# GURU NANAK COLLEGE (AUTONOMOUS)

(Affiliated to University of Madras and Re-Accredited at 'A' Grade by NAAC)

Guru Nanak Salai, Velachery, Chennai – 600042.

## M.Sc. Chemistry

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

# Syllabus

(For the candidates admitted in the Academic year 2020-21 and thereafter)

**Vision**

- To enhance the quality of education beyond the text book / syllabi based – exam oriented system to research and analytical based learning.
- To produce quality graduates and post graduates to excel in the field of education / research / industry.
- To encourage the learners of exceptional quality to take up research and motivate them to contribute to the needs of the society.
- To encourage the faculty to constantly involve themselves in research in addition to the regular work , which would enable them to develop research oriented learning skills.

**Mission**

- To inculcate the scientific methodology of learning chemistry by focusing more on practicals.
- To enhance the creativity in learning chemistry among the learners using visual aids.
- To produce and to modernise the infra structure to impart and understand the importance of practical skill accuracy and data interpretation.
- To encourage the learners to participate in the teaching – learning process to enhance their analytical and problem solving skill and to develop leadership qualities.
- To motivate the students by conducting seminars/workshops with the inputs of eminent scientists, distinguished alumni and industrialist.
- Visit to Industries and scientific centres to have exposure on sophisticated instruments and recent developments in chemistry.

## PROGRAMME OUTCOME

***At the completion of M. Sc. in Chemistry the students are able to:***

**PO 1:** acquire a broad learning in advances in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective and develop the ability to communicate scientific information in written and oral formats

**PO 2 :** expose broader experimentation in chemistry on applied aspect and also using modern instrumentation to understand the importance of the chemical transformation for high throughput applications.

**PO 3 :** investigate the interdisciplinary nature of chemistry in biology, medicine, materials science to excel in R&D for the benefit of societal needs. Have extra acquaintance in humanities other than chemistry.

**PO 4:** execute the laboratory skills needed to design, and interpret chemical research; acquire a foundation of research in chemistry

**PO 5:** develop the skills required to succeed in higher learning in chemistry, in the chemical industry and in academic profession.

## PROGRAMME SPECIFIC OUTCOME

***The students at the time of graduation will be able to***

**PSO 1:** adopt to the major scientific and technological challenges in research, industry as they are well trained in experimental techniques like synthesis, separation, distillation, crystallization *etc*.

**PSO 2 :** compete in the international, National, state level assessments.

**M.Sc., - CHEMISTRY**
**COURSE STRUCTURE (2020 – 22) Batch**

| Semester | Course Component | Subject Code | Subject Name | Credits | Hours | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|---|
| Semester – I | Core-1 | 20PCHE301 | Organic Chemistry I | 4 | 4 | 50 | 50 | 100 |
| | Core-2 | 20PCHE302 | Inorganic Chemistry I | 4 | 4 | 50 | 50 | 100 |
| | Core-3 | 20PCHE303 | Physical Chemistry I | 4 | 4 | 50 | 50 | 100 |
| | Core Elective-1 | 20PCHE304 | Analytical Chemistry | 3 | 4 | 50 | 50 | 100 |
| | Core Elective -2 (P)* | 20PCHE308P | Organic Chemistry Practical | - | 4 | 50 | 50 | 100 |
| | Core Elective -3 (P)* | 20PCHE309P | Inorganic Chemistry Practical | - | 4 | 50 | 50 | 100 |
| | Core Elective-4 (P)* | 20PCHE310P | Physical Chemistry Practical | - | 4 | 50 | 50 | 100 |
| | Soft Skill - 1 | 19PGSL401 | Personality Enrichment | 2 | 2 | 50 | 50 | 100 |
| **Total Credits: 17 / Total Hours per week: 30** | | | | | | | | |
| Semester – II | Core-4 | 20PCHE305 | Organic Chemistry II | 4 | 4 | 50 | 50 | 100 |
| | Core-5 | 20PCHE306 | Inorganic Chemistry II | 4 | 4 | 50 | 50 | 100 |
| | Core-6 | 20PCHE307 | Physical Chemistry II | 4 | 4 | 50 | 50 | 100 |
| | Core Elective -2 (P) | 20PCHE308P | Organic Chemistry Practical | 3 | 4 | 50 | 50 | 100 |
| | Core Elective -3 (P) | 20PCHE309P | Inorganic Chemistry Practical | 3 | 4 | 50 | 50 | 100 |
| | Core Elective-4 (P) | 20PCHE310P | Physical Chemistry Practical | 3 | 4 | 50 | 50 | 100 |
| | EDE 1[#] | 20PCHE311 | Nutrition and Dietetics | 3 | 4 | 50 | 50 | 100 |
| | Soft Skill - 2 | 20PGSL403 | Workplace Communication Skills | 2 | 2 | 50 | 50 | 100 |
| **Total Credits: 26 / Total Hours per week: 30** | | | | | | | | |

| Semester | Course Component | Subject Code | Subject Name | Credits | Hours | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|---|
| Semester – III | Core-7 | 20PCHE312 | Organic Chemistry III | 4 | 4 | 50 | 50 | 100 |
| | Core-8 | 20PCHE313 | Inorganic Chemistry III | 4 | 4 | 50 | 50 | 100 |
| | Core-9 | 20PCHE314 | Physical Chemistry III | 4 | 4 | 50 | 50 | 100 |
| | Core -10 (P)* | 20PCHE315P | Electroanalytical Practical | - | 4 | 50 | 50 | 100 |
| | Core -11 (P)* | 20PCHE316P | Analytical Chemistry Practical | - | 4 | 50 | 50 | 100 |
| | Core Elective –5 | 20PCHE317 | Chemistry of Natural Products | 3 | 4 | 50 | 50 | 100 |
| | EDE II[#] | 20PCHE318 | Applied Chemistry | 3 | 4 | 50 | 50 | 100 |
| | Soft Skill-3 | 19PGSL403 | Self and Time Management Skills | 2 | 2 | 50 | 50 | 100 |
| | Summer Internship** | 20PINT401 | Summer Internship ** | 2 | | | | |
| **Total Credits: 22 / Total Hours per week: 30** | | | | | | | | |
| Semester – IV | Core-12 | 20PCHE319 | Organic Chemistry IV | 4 | 4 | 50 | 50 | 100 |
| | Core-13 | 20PCHE320 | Inorganic Chemistry IV | 4 | 4 | 50 | 50 | 100 |
| | Core - 14 | 20PCHE321 | Physical Chemistry IV | 4 | 4 | 50 | 50 | 100 |
| | Core -10 (P) | 20PCHE315P | Electroanalytical Chemistry Practical | 4 | 4 | 50 | 50 | 100 |
| | Core -11 (P) | 20PCHE316P | Analytical Chemistry Practical | 4 | 4 | 50 | 50 | 100 |
| | Core -15 | 20PCHE322 | Group Project | 4 | 8 | 50 | 50 | 100 |
| | Soft skill-4 | 19PGSL404 | Spoken and Presentation Skills | 2 | 2 | 50 | 50 | 100 |
| | **Total Credits: 26 / Total Hours per week: 30** | | | | | | | |
| **Grand Total Credits: 91 / Total Hours per week: 120** | | | | | | | | |

* Practical Examinations are conducted once in a Academic year - at the end of semester II and semester IV.

** The students should undergo summer internship for three weeks after the second semester and the reports to be submitted

[#] Any one EDE to be opted by students in semester II and semester III.

# SEMESTER - I

# GURU NANAK COLLEGE (AUTONOMOUS), CHENNAI – 600 042

**(Effective for the batch of candidates admitted in 2020 – 21)**

## CORE - I
## ORGANIC CHEMISTRY – I

| | | |
|---|---|---|
| **SUBJECT CODE:20PCHE301** | **THEORY** | **MARKS 100** |
| **SEMESTER: I** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES:**

- This course aims to explain basic concepts in stereochemistry and methods of determining reaction mechanisms.
- To explain synthetic application of aliphatic nucleophilic substitution, elimination reactions in organic synthesis.

**UNIT - I: Stereochemistry - I** **(15 hrs)**

Optical activity - chirality- conditions for optical activity-asymmetry and dissymmetry-dissymmetry of allenes, biphenyls, paracyclophanes, ansa compounds and molecules with helical structures - absolute configuration- D/L and R/S notation of acyclic chiral molecules, allenes, biphenyls and spiro compounds-molecules with more than one asymmetric centre - erythro/threo and meso / dl configuration - Fischer Projection - Newmann and Sawhorse projection-interconversion of projection formulae- prochiral centre - Crams rule and Prelogs rule-optical purity – enantiomeric excess – stereospecific and stereoselective reactions.

Geometrical isomerism: E-Z nomenclature of olefins and oximes - Geometrical and optical isomerism of mono and disubstituted cyclopropane, cyclobutane, cyclopentane and cyclohexane derivatives - homotopic, enantiotopic and diastereotopic hydrogen - prochiral carbon (up to 10 carbons only) - pro R and pro S & Re and Si face- determination of configuration.

**UNIT - II: Stereochemistry – II** **(10 hrs)**

Conformation and conformational analysis - conformation of simple 1,2- disubstituted ethane derivatives - cyclopropane, cyclobutane, cyclopentane and cyclohexane derivatives-conformational free energy – conformational analysis of mono and disubstituted cyclohexanes and

their stereochemical feature (geometrical and optical isomerism)-conformation and stereochemistry of decalin and 9 - methyl decalin- conformation of glucose.

Conformation and reactivity: steric and product development control – reduction of tertiary butyl cyclohexanone by hydride – stereo chemistry of oxidation of cis and trans tertiary butyl cyclohexanols by Cr (VI) – stereochemistry of the reaction between nitrous acid and α-amino cyclohexanols. Asymmetric synthesis: Evans and Enders methods

**UNIT - III: Methods of Determining Reaction Mechanisms (15 hrs)**

Kinetic and non-kinetic methods of determining reaction mechanisms-Thermodynamic and kinetic aspects - spectroscopic studies – Hammond's postulate - isotope effects – energy profile diagrams – intermediate *vs* transition state – product analysis and its importance – cross over experiments. Quantitative treatment of structure and reactivity – Hammett and Taft equations Classification of solvents, solvent effects in organic chemistry – solute – solvent interactions– specific and non-specific selective solvation.

$S_N1$, $S_N2$ and $S_Ni$ mechanism – neighbouring group participation – reactivity,structural and solvent effects – substitution in norbornyl and bridgehead systems– substitution by ambident nucleophiles such as cyano, nitro, phenoxide and ambident dianions – substitution at carbon doubly bonded to oxygen and nitrogen – alkylation and acylation of amines, halogen exchange, von-Braun reaction, alkylation and acylation of active methylene carbon compounds, hydrolysis of esters, Claisen and Dieckmann condensations.

**UNIT - IV: Organic Reaction Mechanisms - Addition to carbon-carbon and carbon-hetero multiple bonds (10 hrs)**

Mechanism - Electrophilic, nucleophilic and free radical addition. Addition of halogen, nitrosyl chloride to olefins, Hydration of olefins and acetylenes. Hydroboration, Hydroxylations and Michael addition. Diels-Alder reaction, 1,3 -dipolar additions. Carbene and their addition to double bonds- Simmon Smith reaction, Mannich, Stobbe, Darzen,Wittig, Wittig-Horner and Benzoin reactions. Nitrene: Methods for generating nitrenes and their reactions. (Stereochemical aspects to be studied wherever applicable).

**UNIT – V: Elimination Reactions** **(10 hrs)**

$E_1$, $E_2$ and $E_1CB$ mechanism – spectrum, orientation of the double bond - Hoffman and Saytzeff rule – competition, elimination and substitution. Typical eliminations to be studied – dehydration, dehydro-halogenation and similar reactions. Stereochemistry of $E_2$ eliminations in cyclohexanes and bicyclic systems. Mechanism of pyrolytic elimination. Examples: Chugaev and Cope elimination.

**TEXT BOOKS:**


1. E. Eliel, S.H.Wilen and L.N.Mander, Stereochemistry of Carbon Compounds, John Wiley & Sons, New York, second edition,1994.
2. D.Nasipuri, Stereochemistry of Organic Compounds, Wiley Eastern Ltd, New Delhi, second Edition, 1994.
3. P.S. Kalsi, Stereochemistry, Conformation and Mechanism, New Age International Ltd, sixth edition, 2006.
4. P.S. Kalsi, Stereochemistry and Mechanism Through Solved Problems, New Age International Ltd, third edition, 2001.
5. J. March, Advanced Organic Chemistry; Reactions, Mechanisms and Structure, Wiley interscience, sixth edition, 2007.
6. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, Organic chemistry, Pearson Prentice hall, seventh edition, 2012.
7. P.S. Kalsi, Organic reactions and their Mechanism, New Age International Ltd, third edition, 2012.

**REFERENCE BOOKS**:


1. K. Mackie, M. Smith, P. Aitken, Guide Book to Organic Synthesis, ELBS, England, third edition, 2000.
2. R. Bruckner, Advanced Organic Chemistry Reaction Mechanism, Elsevier, New Delhi, 2002.
3. T.L. Gilchrist and C.W. Rees, Carbenes, Nitrenes and Arynes, Thomas Nelson and Sons Ltd., London, 1967.
4. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press, second edition, 2014.
5. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry, Parts A and B. Springer, fifth edition, 2015.


**WEBLINKS**

1. www.epathshala.nic.in
2. www.khanacademy.org
3. www.nptel.ac.in
4. http:/swayam.gov.in
5. Virtual Textbook of Organic Chemistry
6. https://vlab.amrita.edu/

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 1 | 1 |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | 1 |
| | Unit – 4 | 1 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

**CORE - 2**

**INORGANIC CHEMISTRY – I**

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE302** | **THEORY** | **MARKS 100** |
| **SEMESTER: I** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To impart the knowledge about the theories about bonding, structure, propertiesand reactions of various coordination complexes.
- To impart the basics of reaction mechanisms and substitution reactions ofcoordination complexes
- To introduce the rings, cages and cluster type of inorganic compounds.

