FACULTY OF SCIENCES

SYLLABUS

FOR

B.Sc. (Hons. School) Chemistry

(Under Credit Based Continuous Evaluation Grading System)
(SEMESTER: I - VI)

Examinations: 2017-18

GURU NANAK DEV UNIVERSITY AMRITSAR

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B.Sc. (Hons. School) Chemistry (Semester System)
(Under Credit Based Continuous Evaluation Grading System)

SCHEME AND SCHEDULE OF COURSES

SEMESTER–I

Applicable for new admission

Sr. No.	Course No.	Course Title	Credits L-T-P
1.	CYL101	Inorganic Chemistry-I	3-1-0
2.	CYL102	Organic Chemistry of Functional Group -I	3-1-0
3.	MTL141	Mathematics-I	3-1-0
4.	PHL191	Optics	3-1-0
5.	ENL-101	Communicative English	2-0-0
6.	PBL-121	Punjabi Compulsory **OR**	2-0-0
	PBL-122	ਮੁੱਢਲੀ ਪੰਜਾਬੀ	
7.	*SOA-101	Drug Abuse: Problem, Management and Prevention (Compulsory)	3-0-0
8.	CYP101	Organic Chemistry Lab-I	0-0-3
9.	PHP191	Physics (Optics Lab)	0-0-2

SEMESTER–II

Sr. No.	Course No.	Course Title	Credits L-T-P
1.	CYL110	Inorganic Chemistry-II (Chemistry of s & f block elements)	3-1-0
2.	CYL114	Physical Chemistry-I	3-1-0
3.	MTL142	Mathematics-II	3-1-0
4.	PHL-196	Modern Physics-I	3-1-0
5.	ENL-151	Communicative English	2-0-0
6.	PBL-131	Punjabi Compulsory **OR**	2-0-0
	PBL-132	ਮੁੱਢਲੀ ਪੰਜਾਬੀ	
7.	*SOA-102	Drug Abuse: Problem, Management and Prevention (Compulsory)	3-0-0
8.	CYP113	Inorganic Chemistry Lab-I	0-0-3
9.	PHP 196	Electricity and Magnetism Lab	0-0-2
10.		Interdisciplinary Course-I	4-0-0

***Note :- This Paper marks are not included in the total marks.**

B.Sc. (Hons. School) Chemistry (Semestem System)
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SEMESTER - III

Sr. No.	Course No.	Course Title	Credit L-T-P
1	CYL201	Organic Chemistry of Functional Groups-III	3-1-0
2	CYL206	Physical Chemistry-II	3-1-0
3	MTL241	Mathematics-III	3-1-0
4	PHL291	Modern Physics-II	3-1-0
5	*ESL220	Environmental Studies (Compulsory)	3-0-0
6	PHP291	Modern Physics Lab	0-0-2
7.		Interdisciplinary Course-II	4-0-0

SEMESTER -IV

Sr. No.	Course No.	Course Title	Credit L-T-P
1	CYL211	Heterocyclic Chemistry	3-1-0
2	CYL212	Chemical Spectroscopy–I	3-1-0
3	MTL242	Mathematics–IV	3-1-0
4	PHL296	Physics	3-1-0
5	CSL299	Computer for Chemists	2-0-0
6	CYP212	Physical Chemistry Lab–I	0-0-3
7	CSP299	Computer Lab	0-0-2
8.		Interdisciplinary Course-III	4-0-0

***Note :- This Paper marks are not included in the total marks.**

B.Sc. (Hons. School) Chemistry (Semestem System)
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SEMESTER-V

Sr. No	Course No.	Course Title	Credit
1.	CYL-301	Organic Synthesis-I Stereochemistry & Structure Reactivity Relationships	3-1-0
3.	CYL-303	Chemical Spectroscopy-II	3-1-0
4.	CYL-304	Ligand Field Theory	3-1-0
5.	CYL-305	Quantum Chemistry-I	3-1-0
6.	CYL-306	Physical Chemistry-III	3-1-0
7.	CYP-301	Organic Chemistry Lab-III	0-0-3
8.	CYP-302	Physical Chemistry Lab-II	0-0-3

SEMESTER-VI

Sr. No	Course No.	Course Title	Credit
1.	CYL-310	Co-ordination Chemistry	3-1-0
2.	CYL-311	Organic Synthesis-II Reactive Intermediates	3-1-0
3.	CYL-313	Instrumental Methods of Analysis	3-1-0
4.	CYL-314	Physical Chemistry-IV	3-1-0
5.	CYP-305	Inorganic Chemistry Lab-II Quantitative Analysis	0-0-3
6.	CYP-304	Physical Chemistry Lab-III	0-0-3

CYL101: Inorganic Chemistry-I

Credit: 3-1-0

1. Atomic Structure and Chemical Peroiodicity: (15 Hrs.)

The origin and distribution of the elements, The structure of the periodic table, The de Broglie relationship, The uncertainty principle, Schrodinger wave equation and its derivation, Energy quantization, Significance of wave function . The Born interpretation, Quantum numbers, Normal and orthogonal wave functions, Radial and angular probability distribution curves, The building up principle in many electron atoms, Penetration and shielding (The Slater's rules), Atomic parameters and their variation in periodic table, Electronegativity and various scales, Variation of electronegativity with partial charges and hybridization, Electroneutrality principle, Hardness and softness, Perturbation theory.

2. Bonding in Ionic Compounds: (15 Hrs.)

(a) Properties of ionic substances, Occurrence of ionic bonding, The radius ratio rules, Efficiency of packing, Hexagonal close packing, Cubic close packing, Structures of different crystal lattices, Sodium chloride, Cesium chloride, Wurtzite, Zinc blende, Fluorite, Rutile, Cristobalite, Nickel arsenide, Pervoskite, Rhenium oxide, Calcium carbide, The calcite and aragonite structures.

(b) Lattice energy, Born-Haber cycle, The calculations of the lattice energy on the basis of Born-Lande equation, The predictive power of thermochemical calculations on ionic compounds, Covalent character in predominantly ionic compounds, Imperfections of crystals, Conductivity in ionic solids, Band theory, Intrinsic and photoexcited semiconductors, Transistors, High temperature superconductors.

3. The Covalent Bond: (15Hrs.)

The Lewis theory, Valence bond theory - A mathematical approach, Resonance, Valence Shell Electron Pair Repulsion Model (VSEPR theory), Prediction of structures and variation of bond angles on the basis of VSEPR theory, Shortcomings of VSEPR theory, Concept of hybridization, Rules for obtaining hybrid orbitals, Extent of d-orbital participation in molecular bonding (SO_2, PCl_5, SO_3), Molecular orbital theory (LCAO method), Symmetry of molecular orbitals, Applications of MOT to homo- and hetero-nuclear diatomic molecules, Molecular orbital energy level diagrams (Be_2, N_2, O_2, F_2, LiH, NO, CO, HCl, NO_2, BeH_2, NO_2^-).

Recommended Books:

1. D.F.C. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS Oxford, 1991.
2. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, 4th Ed, Pearson Education, Singapore, 1999.
3. J.D.Lee, Concise Inorganic Chemistry, ELBS, Oxford 1994.

CYL102: Organic Chemistry of Functional Groups - I

Credit -: 3-1-0

1. Structure and Bonding 3 Hrs

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, change transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen boding.

2. Mechanism of Organic Reactions 5 Hrs

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, hemolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles. Types of organic reactions. Energy considerations.
Reactive intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal changes on intermediates and other ionic species.
Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

3. Stereochemistry of Organic Compounds 8 Hrs

Concept of isomerism. Types of isomerism.
Optical isomerism - elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, Chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enatiomers, inversion, retention and racemization.
Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.
Geometric isomerism - determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.
Conformational isomerism - conformational analysis of ethane and n-butane; conformations of cyclohexan, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation.

4. Alkanes and Cycloalkanes **5 Hrs**

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference of Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reaction of alkanes.
Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.
Cycloalkanes -- nomenclature, methods of formation, chemical reaction, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring: banana bonds.

5. Alkenes, Cycloalkenes, Dienes and Alkynes **8 Hrs**

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.
Chemical reactions of alkenes - mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$. Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

Methods of formation, conformation and chemical reactions of cycloalkenes.
Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions - 1,2 and 1,4 additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

6. **Alcohols** **5 Hrs**

Clasification and nomenclature.
Monohydric alcohol - nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding, Acidic nature. Reactions of alcohols.
Dihydric alcohols - nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)4 and HIO4] and pinacol-pinacolone rearrangement.
Trihydirc alcohols - nomenclature and methods of formation, chemical reactions of glycerol.

7. **Alkyl and Aryl Halides** **5 Hrs**

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nuclephilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams.
Polyhalogen compounds: chloroform, carbon tetrachloride.
Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.
Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

8. Arenes and Aromaticity **6 Hrs**

Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene : Molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity: The Huckel rule, aromatic ions, Aromatic electrophilic substitution -general pattern of mechanism, role of sigma and pi complexes. Machansim of nitration, halogenation, sulponation, mercuration and Friedel-Crafts reaction. Energy profie diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivations. Birch reduction. Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.

Books Suggested:

1. Organic Chemsitry, Morrison and Boyd, Prentice- Hall.
2. Fundamentals of Organic Chemistry, Solomons, John Wiley.
3. Organic Chemistry. F.A. Carey, McGraw Hill, Inc.
4. Organic Chemistry, L.G. Wade Jr. Prentice Hall.
5. Organic ChemistryVol. I, II & III, S.M. Mukherji, S.P. Singh and R.P.Kapoor, Wiley Eastern Ltd (New Age International).
6. Introduction to organic chemistry, Stritwieser, Heathcock and Kosover, Macmilan.

MTL141: MATHEMATICS – I

Credit: 3 – 1 - 0

Trigonometry: **10 Hrs**

T- ratios, addition and subtraction formulae, multiple angles, sub-multiple angles, trigonometric equations, inverse trigonometrical functions (proofs of articles are not required).

Algebra: **5 Hrs**

Fundamental principle of counting, Permutation and Combination with simple applications. Principle of mathematical induction, statement of Binomial Theorem and its applications.

Determinants and Matrices: **10 Hrs**

Introduction to matrix, Different kinds of matrices, Addition, Multiplication, Symmetric and Skew symmetric matrix, Transpose of matrix. Determinant of matrix, properties of determinant, product of two determinant of third order.

Adjoint and Inverse of matrix, Rank of matrices, Condition of Consistency of system of linear equations, Eigen vectors and Eigen values using matrices, Cayley's Hamilton Theorem (without proof).

Co-ordinate Geometry: **12 Hrs**

Polar & Cartesian co-ordinates in plane, different forms of straight lines. Angle between two straight lines. Conditions of parallelism and perpendicularity. Standard equations of circle, parabola, ellipse and hyperbola(without proof) and simple problems.

Solid Geometry: Sphere, Cone, Cylinder **8 Hrs**

Books :

1. A Text book of Matrices-Shati Narayan
2. Elementary Engineering Mathematics- B.S.Grewal
3. Mathematical Te
4. A text book of Engineering Mathematics- B. L. Moncha and H.R. Choudhary

PHL191: OPTICS

Credit: 3-1- 0

Interference: Young's experiment, Coherent Source, Phase and Path differences, Theory of interference fringes, Fresnel's biprism, thickness of thin transparent sheet, interference in thin film due to reflected and transmitted light colour of thin film, Newtons rings and their application, Michelson & Febry-Perot Interferometer, Anti reflection coatings, Holography.

Diffraction: Introduction, Franunhoffer diffraction at a single slit and its discussion, Fraunhoffer diffraction at double slit, missing orders in a double slit, Diffraction of N slits and its discussion, Diffraction grating, Missing orders, dispersive power, Rayleigh Criterion for resolving power, resolving power of a diffraction grating.

Polarization: Transverse nature of light, Polarization by reflection and refraction, Brewster's Law, Malus Law, Double refraction, Nicol Prism, Elliptically and circularly polarized light, Quarter-wave and half-wave plates, production and detection of polarized light, Optical activity, specific rotation. Half shade polarimeter.

Reference Books:

1. Text book of Optics: N. Subramanayam, B. Lal and M. N. Avadhamulu
2. Fundamentals of Optics: Jenkins and White

ENL-101: COMMUNICATIVE ENGLISH

Time: 3 Hrs **LTU**
2 0 0

Objective: To introduce students to the skills and strategies of reading and writing by identifying organizational patterns, spotting classification systems and understanding associations between ideas. This course will prepare students to read a variety of texts and also to communicate more effectively through writing. The course will also pay special attention to vocabulary building.

Prescribed Text books:

1. *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

Course Contents:

1. Reading and Comprehension Skills:

Students will be required to read and comprehend the essays in Unit 1 and 2 of the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition. They will be required to answer the questions given after each essay.

