economy: Environment and Policy, Sultan Chand and Co.
7. Manmohan Agarwal and Amit shovon Toy, (2007) ,Globalisation and the Millinnium Development Goals, Orient Black Swan, Hyderabad.
8. Brahmananda, P. R, and V. R. Panchmuki (Eds) (2001), Development Experience in the Indian Economy: Inter-state Respective, Bookwell, Delhi.

9. Ahuluwalia, I. J and I. M. D. Little (Eds) , (1999), India's Economic Reforms and Development, oxford Universities Press, New Delhi.
10. Agarwal, A.N, (1981), Indian Economy, Vishwa prakashan, New Delhi.

Web Sources

https://www.vedantu.com/commerce/national-income

https://en.m.wikipedia.org/wiki/Demographics_of_India

https://en.m.wikipedia.org/wiki/Federation

DEPARTMENT OF COMMERCE - PG - CBCS - LOCF

Title of the Paper: Entrepreneurship Development (NME) Semester: III
Course Code: LPCONM31 Contact Hours: 5hrs/w Credit: 4

Course Learning Outcome:

On completion of the course, the students are able to

- know the factors affecting entrepreneurial growth.
- identify the problems faced by women entrepreneurs.
- identify the various institutional support to the entrepreneur.
- advocate for subsidy and incentives to be received from the Government.
- prepare the project reports.

Pre-required knowledge:

- ✓ Entrepreneurial venture
- ✓ Scope for women entrepreneurship
- ✓ Financial assistance from government

Unit- I: Introduction to Entrepreneurs

Entrepreneur - Definition - Concept - Characteristics - Qualities - Classification of entrepreneurs - Entrepreneur Vs Manager - Role of Entrepreneurs in the economic development -- Factors affecting entrepreneurial growth. **Entrepreneurship**- Concept - Distinction between Entrepreneur and Entrepreneurship

Unit- II: Women Entrepreneurs

Introduction - Definition - Problems - Suggestions to overcome - Government steps towards Women Entrepreneurs - Institutions support to women Entrepreneurs in India.

Entrepreneurship Development Programmes (EDP):

Meaning - Objectives - Stages in EDP- Pre-training Stage - Training phase - Post Training - Evaluation and Feedback of EDP.

Unit- III : Assistance to Entrepreneurs:

Financial and Non-Financial Institutions - TIIC and SFC - DIC - SIDBI - SIDCO - Commercial Banks.

Unit- VI : Incentives and Subsidies:

Incentives and subsidies of State and Central Govt - Objectives -Aims - Tax Concession - Assistance to MSME's - Backward areas - Industrial Estates

Unit-V : Project Report:

Meaning - Steps - Contents - Reasons for failure of a Project Report – Format – Guidelines.

Suggested Topics/Practical Exercises:

The learners are required to

- ✓ list the various factors affecting entrepreneurial growth.
- ✓ explain the steps to overcome the problem face by women entrepreneur.
- ✓ name any two financial institutions supporting entrepreneurs to grow in Tamilnadu.
- ✓ cite examples for the growth of business using Seed Capital Assistance / Scheme.
- ✓ draw a project report for a new business concern.

Suggested Readings:

(i) Text Books

1. Gupta.C.B. (2018). Entrepreneurship Development. New Delhi: Sultan Chand and Sons.
2. Gordon. E. and Dr. Natarajan. K. (2020). Entrepreneurship Development. Mumbai: Himalaya Publising House.

(ii) Reference Books

1. Gupta . C.B.& Srinivasan. N.P. (2018), Entrepreneurship Development. New Delhi: Sultan Chand and Sons.
2. Khanka S.S. (2018) Entrepreneurial Development. New Delhi: S.Chand & Company Ltd..
3. Kanishka Bedi. (2012). Management and Entrepreneurship, New Delhi: Oxford University Press.

(iii) Web-Sources:

1. www.tiic.in
2. www.sidco.in
3. www.dic.in

DEPARTMENT OF MATHEMATICS – PG – CBCS - LOCF

Title of the Course: Mathematics for Competitive Examinations (NME)		**Semester: III**
Course Code: LPMSNM31	**Contact Hours : 5hrs/w**	**Credits: 4**

Course Learning Outcomes:

On completion of the course, the students are able to

- formulate the problem quantitatively
- recall appropriate arithmetical methods to solve the problem
- demonstrate various principles involved in solving mathematical problems.
- evaluate various real life situations by resorting to analysis of key issues and factors
- develop various mathematical skills to solve the problems

Pre-required Knowledge:

- ✓ Addition and subtraction
- ✓ multiplication and division
- ✓ product tables

Unit I:Quantitative Aptitude - I

HCF and LCM of numbers-Decimal Fractions – Simplification - Average-Problems on numbers-Problems on ages.

Unit II: Quantitative Aptitude – II

Percentage-Profit and loss-Ratio and proportion-Partnership-Simple interest-Compound interest.

Unit III: Quantitative Aptitude - III

Time and work-Time and distance-Problems on trains-Alligator or mixture.

Unit IV: Quantitative Aptitude and logic

Calendar – Clocks – Stock and shares - Odd man out and series.

Unit V: Reasoning

Verbal and non-verbal reasoning- verbal Reasoning – Analogy - Mathematical operations – Inserting the character. Non-Verbal Reasoning – Analytical Reasoning

Suggested Topics for Group Discussion/ Presentations:

1. Simplification
2. Simple and compound interest
3. Problems on trains
4. Stock and shares
5. Non-verbal reasoning

Suggested Readings:

(i) Text Books:

1. R.S. Agarwal, Quantitative Aptitude for Competitive Examinations Revised and Enlarged edition, S.Chand Publications, New Delhi, Reprint 2007.
2. R.S. Agarwal, Verbal and Non-Verbal reasoningS.Chand Publications, New Delhi,Reprint 2009.
   Unit I: Book1: Section 2,3,4,6,7& 8.
   Unit II: Section 10,11,12,13,21 & 22.
   Unit III: Section 15,17,18& 20.
   Unit IV: Section 27,28,29 & 35.
   Unit V: Book 2:Part I – Section I- 2,13 &16. Part II –

Section – 4

(ii) Reference books:

1. R.Gupta, Quantitative Aptitude, Unique Publishers Pvt. Ltd, 2013.
2 Arora. P.N. and Arora. S., Quantitative Aptitude Mathematics, Volume-1 S Chand & Company Ltd., New Delhi, 2009.
3. Kothari. C.R., Quantitative Techniques,Vikas Publishing House Pvt. Ltd., New Delhi, 1989.
4. Srinivasan. T.M., Perumalswamy. S. and Gopala Krishnan. M.D., Elements of Quantitative Techniques, Emerald Publishers, Chennai, 1985.

(iii) Web Resources:

1. https://mathematician0.weebly.com/
2. https://youtu.be/rHzggZDdtc4
3. https://youtu.be/ZADjT-wsQJw
4. https://youtu.be/ETiRE7N7pEI
5. https://www.youtube.com/watch?v=tnc9ojITRg4&list=PLpyc33gOcbVA4qXMoQ5vmhefTruk5t9lt

DEPARTMENT OF BOTANY - PG - CBCS - LOCF

Title of the Course: Plants and Human Welfare (NME)		**Semester: III**
Course Code: LPBYNM31	**Contact hours: 5hrs/w**	**Credit:4**

Course Learning Outcomes:

On completion of the course, the students are able to

- acquire knowledge on Plants as food
- understand the cultivation of mushrooms.
- recognize the need of plant drugs.
- familiarize with the wood and its types.
- come to know about the Organic farming.

Pre-required knowledge:

- Plant groups
- Raw drugs
- Farming techniques

Unit I: Plants as food

Importance of plant genetic resources and utilization. Present status of resources in India. Agricultural, vegetable, horticultural and medicinal plants. Higher plants as food - Cereals- Rice, Pulses- Pigeon pea.

Unit II: Cultivation of mushrooms – *Pleurotus*

General characters of mushroom – present status of the mushroom industry in India common edible and non-edible mushrooms. Nutritive and Energy value of edible mushrooms.

Unit III: Biological Drugs

Brief history and scope of raw drugs of plant origins. Definition, herbals, classification and description. Classification of vegetable drugs. Biological sources of drugs.

Unit IV: Timbers

Structure of wood, sap wood – heart wood transition, properties of wood (Physical, chemical & mechanical). Dendrochronology and its significance. Commercial uses of woods of South India - Teak (*Tectona grandis*), Neem (*Azadirachta indica*).