**UNIT - I: Bonding and properties of coordination complexes (15hrs)**

Introduction to CFT, CFSE, spectrochemical series and applications. High spin and low spin Complexes-Magnetic properties of coordination compounds. Nephelauxetic effect, Molecularorbital theory- Based on group theoretical approach, Symmetry of molecular orbitals formed from atomic orbital overlap, LCAO-MO model, TASO, LUMO and HOMO concepts in bonding. M.O. diagrams of octahedral, tetrahedral and square planar complexes. Calculation of $\Delta_o$ and $\Delta_\tau$ and their relationship, Jahn-Teller tetrahedral distortion. Charge transfer spectra.

**Unit II: Stability and stereo isomerism of coordination complexes (10 hrs)**

Stability of complexes-Thermodynamic stability-stepwise and overall stability constants and their relationships. Factors affecting the stability of the complexes, HSAB approach, Chelate effect, importance of chelates. Determination of stability constants by Job's and Bjerrum's method. Stereoisomerism in inorganic complexes, Optical rotatory dispersion (ORD) and circular dichroism (CD). Isomerization and racemization reactions in octahedral complexes.

**UNIT-III: Coordination chemistry-Reaction mechanisms (10hrs)**

Electron transfer reactions – Inner sphere (ISET) and outer sphere (OSET) electron transfer processes. Key ideas concerning electron transfer between transition metals. Chemical activation and electron transfer, Role of bridging ligand with ISET

reaction – tunneling transfer– multiple bridging in the activated complex in the ISET process. Complimentary and non- complimentary ET reactions. Cross reactions and marcus Hush theory.

**UNIT - IV: Substitution reactions in coordination compounds (10 hrs)**

Reaction mechanism of coordination compounds – Types of ligand substitution reactions – mechanism; Dissociative mechanism (D), Associative mechanism (A) interchange mechanism (I), Labile and Inert complexes. Substitution Reaction in octahedral complexes – general mechanism, general rate law for A,D and I - distinction between D, Id, IA pathways, replacement of coordinated water, mechanism of acid hydrolysis, base hydrolysis – DCB mechanism – direct and indirect evidences in favour of the mechanism. Ligand substitution reactions without cleavage of M-L Bond. Anation Reactions. Substitution in square planar complexes – General mechanism, Trans effect, influences of entering and leaving groups. Application of trans effect– synthesis of isomers of Pt(II) complexes – theories of trans effect and cis-trans isomerisationreaction. Application of substitution reactions in the synthesis of Platinum and Cobalt complexes. Stereochemical changes in dissociation ($S_N2$) and displacement ($S_N2$) mechanism through various geometries of coordination compounds.

**UNIT - V: Inorganic Rings, Cages and Clusters (15hrs)**

Boron-nitrogen compounds: Borazines and B-N clusters. P-N and P-S compounds: polyphosphazene and cyclic aminophosphanes, phosphorus-oxide and phosphorus-sulfide cages. Sulfur-nitrogen compounds. Macrocyclic ligands; types-Schiff bases; crown ethers andcryptands and porphyrins.

Clusters: Boranes, carboranes, metalloboranes and metallocarboranes-synthesis and structure of neutral boron hydrides, polyhedral borane anions and dianions, Capping rules, PSEPT (Wade's rules). Low nuclearity metal-carbonyl clusters and 14n+2 rule, high nuclearity metal-carbonyl and other clusters (Rhenium cluster complexes) with internal atoms. Isopoly and heteropoly acidsand salts (Mo, W, V, Nb and Ta), Heteropoly anions-structure and reactivity; heteropoly blues.

**TEXT BOOKS:**


1. J.E. Huheey, Inorganic Chemistry - Principles, Structure and Reactivity; HarperCollins, NY, fourth edition, 1993.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry - AComprehensive Text, John Wiley & Sons, fifth edition, 1988.
3. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, Sengage Learning IndiaPvt. Ltd, first edition, 2010.
4. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Literary Licensing, LLC, 2012.
5. A.E. Martell, Coordination Chemistry, Vol. I, Van Nostrand-Reinhold, 1971.


**REFERENCE BOOKS:**


1. R.L. Carlin, Transition metal Chemistry, Vol. 1 to 5, Academic Press, London, 1968.
2. D.F. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, OxfordUniv. press, New York, second edition.1994.
3. I. G.Wilkinson, Comprehensive coordination Chemistry, Vol.1, Elsevier, 1987.
4. F.Basolo and R.G. Pearson, Inorganic reaction mechanism, John Wiley, NewYork, second edition, 1967.
5. R.A. Henderson, Mechanisms of Reactions at transition metal sites,Oxford Scientific. Publication, 1995.


**Web Links:**

1. https://www.chemicalforums.com/
2. https://nptel.ac.in/
3. https://chem.libretexts.org/
4. http://www.ilpi.com/genchem/web.html#12

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | 2 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

**CORE - 3**

**PHYSICAL CHEMISTRY – I**

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE303** | **THEORY** | **MARKS 100** |
| **SEMESTER: I** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To learn the basic concepts in group theory and the need for quantummechanics and appreciate their significance.
- To learn the basic concepts in chemical kinetics.

**UNIT – I: Quantum Chemistry–I** **(12 hrs)**

Inadequacy of classical theory-black body radiation-photo electric effect-Compton effect- Bohr's Quantum theory and subsequent developments-wave particle duality-de Broglie equation- Heisenberg's uncertainty principle. Quantum mechanical postulates - The Schrodinger equation- elementary applications of Schrodinger equation- the particle in a box (one, two and three dimensional cases) – particle in a ring.

**UNIT – II: Group Theory-I** **(12 hrs)**

Symmetry elements and symmetry operations-point groups-identification and determination.Reducible and irreducible representations-direct product representation -Orthogonality theorem-its consequences-character table.

**UNIT – III: Group theory –II** **(12 hrs)**

Hybrid orbitals in non-linear molecules-($CH_4$, $XeF_4$, $BF_3$, $SF_6$ and $NH_3$). Symmetrybased selection rules for infrared, Raman and electronic spectra of ethylene and formaldehyde- application of group theory.

**UNIT – IV: Chemical Kinetics-I** **(12 hrs)**

Effect of temperature on reaction rates-collision theory of reaction rates-molecularbeams- collision cross sections-effectiveness of collisions-probability factors-potential energy surfaces- partition functions-and activated complex. Eyring equation-estimation offree energy and entropy of activation and their significance.

**UNIT – V: Chemical Kinetics-II** **(12 hrs)**

Reactions in solutions-effect of pressure, dielectric constant and ionic strengthon reactions in solutions-kinetic isotope effects –linear free energy relationships- Hammett and Taft equations.

**TEXT BOOKS:**


1. D.A. McQuarrie, Quantum Chemistry, University Science books, viva books Pvt.Ltd, second edition, reprint, 2007.
2. I.N. Levine, Quantum Chemistry, Pearson Education Pvt. Ltd, fifth edition, 2004.
3. R. Anantharaman, Fundamentals of Quantum Chemistry, Macmillan India Limited,first edition, 2000.
4. R.K. Prasad, Quantum Chemistry, New Age India, fourth edition, 2010.
5. V.Ramakrishnan and M.S.Gopinathan, Group theory in Chemistry Vishal publications.1988. 6. K.V.Raman, Group theory and applications in Chemistry,Tata McGraw Hill, 1990.
6. S. Swarnakakshmi, T.Saroja, R.M.Ezhilarasi, A Simple approach to group theoryin Chemistry, Universities Press, first edition 2008.
7. R.K. Prasad Quantum Chemistry-theory solved problems and solutions, New Age
8. J.Rajaram and J.C.Kuriacose, Kinetics and Mechanism of ChemicalTransformations, McMillan India Ltd., third edition, reprint, 2009.
9. K.J.Laidler, Chemical Kinetics.Harper and Row, Pearson Pvt. Ltd New York,third edition, 2011.
10. K. L. Kapoor, A text book of Physical Chemistry, Macmillan India
11. Ltd, reprint,2010. International Pvt. Ltd, 2009.


**REFERENCE BOOKS:**


1. F.A. Cotton, Chemical application of group theory, John Wiley & Sons Inc., NewDelhi, third edition, 2009.

2. Alan Vincent, Molecular Symmetry and Group theory-Programmed introductionto chemical applications, Wiley, New Delhi, 2010.

3. H.Eyring, J.Walter and G.Gimball, Quantum Chemistry, John Wiley & Sons Inc., NewYork, 1944.

4. L.S. Pauling and F.B. Wilson, Introduction to quantum mechanics, McGraw HillBook Company, NewYork, 1935.

5. P.W. Atkins, Molecular quantum mechanics, Oxford University Press, Oxford,third edition, 1997.

6. David J. Griffiths, Introduction to Quantum mechanics, dorlingkinderly Pvt.Ltd,second edition, fifth reprint, 2008.

7. G.M. Barrow, Physical Chemistry, Tata McGraw Hill, fifth edition, 2008.

8. R.G. Frost and Pearson, Kinetics and Mechanism, Wiley, New York, third edition, 1981.

9. W.J. Moore and R.G. Pearson, Kinetics and Mechanism, Wiley New York, third edition,1981

**Web Links:**

1. www.chemguide.co.uk>physical>basicrates>energyprofiles
2. iopscience.iop.org
3. http://nptel.ac.in
4. mooc.org
5. http://www.ch.ic.ac.uk/achemlab/symmetry/
6. http://www.reciprocalnet.org/edumodules/symmetry/intro.html

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 1 | 1 |
| | Unit – 2 | 1 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 1 | |
| | Unit – 5 | 2 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

## CORE ELECTIVE - 1
## ANALYTICAL CHEMISTRY

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE304** | **THEORY** | **MARKS 100** |
| **SEMESTER: I** | **CREDITS: 3** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To create the better understanding of "Analytical Chemistry" to evolve proper analytical data and practice to report the result with uncertainty.
- To enhance the competency in the analysis of complex materials and also the finished products of chemical manufacturing sectors; to enable the instrumental based chemical analysis in all the arena of chemical processes.
- To establish the competency of chemical analysis in applied research, chemical processes and testing/quality control laboratories with a view to eliminate the gap between academicand industry and also the basic and applied sciences.

**UNIT - I: Fundamentals in Chemical Analysis and Analytical Laboratory Functioning (10 hrs)**

Statistical treatment of analytical data: regression analysis, standard deviation - comparison of results- F, T and Q tests. Calibrations – general idea of calibration, calibrationof glasswares, balance, instruments and other equipment. Uncertainty in chemical analysis: theory, significance, sources of uncertainty for simple volumetric analysis.

Details on method development and method validation in chemical analysis, essentialsof quality control and quality assurance systems in chemical processes; Basic idea and necessity of accreditations/certification such as GLP, ISO (NABL), FDA and FSSAI. Role ofISI and Agmark certification on the consumer products.

**UNIT - II: Sampling, Analysis of Complex Materials and Atomic spectroscopy (15 hrs)**

Sampling of solid, liquid and gases – primary sample, laboratory sample, analytical sample, handling, collection, transport, storage. Physico-chemical analysis of medicines(formulated), ores, fertilizers, alloys, packed foods, water and air. [Note: Any one representative example in each category and testing of important parameters only]

Theory, instrumentation and applications of Atomic absorption spectroscopy, ICP- MS; Flame emission spectrometry and ICP-OES. Application of these techniques in water andfood analysis. Moisture analyser (KFR method) and C, H, N analysis (instrumental methods).

**UNIT - III: Separation Techniques (15 hrs)**

Chromatographic techniques: General aspects, classification, principle, instrumentation (if applicable) and applications of column, ion-exchange, electrophoresis, TLC, paper

chromatography, GLC and HPLC (with different detectors) and GPC. Special emphasis on GC- MS, GC-MS/MS, LC-MS, LC-MS/MS. Role of chromatographic techniques in R & D and quality control laboratories.

**UNIT - IV: Electroanalytical Methods (12 hrs)**

Polarography – Theory and instrumentation. Types of current - includes kinetic & catalytic current and advantages and disadvantages of DME. Significance ofIlkovic equation and its significance. Qualitative and quantitative applications to the analysis of inorganic compounds and determination of dissolved oxygen. Cyclic voltammetry – theory, instrumentation and applications to inorganic and organic compounds. Application of CV in applied research viz., prediction of reaction mechanism, redox behaviour of chemical compounds and identification of number of electrons in the electrochemical processes. Amperometry and biamperometry - theory,instrumentation and applications.

**UNIT - V: Thermal and Radio analytical Methods (8 hrs)**

Principle, instrumentation and applications of TGA, DTA and DSC. Radio analytical methods - principle, instrumentation and applications of neutron activation and isotopic dilution analysis. Radiometric titrations, determination of age of fossils,radiometric methods in diagnosis of diseases.

**TEXT BOOKS:**


1. David Harvey; Modern Analytical Chemistry; McGraw-Hill, first edition, 2000.
2. J. Mendham, R.C. Denney, J.D. Barnes and M.Thomas, Vogel's Text book ofquantitative Chemical Analysis; Pearson Education Pvt.Ltd. sixth edition, 2004.


**REFERENCE BOOKS:**


1. E Prichard, Quality in the analytical chemistry laboratory, John Wiley and sons, 1997.
2. W Funk, V Dammann, G. Donnevert, Quality assurance in analytical, VCH Weinheim,1995.
3. Douglas A. Skoog, Donald M. West and F.James Holler, Fundamentals ofAnalytical Chemistry; ninth edition, Harcourt Asia Pvt., Ltd., 2001.
4. Douglas A. Skoog, Donald M. West and F. James Holler, Analytical Chemistry: An Introduction; seventh edition, Saunders College Publishers, 2000.
5. Dean, John A. Merritt, Lynne L., Jr. Settle, Frank A., Jr. Willard, Hobart H; Instrumental Methods of Analysis, Wadsworth Publishing, seventh Edition,1988.
6. D.A. Skoog, Principles of Instrumental Analysis, 5th ed., Saunders CollegePublishing, Philadelphia, London, 1998.
7. A. J. Bard and L.R. Faulkner, Electrochemical Methods, John Wiley, 1980.
8. S. M. Khopkar, Environmental Pollution Analysis, New Age Internationalpublication, 2011.
9. Seonard'lCiacere, Water and water pollution (hand book), Vol I to IV, Marcel Dekkerinc. N.Y.1972.
10. Guidelines for drinking-water quality, third edition, (incorporating first and secondaddenda), WHO report.
11. Martin Hocking, Handbook of chemical technology and pollution control, AP Publication, third edition, 2005.
12. Chemical analysis of metals; Sampling and analysis of metal bearing ores: American Society for Testing and Materials Technology & Engineering, 1980.