2. Developing Vocabulary and using it in the Right Context:

The students will be required to master "Word List" and "Correct Usage of Commonly Used Words and Phrases" from the Chapter "Vocabulary" in the book *The Written Word.*

3. Writing Skills

Students will be required to learn "Report Writing" and "Letter Writing" as in the book *The Written Word.*

Students will be required to write long essays based on the prescribed text book *Making Connections: A Strategic Approach to Academic Reading.*

Minor 1:

Syllabus to be covered:
1. Unit 1 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. Report Writing from *TheWritten Word.*

Suggested Paper Pattern:

1. Report Writing (8 marks)
2. Short answer type questions from Unit 1 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 1 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

Minor 2:

Syllabus to be covered:

1. "Word List" from the Chapter "Vocabulary" in the book *The Written Word.*
2. Unit-2 from the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

Suggested Paper Pattern:

1. Word List from the Chapter "Vocabulary" in the book *The Written Word* (8 marks)
2. Short answer type questions from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

Suggested Paper Pattern for Major Exam:

1. Letter Writing as prescribed in *The Written Word /*1 out of 2 (10 marks)
2. Short answer type questions from Unit 1,2 of *Making Connections: A Strategic Approach to Academic Reading* (14 marks)
3. "Word List" and "Correct Usage of Commonly Used Words and Phrases" from the Chapter "Vocabulary" present in the book *The Written Word.* (10 marks)
4. Essay type question from Unit 1,2 of *Making Connections: A Strategic Approach to Academic Reading* 1 out of 2 (8 marks)
5. Report Writing from *The Written Word* (8 marks)

PBL-121: ਪੰਜਾਬੀ–I (ਲਾਜ਼ਮੀ)
p`T-km Eq p`T-psqk-

Credits: 2–0–0

(I) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :
(a) grmK isG ms`iPr : gt`r
(E) sj`n isG : pT`x dl Dl
(e) krq`r isG dgl : acl Efl v`ll grg`bl
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. grmKl ErQgr`Pl dl jgq, (plql; mh`rnl; ibdl, itpl q EDk); ivr`m icn, Sbd jV (SD-ESD)

(II) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :
(a) sqK isG Dlr : s-Jl kD
(E) klvq isG ivrk : aj`V
(e) mihdr isG srn` : jQd`r mkd isG
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. lK rcn` (jlvnl-prk, sm`jk Eq clq iviSE- aq):
10 lK ilKv`ax (kl`s ivc Eq Gr lel EiBE`s)

(III) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kh`xlk`r :
(a) pm pk`S : m`V` bd`
(E) glz`r isG sD : klCx
(e) mhn Bf`rl : Gtx`
(s) virE`m isG sD : dldl
(kh`xl-s`r, ivS`-vsq, kh`xl-kl`, kh`xlk`r)

2. pr` pV k pSn- d aqr dx`
(E`qm En`qm psqk d kh`xl B`g ivcl 15 pirE- d EiBE`s krv`ax)

PBL-122: ਮੁੱਢਲੀ ਪੰਜਾਬੀ
(In lieu of Punjabi Compulsory)

Credits: 2-0-0

ਪਾਠ-ਕ੍ਰਮ

1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ,
   ਗੁਰਮੁਖੀ ਲਿਪੀ
   ਗੁਰਮੁਖੀ ਲਿਪੀ : ਬਣਤਰ ਅਤੇ ਤਰਤੀਬ

2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ
   ਸੁਰ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ
   ਵਿਅੰਜਨ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ

3. ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ
   ਸਾਧਾਰਨ ਸ਼ਬਦ
   ਇਕ ਉਚਾਰਖੰਡੀ ਸ਼ਬਦ

ਯੂਨਿਟ ਅਤੇ ਥੀਮ

1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ : ਨਾਮਕਰਣ ਅਤੇ ਸੰਖੇਪ ਜਾਣ ਪਛਾਣ, ਗੁਰਮੁਖੀ ਲਿਪੀ : ਨਾਮਕਰਣ, ਗੁਰਮੁਖੀ ਵਰਣਮਾਲਾ; ਪੈਂਤੀ ਅੱਖਰੀ, ਅੱਖਰ ਕ੍ਰਮ, ਸੁਰ ਵਾਹਕ (ਓ ਅ ੲ), ਲਗਾਂ ਮਾਤਰਾਂ, ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣ, ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ, ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ।

2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ ਅਤੇ ਉਚਾਰਨ; ਸੁਰਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ (ਲਘੂ-ਦੀਰਘ ਸੁਰ); ਸੁਰ ਅਤੇ ਲਗਾਂ ਮਾਤਰਾਂ; ਵਿਅੰਜਨਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ; ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣਾਂ (ਹ, ਰ, ਵ) ਦਾ ਉਚਾਰਨ ; ਲ ਅਤੇ ਲ਼ ਦਾ ਉਚਾਰਨ; ਭ, ਧ, ਢ, ਝ, ਘ ਦਾ ਉਚਾਰਨ; ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣਾਂ ਦਾ ਉਚਾਰਨ।

3. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ : ਸਾਧਾਰਨ ਸ਼ਬਦ; ਇਕੱਲਾ ਸੁਰ (ਜਿਵੇਂ ਆ); ਸੁਰ ਅਤੇ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਆਰ); ਵਿਅੰਜਨ ਅਤੇ ਸੁਰ (ਜਿਵੇਂ ਪਾ); ਵਿਅੰਜਨ ਸੁਰ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਪਾਰ); ਕੋਸ਼ਗਤ ਸ਼ਬਦ (ਜਿਵੇਂ ਘਰ, ਪੀ); ਵਿਆਕਰਣਕ ਸ਼ਬਦ (ਜਿਵੇਂ ਨੂੰ, ਨੇ); ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ-1; ਲਿੰਗ-ਪੁਲਿੰਗ, ਇਕ ਵਚਨ-ਬਹੁ ਵਚਨ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ-1: ਖਾਣ-ਪੀਣ, ਸਾਕਾਦਾਰੀ, ਰੁੱਤਾਂ, ਮਹੀਨਿਆਂ, ਗਿਣਤੀ, ਮੌਸਮ ਆਦਿ ਨਾਲ ਸੰਬੰਧਿਤ।

SOA : 101 - DRUG ABUSE: PROBLEM, MANAGEMENT AND PREVENTION (COMPULSORY)
PROBLEM OF DRUG ABUSE

Time: 3 Hours **Credit 3-0-0**

1) **Meaning of Drug Abuse:** Concept and Overview, Historical Perspective of Drug Abuse, Drug Dependence, Drug Addiction, Physical and Psychological Dependence: Drug Tolerance and withdrawal symptoms.

2) **Types of Abused Drugs and their Effects.**
   1) Stimulants: Amphetamines – Benzedrine, Dexedrine, Cocaine.
   2) Depressants: Alcohol Barbiturates: Nembutal, Seconal, Phenobarbital and Rohypnol.
   3) Narcotics: Heroin, Morphine, Oxycodone.
   4) Hallucinogens: Cannabis, Marijuana, Hashish, Hash Oil, MDMA, LSD.
   5) Steroids.

3) **Nature and Extent of the Problem:** Magnitude or prevalence of the menace of Drug Abuse in India and Punjab, Vulnerable groups by age, gender and economic status, Signs and Symptoms of Drug Abuse: Physical, Academic, Behavioural and Psychological Indicators.

References:

1. Ahuja, Ram (2003), *Social Problems in India*, Rawat Publication, Jaipur.
2. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
3. Inciardi, J.A. 1981. *The Drug Crime Connection.* Beverly Hills: Sage Publications.
4. Kapoor. T. (1985) *Drug epidemic among Indian Youth*, New Delhi: Mittal Pub.
5. Modi, Ishwar and Modi, Shalini (1997) *Drugs: Addiction and Prevention*, Jaipur: Rawat Publication.
6. National Household Survey of Alcohol and Drug abuse. (2003) New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
7. Sain, Bhim 1991, *Drug Addiction Alcoholism,* Smoking obscenity New Delhi: Mittal Publications.
8. Sandhu, Ranvinder Singh, 2009, *Drug Addiction in Punjab*: A Sociological Study. Amritsar: Guru Nanak Dev University.
9. Singh, Chandra Paul 2000. *Alcohol and Dependence among Industrial Workers*: Delhi: Shipra.
10. Sussman, S and Ames, S.L. (2008). *Drug Abuse: Concepts, Prevention and Cessation,* Cambridge University Press.
11. World Drug Report 2010, United Nations office of Drug and Crime.
12. World Drug Report 2011, United Nations office of Drug and Crime.

CYP101: Organic Chemistry Lab–I

Credit: 0-0-3

The preliminary examination of physical and chemical characteristics (physical state, colour, odor and ignition tests), elemental analysis (nitrogen, sulphur, chlorine, bromine, iodine), solubility tests including acid-base reactions, classification tests involving functional reactivity other than acid-base test, preparation of derivatives for given pure organic compounds.

The following categories of compounds should be analyzed.

-phenols, carboxylic acids

-carbonyl compounds - ketones, aldehydes

-carbohydrates

-aromatic amines

-amides, ureas and anilides

-aromatic hydrocarbons and their halo- derivatives.

Suggested Book:

Practical Organic Chemistry by F.G. Mann and B.C. Saunders

PHP-191: Physics (Optics Lab)

Credit: 0-0-2

1. Find the refractive index of the glass of the given prism using spectrometer.
2. Find the refractive index of water using hollow prism.
3. Calibrate the prism spectrometer using mercury lamp.
4. Find the wavelength of sodium light using a plane diffraction grating.
5. Find the wavelength of sodium light using Newton's rings method.
6. Find the height of the accessible object using Sextant.
7. Find the height of the inaccessible object using Sextant.

CYL110: Inorganic Chemistry-II
(Chemistry of s.& f block elements)

Credit: 3-1-0

Comparative Study of S and P Block Elements:
IA-VII A and Zero Groups: General remarks about each group, trends in electronic configuration, structure of elements, atomic and ionic, Radii, ionization potential, electron affinity, electronegativity, oxidation states, inert pair effect, catenation and heterocatenation, first and second row amomalies, the use of d orbitals by non metals, the use of p orbitals in bonding . Important classes of Compounds of s and p block elements.

Alkali Metals: Oxides, hydroxides, peroxides and super oxides, halides, halides, hydrides, solutions of metals in liquid ammonia, complexes crowns and cryptands and podands.

Alkaline Earth Metals: Solutions of the metals in liquid ammonia, hydroxides, oxides, sulfates, hydrides, halides, carbides, structures of calcium carbide, structures of basic beryllium acetate Be4O(CH3 COO)6, beryllium oxalate complexes Be(OX)2. Structure of chlorophyll `a'.

Group III (Boron Group): Oxides, halides and hydrides of group III elements, boron sesquioxide and borates structure of borates, trihalides and lower halides of boron, preparation of boron hydrides reactions and structures of boranes.

Group IV (Carbon Group): Structure and allotropy of the elements, types and structure of carbides, oxides of carbon and silicon, types and structures of silicates, Organo-silicon compounds and the silicones, halides of IV group elements.

Group V (Nitrogen Group): Hydrides, properties and structure of ammonia, hydrazine, hydroxylamine, trihalides and Pentahalides of V groups elements, oxides of nitrogen, structure of N2O, NO, N2O3, N2O4 and N2O5, oxo acids of nitrogen and phosphorous, phosphazenes and cyclophosphazenes.

Group VI (Oxygen Group): Structure and allotropy of the elements. Oxides of sulfur (structure of SO2 and SO3) oxoacids of sulfur halides of sulfur, selenium and tellurium, compounds of Sulfur and nitrogen (S4N4).

Group VII: Oxides of halogens (OF2, O2F2, Cl2C, ClO2, Cl2O6, BrO2, I2O5) (structures), Preparation, reaction and structure interhalogen compounds. (ClF3, BrF3, I2, Cl5, IF5, IF7) Polyhalides, basic properties of halogens**.**

Zero Group: Clatharate compounds, preparation, structure and bonding of noble gas compounds (XeF2, XeF4, XeF6, XeO3, XeO2F2, XeO4).

Elementary Coordination Chemsitry : Werner's theory, nomenclature of coordination complexes, isomerism in coordination complexes, chelating agents, metal chelates and chelate effects, names and abbreviations of important ligands, polydenate ligands, polypyarzolyborates, macrocylic ligands, macrocylic effect, ketoenolates, troplonates, tripod ligands, conformation of chelate rings, stereochemistry of coordination numbers 2-12, factors determining kinetic and thermodynamic stability.

Books Recommended:

1. J.D. Lee, Concise Inorganic Chemistry, 4th Ed.
2. J.E. Huheey, Inorganic Chemistry, Harper & Row.
3. F.A.Cotton and G. Wilinson, Advanced Inorganic Chemistry, Interscience Publishers.
4. N.N. Greenwood and A. Earnshaw, Chemistry of Elements, Pergamon Press.

CYL114: Physical Chemistry-I

Credit: 3-1-0

1.Gaseous States (8 Hrs)
Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation of state.
Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and vander Waals constants, the law of cooresponding states, reduced equation of state.
Molecular Velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities. Collision number, mean free path and collision diameter. Liquification of gases (based on Joule-Thomson effect).
2.Liquid State (6 Hrs)
Intermolecular forces, structure of liquids (a qualitative description).
Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholestric phases. Thermography.
3. Solid State (10 Hrs)
Definition of space lattice, unit cell.
Laws of crystallography - (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements in crystals X-ray diffraction by crystals. Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).
4. Electrochemistry (21Hrs)
Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.
Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.
Applications of conductivity measurements: determination of degree of dissociation, determinaiton of Ka of acids, determinaiton of solubility product of a sparingly soluble salt, conductometric titrations.