Unit V: Organic farming

Organic farming, vermin-composting. Leguminous plants in green manuring. Biofertilizer -*Rhizobium* and Blue green algae (*Nostoc*); Biopesticides: *Bacillus thuringiensis*.

Suggested Topics for Seminar/ Presentation/ Group Discussion:

- Plants as food
- Recent methods for mushroom cultivation
- Biological sources of drugs
- Dendrochronology and its significance
- Techniques of vermicomposting and Methods of organic farming

Suggested Readings:

Text Books:

1. Albert F. Hill. (1952). Economic Botany. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. PradeepSachdeva. (2014). A Naturalists Guide to the Trees & Shrubs of India. *Prakash books* Publishers, Chennai. ISBN: 978817599408.
3. Board Eiri (2008) Hand Book of Tree Farming. *Engineers India Research Institute Publishers*. New Delhi.
4. Suman, B.C. & Sharma, V.P. (2007). Mushroom cultivation in India. *DayaPublishingHouse*, Delhi.

Reference Books

1. Dorian Q. Fuller, Eleni Asouti.(2008)Trees and Woodlands of South India. *Munshiram Manoharlal Publishers*. New Delhi. ISBN: 9788121512145.
2. Sanjay Tiwari, and Nikhil Devasar. (2019). 100 Indian Trees: The Big Little Nature Book. *DK India publishers*, New Delhi.
3. NeginhalS.G. (2020). Forest Trees of South India. *Notion Press publishers*, Chennai.
4. Diego Cunha Zied, Arturo Pardo-GimAcnez. (2017). Edible and Medicinal Mushrooms: Technology and Applications. *John Wiley & Sons*.
5. Kochhar, S.L. (1981). Economic Botany in the Tropics. *McMillan India Ltd*., Madras.
6. Mukharjee, S.K. (1969). Survey of Plants of India. Bull. *Botanical Survey India*, 11(3): 217-223.
7. Sambamurthy, A.V.S.S. and N.S. Subramaniyam. (1989). A Textbook of Economic Botany. *Wily Eastern Ltd*., New Delhi.
8. Albert E Hill and O P Sharma (1996). Economic Botany. *Tata McGraw Hill Co. Ltd*., New Delhi.
9. Anonymous. (1948-1976). The Wealth of India - A Dictionary of Indian Raw Materials and Industrial Products. Vol. I to X. *Publication and Information Directorate, CSIR*, New Delhi.

Web Sources:

1. https://byjus.com/biology/food-sources-animal-plant-products/
2. https://foodplantsinternational.com/
3. https://namyco.org/mushroom_cultivation_resources.php
4. https://www.fs.fed.us/wildflowers/ethnobotany/medicinal/index.shtml

DEPARTMENT OF PHYSICS – PG – CBCS - LOCF

Title of the Course: Physics for Competitive Examinations (NME)		Semester: III
Course Code: LPPHNM31	Contact Hours: 5hrs/w	Credit: 4

Course Learning Outcomes:

On completion of the course, the students are able to

- understand various systems of units and newton's laws of motion
- acquire the basic knowledge on gravitation
- understand the various aspects in electrostatics and electricity
- have knowledge on various properties of light
- understand the electronic devices, circuits and various number systems

Pre-Required Knowledge:

- ✓ Gravitational force, acceleration due to gravity mass and other physical quantities
- ✓ Heat, energy, temperature, basic mathematics, basic ideas on charge and current
- ✓ Elementary idea on planetary systems and space

Unit I: Systems of Units and Newton's Laws

System of units S.I.- Fundamental units- derived units – Dimension of physical quantity – uses of dimensional equations – limitation of dimensional analysis. Force and

inertia, Newton's first law of motion – momentum – second law of motion – conservation of linear momentum – Newton's Third law of motion – friction – laws of limiting friction – static and dynamic friction.

Unit II: Gravitation

Gravitation-Kepler's law of planetary motion – universal law of gravitation – acceleration due to gravity – variation of 'g' at poles – equator – Altitude – depth – rotation of earth – difference between mass and weight – Inertial mass and gravitational mass –Satellite – Orbital velocity – escape velocity – Rocket.

Unit III: Electrostatics and Electricity

Charge and fields – Coulomb's law – electric field due to a point charge – Gauss law – Application of Gauss law – Electric field due to parallel sheet of charge – Electric potential –Potential due to a point charge – Capacitor – Principle of a capacitor – Capacitance of a parallel plate capacitor –Effect of dielectric on capacitance – current and resistance – Electric current –Current density – Expression for current density – Ohm's law and electrical conductivity – Kirchoff's law – Application of Kirchhoff's law to Wheatstone network and measurement of resistance.

Unit IV: Optics and Sound

Light – Reflection of light – Laws of reflection – Refraction of light – Laws of reflection – Dispersion visible range dual nature – Total internal reflection – Laser – Interaction of light with matter – Population inversion - Applications of laser. Simple Harmonic motion – Progressive wave properties – stationary waves – properties – ultrasonic – Properties and applications.

Unit V: Electronics

Difference between conductor, insulator and semiconductor using band theory – Intrinsic and extrinsic semiconductor – semiconductor diode –diode as a rectifier – Photo diode – LED – Zener diode as a voltage regulator – Number system – Binary, octal, Hexadecimal – Inter conversion – Cray code – exes 3 code , ASCII code – Basic

gates – De-Morgan's theorem – Universal gates – Binary addition –Binary subtraction – 2's complement method - 1's complement method – binary multiplication – binary division.

Suggested Topics for Group Discussion/Presentation:

- ✓ Newton's laws of motion, concept of friction and its associated quantities
- ✓ Newton's law of Gravitation-Kepler's law of planetary motion,
- ✓ Electrostatics force, Electric field, electric potential, capacitors. Ohm's law Kirchoff's law
- ✓ Various properties of light, laser fundamentals and applications, Ultrasonics and applications.
- ✓ Various types of semiconductor devices, binary number systems

Suggested Readings:

(i) Text Books:

1. Murugeshan, R. Mechanics, Properties of matter and sound. For Bsc ancillary physics, Reprint (2016).
2. Murugeshan, R. Optics, Spectroscopy and Modern Physics, For Bsc ancillary physics, 1st edition (2017).
3. Murugeshan, R. Electricity and electronics, for B.Sc Ancillary Physics, 1st edition, (2014).

(ii) Reference Book:

Halliday, D. Resnick, R and Walker, J. Principle of Physics, International Student version, Wiley India Private Ltd., 9th edition, reprint (2012).

(iii) Web Sources:

1. https://www.khanacademy.org/science/physics
2. https://ocw.uci.edu/courses/physics_3a_basic_physics.html
3. https://www.concepts-of-physics.com/dr-hc-verma/videos.php#hc-verma-videos-on-mechanics

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Title of the paper: Organic Chemistry – IV **Semester: IV**

Subject Code:LPCHCT41 **Contact Hours: 5hrs/w** **Credits: 5**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ gain knowledge on the basic concepts of green chemistry.
- ✓ gain knowledge on the basic concepts of retrosynthetic analysis.
- ✓ understand and are able to apply the correct role of organometallic and transition metals in organic synthesis
- ✓ elucidate the structure, describe synthesis of important heterocycles and steroids.
- ✓ explain the characteristics of important heterocycles and steroids.

Pre-Required Knowledge:

- ✓ Introduction to Green Chemistry
- ✓ Nomenclature of Heterocycles Compounds
- ✓ Knowledge of the synthetic organic chemistry

UNIT I: ESSENTIALS OF GREEN CHEMISTRY

Green chemistry: definition, needs and goals. - Twelve principles of green chemistry. Usage of Conventional and Green solvents: Advantages, Limitations and drawbacks. Green Synthesis: Designing, Choice of starting materials, choice of reagents, choice of catalysts: bio catalysts, polymer supported catalysts, choice of solvents. Synthesis involving basic principles of green chemistry. Applications: synthesis of adipic acid, and paracetamol. Microwave, Ultrasonication reactions – Esterification, reduction and coupling reactions.

UNIT II: REAGENTS IN ORGANIC SYNTHESIS - I

Organometallic reagents:

Organo-magnesium Reagent: Grignard reaction – Organo-lithium reagent: Butyl Lithium – Organo-copper reagent: Gilman reagent – Organo-aluminium reagent: DiBAL-H, Trialkylaluminium – Organo-mercuric reagent: mercuric acetate - Organo-silicon reagent: Trimethylsilyl iodide,

trimethylsilyl cyanide, Trialkylsilanes – Organo-tin reagents: tributyl tin hydride.