13. Manual of Procedures for Chemical and Instrumental Analysis of Ores, Minerals, and Ore Dressing Products. Government of India Ministry of Steel & Mines, IndianBureau of Mines, 1979.
14. Yeshajahu Pomeranz, Clifton E. Meloan, Food Analysis: Theory and practice, Springer, third edition, 2002.
15. George Charalanbous, Analysis of food and beverages, Academic press, 1978.
16. Connor's Text book of Pharmaceuticals Analysis, Johnwiley, third edition, 2001.
17. Encyclopaedia of industrial chemical analysis, Snell et al; Inter science, 1966.

**Web links:**

1. https://chem.libretexts.org/
2. https://nptel.ac.in/course.html
3. https://www.lcresources.com/resources/reslinks.html
4. https://www.chemicalforums.com/index.php?PHPSESSID=kjkh7llj um5hebh scma2hhlsp 7&board=8.0
5. Refer websites of ISO, NABL, FDA, USEPA, ASTM, ICH, FSSAI & BIS

**Visits to**:

i. GLP, ISO & FDA certified R&D and QC laboratories.
ii. BIS & FSSAI approved establishments.
iii. Various chemical industries with established analytical laboratories

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 1 | 1 |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | 1 |
| | Unit – 4 | 2 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

# SEMESTER - II

## CORE - 4
## ORGANIC CHEMISTRY - II

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE305** | **THEORY** | **MARKS 100** |
| **SEMESTER: II** | **CREDITS: 4** | **TOTAL HOURS: 60** |

### COURSE OBJECTIVES

- This paper explains the concepts of aromatic compounds, theirelectrophilic and nucleophilic substitution reactions.
- In addition, mechanism of some of the important rearrangements andpericyclic reactions in organic chemistry will be discussed.
- The first part of the course brings forth the salient features of oxidationand reduction reactions in organic synthesis.

### UNIT - I: Oxidation and Reduction (15 hrs)

Mechanism – study of the following oxidation reactions – use of chromium(VI), $MnO_4^-$, $MnO_2$, TPAP, Moffatt, Oppenauer and Swern oxidation of alcohol –oxidative cleavage of glycols and their related compounds, Oxidative cleavage of ketones, aldehydes and alcohols, Ozonolysis- oxidation of methylene to carbonyl, oxidation of aryl methane – allylic oxidation of olefins. Reductions: catalytic hydrogenation – Hydrides – Nucleophilic and Electrophilic - MPV reduction- Selectivity in reduction of 4-t-butyl cyclohexanones using selectrides- Synthetic importance of Clemmensen and Wolf-Kishner reductions- Modifications of Wolf-Kishner reduction-Birch reduction.

### UNIT – II: Aromatic Electrophilic and Nucleophilic substitutions (15 hrs)

Aromatic electrophilic substitution: The arenium ion mechanism. Orientation and reactivity of mono nuclear, poly nuclear aromatic hydrocarbons (Naphthalene, Anthracene) and Heterocyclic compounds (Quinoline and Isoquinoline) nitration, halogenations, sulphonation, alkylation, acylation and diazonium coupling. Formylation reactions (Gattermann, Gattermann- Koch, Vilsmeyer-Haack and Riemer-Tiemann Reaction)- Synthesis of di and tri substituted benzenes (symmetrical tribromobenzene, 2-Amino-5-methylphenol, 3-nitro-4-bromobenzoicacid, 3,4-dibromo nitrobenzene, 1,2,3-trimethylbenzene) starting from benzene or any mono substituted benzene.

Aromatic nucleophilic substitution: Methods for the generation of benzyne

intermediate and reactions of aryne intermediate - Nucleophilic substitution involving diazonium ions. Aromatic nucleophilic substitution of activated halides. Ziegler alkylation. Chichibabin reaction and von-Richter rearrangement

**UNIT – III: Aromaticity** **(10 hrs)**

Concept of aromaticity, Huckel's rule, Craig's rule – Huckel MO theory of aromaticity – frost cycle - Alternant and Non-alternant hydrocarbons –Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds –systems with 2, 4, 8 and 10 electrons – Annulenes (up to C18) compounds, azulene, ferrocene, tropolone and sydnones. Concept of homoaromatic and heteroaromatic molecules.

**UNIT – IV: Pericyclic Reactions** **(10 hrs)**

Introduction-Construction of π molecular orbitals of ethylene and 1,3-Butadiene, Symmetry in π molecular orbitals – Classification - Electrocyclic reactions – Woodward Hoffmann rule- (4n) π and (4n+2) π systems- Ring opening and ring closing reactions - Interconversion of cyclobutene-butadiene system and interconversion of cyclohexadiene-hexatriene, FMO analysis, Correlation diagram method.

Cycloaddition- Woodward - Hoffmann rule in (π2s + π2s) and (π4s + π2s) cycloaddition reactions - FMO analysis and Correlation diagram method. Diels-Alder reaction- Retro Diels- Alder reactions. Cheleotropic Reactions- [2+2] Cheleotropic cycloaddition, Cheleotropic Elimination (Basic idea only) Sigmatropic rearrangements – Classification- Woodward- Hoffmann rule – FMO analysis of [1,3], [1,5] and [1,7] hydrogen shift reactions – carbon shift reactions. [3,3] sigmatropic shifts–Cope and Claisen Rearrangement – Degenerate Cope reaction. Fluxional isomerism – semibullvalene and bullvalene.

**UNIT – V: Molecular Rearrangements** **(10 hrs)**

A study of mechanism of the following rearrangements: Beckmann, Curtius, Hofmann, Schmidt, Lossen, Wolff, Pinacol, Wagner Meerwin, Demjanov, Dienone-Phenol, Favorski, Benzidine, Claisen, Cope, Sommlet-Hauser, Pummerer and Von-Richter rearrangements. A study of the following name reactions: Dieckmann cyclization, Hofmann-Loffler Freytag reaction, , Shapiro reaction, Eschenmoser-Tanabe and Ramburg-Backlund reactions.

**TEXT BOOKS:**


1. R. Bruckner, Advanced Organic Chemistry, Reaction Mechanism, Elsevier, New Delhi.2002
2. J. March, Advanced Organic Chemistry, John Wiley & Sons Singapore, fourth edition, 2009.
3. T.L. Gilchrist and C.W. Rees, Carbenes, Nitrenes and Arynes, Thomas Nelson and Sons Ltd., London, 1967.
4. Niel Issac, Physical Organic Chemistry, Prentice Hall, second edition, 1996.
5. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic reaction, New Age International (P) Limited publisher, third edition, 2014.
6. P.S. Kalsi, Organic Reaction and Mechanism, New Age International Pvt Ltd, third edition, 2012.
7.


**REFERENCE BOOKS:**


1. F. A. Carey and R.J. Sundberg, Advanced Organic Chemistry, Part A and Part-B, Springer (INc), fifth edition, 2015.
2. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press, second edition, 2014.
3. R.O.C. Norman and J.M. Coxon, Principles of organic synthesis, CRC Press, third edition, 2012.
4. W. Carruthers and Goldham, Some Modern Methods of Organic Synthesis, Cambridge University Press, fourth edition, 2012.
5. H.O. House, Modern Synthetic Reactions, The Benjamin Cummings Publishing Company, London, 1972.


**WEBLINKS**

1. www.epathshala.nic.in
2. www.khanacademy.org
3. www.nptel.ac.in
4. http:/swayam.gov.in

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | 1 |
| | Unit – 4 | 1 | |
| | Unit – 5 | 1 | 1 |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

## CORE - 5
## INORGANIC CHEMISTRY - II

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE306** | **THEORY** | **MARKS 100** |
| **SEMESTER: II** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To expose the student to the basics of organometallic chemistry,reactions of organometallic complexes and their industrial applications.
- To educate the bioinorganic compounds to understand their functions andapplications in biological systems.
- To enunciate the nuclear chemistry for higher learning.

**UNIT – I: Introduction to Organometallics (15 hrs)**

Valence electron count and 16/18 electron rules for organometallic compounds;structure and bonding in mono and polynuclear metal carbonyls; back bonding and synergic effect - π acids, dinitrogen as ligand in organometallic compounds. Synthesis,structure, bonding and reactivity of metal alkyls, carbenes, alkenes, alkynes, DCD model, arene complexes - metallocenes and bent metallocenes.

**UNIT – II: Reactions and Industrial Applications organometallic complexes (15hrs)**

Organometallic reactions: association, substitution, addition, oxidative addition, reductive elimination, insertion and deinsertion, electrophilic and nucleophilic attack on ligands and fluxional isomerism. Catalytic applications of organometallics: Hydrogenation of olefins, Wacker-Smidt synthesis, oxo process, Repp's catalyst, Monsanto acetic acid process, Zeigler-Natta polymerization of alkenes and oligomerisation, Enantioselective functional group interconversions. Transmetallation and cyclization reaction of organometallics.

**UNIT – III: Introduction of Bio-inorganic chemistry (10hrs)**

Introduction to Bio - inorganic chemistry. Metal Storage, Transport and Biomineralisation; ferritin, transferrin and siderophores, sodium and potassium ion balance. Essential and trace metal ions. Metalloenzymes - Zinc enzymes – carboxypeptidase and carbonic anhydrase, Vitamin $B_{12}$, catalase, peroxidase,

superoxide dismutase and copper proteins. Medicinal applications of coordination compounds– antirheumatoid - gold compound –anti diabetic - anti cancer agents– roleof metal ion diagnosis and treatment- Cisplatin.

**UNIT – IV: Transport Proteins (10hrs)**

Oxygen Carriers – Haemoglobin, myoglobin – structure – function Oxygenation and stereochemistry – Bohr effect, Non – heme oxygen carriers – Hemerythrin and Haemocyanin. Biological redox systems: cytochromes classification, cytochrome a, b and c. Cytochrome P-450, Iron – sulphur proteins – rubredoxin and ferridoxin. Chlorophylls and photosynthesis – structure, function and mechanism. Nitrogen fixation – introduction – types of nitrogen fixing microorganisms, Nitrogenase enzyme – Metal clusters in nitrogenase – redox property – Dinitrogen complexes – nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia.

**Unit V: Nuclear Chemistry (10 hrs)**

Nuclear structure: Composition of the nucleus, nuclear size, shape and density, Nuclear models: Shell model-salient features, filling of orbitals, nuclear configuration, Liquid drop model, Theories of nuclear forces –pi meson theory. Nuclear reactions: types of nuclear reactions, nuclear fission, fission products, theory of nuclear fission. Orbital electron capture, Artificial radioactivity and applications of nuclear chemistry: Discovery of artificial radioactivity, synthesis of trans-uranium elements, importance and applications of artificial radioactivity, production and separation of radioactive isotopes,

**TEXT BOOKS:**


1. Ram C. Mehrotra and A. Singh, Organometallic Chemistry, A Unified Approach, New Age International, second edition, 2004.
2. J.E. Huheey, Inorganic Chemistry - Principles, Structure and Reactivity; Harper Collins, NY, fourth edition, 1993.
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry - AComprehensive Text, John Wiley & Sons, fifth edition, 1988.
4. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, Sengage Learning India Pvt. Ltd,

first edition, 2010.

5. Jim D. Atwood, Inorganic and Organometallic Reaction Mechanisms, Wiley-VCH; 2 edition, 1997
6. B.D. Gupta and A.J. Ellas, Basic Organometallic Chemistry, Concepts, Syntheses and Applications, Universities press, 2010.
7. K. Hussain Reddy, Bio inorganic chemistry, New Age International Private Ltd, reprint2005.
8. William W. Porterfield, Inorganic Chemistry, An unified approach, academic press inc,1993.

**REFERENCE BOOKS:**

1. G.N.Mukherjee and Arabinda Das, Elements of Bioinorganic Chemistry, U. N. Dhar & Sons Pvt. Ltd., Kolkata [ISBN 81- 85624-37-2].
2. M. Satake and Y. Mido, Bioinorganic Chemistry, Discovery Publishing House, NewDelhi, 2011.
3. Asim K. Das – Bio inorganic Chemistry, Books & Allied (p) Ltd, first edition, 2004.
4. H.J. Arniker, Essentials of Nuclear Chemistry New age international publishers.
5. Samuel Glasstone, Source book of Atomic Energy, D.Van Nostrand CompanyInc., NewYork, Third Edition.

**Web Links:**

1. https://www.chemicalforums.com/
2. https://nptel.ac.in/
3. https://chem.libretexts.org/
4. http://www.ilpi.com/genchem/web.html#12

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
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| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 2 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 1 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

**CORE - 6**

**PHYSICAL CHEMISTRY - II**

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE309** | **THEORY** | **MARKS 100** |
| **SEMESTER: II** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To learn enzyme kinetics, surface reactions and fast reactions.
- To learn the need for quantum mechanics and appreciate its significance.

**UNIT – I Chemical Kinetics-II (10hrs)**

Acid base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law. Catalysis by enzymes-rate of enzyme catalyzed reactions-effect of substrate concentration, pH and temperature on enzyme catalyzed reactions-Inhibitionof enzyme catalyzed reactions.

**UNIT – II Chemical Kinetics-IV (10 hrs)**

Langmuir and BET adsorption isotherms-adsorption coefficient and its significance. Kinetics and mechanism of surface reactions-surface reactions catalyzedby metals, semi- conductor oxides.

**UNIT – III Chemical Kinetics –V (15 hrs)**

Kinetics of complex reactions-reversible reactions-consecutive reactions- parallel reactions-Chain reactions-general treatment of chain reactions-Rice - Herzfeldmechanism and explosions limits. Study of fast reactions –relaxation methods – temperature and pressure jump methods-stopped flow and flash photolysis method.