Reversible and irreversible cells. Measurement of EMF. Standard Cells. Cell reaction and EMF. Convention regarding sign of EMF. Single electrode potentials. determination of single electrode potential. Determination of EMF from single electrode potential. Calculation of thermodynamic quantities of cell reaction (ΔH and ΔS) from EMF. Standard electrode potential, Electrochemical series and its significance. Standard potential and equilibrium constant. Types of electrodes; Gas electrodes, metal- metal ion electrodes. Metal-insoluble salt electrode, Amalgam electrodes. Oxidation- reduction electrodes. Electrochemical cells. Chemicals cells and concentration cells without and with transference. Liquid junction potential. Solubility product and EMF. Potentiometric determination of pH. Potentiometric titrations.

Books Suggested:

1. Principles of physical chemistry
   Author:S.H. Maron& C.F. Prutton.
   Publisher: Collier Macmillan Ltd; 4th Revised edition edition (1 December 1965)
   ISBN-10: 0023762306
2. Physical Chemistry
   Author:K.J. Laidler.
   Publisher: Houghton Mifflin; 4th Revised ed. edition (May 1, 2002)
   ISBN-10: 061815292X
3. Physical Chemistry Vol-1
   Author:K.L. Kapoor.
   Publisher: Laxmi Publications; Fourth edition (2011)
   ISBN-10: 0230332757
4. Physical chemistry
   Author:W.J.Moore.
   Publisher: Longman; 1st Revised edition edition (24 July 1972)
   ISBN-10: 0582442346

MTL142: MATHEMATICS - II

Credit: 3-1- 0

Function, Limit and Continuity: (10 Hrs)
Functions and graphs, Domain and Co-Domain, range, Inverse Functions, Exponential and Logarithmic Functions, limit of Functions, Algebraic Computations of limits, Continuity of Functions at a point, Continuity of Functions in interval.

Differential Calculus I: (08 Hrs)
An Introduction to the Derivative, Differentiation of standard Functions, Formulae on derivative of sum, difference, product and quotient of functions, chain rule, derivative of Trigonometric functions, Inverse Trigonometric functions, Exponential and Logarithmic Functions.

Differential Calculus II: (08 Hrs)
Differentiation of implicit functions, Derivative of functions expressed in parametric form, derivative of higher order, Increasing and decreasing functions, Sign of derivative, Maxima and Minima of a single variable. Introduction to Partial differentiation**.**

Differential Calculus III: (10 Hrs)
Rolle 's, Lagrange and Cauchy mean values theorems and their applications, Taylor theorem and Maclaurian's theorem with Lagrange's form of remainder and applications of formal expansions of functions. (Proofs of theorems are not required).

Integral Calculus: **(09 Hrs)**
Integration as inverse of differentiation, Indefinite Integral of standard forms, Methods of substitution, Methods of fractions, Integration by parts, Definite Integral.

Books Recommended :
1. Differential Calculus- Shanti Narayan
2. Integral Calculus- Shanti Narayan
3. Elementary Engineering Mathematics- B.S.Grewal
4. Mathematical Techniques in Chemistry- Joseph B. Dence
5. A text book of Engineering Mathematics- B. L. Moncha and H.R. Choudhary

PHL-196: MODERN PHYSICS-I

Credit: 3-1-0

Dual Nature of Matter and Radiation: De Brogile's hypothesis, electron diffraction experiments of Davission and Germer, Wave group and particle velocities, Heisenberg's uncertainty principle, principle of the electron microscope, Diffraction of X-rays from crystals, Planck's quantum hypothesis, Bragg's law of determination of structure of simple crystals.

Radioisotopes and their Application: Radioactive decay laws, Uranium and Carbon dating, introduction to α, β and γ decays, Radioisotopes, their production and separation, mass spectrograph, uses of radioisotopes in medicine, agriculture and geology Radiation doses and their units, Biological effects of radiation.

Elementary Particles: Uses of ionization chamber, cloud chamber, Scintillation counter and photographic emulsions as detectors, Classification of elementary particles and their properties, conservation laws. Antiparticles, Origin and general characterization of cosmic rays (Primary and Secondary)

Reference Books:

1. Concepts of Modern Physics: A. Beiser.
2. Essentials of Modern Physics: V. Acota and C. L. Grown
3. Fundamentals of Modern Physics: B. D. Duggal and C. L. Chhabra

ENL-151: COMMUNICATIVE ENGLISH

Time: 3 Hrs **LTU**
2 0 0

Objectives: To equip students with the skill of reading and writing dexterously. By the end of the course the students will be skilled in the art of expressing their ideas in short and long compositions, noting information effectively and summarizing and abstracting more efficiently.

Prescribed Text books:
1. *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

Course Contents:

1. Reading and Comprehension Skills:

Students will be required to read and comprehend the essays in Unit 3 and 4 of the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition. They will be required to answer the questions given after each essay.

2. Writing Skills

Students will be required to learn Paragraph and Essay Writing and Note Making, Summarizing and Abstracting as in the book *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

Minor 1:

Syllabus to be covered:
1. Unit 3 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. ABC of Good notes, Sub dividing your Notes and Summarizing and abstracting included in the Chapter "Note Making, Summarizing and Abstracting" from *The Written Word.*

Suggested Paper Pattern:
1. Theoretical questions based on ABC of Good notes, Sub dividing your Notes and Summarizing and abstracting included in the Chapter "Note Making, Summarizing and Abstracting" *The Written Word* (8 marks).
2. Short answer type questions from Unit 3 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks).
3. Essay type question from Unit 3 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks).

Minor 2:

Syllabus to be covered:

1. Abbreviations and Symbols and Note making in practice from the chapter "Note-Making, Summarizing and Abstracting in the book *The Written Word*

2. Unit-4 from the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

Suggested Paper Pattern:

1. A practical question on Note making in practice "Note-Making, Summarizing and Abstracting" from the chapter the book *The Written Word* (8 marks)

2. Short answer type questions from Unit 4 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

3. Essay type question from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

Suggested Paper Pattern for Major Exam:

1. Practical Question on Paragraph and Essay Writing as prescribed in *The Written Word* /1 out of 2 (10 marks)
2. Short answer type questions from Unit 3,4 of *Making Connections: A Strategic Approach to Academic Reading* (16 marks)
3. Essay type question from Unit 3,4 of *Making Connections: A Strategic Approach to Academic Reading* 1 out of 2 (10 marks)
4. Practical Question on Note Making from *The Written Word* (8 marks)
5. Theoretical Question(s) based on the two chapters from the book *The Written Word* (6 marks)

PBL-131: ਪੰਜਾਬੀ – II (ਲਾਜ਼ਮੀ)
p`T-km Eq p`T psqk-

Credits: 2-0-0

(I) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl,Eimqsr) ivcl hT- ilK kvl :

(a) B`el vlr isG
(E) p: prn isG
(e) p: mhn isG
(kivq`-s`r, ivS`–vsq, k`iv-kl`, kvl)

2. pj`bl Sbd bxqr: D`q/ml, vDqr (Egqr, ipCqr, ivalqpq Eq rp-qrl), sm`s |

(II) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kvl :

(a) Eimq` plqm
(E) f`. hrBjn isG
(e) iSv km`r bt`lvl
(kivq`-s`r, ivS`-vsq, k`iv-kl`, kvl)

2. pr` rcn` : kl`s ivc 10 iviSE- (siBE`c`rk, D`rimk Eq r`jnlqk) q pr` rcn` d EiBE`s krv`ax |

(III) 1. E`qm En`qm (sp. virE`m isG sD Eq f`. sihdrblr isG, gr n`nk dv wnlvristl, Eimqsr) ivcl hT ilK kvl :

(a) f`. jsvq isG nkl
(E) f`. jgq`r
(e) f`. srjlq p`qr
(s) p`S
(kivq`-s`r, ivS`-vsq, k`iv-kl`, kvl)

2. mh`vr q EK`x (EK`x q mh`vr` kS ivc) 200 mh`virE- Eq 100 EK`x- n v`k- ivc vrqx d EiBE`s krv`ax (kl`s ivc q Gr lel)|

PBL-132: ਮੁੱਢਲੀ ਪੰਜਾਬੀ

(In lieu of Punjabi Compulsory)

Credits: 2-0-0

ਪਾਠ-ਕ੍ਰਮ

1. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ
   ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਸ਼ਬਦ
   ਬਹੁ-ਉਚਾਰਖੰਡੀ ਸ਼ਬਦ

2. ਪੰਜਾਬੀ ਵਾਕ-ਬਣਤਰ
   ਸਾਧਾਰਨ-ਵਾਕ : ਕਿਸਮਾਂ
   ਸੰਯੁਕਤ-ਵਾਕ : ਕਿਸਮਾਂ
   ਮਿਸ਼ਰਤ-ਵਾਕ : ਕਿਸਮਾਂ

3. ਪ੍ਰਕਾਰਜੀ ਪੰਜਾਬੀ
   ਚਿੱਠੀ ਪੱਤਰ
   ਪੈਰ੍ਹਾ ਰਚਨਾ
   ਸੰਖੇਪ ਰਚਨਾ
   ਅਖਾਣ ਅਤੇ ਮੁਹਾਵਰੇ

ਯੂਨਿਟ ਅਤੇ ਥੀਮ

1. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ : ਸੰਯੁਕਤ ਸ਼ਬਦ; ਸਮਾਸੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਲੋਕ ਸਭਾ); ਦੋਜਾਤੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਕਾਲਾ ਸਿਆਹ); ਦੋਹਰੇ ਸ਼ਬਦ/ਦੁਹਰਰੁਕਤੀ (ਜਿਵੇਂ ਧੂੜ੍ਹ ਧਾੜ੍ਹ/ਭਰ ਭਰ), ਮਿਸ਼ਰਤ ਸ਼ਬਦਾਂ ਦੀ ਬਣਤਰ/ਸਿਰਜਨਾ; ਅਗੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਉਪ ਭਾਸ਼ਾ), ਪਿਛੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਰੰਗਲਾ), ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ-2: ਪੜਨਾਵੀਂ ਰੂਪ, ਕਿਰਿਆ/ਸਹਾਇਕ ਕਿਰਿਆ ਦੇ ਰੂਪ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ-2: ਮਾਰਕੀਟ/ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਧੰਦਿਆਂ ਨਾਲ ਸੰਬੰਧਿਤ।

2. ਪੰਜਾਬੀ ਵਾਕ-ਬਣਤਰ : ਕਰਤਾ ਕਰਮ ਕਿਰਿਆ; ਸਾਧਾਰਨ ਵਾਕ, ਬਿਆਨੀਆ, ਪ੍ਰਸ਼ਨਵਾਚਕ, ਆਗਿਆਵਾਚਕ, ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ; ਸੁਤੰਤਰ ਅਤੇ ਅਧੀਨ ਉਪਵਾਕ; ਸਮਾਨ (ਤੇ/ਅਤੇ) ਅਤੇ ਅਧੀਨ (ਜੋ/ਕਿ) ਯੋਜਕਾਂ ਦੀ ਵਰਤੋਂ; ਪੰਜਾਬੀ ਵਾਕਾਂ ਦੀ ਵਰਤੋਂ : ਵਿਭਿੰਨ ਸਮਾਜਕ/ਸਭਿਆਚਾਰਕ ਪ੍ਰਸਥਿਤੀਆਂ ਦੇ ਅੰਤਰਗਤ; ਘਰ ਵਿਚ, ਬਾਜ਼ਾਰ ਵਿਚ, ਮੇਲੇ ਵਿਚ, ਸ਼ੌਪਿੰਗ ਮਾਲ/ਸਿਨਮੇ ਵਿਚ, ਵਿਆਹ ਵਿਚ, ਧਾਰਮਿਕ ਸਥਾਨਾਂ ਵਿਚ, ਦੋਸਤਾਂ ਨਾਲ ਆਦਿ।

3. ਇਸ ਯੂਨਿਟ ਵਿਚ ਚਿੱਠੀ ਪੱਤਰ (ਨਿੱਜੀ/ਦਫ਼ਤਰੀ/ਵਪਾਰਕ), ਪੈਰਾ ਰਚਨਾਂ, ਸੰਖੇਪ ਰਚਨਾ ਅਤੇ ਅਖਾਣ ਮੁਹਾਵਰਿਆਂ ਦੀ ਵਰਤੋਂ ਰਾਹੀਂ ਵਿਦਿਆਰਥੀ ਦੀ ਭਾਸ਼ਾਈ ਯੋਗਤਾ ਨੂੰ ਪਰਖਿਆ ਜਾਵੇਗਾ।

SOA: 102 - DRUG ABUSE: PROBLEM, MANAGEMENT AND PREVENTION (COMPULSORY)
DRUG ABUSE: MANAGEMENT AND PREVENTION

Time: 3 Hours **Credit 3-0-0**

1) Consequences of Drug Abuse for:
1) Individual – Education, employment and income issues.
2) Family – Violence
3) Society – Crime.
4) Nation – Law and order problem.

2) Management of Drug abuse:
1) Medical Management: Medication for treatment and to reduce withdrawal effects, Drug De-addiction clinics, Relapse management.
2) Psycho-Social Management: Counselling, family and group therapy, behavioural and cognitive therapy, Environmental Intervention.

3) Prevention of Drug Abuse:
1) Role of family: Parent child relationship, Family support, Supervision, Shaping values, Active Scrutiny.
2) School
   Counselling, Teacher as role-model. Parent-Teacher-Health Professional Coordination, Random testing on students.
3) Media:
   Restraint on advertisements of drugs, advertisements on bad effects of drugs, Publicity and media, Campaigns against drug abuse, Educational and awareness program
4) Legisltaion: NDPs act, Statutory warnings, Policing of Borders, Checking Supply/Smuggling of Drugs, Strict enforcement of laws, Time bound trials.