UNIT III: REAGENTS IN ORGANIC SYNTHESIS - II

Transition metal complexes in organic synthesis:

Organo palladium complexation: Heck reaction, Stile coupling, Suzuki reaction, Sonogashira coupling, Wacker oxidation – Organo-rhodium complexes: Wilkinson's catalyst – Organo-boron reagents: diborane (BH_3/THF), 9-BBN, Optically active boranes – Metal carbonyl complexes involving Fe, Co and Ni.

UNIT IV: RETRO SYNTHETIC ANALYSIS AND SYNTHETIC STRATEGIES

Planning a synthesis – Relay approach and convergent approach to total synthesis – Retrosynthetic analysis of simple organic compounds – Functional group inter conversions – use of activation and blocking groups in synthesis – Homogeneous hydrogenation – Regioselectivity – Diastereoselectivity – Enantioselectivity- Umpolung synthesis – Robinson annelation – A schematic analysis of the total synthesis of the following compounds, 2,4 – dimethyl 1,2 – hydroxypentanoic acid and Trans – 9 – methyl-1-decalone.

UNIT V: HETEROCYCLES AND STEROIDS

Heterocycles: Synthesis and reaction of Oxazole, Thiazole, Caffeine and Flavones.

Steroids: Classification - Conformational aspects of A/B cis and A/B trans steroids – structural elucidation of cholesterol – chemistry of bile acids – Synthesis of Male sex hormones: androsterone and testosterone – Synthesis of Female sex hormones: oestrone and progesterone.A basic idea about adrenocortical hormones (structural elucidation not required).

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- ✓ Green chemistry
- ✓ Transition metal complexes in organic synthesis
- ✓ Retrosynthetic analysis of simple organic compounds

- ✓ Synthesis and reaction of Heterocycles compounds
- ✓ structural elucidation of Steroids

Suggested Readings:

Text Books:

1. V.Kumar, An Introduction to Green Chemistry, Vishal Publishing Co., Jalandhar, 2007.
2. Jerry March Advanced organic chemistry Wiley 4th edition 1992.
3. Jagadamba Singh and L.D.S. Yadav, Organic synthesis, PragatiPrakashan, 2007.
4. Carey and Sundberg, Advanced Organic Chemistry – Structure & Mechanism Part A, V Edition Springer, 2008
5. Jagadamba Singh, Photochemistry and Pericyclic Reactions, New Age, III Edition, 2012.
6. Stuart Warren, Organic Synthesis - The Disconnection approach, John Wiley & Sons, 2004.
7. P.S. Kalsi, Organic Synthesis through Disconnection Approach, Med Tech Publishers. 2017.
8. John A. Joule, Keith Mills, Heterocyclic chemistry, 5th edition, Wiley-Blackwell, 2010.

Reference Books:

1. Paul T. Anastas and John C. Warner, Green Chemistry (Theory and Practice), Oxford Univ. Press, NewYork, 1988.
2. R.O.C. Norman, Organic synthesis III Edition 1993.
3. C.H. Depuy and O.L. Chapman, Molecular reactions and Photochemistry. Prentice Hall, 1972.
4. H.H. Jaffe and M. Orchin, The Importance ofAntibonding Orbitals, Oxford &IBH.1967.
5. R.E. Ireland, Organic synthesis, Prentice Hall of India Pvt. Ltd., 1975.
6. I.L Finar, Organic chemistry, Vol. II, ELBS, 1975
7. W. Klyne, Chemistry to Steroids, Methuen and Co., NewYork , 1965.
8. R.M. Achesen, Chemistry of Heterocyclic compounds, Wiley Eastern, 1973.

Web Sources:

1. https://www.swayamprabha.gov.in/index.php/ program/ archive/8
2. https://www.youtube.com/channel/UCo-V97xlCS5VmGnkh LjGTfg/playlists
3. https://www.youtube.com/watch?v=0-HlX6FOvEg
4. https://www.youtube.com/watch?v=zyRRHfH9_Zg
5. https://www.youtube.com/watch?v=ii2DNupKG_4
6. https://nptel.ac.in/courses/104/106/104106131/

Title of the paper: Inorganic Chemistry-IV **Semester: IV**

Course code: LPCHCT42 **Contact Hours: 5hrs/w** **Credits: 5**

Course Learning Outcomes:

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

- ✓ understand electroanalytical techniques and their applications.
- ✓ handle data using MS-Excel
- ✓ understand the thermoanalytical techniques and their applications.
- ✓ study the spectro-analytical techniques and their applications to inorganic complexes.
- ✓ gain knowledge on nuclear chemistry, nuclear waste disposals and atomic power projects in India.
- ✓ understand the chemistry of lanthanides and actinides and their applications in different fields.

Pre-Required Knowledge:

- ✓ Electrochemistry-Introduction- electrochemical reactions-Faraday's law of electrolysis-electrode-electrolyte interface.
- ✓ Basic knowledge on handling Ms-Excel
- ✓ Nuclear chemistry-mass defect, binding energy, packing fraction-law of radioactivity.

UNIT I: ELECTROANALYTICAL TECHNIQUES

Electrogravimetry – principles and its applications - electrolytic cell- working electrodes – auxiliary electrodes and reference electrodes – Coulometry-coulometric titrations– cyclic voltammetry – reversible, quasi reversible and irreversible electron transfer process-principles and theory of Faradaic process – coupled chemical reactions and application to inorganic complexes–stripping voltammetry – chronopotentiometry –amperometry and amperometric titration.

UNIT II: THERMO-ANALYTICAL METHODS AND DATA HANDLING

Thermoanalytical techniques – Principle, Instrumentation (block diagram only) and applications of thermogravimetry – Differential thermal analysis and Differential scaningcalorimetry – Factors affecting TG and DTA curves.

Ways of expressing accuracy and precision – standard deviation–coefficient of variation- comparison of results – student's t test and F- test – Rejection of results – Q test - Correlations and regression – correlation coefficient and regression analysis – linear regression – Using Ms-excel spreadsheets for plotting calibration curves – slopes, intercept and coefficient of determination

UNIT III: SPECTRO-ANALYTICAL METHODS

Laws of absorption – principles and applications of fluorimetry, nephlometry and turbidimetry – Flame photometry, AAS, AES and AFS – ORD & CD - applications of ORD & CD to inorganic metal complexes.

UNIT IV: NUCLEAR CHEMISTRY

Different types of nuclear reactions with natural and accelerated charged particles – transmutation, nuclear cross section, (coloumb barrier, excitation energy and threshold energy) – spallation – fission and fusion – Characteristics of fission reaction, product distribution and theories of fission – fissile and fertile isotopes – nuclear fusion – stellar energy – synthesis of elements– feed materials production- nuclear reactors – reprocessing of nuclear materials – Activation

analysis – radiation protection – waste disposal – atomic power projects in India.

UNIT V: LANTHANIDES AND ACTINIDES

Chemistry of lanthanides and actinides: Position of Lanthanides and actinides in the periodic table – 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 – Actinides – separation of Pu from fission products – electronic configuration – oxidation state – comparison of lanthanides and actinides – Uses of lanthanides and actinides.

SUGGESTED TOPICS FOR GROUP DISCUSSIONS/PRESENTAITONS

- ✓ Everyday electrochemistry
- ✓ Man and Modern analytical techniques
- ✓ Absorption spectroscopy in analytical chemistry
- ✓ Nuclear Medicine
- ✓ Analytical chemistry of rare earth materials.

Suggested Readings:

Text Books:

1. D.A Skoog and D.M. West principles of instrumental analysis, Saunders College Publishing VII Edition, 2000
2. Michael E Brown, Introduction to Thermal analysis, Chapman Hall, New York, 1988

Reference Books:

1. Gary L Miesier and DolnaldATarr, Inorganic Chemistry, 3rd edition, Pearson education, 2009
2. S. Glasstone. Source book of atomic energy, East West press Litton educational Publishing, Inc., 1967.
3. H J Arniker, Essential of nuclear chemistry, Wiley Eastern Limited, New Delhi, 1995.
4. H. Willard, Merit & J.A. Dean, Instrumental methods of analysis, CBS Publishers, 1986.

5. Vogel's Text book of quantitative inorganic analysis, ELBS Longman group UK 1989. .
6. Gary D Christian, Analytical Chemistry, 6th edition, Wiley-India, 2004.
7. Satya Prakash. Advanced chemistry of rare elements, S. Chands & Co, Pvt.Ltd.New Delhi, 1987.
8. T. Moeiller, The chemistry of the Lanthanides, Reinhold Publishing Corporation, NewYork, 1963.
9. H.D.Mattur and D.P Tandon, Chemistry of rare elements, S. Chand, Ram Nagar, 1986.

