



ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ

ಜ್ಞಾನ ಗಂಗಾ, ಕಲಬುರಗಿ-585 106, ಕರ್ನಾಟಕ

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ಕ್ರ.ಸಂ.ಗುವಿಕ/ವಿಮವಿ/ಬಿ.ಓ.ಎಸ್./2019-20/345

ದಿನಾಂಕ: 01/07/19

ಅಧಿಸೂಚನೆ

ವಿಷಯ:-ಸ್ನಾತಕ ರಸಾಯನಶಾಸ್ತ್ರ ಕೋರ್ಸಿನ 5ನೇ ಮತ್ತು 6ನೇ ಸೆಮೆಸ್ಟರನ ಪಠ್ಯಕ್ರಮದಲ್ಲಿ ತಿದ್ದುಪಡಿ ಕುರಿತು.

ಉಲ್ಲೇಖ:-1. ಅಧ್ಯಯನ ಮಂಡಳಿ ಸಭೆಯ ದಿನಾಂಕ 10.12.2018

2. ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಡವಳಿ ಸಂಖ್ಯೆ 11 ದಿನಾಂಕ 27.12.2018

3. ಕುಲಪತಿಗಳ ಅನುಮೋದನೆ ದಿನಾಂಕ 1.7.2019

ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಅನುಮೋದನೆ ಮೇರೆಗೆ ಸ್ನಾತಕ ರಸಾಯನಶಾಸ್ತ್ರ 5ನೇ ಮತ್ತು 6ನೇ ಸೆಮೆಸ್ಟರನ ಪಠ್ಯಕ್ರಮದಲ್ಲಿ ಬದಲಾವಣೆ ಮಾಡಿ ಅಧ್ಯಯನ ಮಂಡಳಿ ಸಭೆಯಲ್ಲಿ ಅನುಮೋದನೆ ಪಡೆಯಲಾಗಿರುತ್ತದೆ.

ಮುಂದುವರೆದು, ಸದರಿ ಪಠ್ಯಕ್ರಮವನ್ನು ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೋದನೆ ನಿರೀಕ್ಷಿಸಿ ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಒಪ್ಪಿಗೆ ಮೇರೆಗೆ 2019-20ನೇ ಸಾಲಿಗೆ ಅನ್ವಯವಾಗುವಂತೆ ಸದರಿ ಕೋರ್ಸುಗಳ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಜಾರಿಗೊಳಿಸಲಾಗಿದೆ.

ಈ ಮಾಹಿತಿಯನ್ನು ಸಂಬಂಧಪಟ್ಟ ಶಿಕ್ಷಕರ ಹಾಗೂ ವಿದ್ಯಾರ್ಥಿಗಳ ಗಮನಕ್ಕೆ ತರಲು ಸೂಚಿಸಲಾಗಿದೆ. ಪಠ್ಯಕ್ರಮದ ವಿವರವನ್ನು ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವೆಬ್‌ಸೈಟ್ www.gug.ac.in ದಿಂದ ಪಡೆಯಬಹುದು.

ಕುಲಸಚಿವರು 01/7

ಗುಲಬರ್ಗಾ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕಲಬುರಗಿ

ಗೆ,

1. ಮುಖ್ಯಸ್ಥರು, ರಸಾಯನಶಾಸ್ತ್ರ ಅಧ್ಯಯನ ವಿಭಾಗ, ಗು.ವಿ.ಕಲಬುರಗಿ
2. ಎಲ್ಲಾ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಂಶುಪಾಲರಿಗೆ

ಪ್ರತಿಗಳು:-

1. ಡೀನ್‌ರು, ವಿಜ್ಞಾನ & ತಂತ್ರಜ್ಞಾನ ನಿಕಾಯ ಗು.ವಿ.ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ
2. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ), ಗು.ವಿ.ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ
3. ನಿರ್ದೇಶಕರು, ಯೋಜನೆ ಮೇಲ್ವಿಚಾರಣೆ ಹಾಗೂ ಮೌಲ್ಯಮಾಪನ ಮಂಡಳಿ ಗು.ವಿ.ಕಲಬುರಗಿ
4. ಗ್ರಂಥಪಾಲಕರು ಗು.ವಿ.ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ
5. ವಿಜ್ಞಾನ & ತಂತ್ರಜ್ಞಾನ ನಿಕಾಯದ ಎಲ್ಲಾ ವಿಭಾಗಗಳ ಮುಖ್ಯಸ್ಥರಿಗೆ
6. ಮುಖ್ಯಸ್ಥರು, ಗಣಕಕೇಂದ್ರ ಗು.ವಿ.ಕಲಬುರಗಿ ಇವರಿಗೆ ಸದರಿ ಪಠ್ಯಕ್ರಮವನ್ನು ವಿಶ್ವವಿದ್ಯಾಲಯದ ವೆಬ್‌ಸೈಟ್‌ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು ತಿಳಿಸಲಾಗಿದೆ.
7. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು/ ಕುಲಸಚಿವರ ಆಪ್ತ ಸಹಾಯಕರ ಗು.ವಿ.ಕಲಬುರಗಿ ರವರ ಮಾಹಿತಿಗಾಗಿ.