**UNIT – IV: Quantum Chemistry–II (10 hrs)**

The harmonic oscillator- the rigid rotor-the hydrogen atom-the Schrodinger equation for hydrogen atom– the solution – the origin of quantum numbers (angular momentum and spin)-their physical significance.

**UNIT – V: Quantum Chemistry–III (15 hrs)**

Approximation methods – perturbation and variation method- Application to hydrogen, helium atoms- R-S coupling, j-j coupling and term symbols for atoms in ground state- Slater rules, Slater orbital and HFSCF methods- Born - Oppenheimer approximation- Valence Bond theory for hydrogen molecule – LCAO – MO theory fordi

and poly atomic orbitals - concepts of hybridization- Huckel theory for conjugated molecules (ethylene, butadiene, benzene, pyridine *) semi empirical methods.

*** not for ESE.**

**TEXT BOOKS:**


1. D.A. McQuarrie, Quantum Chemistry, University Science books, viva books Pvt.Ltd, second edition, reprint, 2007.
2. I.N. Levine, Quantum Chemistry, Pearson Education Pvt. Ltd, fifth edition, 2004.
3. R. Anantharaman, Fundamentals of Quantum Chemistry, Macmillan India Limited, first edition, 2000.
4. R.K. Prasad, Quantum Chemistry, New Age India, fourth edition, 2010.
5. V.Ramakrishnan and M.S.Gopinathan, Group theory in Chemistry, Vishal publications.1988.
6. K.V.Raman, Group theory and its applications in Chemistry,Tata McGraw Hill, 1990.
7. S.Swarnakakshmi, T.Saroja, R.M.Ezhilarasi, A Simple approach to group theory in Chemistry, Universities Press, first edition 2008.
8. R.K. Prasad Quantum Chemistry-theory solved problems and solutions, New Age
9. J.Rajaram and J.C.Kuriacose, Kinetics and Mechanism of ChemicalTransformations, McMillan India Ltd., third edition, reprint, 2009.
10. .K.J.Laidler, Chemical Kinetics. Harper and Row, Pearson Pvt. Ltd, New York,third edition, 2011.
10. K. L. Kapoor, A text book of Physical Chemistry, Macmillan India Ltd, reprint,2010. International Pvt. Ltd, 2009.


**REFERENCE BOOKS:**


1. F.A. Cotton, Chemical application of group theory, John Wiley & Sons Inc., New Delhi, third edition, 2009.
2. Alan Vincent, Molecular Symmetry and Group theory-Programmed introductionto chemical applications, Wiley, New Delhi, 2010.
3. H.Eyring, J.Walter and G.Gimball, Quantum Chemistry, John Wiley & Sons Inc., NewYork, 1944.
4. L.S. Pauling and F.B. Wilson, Introduction to quantum mechanics, McGraw HillBook Company, NewYork, 1935.
5. P.W. Atkins, Molecular quantum mechanics, Oxford University Press, Oxford,third edition, 1997.

6. David J. Griffiths, Introduction to Quantum mechanics, dorlingkinderlyPvt.Ltd,second edition, fifth reprint, 2008.

7.G.M. Barrow, Physical Chemistry, Tata McGraw Hill, fifth edition, 2008.

8. R.G. Frost and Pearson, Kinetics and Mechanism, Wiley, New York, third edition, 1981.

9. W.J. Moore and R.G. Pearson, Kinetics and Mechanism, Wiley New York, third edition,1981.

**Web Links:**

1. **1. http:/swayam.gov.in**

   **2. http://search.ebscohost.com**

   **3. MATLAB**

   4. www.virtlab.com

   5. nptel.ac.in

   6. http://antoine.frostburg.edu/chem/senese/101/quantum/index.shtm

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 1 | 1 |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | 1 |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

## CORE ELECTIVE – 2 (P)
## ORGANIC CHEMISTRY PRACTICAL

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE308P** | **PRACTICAL** | **MARKS 100** |
| **SEMESTER: I & II** | **CREDITS: 3** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- The practical is designed to give an exposure to lab techniques in analysis of organicmolecules and synthesis of simple organic compounds.
- To provide the basic training for extraction of compounds from natural products andchromatographic separation.

**Unit I. Analysis of a mixture of the organic compounds.**

Identification of components in a two component mixture and preparation of their derivatives. Determination of b.p./m.p. for components and m.p. for the derivatives.

**Unit II. Preparation of organic compounds**

***a. Single stage (Any five)***

1. Preparation of o-benzylbenzoic acid
2. p-Nitrobenzoic acid from p-Nitrotoluene
3. Anthroquinone from anthracene
4. Benzhydrol from benzophenone
5. m-Nitroaniline from m-dinitrobenzene
6. 1, 2, 3, 4-Tetrahydrocarbozole from cyclohexanone
7. Methyl orange from sulphanilic acid

***b. Two stage* (any three):***

1. Sym-Tribromobenzene from aniline.
2. p-nitro aniline from acetanilide
3. m-Nitrobenzoicacid from methyl benzoate.
4. 2, 4-Dinitrobenzoic acid from p-nitro toluene.
5. m-Nitro benzoic acid from benzaldehyde
6. p-bromoaniline from acetanilide

**Unit III A) Extraction of natural products * (any two)**

1. Caffeine from tea leaves
2. Lactose from milk
3. Citric acid from lemon
4. Pipierine from black pepper

***B) Chromatographic Separations:****

1. Column chromatography - separation of anthracene and acid from anthracene picrate.
2. Thin layer chromatography separation of green leaf pigments.
3. Paper chromatography
4. Identification of amino acids

***C) Quantitative estimation of common drugs****

1. Estimation of vitamin C in tablets by Iodimetry.
2. Estimation of Aspirin by spectrophotometry

**Only for Internal Assessment*

## CORE ELECTIVE – 3 (P)
## INORGANIC CHEMISTRY PRACTICAL

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE309P** | **PRACTICAL** | **MARKS 100** |
| **SEMESTER: I & II** | **CREDITS: 3** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To train the candidate in inorganic compound preparation, separation of the two metalions by chromatographic method and deduction identification of cations by semi micromethod.

**EXPERIMENTS**

**Unit I**.

**Semi micro qualitative analysis:** A mixtures containing two common and two rarecations. The following are the rare cations to be included: W, Mo, Ti, Te, Se, Ce, Th, Zr,V, U andLi.

**Unit II. Complexometric titrations (EDTA) - Estimation of Ca, Mg and Zn.**

**Unit III. Preparation of the following complexes (any seven) :**

1. Potassium tris (oxalato) aluminate (III) trihydrate.
2. Tris (thiourea) copper (I) chloride
3. Potassium tris (oxalato) chromate (III) trihydrate
4. Sodium bis (thiosulphato) cuprate (I)
5. Tris (thiourea) copper (I) sulphate
6. Sodium hexanitrocobaltate (III)
7. Chloropentammine cobalt (III) chloride
8. Bis (acetylacetanato) copper (II)
9. Hexaminenickel (II) chloride
10. Bis (thiocynato) pyridine manganese, (ll)

**Unit IV. (Only for internal assessment)**

Separation of a mixture of two metal ions by paper chromatography. Separation of zinc and magnesium on a cation exchanger.

**TEXT BOOKS:**


1. A.L. Vogel, Text book of Inorganic quantitative analysis, ELBS, Third edition, 1976.
2. G.S.Vehla, Vogel's textbook of Macro and Semimicro Qualitative InorganicAnalysis, fifth edition, Revised, 1979.
3. Dougles A. Skoog, F. James Holler. Stanley R Crouch, Principles of Instrumental Analysis, third edition 2007.

## CORE ELECTIVE – 4 (P)
## PHYSICAL CHEMISTRY PRACTICAL

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE310P** | **PRACTICAL** | **MARKS 100** |
| **SEMESTER: I & II** | **CREDITS: 3** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To understand and verify the concepts and equations in physical chemistry by carrying out suitable experiments.
- Typical list of possible experiments are given. A minimum of 10 – 12 experimentshave to be performed.

**COURSE OUTCOME:**

CO 1: Determine the order and calculate the rate constant for the reaction.
CO 2: Draw and interpret the phase diagram of two component systems.
CO 3: Apply distribution law to find the partition coefficient and equilibrium constant.
CO 4: Verify Freundlich adsorption isotherm .

**UNIT I**

1. Study of the adsorption of acetic acid or oxalic acid on charcoal, verification of Freundlich isotherm and determination of concentration of given acetic acid or oxalic acid.
2. Construction of phase diagram for a simple binary system; naphthalene – biphenyl, naphthalene –p-dichlorobenzene, naphthalene-diphenylamine.
3. Construction of phase diagram for the three component system (partially miscible liquid system) acetone – chloroform – water; chloroform –acetic acid – water.
4. Determination of the equilibrium constant of the reaction between iodine and potassium iodide by partition method.
5. Determination of the concentration of given potassium iodide solutions by partition method.
6. Determination of molecular weight of benzoic acid in benzene and the degree of association of benzoic acid in benzene using partition method.

**UNIT II**

1. Kinetic study and comparison of rate constant for the inversion of cane sugar in presence of acid using polarimeter.
2. Kinetic study of the reaction between acetone and iodine in acidic medium and determination of the order with respect to iodine and acetone.
3. Kinetic study of saponification of ethyl acetate by sodium hydroxide conductometrically and determination of order of the reaction.

4. Kinetic study and comparison of acid strengths using acid catalysed hydrolysis of methyl acetate.
5. Determination of temperature coefficient and energy of activation for the acid catalyzed hydrolysis of methyl acetate.
6. Determination of the rate constant and order for the reaction between potassium persulphate and potassium iodide.
7. Study of the primary salt effect on the kinetics of oxidation of iodide by persulphate
8. Kinetic study of the decomposition of sodium thiosulphate by mineral acid.

**REFERENCE**


1. B.Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Published by viva books, 2012.
2. B.D.Khosla, V.C. Garg and A. Khosla, Senior Practical Physical chemistry, R.Chand & Co New Delhi, 2011.
3. P.S.Sindu, Practical Physical chemistry- A modern Approach, MacMillan India Ltd, first edition, 2006.
4. C.W. Garland, J.W.Nibler and D.P. Shoemaker Experiments in Physical Chemistry, Tata McGraw-Hill, NewYork, eighth edition, 2003.
5. A.M. Halpern, G.C. McBane, Experiments in Physical Chemistry, W.H. Freeman & Co, New York. Third edition, 2003.

# SEMESTER - III

## CORE – 7
## ORGANIC CHEMISTRY – III

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE312** | **THEORY** | **MARKS 100** |
| **SEMESTER: III** | **CREDITS: 4** | **TOTAL HOURS: 60** |

### COURSE OBJECTIVES

- The first part of the paper explains about electronic and vibrational spectroscopy through problem solving approach.
- The instrumentation methods and the applications of NMR spectroscopy, Mass spectrometry in the determination of structure of organic molecules are given.
- Photochemical reactions involving carbonyl, alkene are discussed in detail.

**UNIT-I: UV-Vis and IR spectroscopy (10 hrs)**

Principles and applications of ultraviolet and infrared spectroscopy in organic molecular structure determination. Optical rotatory dispersion and its applications. Cotton effect, Octant rule and axial haloketone rule. Woodward- Fieser rule for conjugate systems and unsaturatedketones – Scott rules for aromatic ketones with problem solving approach. (for molecules with a maximum number of $C_{10}$)

**UNIT – II: Nuclear Magnetic Resonance Spectroscopy (10hrs)**

**N**uclear magnetic resonance spectra: Theory- the nuclear spin, Larmor frequency, NMR isotopes, population of nuclear spin levels - relaxation processes. Chemical shift- shielding constant, diamagnetic anisotropic influence - ring currents – diatropy and paratropy. Spin-spin interaction- low and high resolution spectra. Nuclear magnetic decoupling - double resonance - nuclearoverhauser effect- Fourier transform technique - $^{13}C$ NMR spectroscopy.

**UNIT – III: Applications of NMR Spectroscopy to Organic Compounds (15 hrs)**

Proton NMR applications to structure elucidation of simple organic molecules - chemical shift values of various chemically non-equivalent protons and correlation to protons bondedtocarbon and protons bonded to other nuclei - chemical exchange, effect of deuteration. Firstorder PMR spectra - complex spin-spin interaction between two, three, four and interactingnuclei, virtual coupling, simplification of complex spectra using shift reagents - couplingconstant - variation of coupling constant with dihedral angle, Karplus curve. $^{13}C$-NMRapplications to structure elucidation of simple organic molecules – complete decoupled CMR -off resonance spectra-chemical shift values. Elementary treatment of two-dimensionalNMR spectroscopy, NOESY, COSY, and DEPT.

**UNIT – IV: Mass Spectrometry (15 hrs)**

Fragmentation process, even and odd electron ions, scission with rearrangement. Retro Diels Alder reaction, Mc Lafferty rearrangement, double bond and/ or ring equivalents implied from a formula. Fragmentation associated with functional groups aliphatic compounds, aldehydes, ketones, carboxylic acids, esters, amides, alcohols, thiols, amines, ethers, sulphides and halides, aromatic compounds, elimination due toortho groups. Identification of organic compounds using mass spectrometry – problems.

Conjunct problems based on UV-Vis, IR, NMR and Mass data. Determination of molecular formula using analytical data.

**UNIT – V Organic Photochemistry (10 hrs)**

Photo chemistry of ketones – Norrish Type-I, Norrish type –II - Photo reduction, - photo chemistry of olefins - cis –trans isomerisation - Photocycloaddition, - Paterno–Buchi reaction – photo chemistry of aromatic compounds – photo rearrangements -Di-π methane rearrangement, Barton reaction and Photo Fries reaction – Photochemistry of cyclohexadienones – photochemistry of santonin - synthesis of Vitamin D from cholesterol.