References:

1. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
2. Inciardi, J.A. 1981. *The Drug Crime Connection*. Beverly Hills: Sage Publications.
3. Modi, Ishwar and Modi, Shalini (1997) *Drugs: Addiction and Prevention*, Jaipur: Rawat Publication.
4. Sain, Bhim 1991, *Drug Addiction Alcoholism*, Smoking obscenity New Delhi: Mittal Publications.
5. Sandhu, Ranvinder Singh, 2009, *Drug Addiction in Punjab*: *A Sociological Study. Amritsar*: Guru Nanak Dev University.
6. Singh, Chandra Paul 2000. *Alcohol and Dependence among Industrial Workers*: Delhi: Shipra.
7. World Drug Report 2011, United Nations office of Drug and Crime.
8. World Drug Report 2010, United Nations office of Drug and Crime.

CYP113: Inorganic Chemistry Lab-I

(6hrs / week) **Credit: 0-0-3**

Identification of cations and anions in a mixture which may contain combinations of acid ions. These must contain interferring acid anions and one, the insoluble.

a) Special Tests for Mixture of Anions

- **(i)** Carbonate in the presence of sulphate.
- **(ii)** Nitrate in the presence of nitrite
- **(iii)** Nitrate in the presence of bromide and iodide.
- **(iv)** Nitrate in the presence of chlorate.
- **(v)** Chloride in the presence of bromide and iodide.
- **(vi)** Chloride in the presence of bromide.
- **(vii)** Chloride in the presence of iodide.
- **(viii)** Bromide and iodide in the presence of each other and of chloride.
- **(ix)** Iodate and iodide in the presence of each other.
- **(x)** Phosphate, arsenate and arsenite in the presence of each other.
- **(xi)** Sulphide, sulphite, thiosulphate and sulphate in the presence of each other.
- **(xii)** Borate in the presence of copper and barium salts.
- **(xiii)** Oxalate in the presence of fluoride.
- **(xiv)** Oxalate, tartrate, acetate, citrate in the presence of each other.

b) Separation and Identification of Cations in Mixtures

- **(i)** Separation of cations in groups.
- **(ii)** Separation and identification of Group I, Group II (Group IIA and IIB), Group III, Group IV, Group V and Group VI cations.

c) Identification of Cations Including Less Familiar Elements by Spot Tests Assisted by Group Analysis (3 cations).

Book: Vogel's book on Inorganic Qualitative Analysis

PHP-196: ELECTRICITY & MAGNETISM LAB

(4 hrs/ week) **Credit: 0-0-2**

1. To find the impedance of a AC circuit containing R, L and C in series.
2. To determine the capacitance of a capacitor by discharging through voltmeter.
3. To convert a Weston type galvanometer into a volt meter of range 0-3 volts.
4. To convert a Weston type galvanometer into an ammeter of a given range.
5. Find the internal resistance of a cell using a Voltmeter.
6. To determine the capacitance of a capacitor using flashing & quenching of a neon lamp.

CYL201: Organic Chemistry of Functional Groups – III

Credit: 3-1-0 **(45 hrs.)**

1. Phenols **5 Hrs**

Nomenclature, structure and bonding. Physical properties, Acidity of phenols and substituent effects, Comparative acidic strengths of alcohols and phenols, Resonance stabilization of phenoxide ion. Preparation and reactions of phenols - electrophilic aromatic substitution, acylation and carboxylation, Kolb-Schmitt reaction. Preparation of aryl ethers, Cleavage of aryl ethers by hydrogen halides, Claisen rearrangement of allyl aryl ethers, Oxidation of phenols. Gatterman synthesis, Hauben-Hoesch reaction, Laderer-Manasse reaction and Reimen-Tiemann reaction.

2. Ethers, Epoxides and Sulphides **4 Hrs**

Nomenclature of ethers, epoxides and sulphides. Structure and bonding in ethers and epoxides. Physical properties of ethers, Preparation of ethers. The Wilamson ether synthesis, Acid catalyzed cleavage of ethers. Preparation of epoxides, Conversion of vicinal halohydrins to epoxides, Reactions of epoxides: Nucleophilic ring opening, acid-catalyzed ring opening. Preparation of sulphides, oxidation and alkylation of sulphides. cleavage and autoxidation, Ziesel's method. Reactions of Grignard and organolithium reagents with epoxides.

3. Aldehydes and Ketones **7 Hrs**

Nomenclature and structure of the carbonyl group. Physical properties, Sources of aldehydes and/or ketones from alkenes, alkynes, carboxylic acids, acid chlorides, nitriles and alcohols. Reactin of aldehydes with Grignard reagent to produce ketones. Hydroformylation, Synthesis of aldehydes and ketones using 1,3-dithianes. Reactions of aldehydes and ketones: Clemmensen, Wolff-Kishner, $LiAlH_4$, and $NaBH_4$ reductions. Addition of Grignard reagents and organolithium reagents to aldehydes and ketones. Principles of nucleophilic addition: hydration of aldehydes and ketones, cyanohydrin formation, acetal formation. Benzoin, aldol, Perkin and Knoevenagel condensations. Use of acetals as protecting groups. Reactions of aldehydes and ketones with ammonia, primary amines and secondary amines. Enamines and Wittig reaction, Stereoselective addition to carbonyl groups. Oxidation of aldehydes. Mannich reaction. Baeyer-Villiger oxidation of ketones, Cannizzaro reaction. Meerwein-Ponndorf-Verley reaction, Halogenation of enolizable ketone. An introduction to α,β-unsaturated aldehydes and ketones.

4. Carboxylic Acids **5 Hrs**

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength . Dicarboxylic acids. Methods of formation and effect of heat and dehydrating agents. Preparation of carboxylic acids: carboxylation of Grignard reagents, oxidation of alkylbenzenes, oxidation of primary alcohols, aldehydes. Preparation and hydrolysis of nitriles. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation. Intramolecular ester formation. Hydroxy acids: malic, tartaric and citric acids. Methods of formation and chemical reactions of unstaturated monocarboxylic acids.

5. Carboxylic Acid Derivatives **5 Hrs**

Nomenclature and structure of acid chlorides, esters, amides, acid anhydrides and nitriles. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution in acyl chlorides and acid anhydrides. Sources and physical properties of esters. Acid as well as base catalyzed ester hydrolysis. Reactions of esters with ammonia, amines, Grignard reagents and lithium aluminium hydride. Amides: hydrolysis of amides. Lactams. Preparation of nitriles, hydrolysis, addition of Grignard reagents to nitriles.

6. Carbohydrates **7 Hrs**

Classification of carbohydrates, Fischer projections and D-, L- notations of glyceraldehyde, aldotetroses, aldopentoses and aldohexoses. Cyclic forms of carbohydrates: Furanoses and Pentoses. Mutarotation and mechanism. Introduction to ketoses, deoxy sugars, amino sugars and branched chain carbohydrates. Glycosides: The Fischer glycosidation, mechansm. examples of disaccharides and polysaccharides. Reactions of carbohydrates: Reduction of monosaccharides, oxidation of monosaccharides. Determination of ring size of monosaccharides. Cyanohydrin formation and chain extension. Kiliani-Fischer synthesis. Epimerization, isomerizaion and retro-cleavage: Interconversion of glucose into mannose, fructose. Acylation and alkylation of carbohydrate hydroxyl group. Mechanism of osazone formation, An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

7. Amines **6 Hrs**

Amine nomenclature, Structure and bonding, physical properties. Basicity of amines. Structural features effecting basicity of amines.tetraalkylammonium salts as Phase Transfer Catalysts. Preparation of primary, secondary and tertiary amines: Nucleophilic substitution by azide ion on alkyl halides, nitration of arenes, nucleophilic ring opening of epoxides by ammonia, nucleophilic addition of amines to aldehydes and ketones, nucleophilic substitution by ammonia on α-halo acids. Nucleophilic acyl substitution. Preparation of amines by alkylation of ammonia, The Gabriel synthesis of primary alkylamines, preparation of amines by reduction of azides,

eopxides, nitriles, nitro and amides. Reductive amination, Reaction of amines with alkyl halides, The Hofmann elimination. Electrophilic aromatic substitution in arylamines, nitrosation of alkylamines and arylamines. Synthetic transformations of aryl diazonium salts, azo coupling.

8. Amino Acids, Peptides, Proteins and Nucleic Acids 6 Hrs

Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, the Edman degradation. The strategy of peptide synthesis: amino and carboxyl group protection, peptide bond formation. Solid-phase peptide synthesis: The Merrifield method. Secondary structures of peptides and proteins. Introduction to tertiary and quaternary structures of proteins. Protein denaturation/renaturation. Nucleosides and nucleotides. secondary structure of DNA: The double helix. Tertiary structure of DNA: supercoils. Nucleic acids: Introduction. Constitutents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Books Recommended:

1. Organic Chemistry. F.A. Carey, McGraw Hill, Inc. 8th edition.
2. Organic Chemistry, Morrison and Boyd, Prentice Hall.

Suggested books:

3. Fundamentals of Organic Chemistry, Solomons, John Wiley.
4. Organic Chemistry, L.G. Wade Jr. Prentice Hall.
5. Organic Chemistry Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd (New Age International).
6. Introduction to organic chemistry, Stritwieser, Heathcock and Kosover, Macmilan.

CYL-206: Physical Chemistry-II

Credit: 3-1-0

1. Thermodynamics-I: 10Hrs

Definition of Thermodynamic Terms: System, surroundings etc. Types of systems, intensive and extensive properties, state and path functions and their differentials, thermodynamics process, concept of heat and work.

First Law of Thermodynamics: Statement, definition of internal energy and enthalpy, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU&dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: Standard state, standard enthalpy of formation - Hess's Law of heat summation and its applications. Heat of a reaction at constant pressure and at constant volume, enthalpy of neutralization, bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy and Kirchhoff's equation.

2. Thermodynamics-II: 10Hrs

Second law of thermodynamics: need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Concept of Entropy: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change. Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities. A &G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

3. Chemical Equilibrium: 5 Hrs

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore - Clapeyron equation and Clausius-Clapeyron equation, applications.

4. Colligative Properties: 10 Hrs

Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, Law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

5. **Chemical Kinetics:** **10 Hrs**

Chemical kinetics and its scope. Order & Molecularity. Rate constants and rate coefficients. Rate laws. Factors affecting rates: concentration, temperature, pressure, solvent, light, catalyst. Differential method, method of integration, First order, Second order and Third order reactions with examples, half lives, pseudo-molecular reactions, isolation method, reaction of nth order, comparison of methods. Arrhenius equation, Numerical Problems.

Books Suggested:

1. Glasstone,b.2003 Thermodynamics for Chemists, East West Press, NewDelhi.
2. Rock, P.A. (1983) Chemical Thermodynamics, University Science Books, Saisalito, CA.
3. Maron S.H., Pretton C.F. (1965) Principles of Physical Chemistry, 4th Edition, , Mac Millan Publishing Company, New York.
4. Atkin, P., Paula J, (2002) Atkin's Physical Chemsitry, 7th Edition, Oxford University Press, London.
5. Kapoor, K.L (2006) A Text Book of Physical Chemistry, 6th Volume, Macmillan Publishers India Ltd., New Delhi.
6. Laidler, K.J.(1995) The world of Physical Chemsitry, 3rd Volume, Oxford University Press, London.
7. Frost, A.A., Pearson R.G. (1961) Kinetics and Mechanism, A study of homogeneous Chemical Reactions, 2nd Edition, John Wiley & Sons, New York.

MTL241: Mathematics-III

Credit 3-1-0

Integral calculus: (8 Hrs)

Integral calculus: double, triple integrals, determination of C.G. using double and triple integrals. Integration by trapezoidal and Simpson's rule.

Differential Equations: (8+7 Hrs)

Ordinary differential equations. Formation of differential equation, solution of linear differential equation of the first order and first degree. Solution of homogeneous and non homogeneous differential equations with constant coefficient. The chemical application of the first differential equations.

Series solutions of Bessel and Legendre differential equations. Bessel function and Legendre Polynomials. Recurrence and orthognality relations, Rodrigue's Formulae.

Parital differential equations (8+7+8 Hrs)

(A) Formation of partial differential equations. Solution by Charpit's Method. Solution of homogeneous partial differential equations with constant coefficients.

(B) De-Moivre's theorem and its applications: Functions of complex variables. Analytic functions. C-R equations, complex line integral. Cauchy's integral theorem & Cauchy's integral formula.

(C) Taylor's theorem. Laurent's theorem. Cauchy's residue Theorem. Integration round unit circle. Evaluation of integrals of the type $\int_{-\infty}^{\infty} f(x)dx.\infty$

Books Recommended:

1. B.S. Grewal – Higher Engineering Mathematics.
2. Erwin Kreyszig-Higher Engineering Mathematics.
3. Joseph B, Dence-Mathematical Techniques in Chemistry.
4. B.L. Manocha and H.R. Choudhary – A text book of Engineering mathematics.
5. Margenau Murphy – Mathematics for Physical and Chemists.