NEW

GULBARGA UNIVERSITY, KALABURG
Department of P.G. Studies and Research
in Chemistry

Syllabus for

B. Sc. With Chemistry

CHOICE BASED CREDIT SYSTEM
(CBCS)

With effect from
Academic Year 2018-19



GULBARGA UNIVERSITY



**Distribution of Courses/ Papers in Undergraduates Programme I to VI Semester
B.Sc., CHEMISTRY: SYLLABUS: (Choice Based Credit System) effect from 2018-19**

Semester No.	Code	Title of the Paper	Marks			Teaching hours / week			Credit
			Sem. Exam	IA	Total	L	T	P	
FIRST	AECC-1a	Kannada/MIL-1	80	20	100	2	1	-	3
	AECC-1b	English-1	80	20	100	2	1	-	3
	AECC-1c	Environmental Studies	40	10	50	2	-	-	2
	DSC-CHEM-1A	Chemistry: Atomic structure Chemical periodicity Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	80	20	100	4	-	-	4
	DSC-2A	Botany/Mathematics	80	20	100	4	-	-	4
	DSC-3A	Zoology /Physics	80	20	100	4	-	-	4
	DSC-CHEM -1A	Chemistry Practical	40	10	50	-	-	2	2
	DSC-2A	Botany Practical	40	10	50	-	-	2	2
	DSC-3A	Zoology Practical/ Physics Practical	40	10	50	-	-	2	2
Total Marks for First Semester:					700				26
SECOND	AECC-2a	Kannada/MIL-2	80	20	100	2	1	-	3
	AECC-2b	English-2	80	20	100	2	1	-	3
	AECC-2c	Indian Constitution	40	10	50	2	-	-	2
	DSC-CHEM -1B	Chemistry : Chemical Energetics, Equilibria, s-Blocks elements & Functional Organic Chemistry – I	80	20	100	4	-	-	4
	DSC-2B	Botany/Mathematics	80	20	100	4	-	-	4
	DSC-3B	Zoology /Physics	80	20	100	4	-	-	4
	DSC-CHEM -1B	Chemistry Practical	40	10	50	-	-	2	2
	DSC-2B	Botany Practical	40	10	50	-	-	2	2
	DSC-3B	Zoology Practical/ Physics Practical	40	10	50	-	-	2	2
Total Marks for Second Semester:					700				26
THIRD	AECC-3a	Kannada/MIL-3	80	20	100	2	1	-	3
	AECC-3b	English-3	80	20	100	2	1	-	3
	DSC-CHEM -1C	Chemistry : Solution, Phase Equilibrium, Conductance, Electro Chemistry, p-Block elements & Functional group Organic Chemistry – II	80	20	100	4	-	-	4
	DSC-2C	Botany/Mathematics	80	20	100	4	-	-	4
	DSC-3C	Zoology /Physics	80	20	100	4	-	-	4
	DSC-CHEM -1C	Chemistry Practical	40	10	50	-	-	2	2
	DSC-2C	Botany Practical	40	10	50	-	-	2	2
	DSC-3C	Zoology Practical/ Physics Practical	40	10	50	-	-	2	2
Total Marks for Third Semester:					650				24