Web Sources:

1. http://162.241.27.72/siteAdmin/ddeadmin/uploads/4/PG_ M.Sc._Chemistry_34441%20 Analytical%20Chemistry.pdf
2. https://www.youtube.com/watch?v=N5gqM2ftl54
3. https://www.youtube.com/watch?v=k61wjab7iUs
4. https://nptel.ac.in/courses/115/104/115104043/
5. https://nptel.ac.in/courses/103/106/103106101/
6. https://www.alchemyst.co.uk/pdf/Inorganic/lanthanides _and_actinides.pdf

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Title of the paper: Physical Chemistry – IV **Semester: IV**

Course Code: LPCHCT43 **Contact Hours: 5hrs/w** **Credits: 5**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ develop their understanding on the concept of bio-energetics
- ✓ learn the Binding of oxygen by myoglobin and Hemoglobin.
- ✓ understand theFast reaction techniques.
- ✓ understand the application of photoelectron spectroscopy to the study of surface.
- ✓ learn the physical properties of the electronically excited molecules and Stern –Volmer equation and its application.
- ✓ understand the Experimental techniques in photochemistry.

- ✓ know the fundamental concepts of Radiation Chemistry and Heterogeneous Catalysis.

Pre-Required Knowledge:

- ✓ ATP bioenergtics
- ✓ High energy radiations
- ✓ Thermal and photochemical reactions.

UNIT I: BIOENERGETICS

Thermodynamics in biology – concept of irreversible thermodynamics - energy flux biological standard states – Exergonic and endoergonic reactions –ATP, coupled reactions –Biological energy conversion- High energy metabolites –properties of ATP and its central role in bioenergetics –Binding of oxygen by myoglobin - Binding of oxygen by Hemoglobin – (elementary ideas).

UNIT II: CHEMICAL KINETICS – II

Fast reaction techniques- chemical relaxation methods- temperature and pressure jump method- reactions in flow system- continuous and stopped flow shock wave tube methods- chemical kinetics in crossed molecular beams. Catalysis by enzymes- Michalies-Menton Kinetics – influence of pH – influence of temperature – homogeneous catalysis – Acid-base catalysis- Van't Hoff intermediate – Arrhenius intermediate.

UNIT III: SURFACE PHENOMENA

Introduction - Adsorption of gases on solids – physisorption and chemisorption – adsorption isotherms - Freundlich, Langmuir, BET adsorption isotherms – Adsorption on liquid surfaces – surface tension – Gibb's adsorption isotherm - measurement of surface area –Application of photoelectron spectroscopy to the study of surface - Micelles - critical Micelle concentration (CMC) - structures. Micro emulsion.

UNIT IV: PHOTOCHEMISTRY

Physical properties of the electronically excited molecules – excited states dipole moments , pKa and redox potentials photophysical process in electrochemically excited molecules

– fluorescence phosphorescence and other deactivation process – Stern –Volmer equation and its application - photosensitization and chemiluminescence -Experimental techniques in photochemistry- chemical actinometry - Flash photolysis-study of photochemical reactions like H_2-X_2 – Elementary aspects of photosynthesis, photochemical conversion of solar energy and storage batteries.

UNIT V: RADIATION CHEMISTRY AND HETEROGENEOUS CATALYSIS:

Source of high energy – interaction of high energy radiation with matter – radiolysis of water - determination of G-value – mode of reaction of hydrated electrons experimental techniques of radiation chemistry – Dosimetry - elementary aspects of radiation chemistry in biology and industry.

Heterogeneous catalysis – chemical reaction on solid surface – kinetics and mechanism of unimolecular and bimolecular reactions – Langmuir -Hinshelwood mechanism – Langmuir –Rideal mechanism – NH_3 synthesis - hydrogenation of C_2H_4 – cracking of hydrocarbons.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- ✓ coupled reactions
- ✓ Michalies-Menton Kinetics
- ✓ physisorption and chemisorption
- ✓ solar energy and storage batteries
- ✓ Radiolysis of water

Suggested Readings

Text books

1. A.G. Marshall, “Biophysical chemistry” John wiley& sons. New York 1978.
2. K.J. Laidler, Chemical Kinetics”, 3rd ed.; Harper & Row, New York, 1987.
3. A. Muzumder, Fundamental of Radiation Chemistry, www.ScienceBookMix .com
4. Physical chemistry of surfaces, fifth edition. A. W. Adamson. John Wiley &Sons, Chichester, 1990.

5. K.K. Rohatgi, Mukherjee. Fundamentals of Photochemistry, New Age International, 1976.

Reference Books:

1. K.J. Laidler. Physical chemistry with biological application – Benjamin –Cumming Publishing Co. Ind 1980
2. K.J. Laidler. Theories of chemical reaction rates.McGraw Hill, 1969.
3. F. Wilkinson. Chemical Kinetics and Reaction Mechanism. Van Nostrand Reinhold Co.. New York. 1980.
4. C. Kalidas. Chemical Kinetic methods. New Age International. 1996.
5. J. D. Hoffman, G. T. Davis, and J. I. Lauritzen Jr., in "Treatise on Solid State Chemistry," N. B. Hanny, Ed., Plenum Press, New York, N.Y., 1976.
6. K.J. Laidler, Chemical Kinetics", 3rd ed.; Harper & Row, New York, 1987.4. A.D. Tillu. Introductory Goel Publicity House. Meerut. 1991.
7. A.K. Cheltham and P. Dav, Solid state chemistry compounds. Oxford Science Publications. 1993.
8. N.J. Turro. Modern Molecular Photochemistry, Benjamin/Cummings, Menlo Park, 1978.

Web Sources:

1. https://nptel.ac.in/courses/104/105/104105076/
2. https://nptel.ac.in/content/storage2/courses/122101001/downloads/lec-27.pdf
3. https://www.youtube.com/watch?v=oaWQWB1S5Q4
4. https://nptel.ac.in/content/storage2/courses/103104045/pdf_version/lecture25.pdf
5. http://nsdl.niscair.res.in/bitstream/123456789/251/1/Photochemistry%20revised.pdf

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Title of the paper: Polymer Chemistry **Semester: IV**
Course Code: LPCHDS41 **Contact Hours: 4hrs/w** **Credits: 3**

Learning Outcomes:

On completion of the course, the students are able to

- ✓ explain the mechanism of polymer material formation.
- ✓ know the concept of molecular weight and structure property relationship
- ✓ understand the polymerization procedures
- ✓ know the characterization of polymers
- ✓ gain the knowledge of polymer composites

Pre-Required Knowledge:

- ✓ Introduction of the polymers
- ✓ Average molecular weight-Number average and weight average molecular weights
- ✓ Crystallinity in Polymers

UNIT I: BASIC CONCEPTS OF POLYMER CHEMISTRY

Repeating Unit, degree of polymerization, classification, stereochemistry of polymers and nomenclature of stereoregular polymers.Chain polymerization, free radical polymerization, ionic polymerization and coordination polymerization: Ziegler Natta catalyst, step polymerization, ring opening polymerization (only mechanism).Copolymerisation: Block and graft copolymers – preparation.

UNIT II: POLYMERISATION TECHNIQUES AND GLASS TRANSITION TEMPERATURE

Bulk, solution polymerization: Melt polycondensation, solution polycondensation, interfacial condensation, solid and gas phase polymerization. Definition of glass transition temperature (T_g), factors influencing the glass transition temperature, importance of glass transition temperature T_g and molecular weight, T_g and melting point.

UNIT III: POLYMER PROCESSING

Plastics (major types), elastomers, fibers and compounding –Processing Techniques: calendaring - die-casting and rotational casting Compression and injection mouldings-film extrusion and –thermoforming – reinforcing.

UNIT IV: POLYMER DEGRADATION

Definition- Types of degradation- Random and Chain-end degradation with examples -Thermal, mechanical, ultrasonic and photodegradation – role of Photostabilisers – Degradation by high energy radiation-oxidative degradation – antioxidants - hydrolytic degradation.