PHL291: Modern Physics –II

Credit: 3-1-0

Basics of Relativity: The Michelson – Morley experiment, Co-ordinate transformation, Special theory of relativity, The Lorentz transformation. Simultaneously and relativity. The relativistic Doppler shoft and relativistic velocity addition.

Optics and Lasers : Removal of spherical and chromatic aberrations, Eye-pieces – Ramsder and Huyge's Michelson interferimeters, concepts of resolving power of the optical instruments.
Laswer principle and action, Einsten theory of radiation, polulation inversion, Laser types, He-Ne Laser Ruby Laser Co2 lasers, Semiconductor Laser. Applications of Lasers in medicine and chemistry.

Basic Electronics : Feed Back Amplifier, Oscillators, Calpit & Hortley Oscillators. Basics of Operational amplifier, summer, subtractor, Differatiotor Integrator.

References:

(i) Optics by A.K.Ghatak.
(ii) Optical Electronics – A.K.Ghatak & R.Thyagrajan.
(iii) Modern Physics – J.Bernetein, Paul M.Fishbane and Stephen Gasiorowic.
(iv) Interated Electronics Millman & Halkias.

ESL 220 Environmental Studies (Compulsory)

Credit 3-0-0

1. **The Multidisciplinary Nature of Environmental Studies:** Definition, scope & its importance, Need for public awareness.

2. **Natural Resources**: Natural resources and associated problems.
   - **a)** **Forest Resources**: Use of over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
   - **b)** **Water Resources**: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
   - **c)** **Mineral Resources**: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
   - **d)** **Food Resources**: World food problems, change caused by agriculture and overgrazing, effects or modern agriculture, fertilizer-pesticide problem, salinity, case studies.
   - **e)** **Energy Resources**: Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.
   - **f)** **Land Recourses**: Land as a resource, land degradation, soil erosion and desertification.
   - **g)** Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

3. **Ecosystem:**
   Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.
   Introduction, types, characteristic features, structure and function of the following ecosystems:
   a. Forest ecosystem
   b. Grassland ecosystem
   c. Desert ecosystem
   d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

4. **Biodiversity and its Conservation:**
   Definition: Genetic, species and ecosystem diversity, Biogeographical classification of India.
   Value of Biodiversity: Consumptive use; productive use, social, ethical, aesthetic and option values.
   Biodiversity of global, National and local levels, India as mega-diversity nation "Hot-spots of biodiversity.
   Threats to Biodiversity: Habitat loss, poaching of wild life, man wildlife conflicts
   Endangered and endemic species of India.
   Conservation of Biodiversity: In situ and Ex-situ conservation of biodiversity.

5. **Environmental Pollution:**
   Definition, Causes, effects and control measures of:
   a) Air Pollution
   b) Water Pollution
   c) Soil Pollution
   d) Marine Pollution
   e) Noise Pollution
   f) Thermal Pollution

g) Nuclear Hazards
Solid Waste Management: Causes, effects and control measures of urban and industrial wastes.
Role of an individual in prevention of pollution.
Pollution case studies Disaster Management: Floods, Earthquake, Cyclone and Landslides

6. Social Issues and Environment:

* From unsustainable to sustainable development
* Urban problems related to energy
* Water conservation, rain water harvesting, watershed management
* Resettlement and rehabilitation of people; its problems and concerns. Case studies
* Environmental ethics: Issues and possible solutions.
* Climate change, global warning, acid rain, ozone layer depletion, nuclear accidents and holocause. Case studies.
* Wasteland reclamation
* Consumerism and waste products
* Environmental Protection Act
* Air (prevention and Control of Pollution) Act
* Water (prevention and Control of Pollution) Act
* Wildlife Protection Act
* Forest Conservation Act
* Issues involved in enforcement of environmental legislation
* Public awareness

7. Human Population and the Environment

* Population growth, variation among nations
* Population explosion-Family welfare programme
* Environment and human health
* Human rights
* Value education
* HIV / AIDS
* Women and child welfare
* Role of information technology in environment: and human health
* Case studies

* **Road Safety Rules & Regulations:** Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs
* **Accident & First Aid:** First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance

8. National Service Scheme

- **Introduction and Basic Concepts of NSS:** History, philosophy, aims & objectives of NSS: Emblem, flag, motto, song, badge etc.; Organization structure, roles and responsibilities of various NSS functionaries.
- **Health, Hygiene & Sanitation:** Definition, needs and scope of health education; Food and Nutrition; Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan); National Health Programme; Reproductive health.

- **Civil/Self Defense:** Civil defense services, aims and objectives of civil defense; Needs for self defense training.

9. Field Work: Visit to a local area to document environmental assets–river / forest / grassland / hill / mountain. Visit to a local polluted site–Urban / Rural / Industrial / Agricultural. Study of common plants, insects, birds. Study of simple ecosystems–pond, river, hill slopes, etc. (Field work equal to 5 lecture hours)

References:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Bharucha, E. 2004. The Biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad.
4. Brunner, R. C. 1989. Hazardous Waste Incineration, McGraw Hill Inc. New York.
5. Clark, R. S. 2000. Marine Pollution, Clanderson Press Oxford.
6. Cunningham, W. P., Cooper, T. H., Gorhani, E. & Hepworth, M. T. 2001. Environmental Encyclopedia, Jaico Publications House, Mumbai.
7. De, A. K. 1989. Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment, New Delhi.
9. Hawkins, R. E. 2000. Encyclopedia of Indian Natural History, Bombay Natural History Society.
10. Heywood, V. H & Waston, R. T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
11. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
12. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
13. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
14. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
15. Odum, E. P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA.
16. Rajagopalan, R. 2005. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
17. Sharma, B. K. 2001. Environmental Chemistry. Geol Publishing House, Meerut.
18. Sharma, J. P. 2004. Comprehensive Environmental Studies, Laxmi Publications (P) Ltd, New Delhi.
19. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
20. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.
21. Survey of the Environment. 2005. The Hindu.
22. Tiwari, S. C. 2003. Concepts of Modern Ecology, Bishen Singh Mahendra Pal Singh, Dehra Dun.
23. Townsend, C., Harper, J. and Michael, B. 2001. Essentials of Ecology, Blackwell Science.
24. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar.

PHP-291: MODERN PHYSICS LAB

Credit: 0-0-2

1. To determine e/m by short solenoid method.
2. To determine e/m by long solenoid method.
3. To determine e/m by magnetron value.
4. To determine Ionisation potential of Hg.
5. To find planck's constant using photo cell.
6. To determine electronic charge by Millikan's Oil Drop Apparatus.

CYL-211: Heterocyclic Chemistry

Credit: 3-1-0

1. Nomenclature of Heterocycles (4 Hrs)

Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles.

2 Aromatic Heterocycles (5 Hrs)

Aromatic resonance energy, structure of six-membered heteroaromatic systems (pyridine, diazines, pyridones and pyrones), structure of five-membered heteroaromatic systems (pyrrole, thiophene, furan, azoles), bicyclic heteroaromatic compounds. Heteroaromatic reactivity and tautomerism in aromatic heterocycles

3. Non-aromatic Heterocycles (6 Hrs)

Strain – bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction.
Stereo-electronic effect – anomeric and related effects. Attractive interactions – hydrogen bonding and intermolecular nucleophilic-electrophilic interactions

4. Heterocyclic Synthesis (4 Hrs)

Principles of heterocyclic synthesis involving cyclization and cycloaddition reactions

5. Small Ring Heterocycles (4 Hrs)

Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes

6. Benzo-Fused Five-Membered Heterocycles (4 Hrs)

Synthesis and reactions including medicinal applications of benzopyrroles, Benzofurans and benzothiophenes

7. Meso-ionic Heterocycles (4 Hrs)

General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications.

8. Six-Membered Heterocycles with One Heteroatom (6 Hrs)

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones.

Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.

9. Six-Membered Heterocycles with Two or More Heteroatoms (4 Hrs)

Synthesis and reactions of diazines, triazines, oxadiazoles and thiadiazoles

10. Purines: Synthesis and Reactions (4 Hrs)

Approaches for the construction of purine ring, reactions of purines with electrophilic reagents, with nucleophilic reagents, reactions with bases, reactions of C-metallated purines

Books Suggested:

1. Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, 3rd edition, Indian reprint, 2004. Chennai Microprint Pvt. Ltd.
2. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical
3. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.
4. An Introduction to Heterocyclic Compounds, R.M. Acheson, John Wiley
5. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergamon Press.
6. Heterocyclic Chemistry, A. Paquett

CYL212: Chemical Spectroscopy – I

Credit: 3-1-0

1. General features of Spectroscopy: (5 hrs.)
Units and conversion factors, Introduction to spectroscopy, Nature of radiation, Energies corresponding to various kinds of radiation, Intensities of spectral lines, selection rules and transition moments, Line widths, Broadening (Book 1)

2. Pure Rotational Spectra: (10 Hrs.)
Classification of molecules according to their moment of inertia. Rotational energy levels of hydrogen chloride. Determination of molecular geometry by rotational spectrum, isotopic substitution effects. Stark effect, Estimation of molecular dipole moments, Selection rules, Rotational Raaman Spectra, anisotropic polarizability, specific selection rule in Raman Spectra, Stokes and anti – Stokes lines.

3. Vibrational Spectra (5 Hrs.):
Diatomic molecules, Force constants, Fundamental vibration frequencies, anharmonicity of molecular vibrations and its effect on vibrational frequencies, Frequencies of the vibrational transitions of HCl. Vibrational rotation spectra of CO, P,Q and R branches.

4. Infrared and Raman Spectra (15 Hrs.):
Vibrations of polyatomic molecules. Examples of CO_2, H_2 O. Mechanics of measurement of infrared and Raman spectra, absorption of common functional groups, their dependence on chemical environment (bond order, conjugation, H – bonding), Use of group theory to determine the number of active infrared and Raman active lines. Fermi resonance, combination bands and overtones, complications due to interactions of vibrations of similar frequency. Application of IR in structure elucidation of organic compounds – Carbonyls and effect of substituents on it, C-H, N-H, O-H vibrations and H-bonding – unsubstituted, mono and di-substitute aromatic compounds – Far IR region, Metal ligand vibrations, Group frequencies of complex ligands – CN stretching and effect of co-ordination on it. Nitro-nitrito- and C=O ligands and the effect of their co-ordination with metal ions and IR spectra.

5. UV and Visible Spectroscopy of organic molecules (10 Hrs.):

Measurement technique, Beer – Lambert's Law, molar extinction coefficient, oscillator strength and intensity of the electronic transition, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra.

Chromophores, auxochromes, electronic spectra of polyatomic molecules, Woodward rules for conjugated dienes and α, β- unsaturated carbonyl groups, extended conjugated and aromatic sterically hindered systems, red shift, blue shift, hypo and hyperchromic effect.

References:

1. R.S.Drago, "Physical Methods in Chemistry".
2. R.M. Silverstein, G.C. Bassler, T.C. Morrill, "Spectrometic Identification of Organic Compounds.
3. W. Kemp, "Organic Spectroscopy".
4. D.H. Williams, I. Pleming, "Spectroscopic Methods in Organic Chemistry".
5. J.R.Dyer, "Application of Absorption Spectroscopy of Organic Compounds".
6. D. H. Williams, I. Fleming, "Spectroscopic Problems in Organic Chemistry" 1967.
7. R.C. Banks, E.R. Matjeka, G. Mercer, "Introductory Problems in Spectroscopy" 1980.
8. G.M. Barrow "Introduction to Molecular Spectroscopy".
9. C.N. Banwell "Fundamentals of Molecular Spectroscopy".
10. D.L. Pavia, G.M. Lampan and G. S. Kriz, Introduction to Spectroscopy" Hartcourt College Publishers, 2001

MTL-242: MATHEMATICS - IV

Credit: 3-1-0

Vectors Algebra: (9 Hrs)

Definition of vector and scalar. Scalar & Vector product of two vectors. Scalars triple product and vector triple product and their applications. Work done by a force, moment of a force about a point.

Vectors Calculus : (12 Hrs)

Vector differentiation and integration of vectors. Vectors operators, Gradient, Divergence and Curl. Gauss, Stoke and Green's Theorem (Statement only) and their applications.

Laplace Transform: (12 Hrs)

Definition of elementary transforms, transforms of integrals and derivatives. Laplace transforms of periodic functions, inverse Laplace transforms of periodic functions. Solutions of ordinary differential equations and simultaneous differential equations using Laplace transforms.

Fourier Series : (12 Hrs)

Periodic Functions, Dirichlet Conditions, Fourier Series & Fourier coefficient, functions having arbitrary period, Sin and Cosine Series, half range expansions, Fourier integral (definitions), Harmonic Analysis.

Books Recommended:

1. B.S. Grewal – Higher Engineering Mathematics.
2. Erwin Kreyszig-Higher Engineering Mathematics.
3. Joseph B, Dence-Mathematical Techniques in Chemistry.
4. B.L. Manocha and H.R. Choudhary – A text book of Engineering Mathematics.
5. Margenau Murphy – Mathematics for Physics and Chemists.

PHL-296: Physics

Credit: 3-1-0

Electrostatics: 15 Hrs.

Forces between charges, concept of electric field. Flux of the electric field. Gauss's law and Coulomb's law. An insulated conductor, experimental proof of Gauss's and Coulomb's laws. Applications of Gauss's law. Concept of electric potential. Relationship between potential, electric field strength and energy.