**TEXT BOOKS:**

1. Elementary Organic Spectroscopy revised edition by Y R Sharma
2. Spectroscopy of Organic Compounds revised edition by P.S. Kalsi

**REFERENCE BOOKS**

1. Introduction to Spectroscopy, 5th Edition by Donald L. Pavia (Author), Gary M. Lampman (Author), George S. Kriz (Author),James A. Vyvyan (Author)
2. Organic Spectroscopy by Pradeep Pratap Singh Ambika
3. Organic Spectroscopy : Principles & Applications, Paperback edition, by Jag Mohan

**WEBLINKS**

1. www.epathshala.nic.in
2. www.khanacademy.org
3. www.nptel.ac.in
4. http:/swayam.gov.in

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | 1 |
| | Unit – 4 | 1 | 1 |
| | Unit – 5 | 1 | 1 |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

## CORE – 8
## INORGANIC CHEMISTRY – III

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE313** | **THEORY** | **MARKS 100** |
| **SEMESTER: III** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To introduce the concept of interaction of matter with electromagnetic radiations leading to structural determination of inorganic and organometallic compounds.

- To understand the basic concepts of UV- VIS, IR, Raman, ESR, Mossbauer, Photo electron, NQR & NMR spectra & determine the structure of unknown compounds and to develop problem solving skills.
- To educate the photochemistry of inorganic compounds for applied research.

**UNIT – I: Applications of IR and Raman Spectroscopy (8 hrs)**

Introduction to IR and Raman spectroscopy. Applications of Infrared and Raman, electronic spectroscopy to inorganic systems-metal complexes, organometallic and simple inorganic compounds with special reference to coordination sites, isomerism etc., inorganic structure determination. Vibrational spectra of metal carbonyls.

**UNIT – II: Electronic spectroscopy and its Applications (15 hrs)**

Electronic spectra of diatomic and polyatomic molecules- Term states of $d^n$ ions - Term Symbols - Characteristics of d-d transitions - electronic spectra of coordination compounds - selection rules - band intensities and band widths - energy level diagrams of Orgel and Tanabe – Sugano diagrams - spectra of $Ti^{3+}$, $V^{3+}$, $Ni^{2+}$, $Cr^{3+}$, $Co^{2+}$, $Cr^{2+}$ and $Fe^{2+}$ - calculation of 10Dq and B for $V^{3+}$(oct) and $Ni^{2+}$(oct) complexes. Charge transfer spectra - classification, mechanisms and interpretation with suitable examples. Applications of UV-Visible spectroscopy to inorganic and organometallic compounds with regard to structural elucidation.

**UNIT – III: Mossbauer and NQR Spectroscopy and applications of NMR Spectroscopy to Inorganic molecules (12hrs)**

Mossbauer spectroscopy–principle–instrumentation–recoil energy–Doppler effect- number of MB signals – isomer shift – quadrupole splitting – magnetic splitting. Applications of $^{57}Fe$, $Sn^{119}$ and $I^{129}$ Mossbauer spectroscopy. NQR spectroscopy – theory and instrumentation – nuclear quadrupole couplingconstants –applications. Applications of $^{11}B$, $^{31}P$, $^{19}F$, $^{119}Sn$ and $^{195}Pt$ NMR spectroscopy in the structural assessment of simple inorganic compounds. Applications of NMR in the study of co-ordination complexes, organometallic derivatives and trans effect. Inter and intramolecular exchange studies using NMR- Fluxional behavior of inorganic molecules.

**UNIT – IV: ESR Spectroscopy and Photoelectron Spectroscopy (15 hrs)**

ESR spectra of transition metal complex - copper, manganese and vanadyl complexes. Applications of ESR spectroscopy based on multiplicity, anisotropy, magnitude of **g** values and A values – covalency of complexes. Photoelectron spectroscopy – basic principles of UPS and XPS– photoelectron spectra- Koopmann's theorem- fine structure in PES, applications of UPS. ESCA- Introduction – Chemical shift and Correlation with electronic charges - satellite peaks, spectral splitting, instrumentation, applications - Auger electron spectroscopy - determination of dipole moment,

**UNIT V: Photochemistry of Co-ordination Compounds (10 hrs)**

Types of Photochemical reaction – photo isomerization, photo substitution and photo redox reactions of Cobalt, Chromium, Platinum and Ruthenium complexes. - Excitons, polarons, solitons, semiconductor junctions, photocurrent and photo voltage, Photoconductors, photovoltaic cells and photo galvanic cells, solar batteries. Solar energy conversion- photo electro chemistry- Role of Ruthenium bipyridine $[Ru(bpy)_3]^{2+}$ complexes in solar energy conversion. The solar spectrum, antennae, reaction centers, photo processes in inorganic, and sensitized solar cells- photo catalysis.

**REFERENCE BOOKS:**


1. R. S. Drago, Physical Methods in Chemistry, Thomson learning, 1977.
2. Drago R.S, Physical Methods for Chemists, Saunders, (W.B), Co.Ltd, second edition, 1992.
3. Ebsworth E.A.V, DWA Rankin and C. Craddock, Structural methods in inorganic chemistry, Blackwell Science Inc. second edition, 1987.
4. Christian G. D., Analytical Chemistry, Wiely, sixth edition, 2004.
5. Silverstein, Basseler and Morrill, Spectroscopic Identification of Organic

Compounds, John Wiley & Sons, New York, fifth edition, 1991.
6. Sharma B. K., Instrumental methods of analysis, Goel Publication, twenty fourth edition, 2005.
7. Skoog D. A., Instrumental methods of analysis - Saunders College Publication, third edition, 2007.
8. Fundamentals of photochemistry by Rohatki and Mukherjee
9. Modern molecular photochemistry by N.J. Turro

**Web Links:**

1. https://www.chemicalforums.com/
2. https://nptel.ac.in/
3. https://chem.libretexts.org/
4. http://www.ilpi.com/genchem/web.html#12

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 1 | |
| | Unit – 2 | 2 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

## CORE – 9
## PHYSICAL CHEMISTRY – III

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE314** | **THEORY** | **MARKS 100** |
| **SEMESTER: III** | **CREDITS: 4** | **TOTAL HOURS: 60** |

### COURSE OBJECTIVES

- To learn the principles of Rotational, vibrational, Raman, electronic and mass spectroscopy and their applications.
- To understand the significance and applications of classical thermodynamics and solution electro chemistry.

**UNIT – I: Spectroscopy I** **(15 hrs)**

Interaction of radiation with matter. Rotational spectroscopy of rigid rotor-derivation of J max- non-rigid rotor- diatomic and polyatomic molecules – Stark effect. Vibrational spectroscopy- harmonic oscillator-anharmonicity- vibrational spectra of polyatomic molecules- overtones, combination of bonds - vibrationalcoupling- Fermi resonance. Vibrational rotational lines-PQR branches- Determinationof bond length, force constant, vibrational frequency. Applications involving isotopic substitution. Raman spectra-Stokes and antistokes lines. Classical and quantum theory-Rotational and vibrational Raman spectra.

**UNIT – II Spectroscopy II** **(10 hrs)**

Electronic spectra of diatomic and polyatomic molecules- Franck-Condon principle – determination of dissociation energy – pre dissociation spectra - selection rules-types of electronic transitions– effect of conjugation and solvent - chromophores, auxochromers, Bathochromic and Hypsochromic shifts. Term symbolsfor electronic states of $H_2$ molecule.

NMR spectroscopy-principle – instrumentation - equation of motion of spin in magnetic fields, chemical shift- spin-spin coupling- relaxation effects.

Mass Spectrometry -Principle – instrumentation – isolation techniques - EI, CI, FD - LD, LIMA, PD, FAB, SIMS - presentation of spectral data – molecular ions-

determination of molecular mass - Isotopic peaks - determination of molecular formula – Meta stable peaks. Fragmentation - nitrogen rule.

**UNIT - III: Thermodynamics – I** **(10 hrs)**

Partial molar properties – Partial molar free energy (chemical potential)- Partial molar volume- partial molar heat content- their significance and determination of these quantities- variation of chemical potential with temperature and pressure.

Thermodynamics of real gases- gas mixture- fugacity definition- determination of fugacity – variation of fugacity with temperature and pressure- thermodynamics of ideal and non ideal binary solutions- dilute solutions- excess functions for non-ideal solutions and their determination- the concepts of activity and activity co-efficient- determination of standard free energies- choice of standard states- determination of activity and activity coefficient for non electrolytes.

**UNIT – IV: Electrochemistry of Solutions** **(10 hrs)**

Ion-solvent interaction- Born's treatment (structureless continuum model only, no derivation); ion- ion interaction-Mean ionic activity and activity coefficient-concept of ionic strength-Debye - Huckel theory of strong Electrolytes- Derivation of Debye-Huckel limiting law - validity of the equation-Debye - Huckel limiting law at low and appreciable concentration of the electrolytes-qualitative and quantitative verification-Deby- Huckel- Bronsted equation.

Ion transport -theory of strong electrolytes for electrolytic conductance-derivation of Onsager equation-validity of the equation-modification of Onsager equation. Ion association- Bjerrum treatment of association-Bjerrum ion association constant-factors influencing ion association-effect of ion association on conductivity and activity coefficient of electrolytes in solution.

**UNIT – V: Dynamic Electrochemistry** **(15 hrs)**

The electrode-electrolyte interface-electrical double layer-IHP-OHP-contact adsorption- surface excess and its importance-Thermodynamics of electrified interface-electro capillary phenomenon - Lippmann equation, Lippmann potential-polarizable and non-polarizable interface. Structure of double layer- Helmholtz- Perrin,

Guoy-Chapmann and Stern models of electrical double layer. Electro kinetic phenomena (Electrophoresis, electro osmosis, sedimentation potential and streaming potential – concepts only) derivation of Butler-Volmer equation for one step electron transfer reactions, Tafel equation - significance of exchange current density and symmetry factor. Polarization and over potential-A brief account of Hydrogen overpotential- factors affecting Hydrogen over potential-mechanism of hydrogen evolution and oxygen evolution-concentration polarization.

Corrosion: Theories, types, prevention and applications of corrosions. Fuel Cells- hydrogen- oxygen fuel cell, construction and applications.

**REFERENCES**


1. R. S. Drago, Physical Methods in Chemistry, Thomson learning, 1977.
2. Drago R.S, Physical Methods for Chemists, Saunders, (W.B), Co.Ltd, second edition, 1992.
3. Pavia D. L. and Chapman G. M. Introduction to Spectroscopy, Books/Cole, fourth edition, 2008.
4. Christian G. D., Analytical Chemistry, Wiely, sixth edition, 2004.
5. Sharma B. K., Instrumental methods of analysis, Goel Publication, twenty fourth edition, 2005.
6. Skoog D. A., Instrumental methods of analysis - Saunders College Publication, third edition, 2007.
7. J.O. M. Bokris and A.K.N. Reddy, Electrochemistry, Vol 1&2, Kluwer academic/Plenum publishers, New York, Second edition.2002.
8. S. Glasstone, Introduction to Electrochemistry, Liton educational Publishing INC, reprint2010.
9. D. R. Crow, Principles and Applications of Electrochemistry, Chapman and Hall, fourth edition, 1994.
10. M. C. Gupta, Statistical thermodynamics, Wiley, Eastern, New Delhi, reprint, 2009.
11. Nester Perez, Electro chemistry and corrosion science, Springer London, reprint, 2010.
12. K.L. Kapoor, Physical chemistry, MacMillan India Ltd, third edition, 2009.


**Web Links:**

1. http://ccl.osc.edu/ccl.cca.html
2. http://www.chem.swin.esu.au/chem_ref.html
3. http://www.colby.edu/chemistry/PChem/Lecture1.html
4. http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/electrode.html#c3
5. www.spectro.com

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 1 | 1 |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | 1 |
| | Unit – 4 | 1 | |
| | Unit – 5 | 1 | 1 |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

## CORE ELECTIVE – 5
## CHEMISTRY OF NATURAL PRODUCTS

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE317** | **THEORY** | **MARKS 100** |
| **SEMESTER: III** | **CREDITS: 3** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To create awareness about the chemistry of biomolecules and their reactions.

**UNIT – I: Nucleic acids** **(10 hrs)**

Pyrimidine and purine bases- synthesis of Adenine, Guanine, Thymine, Cytosine andUracil. Structure and role of nucleic acid – nucleoside, nucleotide and poly nucleotides – DNA and RNA – structure, types – biological functions – genetic code.

**UNIT – II: Proteins and Steroids** **(15 hrs)**

Proteins- classification, Merrifield synthesis, end group analysis, structure and biological functions. Steroids-Diel's hydrocarbon, synthesis of bile acid. Structural elucidation of cholesterol- Conversion of cholesterol into estrone, testosterone and progesterone. Synthesis of equilenin.

**UNIT – III: Terpenoids and Carotenoids** **(15 hrs)**

Classification, occurrence, general methods of determining structure - isoprene rule.Synthesis of the following molecules – α and β-Carotene, lycopene, zingiberin, eudesmol and santonin.

**UNIT – IV: Alkaloids and Anthocyanins** **(10 hrs)**

Total synthesis of cocaine, morphine, reserpine quinine and lysergic acid.Flavones, isoflavones, anthocyanins (Synthesis only)

**UNIT – V: Biosynthesis** **(10 hrs)**

General principles involved in the biosynthesis of amino acids, alkaloids, steroids and terpenoids. Biosynthesis of cholestrol, prostaglandin, phenanthrene alkaloids and bile acids.

**TEXT BOOKS:**


1. I.L. Finar, Organic chemistry, Vol- II, ELBS Publication, fifth edition, 1986.
2. O.P. Agarwal, Organic Chemistry of Natural Products, Krishna PrakashanMedia Pvt. Ltd, forty second edition, 2011.
3. Gurdeep R. Chatwal, Organic chemistry of Natural products, HimalayaPublishing House, 2005.
4. L.A. Pacquette, Principles of Modern Heterocyclic Chemistry, BenjaminCummings Publishing Co, London, 1978.