UNIT V: POLYMER COMPOSITES AND ITS APPLICATIONS

Introduction – Classification of polymers – polymer system – role of matrix in composites – types of composites – Application of fibre composites – Smart composites – Introduction – Functional sensor materials – morphology, thermal and conductivity studies of polymer blend electrolytes.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- ✓ Free radical polymerization
- ✓ Bulk solution polymerization
- ✓ Die-casting and rotational casting
- ✓ Oxidative degradation
- ✓ Application of fiber composites

Suggested Readings:

Text books:

1. V.R.Gowariker, N.V. Viswanathan, JayadevSreedhar, Polymer Science, New Age International Publications, Reprint 2005.
2. Billmeyer, Textbook of polymer science, IIIrd Edition, John Wiley & Sons, New York, 1984.

Reference Books:

1. B.K. Sharma, Polymer Chemistry, Goel Publishing House, Meerut, 1989.
2. M. C. Gupta, A.P.Gupta, Polymer composite , First Edition, New Age International Publishers, 2005.

3. S. Rajendranet. al., Current applied physics, 12 2012, 789-793.
4. A. M. Stephen et. al., Solid State Ionics, 130 2000, 123.

Web Sources:

1. https://onlinecourses.nptel.ac.in/noc20_cy21/preview
2. http://web.mit.edu/5.33/www/lec/poly.pdf
3. https://pubs.acs.org/doi/pdf/10.1021/ed058p837
4. https://ncert.nic.in/ncerts/l/lech206.pdf
5. https://nptel.ac.in/courses/104/105/104105039/
6. https://nptel.ac.in/courses/112/107/112107221/

Title of the paper: Corrosion Science **Semester: IV**

Course code:LPCHDS42 **Contact Hours: 4hrs/w** **Credits:3**

Learning Outcomes:

On completion of the course, the students are able to

- ✓ gain clear knowledge about corrosion process and its different types.
- ✓ understand the basic principles of corrosion science.
- ✓ evaluate the various methods of corrosion testing.
- ✓ understand different forms of corrosion.
- ✓ know the methods of corrosion protection and alloy making.

Pre-Required Knowledge:

- ✓ Corrosion and its classification
- ✓ Expressions for corrosion rate
- ✓ Basic principle of electrochemical reactions

UNIT I: CORROSION PRINCIPLE

Corrosion principles - Faraday's laws of electrolysis, current efficiency, current density, electrode potentials, EMF series, Galvanic series, Nernst Equations, Polarization, Mixed potential theory, Pourbaix-pH diagrams, Passivity – theory and application.

UNIT II: CORROSION DEVELOPMENT

Forms of corrosion: uniform, galvanic, crevice, pitting, intergranular, stress corrosion cracking, corrosion fatigue, hydrogen embrittlement, dealloying. Corrosion prevention and control by various methods- change of metal composition, design improvement, inhibitors, coatings and electrochemical methods of protection.

UNIT III: CORROSION TESTING

Introduction, Classification, Purpose of corrosion testing, Huey test for stainless steel, Streicher test for stainless steel, Stress corrosion test, salt spray test, humidity and porosity tests, Accelerated weathering tests. Electrochemical methods of corrosion rate measurements by Tafel polarization, linear polarization, and impedance spectroscopy-ASTM Standards for corrosion testing.

UNIT IV: ALLOYS

Rapid solidification: non-equilibrium solidification, processing techniques, mechanical, magnetic and corrosion properties of RSP products, and their properties. Mechanical alloying: benefits of mechanical alloying; The process: factors affecting & mechanism involved, process control agents, energy transfer & energy maps. General applications: super alloys, aluminium base materials, amorphous &nanocrystalline materials.

UNIT V: PRODUCTIVE COATINGS

Importance of coatings and the basic requirements of a coating. Properties and methods of application of metallic coatings, organic coatings and linings, phosphate conversion coatings, chromate conversion coatings, anodising, diffusion coatings, CVD/PVD coatings, thermal spray coatings and ceramic linings. Surface pretreatment for ferrous & non-ferrous metals &alloys. Testing& evaluation of coatings. Criteria for choosing a particular coating for industrial applications.

SUGGESTED TOPICS FOR GROUP DISCUSSION / PRESENTATIONS

- ✓ Corrosion principles Faraday's laws of electrolysis.
- ✓ Corrosion prevention and control by various methods
- ✓ Rapid solidification: non-equilibrium solidification, processing techniques
- ✓ Electrochemical methods of corrosion rate measurements
- ✓ Properties and methods of application of metallic coatings.

Suggested readings:

Text Books:

1. Fontana and Greene, Corrosion Engineering, McGraw Hill Book Co, New York, 1983.
2. Raj Narayan, An introduction to metallic corrosion and its prevention, Oxford and IBH, New Delhi, 1983.
3. S.N.Banerjee, "An Introduction to Corrosion Science and Corrosion Inhibition", Oxonian Press P.Ltd, New Delhi, 1985.

References Books:

1. Denny A. Jones, Principles and Prevention of corrosion, Macmillan Publishing Company, 1991.
2. Zahi Ahmed, Principles of corrosion engineering & corrosion control, Butterworth Heinemann, 2006.
3. Budinski, K.G., Surface Engineering for wear resistance, Prentice Hall Inc, Englewood Cliff, New Jersey, USA, 1988.
4. Uhlig, H.H., Corrosion and Corrosion control, John Wiley and sons, New York, USA, 1985.

Web Sources:

1. https://www.electrochem.org/corrosion-science/
2. https://eoncoat.com/corrosion-prevention-methods/
3. https://www.youtube.com/watch?v=ULY7iprHlLw
4. https://www.slideshare.net/deepikajonnes/solid-state-class-12-cbse

5. https://www.slideserve.com/lacey-randolph /solid-state-chemistry

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Title of the paper: Physical Chemistry Practical **Semester: III & IV**
Course code: LPCHCL41 **Contact Hours: 5+5hrs/w** **Credits: 4**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ know the principle of different types of conductometric and potentiometric titrations
- ✓ know the techniques involved in kinetic experiments and partition coefficient determination
- ✓ understand the calculations involved in the heat of solution experiment.
- ✓ know the experiments based on UV-Visible and infrared spectrophotometer

I. Electrochemistry

a) Conductometric titrations

i) Conductivity mixture of acids –base titration.

ii) Conductometric displacement titration.

iii) Conductivity precipitation titration.

iv) Conductometric acid – base displacement titration.

v) Estimation of acetic acid – sodium acetate buffer.

b) Potentiometric titrations

i) Potentiometric redox titration MnO_4^- - I^- system.

ii) Potentiometric redox titration Ce^{4+} - Fe^{2+} system.

iii) Potentiometric precipitation titration Ag^+ - Cl^- - I^- system

iv) Determination of dissociation constant, Kd and Determination of pH of Buffer bypotentiometry.

II. Thermochemistry

Heat of solution – Oxalic acid, Ammonium oxalate, Potassium dichromate and potassium nitrate.

III. Adsorption Isotherm

i) Adsorption of oxalic acid on charcoal

ii) Adsorption of acetic acid on charcoal

Suggested Readings:

Reference Books

1. Thomas, A.O. Text Book of Practical Chemistry Scientific Publication, 4th Revised Edition, 1976.
2. Viswanathan, B. andRaghavan, P.S. Practical Physical Chemistry Viva Books, 3rd Ed., 2009.
3. Levitt, B.P. Findlay's Practical Physical Chemistry, 9thEd., Longman Publications,1973.
4. Palmer, G. Experimental Physical Chemistry, 1st Ed., Cambridge University Press, 1964.
5. Yadav, J. B., Advanced Practical Physical Chemistry, 22nd Ed., GOEL publishingHouse, Krishna Prakashan Media Ltd, 2005.
6. Venkatesan, V., Veeraswamy, R.andKulandaivelu, A.R. Basic Principles of Practical Chemistry, 2nd Ed., Sultan Chand and Sons Publication, New Delhi, 1997.
7. Levitt, B.P. Findlay's Practical Physical Chemistry, 9th Ed., Longman, London, 1985.
8. Lab Manual-Prepared by Faculty, Department of Chemistry, Vivekananda College

Web Sources:

1. https://www.youtube.com/watch?v=RR3ys87p9aA
2. https://www.youtube.com/watch?v=2VzEpsEZOYo
3. https://www.youtube.com/watch?v=tOGdZFDU2eU
4. https://www.youtube.com/watch?v=8jp_wlQcE3Y
5. https://www.youtube.com/watch?v=WwjFwNhmhZ0

DISTRIBUTION OF MARKS

Max marks: 100

Internal	**: 40 marks**	**External**	**: 60 marks**
Attendance	: 10 marks	Experiment	: 40 marks
Laboratory performance and model practical	: 20 marks	Record note book	: 10 marks

		Viva-voce	: 10 marks
Observation note book	: 10 marks		
Total	: 40 marks	Total	: 60 marks

Experiment (40 marks)

Graph	: 10 marks
Calculation	: 5 marks
Tabulation	: 5 marks
Result	: 20 marks
Total	: 40 marks

Result error

% of error	± 2	± 3	± 4	± 5
Marks	20	15	13	10

Title of the paper: Project Work /Dissertation **Semester: III & IV**
Course Code: LPCHPJ41 Contact Hour: 4+5hrs/w **Credits:4**

Course Learning Outcomes:

On completion of the course, the students are able to

- ✓ Sharpen their research acumen by doing Project work towards fresh piece of knowledge.
- ✓ orient the students on the style of research writing.