Ampere's and Faraday's Law: 15 Hrs.

The magnetic field, magnetic forces on a current, torque on a current loop. Hall effect. Ampere's law. Magnetic field near a long wire, magnetic field of a solenoid. Biot-Savart Law. Faraday's experiments. Faraday's law of induction. Lenz's law. Quantitative study of induction. Time varying magnetic field.

Maxwell Equations and Magnetism: 15 Hrs.

Induced magnetic fields, displacement current. Combining all the laws of electromagnetism into Maxwell equations. Poles and Dipoles. Gauss's law and magnetism. Paramagnetism. Diamagnetism. Ferromagnetism and hysteresis. Nuclear magnetism. Three magnetic vectors.

Suggested Books:

1. Physics Part/II David Halliday and Robert Resnick (Principal Text).
2. Berkeley Physics Volume II E. M. Pureell.
3. Introduction to Electrodynamics D.J. Griffiths.

CSL-299: Computer for Chemists

Credit: 2-0-0

1. Computer programming in C language 25 Hrs.

Principles of programming, algorithms and flowcharts.

Elementary programming, a typical C program, printf function.

Introduction of declarations, assignments and variables: concept of an integer, concept of a variable, rules for naming variables, assignment statement, arithmetic operators.

Integer arithmetic expressions, truncation effects, relative priority of arithmetic operators, use of parenthesis, modulus operator.

Floating point numbers, scientific notation, converting integers to floating point and vice versa , coercion and cast operator, type char.

Decision making in C, scanf function, relational operators, logical operators, if statement, if else statement, nesting of if statement.

The while loop, do while loop, for loop, nesting of for loop.

Type char and ASCII code, character strings and how to print them, octal and hexadecimal notation.

User defined functions, returning value from a function, functions with more than one parameters.
Arrays, declaring an array, initializing an array, break statement, strings and character arrays, sorting an array, finding maximum and minimum in an array, multidimensional arrays.
Input and output.

Recommenmded Books:

1. K.V. Raman, Computers in Chemistry, Tata McGraw Hill.
2. Mullish Cooper, The Spirit of C, An Introduction to Modern Programming.

CYP-212: Physical Chemistry Lab- I

Credit: 0-0-3

1. To determine the molecular weight of a compound by Rast's micro method.
2. Determination of coefficient of viscosity of a given liquid by viscometer.
3. To determine the unknown composition of a given mixture of two liquids by viscosity method.
4. To find the mol. wt. of high polymer by using viscosity measurements.
5. To determine surface tension of a given liquid by double capillary rise method.
6. Determination of surface tension of a given liquid by drop number method by stalagmometer.
7. To determine the unknown composition of a mixture of two liquids by surface tension measurements.
8. To determine the critical micelle concentration of a soap (sodium laurate) by surface tension measurements.
9. Determination of molecular weight of a given liquid by steam distillation.
10. To determine the distribution coefficient of I_2 between CCl_4 and water.
11. Determination of transition temperature of given substance by thermometric method.
12. To find the water equivalent of the Dewar's flask.
13. To find heat of neutralization of HCl using Dewar's flask.
14. To determine refractive index of a liquid by Abbe's refractometer and hence the specific and molar refraction.
15. To determine the unknown composition of a given mixture of two liquids by refractive index measurements.
16. To extract oil from given seeds with the help of Soxhlet apparatus.
17. To study the adsorption of acetic acid from its aqueous solution by activated charcoal.

Books Recommended:

1. Findlay's Practical Physical Chemistry.
2. Advanced Practical Physical Chemistry by J.B. Jadav.
3. Quantitative Organic Analysis by Vogel.

CSP-299: COMPUTER LAB

Credit: 0-0-2

Development of small computer codes involving simple formulae in chemistry:

1. Calculation of mean, median, mode.
2. Solution of a quardratic equation.
3. Calculation of linear regression.
4. Calculation of curve linear regression.
5. Calculation of Bohr orbit from de Broglie Lambda for electron.
6. `Calculation of wave number and frequency from value of wave length.
7. Calculation of van der Waals radii.
8. Radioactive decay.
9. Rate constant of a 1st order reaction, 2nd order reaction.
10. Determination
11. Calculation of lattice energy using Born Lande equation.
12. Addition, multiplication and solution of inverse of 3 X 3 matrix.
13. Calculation of average molecular weight of a polymer containing n1 molecules of molecular weight m1, n2 molecules of molecular weight M2 and so on.
14. Program for calculation of molecular weight of organic compound containing C, H,N O and S.
15. Calculation of reduced mass of diatomic molecule.
16. Calculate the RMS and most probable velocity of a gas.
17. Calculate the ionic mobility from ionic conductance values.
18. Determine the thermodynamic parameters for isothermal expansion of monoatomic ideal gas.
19. Calculation of value of g- factor from value of J and S.
20. Calculate the bond length and bond angles using crystal structure data.

CYL-301: Organic Synthesis - I
Stereochemistry and Structure Reactivity Relationships

Credit: 3-1-0

1. Principles of Reactivity **5 Hrs**

Mechanistic significance of entropy, enthalpy and Gibb's free energy. Arrhenius equation. Transition state theory. Uses of activation parameters, Hammond's postulate. Bell-Evans-Polyanyi principle. Potential energy surface model. Mercus theory of electron transfer. Reactivity and selectivity principles.

2. Stereochemistry **10 Hrs**

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Zoptical activity in absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape.
Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

3. Kinetic Isotope Effect **4 Hrs**

Theory of isotope effects. Primary and secondary kinetic isotope effects. Heavy atom isotope effects. Tunneling effect. Solvent effects.

4. Structural Effects on Reactivity **8 Hrs**

Linear free energy relationships (LFER). The Hammett equation, substituent constants, theories of substituent effects. Interpretation of -values. Reaction constant ρ . Deviations from Hammett equation. Dual-parameter correlations, inductive substituent constant. The Taft model, σ_I- and σ_R-scales.

5. Solvation and Solvent Effects **6 Hrs**

Qualitative understanding of solvent-solute effects on reactivity. Thermodynamic measure of salvation. Effects of salvation on reaction rates and equilibria. Various empirical indexes of salvation based on physical properties, solvent-sensitive reaction rates, spectroscopic properties and scales for specific salvation. Use of salvation scales in mechanistic studies. Solvent effects from the curve-crossing model.

6. Acids, Bases, Electrophiles, Nucleophiles and Cataylsis **6 Hrs**

Acid-base dissociation. Electronic and structural effects, acidity and basicity. Acidity function and their applications. Hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The α -effect. Ambivalent nucleophiles. Acid-base catalysis- specific and general catalysis. Bronsted catalysis. Nucleophilic and electrophilic catalysis. Catalysis by non-covalent binding-micellar catalysis.

7. Steric and Conformational Properties **6 Hrs**

Various type of steric strain and their influence on reactivity. Steric acceleration. Molecular measurements of steric effects upon rates. Steric LFER. Conformational barrier to bond rotation-spectroscopic detection of individual conformers. Acyclic and monocyclic systems. Rotation around partial double bonds. Winstein-Holness and Curtin-Hammett principle.

Books Suggested:

1. Mechanism and Theory in Organic Chemistry, T.H. Lowry and K.C. Richardson, Harper and Row.
2. Introduction to Theortical Organic Chemistry and Molecular Modelling, W.B. Smith, VCH, Weinheim.
3. Physical Organic Chemistry, N.S. Issacs, ELBS/Longman
4. Supramolecular Chemistry, Concepts and Perspectives, J.M. Lehn, VCH
5. The Physical Basis of Organic Chemistry, H. Maskill, Oxford University Press.

CYL-303: Chemical Spectroscopy – II

Credit: 3-1-0

1. General Features of Spectroscopy: (5 Hrs.)

Units and conversion factors. Introduction to spectroscopy, Nature of radiation. Energies corresponding to various kinds of radiation, Experimental techniques, intensities of spectral lines, Selection rules and transition moments, Linewidths, Broadening. (Book-1)

2. Nuclear Magnetic Resonance Spectroscopy (25 Hrs.)

The nuclear spin, presessional motion. Larnor frequency, the NMR isotopes, population of nuclear spin levels, spin – spin and spin – lattice relaxation, measurement techniques (CW and FT methods). Solvent used, Chemical Shift, shielding constant, range of typical chemical shifts simple applications of chemical shift ring currents and aromaticity, shifts of ^{1}H and ^{13}C, inductive effect, ring current effect and anisotropy chemical bonds, intermolecular forces effecting the chemical shifts.

Spin – spin interactions, low and high resolution NMR with various examples. Correlation for H bonded to Carbon. 1H bond to other nuclei such as nitrogen, oxygen and sulphur. Complex spin – spin interaction. Interaction between two or more nuclei, splitting due to vicinal and geminal protons, long range coupling. ABX and ABC systems with their coupling constants, shifts reagents. Effects of chemical exchange, fluxional molecules, Hindered rotation on NMR spectrum, Karplus relationship. Nuclear magnetic double resonance, spin decoupling, Nuclear overhauser Effect (NOE). ^{13}C ^{1}H coupling, ^{13}C spectra, Differences from ^{1}H nmr, DEPT, Intensities of lines in ^{13}C.

3. Mass Spectra: (15 Hrs)

Introduction, methods of ionization E1 & C1, Laser desorption, Fast Atom Bombardment (FAB). Secondary Ion Mass Spectrometry (SIMS), field desorption etc. Ion analysis methods (in brief), isotope abundance, Metastable ions, Electron Impact mass spectra, fragmentation patterns for aliphatic compounds, amines, aldehydes, ketons, esters, amides, nitriles, carboxylic acids ethers, aromatic compounds, general rules predicting the fragmentation patterns.
(Books 2, 3, 5)

4. Structure elucidation by combined application of UV, IR, NMR and mass spectra. Solving first 20 problems from reference book 6 and first 20 problems from reference book 7. Tutorials

Books:

1. C.N. Banwell “Fundamentals of Molecular Spectroscopy”.
2. W. Kemp, “Organic Spectroscopy”.
3. D.H. Williams, I. Pleming, “Spectroscopic Methods in Organic Chemistry”.
4. R.S.Drago, “Physical Methods in Chemistry”.
5. R.M. Silverstein, G.C. Bassler, T.C. Morrill, “Spectrometic Identification of Organic Compounds”.
6. D.L. Pavia, G.M. Lampan and G. S. Kriz, “Introduction to Spectroscopy” Hartcourt College Publishers, 2001.
7. R.C. Banks, E.R. Matjeka, G. Mercer, “Introductory Problems in Spectroscopy” 1980.

CYL-304: Ligand Field Theory

Credit: 3-1-0

1. **Symmetry** **(5 Hrs.)**
Symmetry elements, symmetry operations, point group determination, determination of reducible and irreducible representations, character tables, use of symmetry in obtaining symmetry of orbitals in molecules, use of character table to determine which metal orbitals are used in σ and π bond formation in octahedral, tetrahedral and square planar transition metal complexes, qualitative splitting of s, p, d, f orbitals in octahedral, tetrahedral and square planar fields using character tables and without the use of character tables. **(Text 2, 5, 7).**

2. **Orbital Wave Functions** **(5 Hrs.)**
Wave function and shapes of imaginary and real s, p,d and f orbital (cubic and general set in case of f orbitals), Z – component of orbital angular momentum, vector, imaginary and real d orbitals. (Text 1, 2).

3. **Crystal Field Theory** **(10 Hrs.)**
Evaluation of $V_{(x, y, z)}$, $V_{oct.}$, $V_{sq, pl.}$ and $V_{tetragonal}$, evaluation of $V_{oct.}$ .in cartesian co-ordinates, effect of V_{oct} on d-orbital wave functions **(Text 1 & 2).**

4. **Interelectronic Repulsions** **(5 Hrs.)**
Spin-spin, orbital-orbital and spin orbital coupling, L.S. and jj coupling schemes, determination of all the spectroscopic terms of p^n, d^n ions, determination of the ground state terms for p^n, d^n, f^n ions using L.S. scheme, determination of total degeneracy of terms, order of interelectronic repulsions and crystal field strength in various fields, two type of electron repulsion parameters, term wave functions, Bra and Ket notation, derivations of single electron wave functions and their linear combinations for getting the term wave functions of all spectroscopic terms of d^n system, spin orbit coupling parameters (λ) energy separation between different j states **(Texts 1 and 3).**

5. **Free Ions in Weak Crystal Field** **(5 Hrs.)**
The effect of Voct on S, P, D and F terms (with help of the character table and qualitatively), splitting patterns of and G, H and I terms **(Text 1 and 7).**

6. **Free Ions in Medium and Strong Crystal Fields** **(5 Hrs.)**
Strong field configurations, transition from weak to strong crystal fields, evaluation of strong crystal field terms of d^2 and d^3 cases in octahedral and tetrahedral crystal fields (using group theory), construction of the correlation energy level diagrams of d^2 and d^3 configurations in octrahedral and tetrahedral fields, study of energy level diagrams for higher configurations, selection rules of elecronic transitions in transition metal complexes, their proof using group theory, relaxation of the selection rule in centrosymmetric and non centrosymmetric molecules, Orgel diagrams, Tanabe Sugano diagrams, interaction of T_{1g} (P) and T_{1g}(F) terms. **(Text 1, 2, 4 and 5).**

7. **Electronic Spectra of Transition Metal Complexes (10 Hrs.)**
Variation of the Racah parameter, central field covalency, symmetry restricted covalency, differential radial expansion, intermediate coupling, nephlauxetic effect, spectrochemical series, band intensities, factors influencing band widths, variation of 10Dq, vibrational structure, spin orbit coupling, low symmetry components, Jahn-Teller effect, discussion of electronic spectra of octahedral and tetrahedral $d^1 – d^9$ metal ions, calculation of 10Dq and B with and without the use of Tanabe Sugano diagrams, low spin complexes of Mn^{3+}, Mn^{2+}, Fe^{3+}, Co^{3+}, Fe^{2+}, comment on the spectra of second and third transition series, spectra of K_3MoCl_6 and $[Rh(NH_3)_6]^{3+}$, spectra of cis and trans$[Co(en)_2X_2]^+$, $[Mn(H_2O)_6]^{2+}$, $CuSO_4.5H_2O$ and anhydrous complex, comparison of d – d band with f – f bands **(Texts 1, 2, 4 and 5).**

Recommended Books:

1. B.N. Figgis, Introduction to Ligand Field, Wiley Eastern.
2. A.B.P. Lever, Inorganic Electronic Spectroscopy, Elsevier.
3. A. Earnshaw, Introduction to Magnetochemistry, Academic Press.
4. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Inter-Science.
5. R.S. Drago, Physical Method in Chemistry, W.B. Saunders Company.
6. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Inter-science.
7. F.A. Cotton, Chemical Application of Group Theory, Wiley Eastern.