**WEBLINKS**

1. www.epathshala.nic.in
2. www.khanacademy.org
3. www.nptel.ac.in
4. http:/swayam.gov.in

**Question paper pattern:**

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

**Distribution of Questions:**

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | Theory | Problems |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

# SEMESTER - IV

## CORE – 12
## ORGANIC CHEMISTRY – IV

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE319** | **THEORY** | **MARKS 100** |
| **SEMESTER: IV** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To introduce the basic methodology for the synthesis of organic compounds using dissectionmethod, various reagents, name reactions and also to acquire knowledge about green synthetic methods.

**UNIT – I: Modern Synthetic Methodology (15 hrs)**

Retro synthetic analysis- disconnections - Synthons: Donors & acceptor and their syntheticequivalent- FGI-FGA-UMPOLUNG. Formation of C-C bond using alkylation and acylation of enamines, enolates, active methylene compounds and Organometallic compounds-RMgX, $R_2LiCu$,RLi with special reference to synthesis of 1,2 - 1,3 - 1,4 - 1,5- and1,6 - dicarbonyl compounds. Synthesis of unsaturated carbonyl compounds using aldol condensation, Claisen reaction and Michael reaction - Cyclisation methods- Robinson annulations. Formation of C=C bond using Wittig, modified Wittig reactions, Peterson olefination and Julia olefination. Role of sulphur ylides and rearrangements (Pinacol-Pinacolone and Favorski rearrangement) in organic synthesis. Protection and deprotection of functional groups (-OH, $-NH_2$, C=O, -COOH).

**UNIT – II: Synthetic Reagents (15 hrs)**

Reagents used for oxidation- TPAP, Dess-martin, silver carbonate / molecular seives and CAN. Reagents used for Reductions-$(PPh_3)_3RhCl$, Lindlar catalyst, 9-BBN, chiral boranes, $NaBH_3CN$, DIBAL and selectrides - Birch reduction (Hetero cyclic compound). Role of $Bu_3SnH$, trimethylsilyl chloride, LDA and dithiane in organic synthesis. Ring closing metathesis.

**UNIT – III: Synthetic Applications of Name Reaction (10 hrs)**

Sandmeyer reaction, Ullmann reaction, Gomberg reaction, Pschorr reaction, Huns dicker reaction. Heck reaction, Suzuki coupling, McMurry olefination, Prins reaction, Ritter reaction, Mitsunobu reaction, Sharpless asymmetric epoxidation, Kumada coupling, Negishi coupling, Stille coupling Buchwald-Hartwig Cross Coupling and Sonogashira coupling.

**UNIT - IV: Retero Synthesis of Target Molecules (10 hrs)**

Retero synthetic analysis, donor and acceptor synthons- examples and synthesis of target molecules - 5-hexenoic acid, bicyclo (4, 1, 0) heptane-2-one, trans-9-methyl-1-decalone, Cubane, longifolene, cis - jasmone and onocerin.

**UNIT – V: Green Chemistry (10 hrs)**

Introduction to green chemistry; efficiency/atom economy - definition, needs and goals. Twelve principles of green chemistry with detailed descriptions. Comparison of conventional chemical methods with green chemical methods. Organic synthesis in aqueous medium (highlight of requirements) - Diels-Alder reaction, Knoevenagel reaction and Heck reactions. Ionic liquids as solvent - preparation, merits of ionic liquid as solvent and application to Suzuki coupling, Henry reaction and hydrogenations. Polymer supported Phase transfer catalysts – principle of catalysis and applications to C, N, O & S alkylations. Microwave and Ultrasound assisted synthesis – principle behind these techniques and application to esterification, reduction and coupling reactions.

**REFERENCE BOOKS:**


1. William Caruthers and Coldham, Modern methods of organic synthesis, CambridgeUniv, Press, fourth Edition, 2010.
2. Ratan Kumar Kar, Frontier Orbital and Symmetry Controlled Pericyclic reaction,Books & allied Pvt. Ltd, first Edition, 2010.
3. I.L. Finar, Organic chemistry Vol-II, Pearson Education Pvt. Ltd, fifth edition, 2005.
4. Stuart Warren, Organic synthesis- The Dissconnection approach, John Wiley (P)Ltd, Reprint 2011.
5. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry, Part-A and Part-B,Plenum Press, New York, fifth edition, 2015.
6. J. March, Advanced Organic Chemistry, John Wiley & sons, Singapore, fourth edition, 1992.
7. J. Clayden, N. Greeves and S. Warren, Organic Chemistry, Oxford UniversityPress, second edition, 2014.
8. Rashmi Sanghi and M.M. Srivastava, Green Chemistry, Narosa Publishing HousePvt. Ltd, fifth edition, 2012.
9. V.K. Ahluwalia, Green Chemistry- Greener alternative to synthetic organictransformation, Narosa publishing house Pvt. Ltd, first edition, 2011.
10. J.P. Tierney and P. Lidstrom, Microwave Assisted Organic Synthesis, Wiley IndiaPvt. Ltd, first edition, reprint, 2009.
11. R.O.C Norman and J.M. Coxon, Principles of organic synthesis, CRC press, thirdedition, 2012.
12. Ratan Kumar Kar, Fundamentals of organic synthesis –the retro synthetic analysisvol-2, New central book agencies first reprint, 2008.

13. Michael B.Smith, Organic synthesis, McGraw Hill, (Singapore) second edition, 2002.

**WEBLINKS**

1. www.epathshala.nic.in
2. www.khanacademy.org
3. www.nptel.ac.in
4. http:/swayam.gov.in

**Question paper pattern:**

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

**Distribution of Questions:**

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | Theory | Problems |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 1 | 1 |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | 1 |
| | Unit – 4 | 1 | 1 |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

## CORE – 13
## INORGANIC CHEMISTRY – IV

| | | |
|---|---|---|
| **SUBJECT CODE:20PCHE320** | **THEORY** | **MARKS 100** |
| **SEMESTER: IV** | **CREDITS:4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To empower a thorough learning of solid state chemistry and magnetic properties of solids.
- To introduce the recent advancements in the field of materials science namely nano chemistry
- To enable the students to know about the various synthesis and properties ofnanomaterials and to learn the applications of nanoparticles in modern technology.

**UNIT - I: Solid State Chemistry I** **(13 hrs)**

Miller Indices, Point groups, stereographic projection of 32 point groups and space groups, isogonal symmetry groups and reciprocal lattice. X-ray diffraction and Bragg's law, Single Crystal Analysis and its Applications. Powder diffraction - refinement and structure solution of some compounds, Indexing with JCPDS and its application. Structural aspects of rock salt, rutile, fluorite, antifluorite, zinc blende, wurtzite, crystobalite, spinels, inverse spinels and silicates.

**Unit - II: Solid State Chemistry II** **(10 hrs)**

Band theory of solids – band gap, conduction mechanism, temperature dependence of conductivity, intrinsic and extrinsic semiconductors. Perfect and imperfect crystals, lattice defects- types of defects – stoichiometric and non-stoichiometric defects, defect formation, Determination of defects, thermodynamics of Schottky and Frenkel defect and incorporation of stiochometric excess defects (structural and thermodynamic aspects). Phase transitions, diffusion, diffusion coefficient, diffusion mechanisms, vacancy and interstitial diffusion. Inorganic phosphors- synthesis and applications. LED, FED – an introduction, Lasers- introduction and types, Inorganic laser - instrument and principle, Ruby, Nd: YAG laser – working and mechanism

**UNIT - III: Magnetic Properties of Solids (15 hrs)**

Introduction, origin and theory of magnetism, effect of temperature on magnetism – curie and wises law, temperature independent paramagnetism - spin cross over phenomena. magnetic moment and its calculation, types of magnetism and materials – examples and applications. paramagnetic susceptibility of solids. Determination of magnetic susceptibility by Gouy and Faraday method. Domain theory – Hysteresis Loop – applications. Properties of pervoskites andmagneto- plumbites- Hard and Soft magnetic materials- superconductivity in metals, alloys and ceramics materials (mixed oxides)- BCS theory, Meissner effect, superconductors - type I and II, applications -Fullerenes as superconductors.

**UNIT - IV: Nanomaterials-Synthesis, Characterization and Properties (12 hrs)**

Introduction to nanomaterials and nanotechnology. Classification of nanomaterials based on material and dimensions. Synthesis of Carbon based nanomaterials, Metal based materials and dendrimer composites - Bottom up (physicaland chemical techniques) and top down methods (mechanical methods and lithography). Size dependent properties of nano materials. Quantum dots and quantumeffects. Characterization methods of nanomaterials – XRD - Debye Scherer method (determination of structure and crystallite size), Scanning electron microscopy - morphology, atomic Force microscopy, Transition Electron Microscopy - Crystallite size and SAED pattern.

**UNIT - V: Application of Nanomaterials (10 hrs**

Energy-fuel cells, Microbial fuel cell, hydrogen storage, nanophosphors for High Definition TV, Next-Generation Computer Chips, Quantum electronic devices -CNT based applications and Field Emission Display - Biochemical sensor, smart materials. Environmental - Membrane based water purification. Nanocatalysis and photo catalysis. Biological applications – diagnostic and imaging, targeted drugdelivery - cancer treatment, tissue regeneration, theranostic agents. Nano coatings andpaintings. Cosmetic applications. Disadvantages of Nanomaterials – Nanotoxicity. Green Nanochemistry.

**REFERENCE BOOKS:**


1. A.R. West, Basic Solid State Chemistry, John Wiley, second edition,1999
2. W.E. Addison, Structural Principles in Inorganic Chemistry, Longman, 1961,
3. M. Adams, Inorganic Solids, John Wiley Sons,1974
4. A.R.West, Solid State Chemistry and its Applications, John Wiley, second edition, 1999.
5. Elaine A. Moore, Lesley E. Smart, Solid State Chemistry: An Introduction, CRC Press, 2012, Fourth Edition
6. M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic science and Emerging technologies, Overseas Press India Pvt. Ltd, New Delhi, First Edition, 2005.
7. C.N.R. Rao, A. Muller, A.K.Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH, Weinheim, 2004. 6. Kenneth J. Klabunde (Eds), Nanoscale Materials Science, John Wiley & Sons, Inc., 2001.
8. A Textbook of Nanoscience and Nanotechnology; P. I. Varghese, T. Pradeep; Tata McGraw-Hill Education, 2003 - Engineering drawings
9. C.S.S.R.Kumar, J.Hormes, C.Leuschner, Nanofabrication towards biomedical applications, Wiley –VCH Verlag GmbH & Co, Weinheim, 2004.
10. W. Rainer, Nano Electronics and information Technology, Wiley, 2003.
11. K.E. Drexler, Nano systems, Wiley, 1992.
12. G.Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004.


**Web Links:**

1. https://www.chemicalforums.com/
2. https://nptel.ac.in/
3. https://chem.libretexts.org/
4. http://www.ilpi.com/genchem/web.html#12
5. http://www.zyvex.com/nano/
6. https://www.instanano.com/
7. https://www.azonano.com/nanotechnology-equipment-index.aspx
8. http://www.e-booksdirectory.com/listing.php?category=238

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

## CORE – 14
## PHYSICAL CHEMISTRY – IV

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE321** | **THEORY** | **MARKS 100** |
| **SEMESTER: IV** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

- To understand and appreciate the significance of statistical thermodynamics.
- To learn the theory and applications of photo chemistry.
- To learn the basics of computational chemistry.

**UNIT - I: Thermodynamics- II** **(12 hrs)**

Concept of thermodynamic probability- distribution of distinguishable and non distinguishable particles.Maxwell-Boltzmann, Fermi-Dirac and Bose - Einstein statistics- Modes of contribution to energy. Partition function – Translational, vibrational and rotational partition functions for mono, diatomic and poly atomic ideal gases.

**UNIT - II: Thermodynamics – III** **(12 hrs)**

Thermodynamic functions in terms of partition functions- equilibrium constant for isotope exchange and dissociation of diatomic molecules- heat capacity of solids (Einstein and Debye models) -ortho and para hydrogen- Planck's radiation law – electron in metals.

**UNIT – III: Fundamentals of photochemistry:** **(12 hrs)**

Absorption and emission of radiation-Frank-Condon principle- Physical properties of electronic excited molecules - Spin multiplicity - Singlet and triplet excited states - decay of electronically excited states - radiative and non radiative processes-fluorescence and phosphorescence- Spin forbidden non-radiative transitions-internal conversion and inter system crossing-energy transfer process-excimers and exciplexes-delayed fluorescence and phosphorescence - Triplet-Triplet annihilation -static and dynamic quenching-Stern - Volmer analysis. Quantum

efficiency-quantum yield - sensitization and sensitizer - allowed- forbidden process – (Molecular structure and photo physical and photo chemical reactivity)

**UNIT – IV: Techniques and Photochemical Reactions (12 hrs)**

Quantum yield measurements-Flash photolysis techniques- Actinometry-quantum yield of photo physical process and photochemical reactions. Life time measurements – steady state and non steady state methods. Fluorescence spectroscopy – principle-instrumentation and applications – fluorescence-based sensors

**UNIT-V : Computational Chemistry: (12 hrs)***

Introduction to Cheminformatics - History of Cheminformatics - data storage, retrieval and presentation -Types of Databases - Cambridge structural database - different file formats (SMILES,.cif, .mol, .xyz, .pdb etc., ) - Online property calculators with examples. Introduction to Online resources - online 2D and 3D chemical structure drawing - designing of molecules and demonstrating experiments – Protein data bank - Protein structure visualization tools –PyMol, and Swiss PDB Viewer. Introduction to drug design - Structured-based drug design - Ligand based drug design – difference between drugs and inhibitors - Molecular Docking - Types (Rigid & flexible docking) - Online docking servers. (Definitions only - Pharmacophore, pharmacokinetics, lead molecule, search algorithm & scoring function)

***Not for End Semester Examination, only for Continuous Internal Assessment**

**REFERENCES**:


1.M. C. Gupta, Statistical thermodynamics, Wiley, Eastern, New Delhi, reprint, 2009.