Procedure:

1. Each student will be allotted a Project Guide from the faculties of the Department concerned.
2. After the completion of the project work, the student has to submit four copies of detailed project work.
3. Every student should submit typed (A4 paper, 12 Font, 1.5 Space, 20- 30 pages), spirally bind project report duly attested by the supervising teacher and the Head of the Department on the day of submission date. The viva-voce based on the project is conducted individually.
4. Project topic once chosen shall not be repeated by any later batches of students. List of projects submitted year

wise is to be maintained in a register and submitted before the examiners if requested.

5. The project report may contain the following sections:
    1. Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.)
    2. Introduction with relevant literature review and objective
    3. Materials and Methods
    4. Results
    5. Discussion
    6. Conclusion / Summary
    7. References.
6. Project work will be evaluated by both the external and the internal (Project Guide) examiners for the maximum of 100 marks in total on the scale of the maximum of 50 marks for the internal and the external each.
7. Viva-voce will be conducted by the panel comprising HOD, External examiner and Project Guide for the maximum of 100 marks in total on the scale of the maximum of 50 marks for the internal and the external each.

TOUR VISIT

Study tour and Factory/ research institute visit: Students are directed to visit one research institute/ chemical factory preferably with in the state of Tamil Nadu or other states. Scientifically prepared hand written/typed study tour report along with photographs of candidate at the places of visit must be submitted by each student for summative examination on the day of the examination of project evaluation. The board of examiners can decide the scheme of evaluation of project, study tour report and viva voce.

Title of the paper: Nano Chemistry **Semester: IV**

Course code: LPCHSE41 **Contact Hours: 2 hrs/w** **Credits: 2**

Course Learning outcomes

On completion of the course, the students are able to

- ✓ understand the basic concept of Nano chemistry
- ✓ acquire knowledge of carbon nano tubes and its applications
- ✓ understand the structural properties of ceramics and organic and inorganic nanomaterials
- ✓ acquire awareness on Instrumental Techniques used in nanomaterials
- ✓ appreciate the applications ofnanodevices

Pre-Required Knowledge:

- ✓ Definition of nano dimensional materials - Historical milestones - unique properties due to nanosize
- ✓ Basic concepts of nano particles and their types
- ✓ Preparation and properties of nanorods, nano fibre and nanoclay

UnitI: Nanomaterials- An Introduction and Synthetic methods

Classification of Nanomaterials -General methods of synthesis of nanomaterials–Hydrothermal synthesis, Solvothermal synthesis, Microwave irradiation, sol – gel and Precipitation technologies, Sonochemical Synthesis, Hydrodynamic Cavitation.

Unit II: Nanostructured materials and applications of nanomaterials

Carbon Nanotubes (CNTs): Single walled carbon nanotubes (SWNTs), Multiwalled carbon nanotubes (MWNTs), Metal/Oxide nanoparticles (NPs), Nanorods, Nanotubes and Nanofibres,

Applications of Nanomaterials in various fields: Pharmaceuticals, Medical & Health, Energy, Water and Defence

Unit III:Carbon Clusters , Inorganic and organic nanomaterials

Nature of carbon bond: Discovery of C_{60}− C_{60}− Superconductivity in C_{60}-- Graphene

Inorganic nanomaterials : Typical examples –nano TiO_2 / ZnO/CdO/

Organic nanomaterials : Rotaxanes and Catenanes

Unit IV: Characterization techniques for nanomaterials

Electron Microscopy: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning Probe Microscopic Techqnics; Atomic force Microscopy (AFM) and Scanning Tunneling Microscopy.

UnitV:Nanotechnology and nanodevices

DNA as a nanomaterial, DNA complexes- Molecular recognition and DNA based sensor. molecular diodes, self assembled nano transistors, nanoparticle mediated transfection.

SUGGESTED TOPICS FOR GROUP DISCUSSION / PRESENTATIONS:

Suggested Readings

Text Books:

1. T.Pradeep, “Nano: The essentials, Tata Mc Graw Hill, New Delhi, 2007.
2. Nanochemistry: A Chemical Approach to Nanomaterials, G. Ozin, A. Arsenaut, Eds, Royal Society of Chemistry, London, 2005

Reference Books:

1. The Chemistry of Nanomaterials, C.N.R. Rao, A. Muller, A.K. Cheetham, Eds. WileyVCH, Germany, 2004.
2. M-C. Daniel, D. Astruc, Gold Nanoparticles: Assembly, Supramolecular Chemistry,Quantum-size Related

Properties and Applications Towards Biology, Catalysis and Nanotechnology, Chem. Rev. 104 (2004) 293-346.
3. Nano: The Essentials, Understanding Nanoscience and Nanotechnology, T. Pradeep,McGraw Hill Education, New Delhi, 2007.
4. S.Shanmugam, Nanotechnology, MJP Publishers, Chennai, 2010
5. A. Nabok, Organic and Inorganic Nanostructures, Artech House, Boston, 2005.

Web Sources:

1. http://nptel.ac.in
2. http://nisenet.org/
3. http://www.nanoparticles.org/nano%20links/
4. http://www.nsti.org/
5. http://nanozone.org/
6. http://www.understandingnano.com/
7. http://www.nanoparticles.org/nano%20links/
8. http://www.nanotechweb.org/
9. http://www.pjonline.com/pdf/forum/pj_20060318_apsgb.pdf

Title of the paper: Material Chemistry **Semester: IV**
Course code:LPCHSE42 **Contact Hours: 2hrs/w** **Credits: 2**

Course Learning Outcomes

On completion of the course, the students are able to

- ✓ understand the basic concept of Structure of matter and their properties
- ✓ understand basic chemistry of multiphase materials.
- ✓ understand the structural properties of ceramics and nanomaterials.
- ✓ study the properties and structure of liquid crystals
- ✓ gain knowledge on Organic Solids & Ionic conductors

Pre-Required Knowledge

- ✓ Types and properties of alloys
- ✓ Preparation and properties of liquid crystals

- ✓ Preparation and properties of Fullerenes

UNIT-I: MULTIPHASE MATERIALS

Ferrous alloys **and** non- ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.

Glasses**:** Glassy state, glass formers, glass modifiers and applications.

Ceramics**:** Ceramic structures, mechanical properties, refractories- characterizations, properties and applications.

Composites**:** Microscopic composites- fibre-reinforced composites and macroscopic composite.

Unit II:Ceramics, Composites and Nanomaterials

Ceramic structures, mechanical properties, clayproducts. Refractories, characterization, properties and applications. Microscopic composites, dispersion strengthened and particle-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, properties and applications

Unit III:Liquid Crystals.

Liquid Crystals: Thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases. Molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

Unit IV: Magnetic, Optical and thermal properties

Magnetic properties

Magnetic behaviours **of materials:** dia, para, ferro and ferri magnetisms, soft and hard magnetic materials.

Optical Properties

Optical properties **of** materials, elementary ideas about absorption, transmissions and reflection refractive index

Thermal properties

Thermal properties of materials, specific heat, thermal conductivity and thermal expansions.

Unit V:Organic Solids & Ionic conductors

Organic Solids: Fullerenes, Molecular Devices.Fullerenes, doped, fullerenes as superconductors.

Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches, sensors. Non-linear optical materials.

Ionic conductors: Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.