CYL305: Quantum Chemistry – I

Credit: 3-1-0

1. The Dawn of Quantum Mechanics (6 Hrs)

Black body radiation, Planck's radiation law, photoelectric effect, Compton effect, De- Broglie hypothesis the Heisenberg's uncertainly principle, Rydberg's relation for explaining atomic spectrum of hydrogen. Functions, even and odd, well behaved functions, Operators and operator algebra.

2. The Schrodinger Equation: (10 Hrs)

Solution of classical wave equation by separation of variable method, Eigen value equation, Hamiltonian operator. Solution of particle in one, two and three dimensional box, Degeneracy, The Schrodinger Equation in general and its importance. Physical Interpretation of wave function.

3. Angular Momentum (8 Hrs)

Commutative laws, vectors, Angular momentum of one particle system, orbital angular momentum, the ladder operator method for angular momentum.

4. General Principles of Quantum Mechanics (12 Hrs)

Hermitian operator and some important theorems. Eigen functions of commuting operators. Postulates of quantum mechanics, the linear harmonic oscillator, the rigid rotator, Quantization of vibrational and rotational energies.

5. The Hydrogen Atom (5 Hrs)

Outline of various steps in the solution of the electronic Schrödinger equation for hydrogen atom, Radial and angular parts of the hydrogen atomic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. Significance of Quantum numbers, orbital angular momentum and quantum numbers m_l and m_s.

6. Electron Spin (4Hrs)

Electron spin and Pauli's Principle, Spin orbital, The Asymmetric wave functions for Heium atom in ground and excited state, Slater determinant for asymmetric wave function.

Books Suggested:

1. Physical Chemistry, A Molecular Approach by D.A. Mcquarrie and J.D. Simon, 2010 university science books.
2. Quantum Chemistry, Ira N. Levine, 5th edition 1999 Prentice Hall.
3. Quantum Chemistry, H. Eyring J. Walter and G.E. Kimball, 1944, John Wiley & Sons Ink.
4. Molecular Quantum Mechanics, P.W. Atkins and R.S. Friedmann, 2010, Oxford University Press.

CYL306: Physical Chemistry-III

Credit: 3-1-0

Equilibrium Thermodynamics: (10 Hrs.)

Revision of zeroth, 1st, 2nd and 3rd Laws of thermodynamics. The work function and free energy relationships, the Gibbs Helmhotz equation, conditions of equilibrium, partial molar properties, physical significance of partial molar property, chemical potential, Gibb's Duhem equation, Duhem-Margles equation, variation of chemical potential with temperature and pressure, fugacity, determination by graphical method, use of equation of state, generalized method for determination of fugacity. Variation of fugacity with temperature and pressure, fugacity of solids and liquids, Numericals.

Non-Equilibrium Thermodynamics: (10 Hrs.)

Thermodynamic criteria for non-equilibrium states, entropy production for heat flow, matter flow and electric current flows. Rate of entropy production, phenomenological equations, flows and fluxes, Onsager reciprocity relations, Principles of microscopic reversibility, Principle of minimum entropy production, electrokinetic effects, diffusion, electric conduction. Applications of irreversible thermodynamics to biological systems.

Solutions and Their Properties: (15 Hrs.)

Factors affecting solubility, types of solutions, thermodynamic properties of solutions, the solution process, condition for equilibrium between phases, equilibrium between a solution and its vapor phase, Ideal solution, the vapor pressure of ideal solution, vapor pressure of actual liquid pairs, boiling point diagrams of miscible binary mixtures, distillation of binary miscible solutions, Azeotropes, the fractionating column, ratio of distillate to residue, solubility of partially miscible liquid pairs; Maximum, minimum, maximum & minimum solution temperature type, type without critical solution temperature, vapor pressure and distillation diagrams of partially miscible liquid pairs, vapor pressure and distillation of immiscible liquids, solubility of gases in liquids, the Nernst distribution law, solutions of solids in liquids, chemical equilibria in solutions.

Dilute Solutions:

Henrys Law, Freezing points of dilute solutions, determination of M. wts, the B. Pts of solutions, temperature and solubility in dil. solutions.

Phase Equilibria: (10 Hrs.)

Statement and meaning of the terms, Phase, component, degree of freedom, deduction of Gibbs phase rule.

Phase equilibria of one component systems – H_2O, CO_2 and S systems.

Phase equilibria of two component systems-determinatioon of solid –liquid equilibria, simple eutectic diagrams of Bi-Cd, Pb-Ag systems, desilverization of Pb.

Solid solutions – compound formation with congruent M. Pt. – CuCl-$FeCl_3$, Fe_2Cl_6-H_2O and Mg-Zn.

Compound formation with incongruent M.Pt. (peritectic reactions) – NaCl – H_2O, $FeCl_3$ – H_2O, $CuSO_4$- H_2O system.

Three Component Systems

Method of graphical representation, partially miscible three-liquid system –one partially miscible pairs, two partially miscible pairs, three partially miscible pairs, Applications of ternary liquid diagrams.

Books Recommended:

1. Principles of Physical Chemistry, C.F. Prutton and S.H. Maron.
2. Physical Chemistry by G.W. Castellan.
3. Thermodynamics for Chemists, S.Glasstone.
4. Physical Chemistry, P.W. Attkins, 6th edn. Oxford.
5. The Thermodynamics of Biological Processes, D.Jou and J.E. Llebot.
6. Physical Chemistry, W.J. Moore.
7. Physical Chemistry: A Molecular Approach, D.A. MCMarrie & J. D. Simon.

CYP-301: Organic Chemistry Lab–III

Credit: 0-0-3

Note: All reactions in the following experiments are to be monitored by Thin Layer Chromatography (TLC) and characteristic data (UV-visible/fluorescence, IR, NMR, MS) is to be explained.

1. Nitration of o-chlorobenzoic acid and o-chloroacetanalide-separation and identification of isomers. (Ref. 1).
2. Dihydroxylation of cyclohexene with: (a) $KMnO_4$ (Ref 2) and (ii) *p*-toluene sulphonic acid/H_2O_2 (Ref 3) and HCO_2H/H_2O_2 (Ref 4, p 549) Compare product distribution by TLC.
3. Solvent-free Cannizzaro reaction of benzaldehyde (Ref 4, p 1029).
4. Preparation of fluorescein from resorcinol and phthalic anhydride (Ref 4, 3rd Edn., p 935).
5. Preparation of 1,3:4,6-di-*O*-benzylidene-D-mannitol. Also record its optical rotation (Ref 6, p449).
6. Preparation of 1,2-dihydro-1,5-dimethyl-2-phenyl-3*H*-pyrazole-3-one) (antipyrine) Discussion about its pharmacology (Ref 4, p1150).
7. Preparation of 3,5-diethoxycarbonyl-2,4-dimethylpyrrole (Ref 4, p1151).
8. Preparation of 3,5-diphenylisoxazoline using 1,3-dipolar cycloaddition reaction (Ref 6, p646).
9. Preparation of indigo and dyeing of cotton to demonstrate dye-fibre interaction (Ref 6, p661).
10. Synthesis of flavone (**2-Phenyl-4*H*-1-benzopyran-4-one, 2-Phenylchromone) (Ref. 6, p 662).**
11. Synthesis of tetraphenylporphyrin and its Cu^{2+} complex (Ref 6, p 683).
12. Synthesis of 2-phenylindole using Fischer Indole synthesis reaction (Ref 4, p 1161).
13. Acetylation of glucose: Preparation of α-D-glucose pentacetate and β-D-glucose pentacetate (Ref 4, p 644, 645).
14. Synthesis of *p*-nitroaniline from acetanilide (Ref 4, p 919).

Books and references:

1. E. M. Treadwell and T.-Y. Lin, *J. Chem. Edu*., **2008**, 85, p1541.
2. B.T. Burlingham; Rettig, J. C. Rettig, *J. Chem. Edu.* **2008**, 85, p959.
3. A. A. Rosatella, C. A. M. Afonso, and L.C. Branco *J. Chem. Edu.* **2011** *88* (7), 1002-1003.
4. Vogel's text book of practical organic chemistry, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, 5th Ed., 1989, Longman Group.
5. Techniques and experiments for organic chemistry by Addison Ault, 6th edition.
6. Experimental organic chemistry by Laurence M. Harwood, C. J. Moody, Black well Scientific Publications, Oxford, 1989.

CYP302: Physical Chemistry Lab-II

Credit: 0-0-3

pH metry

1. Determination of strength of given strong acid (HCl).
2. To determine strength and dissociation constant of given weak acid (CH_3COOH).

Electrogravimetry

3. To determine %age purity of given salt ($CuSO_4$) solution.

Conductometry

4. Determine the equivalent conductance of a weak electrolyte at infinite solution by Kohlrausch's law and determine the degree of dissociation and dissociation constant of the electrolyte.
5. To determine strength of given strong acid.
6. To determine strength of given weak acid.
7. To determine solubility of a sparingly soluble salt ($PbCl_2$/$BaSO_4$) in water at room temperature.

Potentiometry

8. Titration of strong acid solution (HCl) with NaOH solution using quinhydrone electrode.
9. Titration of a mixture of strong and weak acids (HCl + CH_3COOH) and hence the composition of the mixture.

Refractometry

10. To determine molar refractivity of given liquids and calculate the refraction equivalents of C, H and Cl atoms.

Colorimetry

11. To test the validity of Beer Lambert law.

Nephaloturbiditymetry

12. To estimate the concentration of ions of given salt solution.

Polarimetry

13. To determine specific and molecular rotation of an optically active substance (say cane sugar).

Flame Photometry

14. To determine the concentration of ions (Na^+/K^+) in given solution by drawing calibration curve.

Polarography

15. To verify Ilkovic equation.

Books Recommended:

1. Findlay's Practical Physical Chemistry.
2. Advanced Practical Physical Chemistry by J. B. Jadav.
3. Quantitative Inorganic analysis by Vogel.

CYL310: Co-ordination Chemistry

Credit: 3-1-0

1. Basic Coordination Chemistry (8 Hrs.)

Werner's theory, nomenclature of coordination complexes, isomerism in coordination complexes, chelating agents, metal chelates and chelate effect, names and abbreviations of important ligands, polydentate ligands, polypyrazolyborates , macrocyclic ligands, macrocyclic effect, ketoenolates, troplonates, tripod ligands, conformation of chelate rings, streochemistry of coordination numbers 2 –12 factors detrmining kinetic and thermodynamic stability.

2. Nature of Bonding on Coordination Compounds (20 Hrs)

Application of the valence bod theory to coordination complexes, the electroneutrality principal, the qualitative picture of the crystal field effects in tetrahedral, square planar, octahedral, tetragonal, square pyramidal cases, pairing energy, factors affecting the CFSE, the use of crystal field theory in explaining magnetic properties of transition metal complexes, the thermodynamic effects of the crystal field splitting, the structural consequences of CFSE, the nephalauxetic effect of the spectrochemical series, the limitation of the crystal field theory, the ligand field theory,the jahan theorem and its uses in explaining the distortions in the structures of electrically degenerate system, the molecular orbital treatment of the octahedral, tetrahedral and square planar complexes (qualitative picture only), the comparison of the VBT, CFT and MOT picture of bonding in case of transition metal complexes, the angular overlap model

3. General Properties and Magnetism (7 Hrs)

Definition, general characteristics and positions of transition elements in the periodic table, division into d and f block elements and electronic configurations of the atoms and ions, origin of parmagnetism, diamagnetism, magnetic susceptibility and magnetic moment from magnetic susceptibility, Guoy method to determine the magnetic susceptibility, ferromagnetism, antiferromagnetism.