2. B.C McClellan and Statistical thermodynamics, Chapman and Hall, London.1973.

3. K.L. Kapoor, Physical chemistry, MacMillan India Ltd, third edition, 2009.

4. K.K. Rohatgi Mukherjee, Fundamentals of photochemistry, New Age International Pvt. Ltd, reprint 2008.

5. N. J. Turro, Modern Molecular Photochemistry (MMP), University Press, Menlo Park, CA, 1978.

6. A. Gilbert and J. Baggott, Essentials of Molecular Photochemistry, CRC Press,

London, UK, 1991.
7. Molecular Modelling: Principles And Applications, Andrew R. Leach, 2nd edition, Pearson Education; 2ndedition (2009)

**Web Links:**

1. www.docsity.com
2. www.acdlabs.com
3. www.studocu.com
4. mooc.org
5. nptel.ac.in
6. www.gaussian.com
7. MOLPRO

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 5 | |
| | Unit – 2 | 5 | |
| | Unit – 3 | 5 | |
| | Unit – 4 | 5 | |
| | Unit – 5 | - | |
| **Section B** | Unit – 1 | 1 | 1 |
| | Unit – 2 | 2 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | - | |
| **Section C** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | - | |

## CORE – 10 (P)
## ELECTRO ANALYTICAL CHEMISTRY PRACTICAL

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE315P** | **PRACTICAL** | **MARKS 100** |
| **SEMESTER: III & IV** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

To help the students to understand and apply the concepts of electroanalyticalchemistry.

**UNIT – I: Conductometric Experiments**

1. Determination of equivalent conductance of strong electrolytes andverification of Debye- Huckel-Onsager equation.
2. Determination of dissociation constant of weak electrolyte using Ostwald's dilution law.
3. Conductometric Titration between simple and mixture of strong and weakacids and base and precipitation titration involving a single halide.

**UNIT – II: Potentiometric Experiments**

4. Determination of pH and calculation of pKa.
5. Determination of solubility product of sparingly soluble salt.
6. Potentiometric titrations between simple and mixture of strong and weak acids andbase.
7. Redox Titrations by EMF measurements
8. Precipitation titration of mixture of halides by EMF measurements.

**UNIT – III: Colorimetric Experiments**

9. Photoelectric method: Estimation of Iron, Nickel, Manganese and Copper.
10. *Determination of $Cr^{2+}$ and $Mn^{2+}$ ions present in water sample byColorimetry. (*For CIA only)

**REFERENCE BOOKS**


1. B.Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva books, 2012.
2. B.D.Khosla, V.C. Garg and A. Khosla, Senior Practical Physical chemistry,S.Chand and Co., New Delhi, 2011.
3. P.S.Sindu, Practical Physical Chemistry- A modern Approach,MacMillan India Ltd, first edition, 2006.
4. C.W. Garland, J.W.Nibler and D.P. Shoemaker, Experiments in PhysicalChemistry, Tata McGraw-Hill, NewYork, eighth edition, 2003.
5. A.M. Halpern, G.C. McBane, Experiments in Physical Chemistry, W.H.Freeman & Co, New York. Third edition, 2003.

## CORE – 11 (P)
## ANALYTICAL CHEMISTRY PRACTICAL

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE316P** | **PRACTICAL** | **MARKS 100** |
| **SEMESTER: III & IV** | **CREDITS: 4** | **TOTAL HOURS: 60** |

**COURSE OBJECTIVES**

To impart the quantitative estimation of organic compounds, mixture of inorganic metal ions and spectral interpretations of organic compound and inorganiccomplexes.

**Unit 1: ESTIMATIONS (ANY FOUR):**

1. Estimation of aniline
2. Estimation of phenol
3. Estimation of glucose (Bertrand's Method)
4. Saponification of fat or oil.
5. Iodine value of an oil.

**Unit II: SPECTRAL INTERPRETATION OF ORGANICCOMPOUNDS - UV, IR, PMR AND MASS SPECTRA**

1. 1, 3, 5-Trimethylbenzene
2. Pinacolone
3. Benzyl bromide
4. Phenyl acetone
5. Isopropyl alcohol
6. 2-N, N-Dimethylamino ethanol
7. 4-Picoline
8. Cinnamaldehyde

**Unit III: SPECTRAL INTERPRETATION OF INORGANIC COMPOUNDS**

1. $^{31}P$ NMR Spectra of methylphosphate
2. $^{31}P$ NMR Spectra of $HPF_2$
3. $^{19}F$ NMR Spectra of $CIF_3$
4. $^{1}H$ NMR Spectra of Tris (ethylthioacetoacetanato) cobalt (III)
5. Expanded high resolution NMR spectra of (N-propylisonitrosoacetylacetoneiminato)(acetylacetoneiminato) Nickel(II)

6. ESR Spectra of the aqueous ON $(SO_3)_2^{2-}$ ion.
7. ESR Spectra of the H atoms in $CaF_2$
8. ESR Spectra of the $[Mn(H_2O)_6]^{2+}$ ion
9. ESR Spectra of the bis (salicyladiminato) copper (II)
10. IR Spectra of the sulphato ligand
11. IR Spectra of the nitro and nitritopentaminecobalt (III) chloride
12. IR Spectra of the dimethylglyoxime ligand and its Nickel (II) complex.
13. IR Spectra of carbonyls
14. Mossbauer spectra of $FeSO_4.7H_2O$
15. Mossbauer spectra of $FeCl_3$
16. Mossbauer spectra $[Fe(CN)_6]^{3-}$
17. Mossbauer spectra $[Fe(CN)_6]^{4-}$

**Unit IV: QUANTITATIVE ANALYSIS OF COMPLEX MATERIALS**

To impart the techniques of analysis of alloys; preparation and analysisinorganic complexes.

**a) Analysis of Alloys:**

1. Analysis of copper and nickel from copper-nickel alloy.
2. Estimation of copper and zinc in brass.
3. Estimation of iron and nickel in stainless steel.
4. Estimation of iron and magnesium from the mixture.

**b) Analysis of Inorganic Complex Compounds: (for internal assessmentonly)**

1. Preparation of cis and trans potassium bis(oxalato)diaquochromateand analysis of each of these for chromium.
2. Preparation of potassium tris(oxalato) aluminate (III) and analysis foriron and oxalate.

**REFERENCE BOOKS:**


1. J. Mendham, R.C. Denney, J. Basset and G.H. Jeffery, Vogel's Text book of quantitative Inorganic Analysis, fourth edition ELBS, Longmann, 1978.
2. A. I. Vogel, Text Book of Practical Organic Chemistry, ELBS, London, fifth edition, l989.

## EXTRA DISCIPLINARY ELECTIVE

## EDE – 1
## NUTRITION & DIETETICS

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE311** | **THEORY** | **MARKS 100** |
| **SEMESTER: II / III** | **CREDITS: 3** | **TOTAL HOURS: 45** |

**COURSE OBJECTIVES**

- To introduce the students to the principle of Human Nutrition.
- To understand the relationship between Nutrition and human well being.
- To understand the modifications in nutrients and dietaryrequirements for various diseases.

**Unit - I. NUTRITION** **(9 hrs)**

History of Nutrition - Development of Nutrition as a Science - Definition of Nutrition Undernutrition, over nutrition and malnutrition. protein energy malnutrition -kwashiorkor, Marasmus and Mrasmic Kwashiorkor. The use of food in the body - digestion, absorption, transport, utilisation of nutrients in the body

**Unit - II. VITAMINS** **(9 hrs)**

Fat soluble vitamins - vitamin A, D, E and Vit K - function effects ofdeficiency, sources, requirements, units of measurement and hyper- vitaminosis. Function, effects of deficiency, sources and requirements of water solublevitamins -ascorbic acid, thiamine, riboflavin and Niacin. Importance of folic acid, Vit B12 pyridoxine, Biotin and Pantothanic acid to the body.

**Unit - III. MINERALS** **(9 hrs)**

Distribution in the body, functions, food sources, requirements and effects of deficiency of calcium, phosphorous, Iron and iodine.Trace elements in human nutrition - copper, iron, zinc - functions, food sources,requirements and effects of deficiency. Selenium and vitamin E relationship. Chromium and glucose tolerance factor.

**Unit - IV. WATER** **(9 hrs)**

Distribution of water in the body, water intake and loss, exchange of waterin the body, composition of body fluids.

**Unit - V. DIETETICS** **(9 hrs)**

le of Dietician, Basic concepts in Diet Therapy, Routine Hospital Diets. Regular diet, light diet, soft diet, full liquid diet, and tube feeding. Modifications of Diet – Febrile conditions, infections and surgical conditions. Diets of gastro intestinal disorders, renal diseases, liver diseases, obesity, cardio vascular disorders and diabetes mellitus. Geriatrics - Role of diet.

**Reference :**


1. Guthrie, Helen, Andrews, "Introductory Nutrition" 6th Ed, St. Louis, TimesMirror/Mosby College, 1986.
2. Mudambi S.R., M.V. Rajagopal, "Fundamentals of Food and Nutrition", 2nd Ed.Wiley Eastern Ltd. 1990.
3. Swaminathan, M., "Advanced Textbook of Foods and Nutrition", Vol I,II (2ndEd.revised) Bappco, Bangalore, 1985.
4. Wilson, EVAD, "Principles of Nutrition", 4th Ed. New York, John Wiley & Sons, 1979.
5. Swaminathan, M (1998), "Principles of Nutrition and Dietetics", Bappco, Bangalore.
6. Anderson, M.V. Dibble, P.R. Turkhi, H.S. Mitchell and H.J. Rynbergen. "Nutritional in Health & Disease", 17th Ed. J.R. Lippincatt Co., Philadelphia,1982.
7. Antia, F.P. "Clinical Dietetics and Nutrition", 2nd Ed, Oxford UniversityPress, Delhi, Reprinted in 2000.9
8. Bennian, M. "Clinical Nutrition", Harper and Row, Pub., N.Y. 1979.

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

**EDE – 2**
**APPLIED CHEMISTRY**

| | | |
|---|---|---|
| **SUBJECT CODE :20PCHE318** | **THEORY** | **MARKS 100** |
| **SEMESTER: II / III** | **CREDITS: 3** | **TOTAL HOURS: 45** |

**COURSE OBJECTIVES**

- To gain knowledge on fuels, fertilizers and water technology.
- To know about the food nutrients and adulterants in food, artificial sugar and beverages.
- To learn about the polymer chemistry and its application.
- To acquire knowledge on drugs like Anesthetics, Analgesics, Antibiotics, Antipyretics.
- To understand the basic fundamentals of Nano chemistry.

**Unit – 1. Chemical industries** **(9 hrs)**

Fuels: Fuels - types of fuels with examples - liquid fuels - gaseous fuels - nuclear fuels. Energy - sources of energy - renewable and non - renewable energies - nonconventional energies. Fertilizers: Definition, requirement of a fertilizer, Classification of fertilizers; Urea, ammonium sulphate, NPK fertilizer, super phosphate, triple superphosphate (uses only).

Water Technology- Sources of water, soft and hard water, methods of removal of hardness, Purification techniques - zeolite method, reverse osmosis and ion exchange.

**Unit – 2. Food science** **(9 hrs)**

Food and Nutrition - Sources of food, types; Carbohydrates, Proteins, Fats, Minerals and vitamins (sources and their physiological importance) - Balanced diet - Food adulteration - contamination of Wheat, Rice, Milk, Butter, Ghee etc. with clay stones, water and toxic chemicals - Detection of adulterated foods by simple analytical techniques. Artificial sugar viz., saccharin, Aspartame and cyclamate. Beverages - soft drinks - soda - fruit juices - alcoholic beverages examples.

**Unit – 3. Polymer science** **(9 hrs)**

Classification of polymers-biopolymers and biodegradable polymers. Plastics, polythene, PVC, Bakelite, polyesters, melamine-formaldehyde resins - Freon, Teflon- (uses only). Building materials - cement, ceramics, glass and refractories - definition, composition and application only.

**Unit – 4. Pharmaceutical products** **(9 hrs)**

Definition and Uses of each: Anaesthetics – General and local (Chloroform, diethyl ether); Analgesics – Narcotic and synthetic; Antipyretics (aspirin, paracetamol and ibuprofen) and anti-inflammatory agents (diclofenac, celecoxib). Antibiotics: penicillin, streptomycin and chloramphenicol. (Structures not required) Cancer and Diabetes – Causes and treatment**.**

**Unit -5. Nano ethics** **(9 hrs)**

Definitions - Nano, nanoscience, and nano technology. Nano in nature - difference between bulk and nanomaterials - challenges in nanotechnology. Applications of Nanotechnology -Nanomedicine: diagnosis, biocompatible nanomedical materials. Industrial applications of nanomaterials: nano coatings and nanotextiles as antibacterial and anti - odour agents in deodorant/antiperspirant, shaving/depilatory products, foot powder, oral care.

**Reference books:**

1. M. Swaminathan, Food Science and Experimental Foods, Ganesh and Company, 1979.

2. Jayashree Ghosh, Fundamental Concepts of Applicated Chemistry, S. Chand & Co. Publishers, second edition, 2006.

3. S. Lakshmi, Pharmaceutical Chemistry S. Chand & Sons New Delhi, third edition, 1995.

4.V.R. Gowariker, N.V. Viswanathan and Jayader Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 1978.

5. V. Veeraiyan, Text book of Ancillary Chemistry; Highmount publishing house, Chennai, first edition, 2009.

6.S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

**EDE – 3**
**ENVIRONMENTAL SCIENCE**

| | | |
|---|---|---|
| **SUBJECT CODE :** | **THEORY** | **MARKS 100** |
| **SEMESTER: II / III** | **CREDITS: 3** | **TOTAL HOURS: 45** |

**COURSE OBJECTIVES**

- To gain knowledge about types of environmental pollution,waste managment.
- To acquire knowledge on current issues on disaster management and green chemistry

**UNIT - 1 ENVIRONMENTAL POLLUTION (9 hrs)**

Air Pollution - sources – oxides of nitrogen, sulphur, ozone, hydrocarbons and particulate matter-effects and control measures - Air quality and emission standards. Water Pollution sources– organic, inorganic and heavy metals – Effects- Eutrophication – Transport of pollutants in the aquatic ecosystem - control measures of Ocean, Oil and Ground water pollution -Soil Pollution sources- Industrial, Domestic, Agricultural - Effects of soil pollutants on plants, animals and ground water - Radioactive pollution – sources- radioactive elements, Effects of radiation on surrounding environment and control measures.