SUGGESTED TOPICS FOR GROUP DISCUSSION/ PRESENTATIONS

- ✓ Functional materials
- ✓ Hydrogels in medical applications
- ✓ Solid oxide fuels
- ✓ Mesoporous materials
- ✓ Chemistry of Fullerenes
- ✓ Applications of Liquid crystals

Suggested Readings:

Text Books:

1. Solid State Chemistry and its applications, Anthony R.West, (1998), John Wiley & Sons, New York
2. Materials science, M. Arumugam ,Anuradha publications (2012) , Chennai.
3. C.N R. Rao and J. Gopalkrishnan, New Directions in Solid State Chemistry, (1997) Cambridge Univ. Press

Reference Books

1. Materials Science, S. L. Kakani, Amit Kakani, (2006), New Age International (P) Limited, Publishers, Chennai
2. C.Kittle,Solid State Physics, Wiley Eastern Ltd., 1995.
3. B.S.SaxenaR.C.Gupta and P.M. Saxena, Fundamentals of Solid StatePhysics, Pragati Prakasham Educational Publishers, Meerat

4. K.L Chopra and I.Kaur, Thin Film Devices and Their Applications, Plenum Press, New York, 1983.
5. K.S.V.Santhanam and M.Sharon, Photoelectrochemical solar cell, Elsevier Science Publishers, New York, 1988.
6. J. C. Anderson , K. D. Leaver, J. M. Alexander and R D.Rawlings, Materials Science. ELBS

Web Sources:

1. http://nptel.ac.in
2. http://swayam.gov.in
3. mooc.org
4. https://www.coursera.org
5. http://fraboniandrea.altervista.org/ctsalts/conductors.htm
6. https://www.britannica.com/science/liquid-crystal
7. https://www.youtube.com/watch?v=JlZhHhpVRrI
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5312897/

RULES AND REGULATIONS FOR THE PROJECT / DISSERTATION WORK (UG, PG AND M.PHIL)

- Research supervisors will be allotted to the students / scholars by the respective Department.
- Research topic shall be chosen by the student / scholar in consultation with his/ her research supervisor.
- Every department has to maintain the year-wise list of project works carried out by the students. Research works done by the students / scholars of the previous batches should not be repeated by the students / scholars of the current academic year.
- The general structure of the project report is given below.

  Title page with college emblem

  Research supervisor's certificate

Student's declaration counter signed by Research Supervisor and the HOD

Student's Acknowledgement

Contents

List of Tables if any

Introduction

Review of Literature

Materials and Methods

Results and Discussion

Summary of Findings and Conclusion

Bibliography

Annexure

- Four copies of the project repot should be submitted, typed in A4 Paper in Times New Roman with the font size of 12 and 1.5 line spacing.

SARASWATHI NARAYANAN COLLEGE

(Autonomous Institution – Affiliated to Madurai Kamaraj University)

(Reaccredited with $B^{(2.78)}$ Grade by NAAC in the second cycle)

MADURAI -22

EVALUATION METHOD UNDER CBCS- LOCF

CONTINUOUS INTERNAL ASSESSMENT (CIA)

Internal assessment is based on the continuous evaluation of performance of the students in each semester. Internal mark is awarded to each course in accordance with the following guidelines.

UNDER GRADUATE, POST GRADUATE AND M.PHIL:

1. Internal test will be conducted for the maximum of 60 marks and converted to 15 marks.

2. Two internal tests will be conducted and the average of marks secured in the two tests will be taken as the Final Internal Test mark.
3. The distribution of Internal Assessment marks is given below.

THEORY			**PRACTICAL**		
Test	-	15	Record Note	-	10
Seminar	-	5	CIA	-	15
Quiz	-	5	Model Exam	-	15
		---			---
Internal Maximum	-	25	Internal Maximum	-	40

4. There is no Cumulative Internal Assessment (CIA) for Self Learning. Courses, Add on Certificate / Diploma Programmes and Part-1, subjects other than Tamil.
5. Internal marks for those UG, PG and M.Phil. students who have to Repeat the Semester (RS) for want of attendance should be marked “AA” in the foil card.
6. There is no minimum mark for Internal assessments marks for all the UG, PG and M.Phil. Programmes.
7. Internal test for improvement of marks is not allowed under any circumstances
8. Special Internal Assessment tests for the absentees may be conducted on genuine reasons with the prior approval of HOD, Dean and Principal. Such tests may be conducted before the commencement of the Summative Examinations.

SUMMATIVE EXAMINATIONS (SE)

1. Summative Examinations for all the UG, PG and M.Phil. Programmes are conducted in November and April for the Odd and the Even semesters respectively.
2. Question paper setting along with the scheme of valuation is purely external for all the UG, PG and M.Phil. Programmes.

3. The office of the CEO is conferred with the right of choosing the Question Paper Setters and the External Examiners from the Panels suggested by the Boards of Studies of Programmes offered by the respective Department and approved by the Academic Council of the College. The question papers set for the Summative Examinations will be finalised by the Scrutiny Committee constituted by the office of the COE.
4. 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 / External Examiner, HOD will act as the Internal Examiner / External Examiner.
5. The marks scored by the students in the External Examinations in Self Learning Courses and Add – on Courses will be converted to 100 for each course.
6. The theses submitted by the M.Phil. scholars after the conduct of Awards Committee meeting can be valued and the Viva-Voce Examinations can be conducted. The Principal is empowered to declare the results and it can be ratified in the next Awards Committee meeting.

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No	Level	Parameter Description	Description
1	K1	Remembering	Remembering It is the ability to remember the previously learned
2	K2	Understanding	The learner explains ideas or Concepts
3	K3	Applying	The learner uses information in a new way

4	K4	Analysing	The learner distinguishes among different parts
5	K5	Evaluating	The learner justifies a stand or decision
6	K6	Creating	The learner creates a new product or point of view

1. WEIGHTAGE OF K–LEVELS IN QUESTION PAPER

K-LEVELS (Cognitive Level)						Total
	K1	K2	K3	K4	K5/ K6	
SUMMATIVE EXAMINATIONS– 75 Marks Pattern	21	30	18	18	13	100
SUMMATIVE EXAMINATIONS–50 Marks Pattern	24.5	24.5	17	17	17	100
CONTINUOUS INTERNAL ASSESSMENT(CIA)	24	26	14	25	11	100

QUESTION PATTERN FOR SUMMATIVE EXAMINATIONS For those who join in June 2022 UG and PG (Language Courses, Core Courses, Discipline Specific Electives, Generic Elective Courses, Non-Major Electives(PG))	
	TOTAL MARKS 75
SECTION–A(Answer all questions) **I. Choose the correct answer (FIVE questions – ONE question from each unit)** (Q.No.1-5)-All questions are at K2 level **II. Fill in the blanks (FIVE questions - ONE question from each unit)** (5x1=5) (Q.No.6-10)- All questions are at K1 level	**10**
SECTION-B **Answer all questions not exceeding 50 words each**. **ONE set of questions from each unit** **Q. No. : 11 to 15** (5x2=10) K2 level – 2 Questions K3 level – 1 Question K4 level –1 Question K5/K6 level – 1 Question	**10**
SECTION-C-Either/or type **Answer all questions not exceeding 200 words each**. **ONE set of questions from each unit.** **Q. No. : 16 to 20** (5 x5=25) K1 level – 1 Question K2 level – 2 Questions K3 level – 1 Question K4 level – 1 Question	**25**

SECTION-D-Answer any THREE questions not exceeding 400 words each. **ONE question from each unit.** **Q. No. : 21 to 25** (3x10=30) K1 level – 1 Question K2 level – 1 Question K3 level – 1 Question K4 level – 1 Question K5/K6 level – 1 Question	**30**
Total	**75**

QUESTION PATTERN FOR SUMMATIVE EXAMINATIONS For those who join in June 2022 UG and PG (Skill Enhancement Courses, Self Learning Courses, Non Major Electives (UG)and Part V Courses (except NCC))	
	TOTAL MARKS 50
SECTION–A(Answer all questions) **I. Choose the correct answer (FIVE questions –ONE question from each unit)** (5x1=5) (Q.No.1-5)-All questions are at K2 level **II. Fill in the blanks (FIVE questions – ONE question from each unit)** (5x1=5) (Q.No.6-10)-All questions are at K1 level	**10**
SECTION-B **Answer all questions not exceeding 50 words each.** **ONE set of question from each unit** **Q. No. : 11 to 15** (5x2=10) K1 level – 1 Question K2 level – 1 Question K3 level – 1 Question K4 level – 1 Question K5/K6 level – 1 Question	**10**
SECTION-C **Answer any THREE questions not exceeding 400 words each.** **ONE question from each unit** **Q. No. : 16 to 20** (3x10=30) K1 level – 1 Question K2 level – 1 Question K3 level – 1 Question K4 level – 1 Question K5/K6 level – 1 Question	**30**
Total	**50**