Electronic configuration of first transition series elements, comparative study of the first transition series elements with reference to atomic and ionic radii, ionization potential, redox potential, oxidation state diagram on the basis of redox potentials, Chemistry of scandium to copper with reference to relative stability of their oxidation states, magnetic and spectral properties. **(Text 2).**

4. Structures of Important Complexes (10 Hrs)

Structure of some important complexes of the first transition series (to be discussed in terms of coordination number, shape or oxidation states or nature of bonding), $Ti(NO_3)_4$, $TiCl_4(diars)_2$, $[Ti(Oet)_4]_4$, VF_5, $VO(acac)_2$ and nature of VO^{2+} bond, $[VOCl_3(NMe_3)_2]$, CrO_4^{2-}, $Cr_2O_7^{2-}$ $[CrO(O_2)_2\ Py]$, $[Cr(O_2)_2(bipy)]$, nature of metal, peroxo bond, Cr_2 (η^{2-} acetate)$_4$ and the nature of Cr-Cr bond in this complex, tetrameric $[Co(acac)_2]_4$, tetrahedral complexes being more common in case of cobalt, oxidation of Co(II), complexes by molecualr O_2, $[Ni(acac)_2]_3$, $Ni(DMGH)_2$, $[Ni(Me_6$ - $acac)_2]$, $[Ni(MeSal)_2]$,$[Ni(CN)_5]^{3-}$, anomalous behaviour of nickel(II) complexes, copper(II) acetate dihydrate, $[Cu(CN)_2]^{2-}$, cubane complexes $[CuXL]_4$ where X=halide and L=phosphine or arsine (this topic is to be covered from text 2 and 3).

Recommended Books:

1. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, John Wiley and Sons.
2. J.E. Huheey, Inorganic Chemistry, Harper International.
3. N.N. Greenwood and A. Earnshaw, Chemistry of the Elements, Pergamon Press.
4. J. Jander, Chemical Topics for students (Ionizing solvents), Vol. 3, John Wiley and Sons.

CYL-311: Organic Synthesis – II
(Reactive Intermediates)

Credit 3-1-0

1. Nature of Bonding in Organic Molecules 4 Hrs

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, annulenes, anti-aromaticity, ψ -aromaticity, homo-aromaticity.

2. Reactive Intermediates: Structure and Reactivity 4 Hrs

Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes.

3. Aliphatic Nucleophilic Substitution 14 Hrs

The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanisms.
The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Nucleophilicity and SN2 reactivity based on curve cross model.

Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations. Relationship between poar and electron transfer reactions.

The S_Ni mechanisum.
Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.
Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transferr catalysis and ultrasound, ambident nucleophile, regioselectivity.

4. Aliphatic Electrophilic Substitution 5 Hrs

Bimolecular mechanisms- S_E2 and S_Ei. The S_E1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

5. Aromatic Nucleophilic Substitution 6 Hrs

The S_NAr, S_N1, benzyne an $S_{RN}1$ mechanisms, Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements.

6. Free Radical Reactions (6 Hrs)

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactvity in the attacking radicals. The effect of solvents on reactivity.
Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

7. Addition to Carbon-Carbon Multiple Bonds (6 Hrs)

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity,orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxixation.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. sundberg, Plenum.
3. Modern Physical organic chemistry Eric V. Anslyn /Deniis A.Doughutes.
   P 637-655 (2004) University, Science Books.
4. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
5. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
6. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice Hall
7. Modern Organic Reactions, H.O. House, Benjamin.
8. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.

CYL313: INSTRUMENTAL METHODS OF ANALYSIS

Credit: 3-1-0

1**. Electro Analytical Methods:** Electrolytic and galvanic cell, Cell components, D.C. & A.C. current in a cell, Reversible and irreversible cells. Nature of electrodes potentials. Description of standard hydrogen electrode. Measurement of potentials. Sign conventions. E^o values and their calculations. Effect of concentration on cell potentials. Concept of Liquid Junction potential. Ohmic potential (IR drop). Polarization (overvoltage) phenomenon and its theories. Limitation to the use of standard electrode potentials. **(8 hrs.)**

2. **Potentiometric Methods:** Reference electrodes (Calomel, Ag/AgCl, TI/TICI) Metallic indicator electrodes (first, second and third type). Metallic Redox indicator electrode: Membrance and ion – selective Electrodes: Principle and design: Glass electrode. Gas sensing probes. Enzyme electrode: Ion Sensitive Field Effect Transistors (ISFETS**)** Principal and Potentiometer methods. **(8 hrs.)**

3. **Voltammetry and Polarography:** General introduction, theoretical consideration of classical polarography, polarographic currents, effect of capillary characteristics on diffusion current, residual current, half wave potential. Effect of complex formation on polarographic waves and mixed anodic cathodic waves, oxygen waves, instrumentation, cell, electrodes and their modifications. Application of polarography. Modified voltametric methods, viz.; current sampled polarography, (TAST), pulse polarography square wave, Fast linear sweep, Cyclic voltammetry, Hydrodynamic Voltametric, stripping methods, amperometric titrations and their applications. **(14 hrs.)**

4. **Electrogravimetry and Coulmetry:** Current voltage relationship, electrolysis at constant applied voltage, constant current electrolysis, coulometric methods of Analysis, potentiostatic coulmetry, Amperostatic Coulmetry, application of coulmetric titrations. **(6 hrs.)**

5. **Conductometric Methods:** Electrolytic conductance, relationships used in conductometry, variation of equivalent conductance with concentration, measurement of conductance, conductometric titrations, Applications to various types of titrations for detection of end points. **(5 Hrs.)**

6. **Turbidimetry and Nephelomatry:** Theory of Nephelomatry and Turbidimetry, Brief Instruments, applications. **(3 Hrs.)**

Books:

1. D.A. Skoog and D.M. West: Prinicples of Instrumental Methods of Analysis.
2. D.A.Skoog and D.M. West, F.J.Hollar: Fundamentals of Analysis Chemistry.
3. G.W.Ewing: Instrumental Methods of Analysis.
4. H.H. Willard, L.L. Marritt & J.A. Dean: Instrumental Methods of Analysis.

Recommended for Further Readings:

1. B.H. Vassos and G.W.Ewing: Electro Analytical Chemistry.
2. J.A. Plamberk: Electro Analytical Chemistry.
3. H.A. Flaschka, A.J. Barnard and P.E. Strurrock, Analytical Chemistry.

CYL314: Physical Chemistry-IV

Credit: 3-1-0

1. Macromolecules (20 Hrs)

Condensation polymerization, kinetics and statistics of linear stepwise polymerization, molecular weight control, addition polymerization, kinetics of polymerization, degree of polymerization and chain transfer, determination of rates constant, enthalpy, entropy, free energy and activation energy of polymerization. Ionic and condensation polymerization, kinetics of copolymerization, kinetics and rate of copolymerization, mechanism of copolymerization, various types of copolymerization Polmer solutions: criteria for polymer solubility, conformation of dissolved polymer chains, thermodynamics of polymer solutions. Molecular mass determination by osmometry, viscometry, light scattering and gel permeation chromatography. Polymer structure and properties, glass transition temperature (Tg), melting point transition temperature (Tm), structure property relations (general), Synthesis and properties of commercial polymers.

2. Adsorption and Surface Phenomenon (10 Hrs)

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapor pressure of droplets (Kelvin equation), Physiosorption and chemisorption, adsorption isotherms, derivation of Langmuir, Freundlich, Tempkin and BET adsorption isotherms, estimation of surface area by BET equation, Heterogeneous catalysis, surface catalysed unimolecular and bimolecular reactions, Retarded surface reaction, temporary and permanent catalytic poisons, Activation energy for surface reactions, Thin films.

3. Colloidal State (5 Hrs)

Definition & classification of colloids. Solids in liquids (sols): kinetic, optical and electrical properties, stability of colloids, protective action, Hardy-Schulze law, gold number. Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier. Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloids.

4. Physical Properties and Molecular Structure (5 Hrs)

Optical activity, polarization - (Clausius - Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment, dipole moment and structure of molecules, magnetic properties; para-, dia- and ferro- magnetism.

5. Photochemistry (5 Hrs)

Difference between thermal and photochemical processes. Laws of photochemistry; Lambert's Law. Beer's Law. Grotthus–Drapper law. Einstein law of photochemical equivalence. Jablonski diagram depicting various processes occurring in the excited state like fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), Quantum Yield. Kinetics of photochemical reactions. Photolysis of ammonia. Hydrogen- Chlorine and Hydrogen- Bromine reactions. Effect of temperature on photochemical reactions. Photochemical equilibrium. Stren-Volmer equation. Chemiluminescence.

Books Suggested:

1. Hill, T. L. (2012) *Introduction to Statistical Thermodynamics*. Dover.
2. Atkins, P.W. & J. de Paula (2014) *Physical Chemistry*. W. H. Freeman.
3. Laidler, K. J. (1995) *Physical Chemistry*. Oxford University Press.
4. Maron, S. H. & Prutton, C. F. (1965) *Principles of Physical Chemistry*. Collier Macmillan.
5. Tager, A. (1978) *Physical Chemistry of Polymers*. MIR Publisher, Moscow.
6. Billmeyer, F.W. (2007) *Text Book of Polymer Science*. Wiley.
7. Meier, G., Sackman, E. & Grabmaier, J. G. (1975) *Applications of Liquid Crystal.* Springer.
8. Rohtagi–Mukherjee, K. K. (1978) *Fundamentals of Photochemistry*. Wiley.

CYP 304: Physical Chemistry Lab-III

Credit: 0-0-3

Conductometry

1. Titration of a mixture of strong acid (HCl) and weak acid (CH_3COOH) against alkali.
2. Compare the relative strength of acetic acid and mono chloroacetic acid.
3. Titration of $AgNO_3$ with KCl solution.
4. Determine equivalent conductance of a strong electrolyte at several concentrations and hence verify Onsager's equation.

Potentiometry

5. To titrate ferrous ammonium sulphate against potassium dichromate and hence the formal redox potential of Fe^{2+}--Fe^{3+} system.
6. Determine the dissociation constant of given poly basic acid (oxalic/phosphoric acid).

PH metry

7. To determine pKa1 and pKa2 values of given dibasic acid (oxalic acid).
8. To prepare universal buffer solution.

Electrogravimetry

9. To find the content of Cu and Zn in the given mixture.

Flame Photometry

10. To determine the concentration of ions in given solutions.

Refractometry

11. To determine the electron polarization and electron polarizability of given liquids.

Colorimetry

12. To verify Beer Lambert law and determine stability constant of a complex by mole ratio method.
13. To investigate the complex formation between Fe(III) and thio-cyanate ion.

Chemical Kinetics

14. To investigate inversion of cane sugar in the presence of HCl.
15. To study the kinetics of hydrolysis of ethyl acetate by NaOH and determination of energy of activation.

Transport Number

16. Determination of transport numbers of ions of given electrolyte.

Amperometry

17. To determine the Pb^{2+} ion by its titration with $K_2Cr_2O_7$.

Books Recommended:

1. Findlay's Practical Physical Chemistry.
2. Advanced Practical Physical Chemistry by J. B. Jadav.
3. Quantitative Inorganic analysis by Vogel.

CYP305: Inorganic Chemistry Lab – II
Quantitative Analysis

Credit 0-0-3

A. Gravimetric Analysis

1. Determine nickel (II) in a given sample gravimetrically using dimethylglyoxime.
2. Estimate the iron as its ferric oxide from a given solution of ferrous ammonium sulfate gravimetrically.
3. Estimate chromium (III) as its lead chromate.
4. Estimate lead as its lead molybdate gravimetrically.
5. Estimate cobalt as mercury tetraisothiocyanatocobalt (II) [HgCo (NCS)4]n.
6. Determine silver (I) as its chloride gravimetrically.
7. Determine barium (II) as its chromate gravimetrically.
8. Determine cadmium (II) as [Cd(C5H5N)2(SCN)2] gravimetrically.

B. Volumetric Analysis

(1) **Acidimetry and Alkalimetry**

Determination of a mixture of carbonate and hydroxide.

(2) **Oxidation – Reduction Titrations:**

(a) **KMnO4 Titratons.**

(i) Standardisation with sodium oxalate.

(ii) Determination of Fe(II)

(iii) Determination of H2O2

(b) **Ceric Sulphate Titrations:**

(i) Standardisation with Mohr's salt.

(ii) Determination of Cu(II)

(iii) Determination of oxalates.

(c) **K2Cr2O7 Titrations:**

(i) Standardisation with Fe(II)

(ii) Determination of ferric iron (Ferric ammonium sulphate).

(d) **Iodometry and Iodimetry Titrations:**

(i) Standardisation of sodium thiosphate with $K_2Cr_2O_7$ / KIO_3

(ii) Determination of Cu(II)

(iii) Determination of H_2O_2

(iv) Determination of available chlorine in bleaching powder.

(e) **KIO_3 Titrations:**

(i) Determination of copper.

(ii) Determination of hydrazine.

(3) **Precipitation Titrations**

(i) $AgNO_3$ – standardisation by Mohr's method / by using absorption indicator.

(ii) Determination of chloride.

(iii)Volhard's method for chloride determination.

(4) **Complexometric Titrations (EDTA)**

(i) Standardisation of EDTA with $Pb(NO_3)_2$ / $ZnSO_4.7H_2O$

(ii) Determination of Mg^{2+}

(iii) Determination of Ca^{2+} (by substitution method).

(iv) Determination of total hardness of water (permanent and temporary

(v) Determination of Cu^{2+} and Ni^{2+} by using masking reagent.

Book: Vogel's book on Inorganic Quantitative Analysis