**UNIT - 2 WASTE MANAGEMENT (9 hrs)**

Wastes – sources-Global scenario of wastes - Waste collection, Storage and segregation - Transportation and disposal methods of hazardous waste. Control measures and Impacts of biomedical and e-wastes in environment. Plastic wastes: Sources, Facts & figures of plastic wastescenarios in National & International - Effect of plastic wastes on environment. Different steps inthe treatment of industrial waste-equalization, neutralization, sedimentation, oil separation, floatation, coagulation.

**UNIT- 3 ENVIRONMENTAL TOXICOLOGY AND CURRENT ISSUE (9 hrs)**

Environmental Toxicology and Pharmacokinetics -Toxic effects and dose response relationship a brief idea of carcinogens and non-carcinogens, Biotransformation, Biomarker, Xenobiotics, Toxicity due to Hydrocarbons and pesticides. Global warming -Greenhouse effect, Ozone layer depletion and climate change – Facts and figures of current global warming scenarios in the world
– Remedial measures.

**UNIT- 4 ENERGY AND GREEN TECHNOLOGIES (9 hrs)**

Energy– renewable, non-renewable energy sources, Geothermal, wind, Tidal, solar, nuclear and bio energy –Waste as renewable sources of energy- conversion of methane in to synthetic gas, factors effecting methane formation- Green Chemistry - Principles of green chemistry-inception and evolution - Importance of solvents - catalysts and their role - biological alternatives - Green Technologies in pharmaceutical, polymer, textile agrochemical industry.

**UNIT- 5 ENVIRONMENTAL QUALITY AND DISASTER MANAGEMENT (9 hrs)**

Basic concepts of sustainable development - Guidelines for the preparation of environmental impact statement - Environmental quality standards International organization for standardization
- ISO 14000, 19000 and 22000 standards and certification, Environmental safety - Risk management and emergency preparedness-Earthquakes, Tsunami, Landslides, Cyclones,Floods, and Forest fires predictions, Forecasting and mitigation measures of environmental hazards.

**References:**


1. Bhide and Sundaresan (2000) Solid Waste Management in DevelopingCountries Indian National Scientific Documentation Center, New Delhi.
2. George Tehobanaglous - Milary Theiren and Samuel A vigil (1993)Integrated Solid Waste Management, McGraw Hill Inc.
3. John Pitchel (2005) Waste Management Practices, Municipal, Hazardous, and Industrial. Taylor & Francis Group, LLC
4. Thomous S. Spiro and William M. Stiglicini, Chemistry of The Environment, Prentice Hall of India Pvt. Ltd. (2002).
5. Bregman JI (1999) Environmental Impact Statements. Lewis Publishers, London. 2. Canter LW (1996) Environmental Impact Assessment. Mc GrawHill, New York.
6. Petalc WJ and Allissoon AA (1982) Natural Hazards Risk Assessment and Public Policy
   – Anticipating Unexpected, Springer-Verlag, New York.
7. Shailendra K. Singh, Subash C, Kundu and Shobu Singh (1998) Disaster Management, Mittal Publications, New Delhi.
8. Khanal SK, Surampalli RY, Zhang TC, Lamsal BP, Tyagi RD, Kao CM (2010)

Bioenergy and Biofuel from Biowastes and Biomass, American Society of Civil Engineers, Virginia, USA.

9. Lee S and Shah YT (2013) Biofuels and Bioenergy: Processes and Technologies, CRC Press, Boca Raton, FL, USA.

**Question paper pattern:**

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

**Distribution of Questions:**

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

**EDE – 4**
**FORENSIC SCIENCE**

| | | |
|---|---|---|
| **SUBJECT CODE:** | **THEORY** | **MARKS 100** |
| **SEMESTER: II / III** | **CREDITS: 3** | **TOTAL HOURS: 45** |

**COURSE OBJECTIVES**

- To gain knowledge about types of poisons, explosives.
- To acquire knowledge about forgery, tracking and fire investigation.

**UNIT - 1: Poisons and Pesticides** **(9 hrs)**

Definition of poisons, types of poisons – metal, synthetic chemical, biochemical, gaseous poisons. Mode of ingestion – oral, inhalation, intravenous. Action and impacton human health. Detection of poisons - carbon monoxide, cyanide, ethanol and formaldehyde. Metallic poison – Reinch test - Marsch Berzelius and Gutzeit tests.

**UNIT - 2: Explosives** **(9 hrs)**

Classification of explosives – low explosives and high explosives, homemade explosives, military explosives. Common explosives - TNT, PETN and RDX. Explosion process. post blast residue collection and analysis.

**UNIT - 3: Forgery and Counterfeiting** **(9 hrs)**

Forgery in documents, different types of forged signatures - simulated and traced forgeries, Detection of forgery - uses of ultraviolet rays, comparison of type written letters, checking silver line water mark in currency notes, alloy analysis using AAS todetect counterfeit coins - detection of gold purity in 22 carat ornaments - detecting gold plated jewels - authenticity of diamond

**UNIT - 4: Tracks and Traces** **(9 hrs)**

Foot prints - costing of foot prints - residue prints, walking pattern or tyre marks - miscellaneous traces and tracks, glass fracture, tool marks, paints, fibers. Analysis ofbiological substances - blood, semen, saliva, urine and hair - Cranial analysis (head and teeth) DNA Finger printing for tissue

identification in dismembered bodies - detecting steroid consumption in athletes and race horses

**Unit -5: Arson and fire investigation** **(9 hrs)**

Chemistry of fire, conditions for fire and fire scene patterns. Location of point of ignition. Recognition of type of fire. Searching the fire scene. Collection and preservation of arson evidence. Analysis of fire debris. Analysis of ignitable liquid residue. Scientific investigation and evaluation of clue materials. Information from smoke staining.

**REFERENCE BOOKS**


1. T. H. James, Forensic Sciences, Stanley Thornes Ltd, 1987.
2. Richard Saferstin and Criminalistics - An Introduction to Forensic Science (College Version), Sopfestein, Printice hall, eighth edition, 2003.
3. Fire scene evidence; Almirall J R & Furton K G; CRC Press (2004)
4. Practical: Fire and arson investigation; redsickerr D R & Cannor J J

## Question paper pattern:

| Section | Question Component | Numbers | Marks | Total |
|---|---|---|---|---|
| **Section A** | MCQ: 1-10 , Fill up : 11-15 , T/F : 16-20 Answer all questions | 1 – 20 | 1 | **20** |
| **Section B** | **Short Answer /Problems** Answer any 5 out of 8 questions | 21–28 | 7 | **35** |
| **Section C** | **Essay** Answer any 3 out of 5 questions | 29– 33 | 15 | **45** |
| **TOTAL MARKS** | | | | **100** |

## Distribution of Questions:

| Sections | Units | No. of Questions | |
|---|---|---|---|
| | | **Theory** | **Problems** |
| **Section A** | Unit – 1 | 4 | |
| | Unit – 2 | 4 | |
| | Unit – 3 | 4 | |
| | Unit – 4 | 4 | |
| | Unit – 5 | 4 | |
| **Section B** | Unit – 1 | 2 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 2 | |
| | Unit – 4 | 2 | |
| | Unit – 5 | 1 | |
| **Section C** | Unit – 1 | 1 | |
| | Unit – 2 | 1 | |
| | Unit – 3 | 1 | |
| | Unit – 4 | 1 | |
| | Unit - 5 | 1 | |

# SOFT SKILLS -PG

**DEPARTMENT OF ENGLISH**

**FIRST YEAR – FIRST SEMESTER**
**2020-21**

**PERSONALITY ENRICHMENT**

## UNIT I- SELF DISCLOSURE

- Characteristics of self-disclosure
- Self-disclosure benefits and appropriateness
- Self-disclosure and self-awareness
- Self-disclosure and feedback.

## UNIT II – ANGER, STRESS AND MANAGING FEELINGS

- The nature of stress
- Managing stress through social support systems
- The Nature of anger
- Guidelines for managing anger constructively
- Dealing with an angry person

## UNIT III – INTERPERSONAL EFFECTIVENESS

- Managing anxiety and fear
- Breathing –an antidote to stress
- Progressive muscle relaxation
- Understanding your shyness
- Building one' self esteem
- Avoiding self blame
- Taking risks
- Tolerating failure

- Persisting and celebrating success
- Self talk.

**UNIT IV- STUDY SKILLS**

- Importance of study environment
- Using VCR3 to increase memory power: visualizing, concentrating, relating, repeating, reviewing
- Memory hindrances
- Memory helpers
- Knowing vs memorizing

- Memory and studying
- The SQ3R method; survey, write questions, read, recite, review
- Mnemonic devices – rhymes – acronyms – pegging
- Cooperative learning.

**UNIT V- GOAL SETTING AND MANAGING TIME**

- The basis of effective goals
- Steps to be followed to obtain optimum results from goal setting
- Identifying the reasons for procrastination
- Guidelines to overcome procrastination
- Priority management at home and college

**REFERENCE**

1. Johnson, D.W. *Reaching out – Interpersonal Effectiveness and Self Actualization*. 6th ed. Boston: Allyn and Bacon. 1997.

2. Sherfield, R. M. Montgomery, R.J. and Moody, P, G. *Developing Soft Skills*. 4th ed. New Delhi: Pearson. 2010.

3. Robbins, S. P. and Hunsaker, Phillip, L. *Training in Interpersonal skills*. *Tips for managing people at work*.5th ed. New Delhi: PHI Learning. 2009.

**DEPARTMENT OF ENGLISH**

**SOFT SKILLS FOR PG STUDENTS**

**FIRST YEAR – SECOND SEMESTER**

**WORKPLACE COMMUNICATION SKILLS**

**UNIT I - GOAL SETTING**

- SMART Goals
- Blue print for success
- Short Term, Long Term, Life Time Goals

**UNIT II TEAM BUILDING AND WORKING**

- Team Work – necessity
- Personal, Social and Educational

**UNIT III EMOTIONAL INTELLIGENCE**

- Definition
- Emotional quotient
- Importance of Emotional Intelligence
- Emotion Scales
- Managing Emotions

**UNIT IV - CREATIVITY**

- Out of the box thinking
- Lateral Thinking
- Stimulating innovation and change

**UNIT V - DECISION MAKING & EMPOWERMENT**

- Importance and necessity of Decision Making
- Process and practical way of Decision Making
- Weighing Positives & Negatives

- Power tactics
- Coalition
- Managerial empowerment
- Entrepreneurship

**REFERENCE**


*1. Covey Sean, Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.*

*2. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.*

*3. Thomas A Harris, I am ok, You are ok , New York-Harper and Row, 1972*

*4. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006*

**DEPARTMENT OF ENGLISH**

**SOFT SKILLS FOR PG STUDENTS**

**SECOND YEAR – THIRD SEMESTER**

**SELF & TIME MANAGEMENT SKILLS**

**UNIT I- STRESS MANAGEMENT**

- Definition of Stress
- Types of Stress
- Symptoms
- Stress coping ability
- Stress inoculation training
- Techniques to manage Stress

**UNIT II - CRISIS &CONFLICT MANAGEMENT SKILLS**

- Definition of Crisis
- Ways to overcome Crisis
- Critical Thinking & Innovation
- Problem Solving
- Types of conflict
- Conflict stimulation
- Conflict resolution – Approaches

**UNIT III - INTERPERSONAL SKILLS**

- Group decision making
- Types of leadership
- Emotional intelligence

- Effective leadership
- Negotiation skills

**UNIT IV-TIME MANAGEMENT**

- Concept
- Limitations
- Attendance, Self-Discipline & Punctuality
- Adherence to Time
- Maintaining Work/Life Balance

**UNIT V-SELF-ACTUALIZATION**

- SWOC Analysis
- Self-Regulation
- Self-Evaluation
- Self-Management
- Self-Monitoring
- Self-Criticism
- Self-Motivation
- Self Esteem
- Importance of Self Confidence

**REFERENCE**


1. *Wentz, Fredrick H. Soft skills Training – A workbook to develop skills for employment by, Create Space Independent Publishing Platform; Large edition. May 14, 2012.*
2. *Mitra, Barun K. Personality Development and Soft skills, Oxford University Press. 2011.*
3. *Mackenzie, Alec R. The Time Trap: The Classic book on Time Management New York: AMACOM Books.2009.*

**DEPARTMENT OF ENGLISH**

**SOFT SKILLS FOR PG STUDENTS**

**SECOND YEAR – FOURTH SEMESTER**

**SPOKEN AND PRESENTATION SKILLS**

**Unit – I**

- Body Language
- Kinesics, Proxemics, Para linguistic, Chronemics,
- Nuances of Speech Delivery.
- Personality Development: Building self-esteem.

**Unit – II**

- Team work and participating in group discussions
- Team building and Team work
- Team briefing
- Role of Team leader
- Conflict resolution
- Methodology of Group discussions
- Role Functions in Group Discussion
- Types of Non – functional Behavior
- Improving group performance.
- Participating in Mock group discussions.

**Unit – III**

- Interviews
- Types of Interviews

- Preparing for interviews
- Facing interviews
- Reviewing performance
- Participating in mock interviews.

**Unit – IV**

- Etiquettes for Public Speaking (extempore and lectures)
- Telephone Conversations and Business Meetings

**Unit – V**

- Business Presentations
- Preparing successful presentations
- Thinking about audience
- Making effective use of visual aid
- Delivering presentation-using prompts, dealing with questions and interruptions
- Mock presentations.

**REFERENCE**

*1. Peter, Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill. 2012.*
*2. Singh, Prakash and Raman, Meenakshi. Business Communication. New Delhi: Oxford UP. 2006.*
*3. Bailey, Edward P. Writing and Speaking at Work: A Practical Guide for Business Communication. Pennsylvania: Prentice Hall. 2007.*
*4. Pease, Allan and Peas, Barbara. The Definitive Book of Body Language. New York: Random House. 2006.*
*5. De Bono, Edward.1993. Serious Creativity.Re print.Harper Business. 1993.*