QUESTION PATTERN FOR INTERNAL ASSESSMENT (CIA) For those who join in June 2022 UG and PG	
	TOTAL MARKS 60
SECTION–A(Answer all questions) **I. Choose the correct answer** (5 x 1 = 5) (Q.No.1-5)-All questions are at K2 level **II. Fill in the blanks** (5 x 1 = 5) (Q.No.6-10)-All questions are at K1 level	**10**
SECTION-B **Answer all questions not exceeding 50 words each.** **ONE set of question from each unit**(4 x 2 = 8) Q.No. 11 – K2 level Q.No. 12 – K3 level Q.No. 13 – K3 level Q.No. 14 – K5/ K6 level	**8**
SECTION-C-Either/or type (**Answer all questions not exceeding 200 words each**. (3 x 6 = 18) Q.No. 15 – K3 level Q.No. 16 – K4 level Q.No. 17 – K5/K6 level	**18**
SECTION-D **Answer any TWO questions not exceeding 400 words each.** (2 x 12 = 24) Q.No. 18 – K1 level Q.No. 19 – K2 level Q.No. 20 – K4 level	**24**
Total	**60**

QUESTION PATTERN FOR SUMMATIVE EXAMINATIONS For those who join in June 2022 UG and PG (Language Courses, Core Courses, Discipline Specific Electives, Generic Elective Courses, Non-Major Electives(PG))						
DURATION:3HRS			**MAXMARKS:75**			
K-LEVELS SECTIONS	**K1**	**K2**	**K3**	**K4**	**K5/K6**	**TOTAL MARKS**
SECTION A (Answer all questions, each question carries One Mark)	5	5				**10**
SECTION B (Answer all questions, each question carries TWO Marks, ONE question from Each unit)		4	2	2	2	**10**
SECTION C (Answer all questions-Either/or type-ONE Question from each unit)	5	10	5	5		**25**
SECTION D (Answer any THREE questions, ONE question from each unit, each question carries TEN Marks)	10	10	10	10	10	**30**
TOTAL	20	29	17	17	12	**75**

QUESTION PATTERN FOR SUMMATIVE EXAMINATIONS For those who join in June 2022 UG and PG (Skill Enhancement Courses, Self Learning Courses, Non Major Electives (UG)and Part V Courses (except NCC))						
DURATION:2HRS			**MAX MARKS:50**			
K-LEVELS SECTIONS	**K1**	**K2**	**K3**	**K4**	**K5/ K6**	**TOTALM ARKS**
SECTION A (Answer all questions, each question carries One Mark)	5	5				**10**
SECTION B (Answer all questions, each question carries TWO Marks, ONE question from Each unit)	2	2	2	2	2	**10**
SECTION C (Answer any THREE questions, ONE question from each unit, each question carries TEN Marks)	10	10	10	10	10	**30**
TOTAL	17	17	12	12	12	**50**

BLUE PRINT OF QUESTION PAPER FOR INTERNAL ASSESSMENT (CIA)						
DURATION:2HRS						**MAX MARKS:60**
K-LEVELS / SECTIONS	**K1**	**K2**	**K3**	**K4**	**K5/ K6**	**TOTAL MARKS**
SECTION A (Answer all question. Each question Carries **ONE** Mark)	5	5				**10**
SECTION B (Answer all questions. Each question carries **TWO** Marks)		2	4		2	**8**
SECTION C (Answer all questions- Either/or type -Each question carries **SIX** Marks)			6	6	6	**18**
SECTION D (Answer any TWO questions. Each question carries **TWELVE** Marks)	12	12		12		**24**
TOTAL	17	19	10	18	8	**60**

VALUATION

1. Central valuation system is adopted.
2. Single Valuation system is followed for UG, PG and M.Phil. theory examinations. The valuation is done by the external examiners only.
3. UG and PG Practical Examinations are valued by both Internal and External Examiners.
4. Any discrepancy in the question paper should be brought to the notice of the Controller of Examinations by the respective Course Teacher through the Head of the Department within five days from the date of examination.

DECLARATION OF RESULTS

1. The total credit should not exceed 140 for UG Programmes and 90 for PG Programmes, excluding the credits earned for additional credit courses. This is applicable to the students migrating from other colleges also.
2. The students migrating from other colleges have to appear for the Summative Examinations conducted by the college for non-equivalent theory and practical courses. Mark scored by such a student in the Summative Examinations conducted by the previous college shall be converted to 100 if it is less than 100 for any equivalent course.
3. The students who repeat the semester have to appear not only for Summative Examinations but also for internal tests. The Internal marks scored by such students in their previous attempts shall stand invalid.
4. Results will be published within 20 days from the date of completion of all the Examinations.
5. Results will be declared as per the norms given in the following table in consultation with the Awards Committee.

Maximum and Passing Minimum Marks

Course	External Exam (SE)		Aggregate Marks (CIA + SE)	
	Passing Minimum	Maximum Mark	Passing Minimum	Maximum Mark
UG (Theory)	27	75	40	100
UG – NME / SEC / Part V (except NCC)	18	50 (converted to 75 marks)	40	100
UG – SLC	20	50	40	100
UG (Practicals)	21	60	40	100
UG Project	18	50	40	100
PG (Theory)	34	75	50	100
PG (Practicals)	27	60	50	100
PG (Project)	23	50	50	100
M.Phil. (Theory)	34	75	50	100
M.Phil. Project				
1. Dissertation	50	**100** (Internal 50 + External 50)	-	-
2. Viva – Voce	50	**100** (Internal 50 + External 50)	-	-

REVALUATION AND SUPPLEMENTARY EXAMINATIONS

1. Students can apply for Revaluation within 10 days from the date of the publication of the results.
2. Final year students of UG and PG Programmes can appear for Supplementary Examinations for the arrear papers of only the V and VI Semesters of UG

Programmes and III and IV Semesters of PG Programmes. Students having the maximum of three arrear papers alone are eligible for Supplementary Examinations.

3. Absentees in the Summative Examinations are not eligible to apply for the Supplementary Examinations.
4. Supplementary Examinations will be conducted every year in the month of July.

ATTENDANCE

1. Students with the minimum of 75% of attendance (68 days out of 90 days) in a semester are permitted to appear for the summative examinations.
2. Students who do not have the minimum attendance should go for condonation.
3. Students who do not have the minimum attendance of 20 hrs for Certificate Programme and the minimum attendance of 20 hrs for each course in Diploma Programme will not be permitted to appear for the summative examinations.

The following are the regulations for grant of condonation.

Attendance	Condonation Fee	Authority to Consider	Nature of Penalty
65% - 74% (59-67 days)	Rs.500/-	Head of the Department	As decided by the HOD
50% - 64% (58-45 days)	Rs.1000/-	Principal and the Examination Committee	Application for exemption to be made on prescribed form with the specified remarks of the Principal
< 50% (Below 45 days)	To repeat the whole semester	-----	-----

EXAMINATION RULES AND REGULATIONS

1. Students without hall ticket and identity card are not permitted to appear for the examinations.
2. Possession of materials in any form for copying is strictly prohibited in the examination hall.
3. Students indulging in any form of malpractices in the examination are liable for severe punishment.
4. Students are not allowed into the examination hall after 30 minutes of the commencement of the examination.
5. Students should not write their names or any other identification marking except their register number in the answer scripts.

6. Students who have discontinued the Degree Programme are not permitted to write the summative examinations.
7. Students who have not completed the theory and practical courses during the Programme of their study are allowed to appear for the Summative Examinations in the same syllabi up to a period of three years from the year of the completion of Programme. However, after the completion of three years, they have to appear for the summative examinations for the equivalent course in the current syllabi only. The equivalence of a course is to be decided by the respective HOD, Dean, the Controller of Examinations and the Principal. This is also applicable to those students who repeat the semester.

PENAL ACTIONS FOR VARIOUS FORMS OF MALPRACTICES IN THE SUMMATIVE EXAMINATIONS

Sl. No.	Malpractice	Penal Action
1	In Possession of Materials relevant to the examination concerned	Cancellation of that particular paper.
2	Copied from materials in his/her possession	Cancellation of all papers of that semester
3	Copied from neighbours	Cancellation of all papers including arrear papers of that semester Cancellation of that particular paper of the candidate who helped for copying

4	Copied by exchanging answer script between neighbours	Cancellation of all papers of the candidates who exchanged their answer scripts
5	Misbehaviour in the examination hall	Cancellation of that particular paper
6	Copying and Misbehaviour in the examination hall	Cancellation of all papers of that semester and debarring the candidate from appearing for the next semester examination.
7	Insertion of answer sheets which were previously stolen and written	Cancellation of all papers of that semester and debarring the candidate from appearing for the next semester examination.
8	Impersonation in the examination	Cancellation of all papers of that semester and recommending dismissal from the college.