FOURTH	AECC-4a	Kannada/MIL-4	80	20	100	2	1	-	3
	AECC-4b	English-4	80	20	100	2	1	-	3
	DSC-CHEM -1D	Chemistry : Co-ordination Chemistry, States of Matter & Chemical Kinetics	80	20	100	4	-	-	4
	DSC-2D	Botany/Mathematics	80	20	100	4	-	-	4
	DSC-3D	Zoology /Physics	80	20	100	4	-	-	4
	DSC-CHEM -1D	Chemistry Practical	40	10	50	-	-	2	2
	DSC-2D	Botany Practical	40	10	50	-	-	2	2
	DSC-3D	Zoology Practical/ Physics Practical	40	10	50	-	-	2	2
Total Marks for Fourth Semester:					650				24
FIFTH	SEC-CHEM-1	Basic Analytical Chemistry	40	10	50	2	-	-	2
	SEC-CHEM -2	Pharmaceutical Chemistry	40	10	50	2	-	-	2
	DSE-CHEM -1	Chemistry : Analytical Methods in Chemistry	80	20	100	4	-	-	4
	DSE-2	Botany/Mathematics	80	20	100	4	-	-	4
	DSE-3	Zoology /Physics	80	20	100	4	-	-	4
	DSE-CHEM -1	Chemistry Practical	40	10	50	-	-	2	2
	DSE-2	Botany Practical	40	10	50	-	-	2	2
	DSE-3	Zoology Practical/ Physics Practical	40	10	50	-	-	2	2
Total Marks for Fifth Semester:					550				22
SIXTH	SEC-CHEM -3	Fuel Chemistry	40	10	50	2	-	-	2
	SEC-CHEM -4	Chemistry of Cosmetics & Perfumes	40	10	50	2	-	-	2
	DSE-CHEM -2	Chemistry : Industrial Chemicals & Environment	80	20	100	4	-	-	4
	DSE-5	Botany/Mathematics	80	20	100	4	-	-	4
	DSE-6	Zoology /Physics	80	20	100	4	-	-	4
	DSE-CHEM -2	Chemistry Practical	40	10	50		-	2	2
	DSE-5	Botany Practical	40	10	50		-	2	2
	DSE-6	Zoology Practical/ Physics Practical	40	10	50		-	2	2
Total Marks for Sixth Semester:					550				22
Total Credits for the Course					3800				144

Note: Course = paper; AECC = Ability Enhance Course; DSC = Discipline Specific Core Course; SEC = Skill Enhancement Course; DSE = Discipline Specific Elective, L = Lecture; T = Tutorial; P = Practical. Additional) 2 credits shall be given for the successfully completion of two years of NSS (144 + 2 = 146). AECC-1c and AECC-2c papers shall be approved by the BOS of Environmental Science and Political Science. CHEM : Chemistry

Tutorial/batch = 20 student, Practical/Batch =10 students. AECC-a and AECC-b papers cover communicative skills. Practical four hours per Week for DSE - Discipline Specific Core Course.

TEACHING HOURS:

SEMESTER	THEORY	PRACTICAL
I to VI DSC/DSE	4 Hours/week	4 (4X1 or 2X2) Hours/ week
V th to VI th - SEC	2Hours/Week	

SCHEME OF EXAMINATIONS:

1. There shall be one question paper each for B.Sc. I, II, III and IV semesters in Chemistry Examinations.
2. There shall be two question papers each for B.Sc. V and VI semesters in Chemistry Examinations.
3. In addition there shall be Practical Examinations as per the University Regulations existing from time to time.

QUESTION PAPER PATTERN:

Each question paper shall contain three sections (**Section-A. Section -B and Section -C**)

Ist Sem to IVth Sem DSC & Vth VI Sem DSE: **Section-A: (15 x 1 = 15 Marks)** - (One marks 15 question all compulsory); **Section-B: (05 x 05 = 25 Marks)** - Five mark 7 questions to be given, candidate has to answer any five question ; **Section-C: (08 x 05 = 40 Marks)** - Eight marks 7 question to be given (single question or bit question) Candidate has to answer any five questions

Vth Sem to VIth Sem SEC

Section-A: (09 x 1 = 09 Marks) - One marks 09 question all compulsory ; **Section-B: (05 x 03 = 15 Marks)** - Five mark 4 question to be given, candidate has to answer any 3 question ; **Section-C: (08 x 02 = 16 Marks)** - eight marks 3 question to be given (single question or bit question) Candidate has to answer any two questions

SCHEME OF MARKING.

Each theory paper is of 100 marks.

SEMESTER	THEORY	EXAM. HOURS	MARKS	INTERNAL ASSESSMENT	TOTAL MARKS
I to IV - DSC	Paper-I, II, III and IV	3 hours	80 marks	20 Marks	100 Marks
V and VI DSE	Paper -V and VI	3 hours	80 marks	20 Marks	100 Marks
V and VI SEC	Paper -V and VI	2 hours	40 marks	10 Marks	50 Marks

DISTRIBUTION OF MARKS FOR PRACTICAL EXAMINATION:

Each practical is of 50 marks and of three hours duration.

EXPERIMENT	JOURNAL	VIVA -VOCE	INTERNAL ASSESSMENT	TOTAL MARKS
30Marks	05 marks	05 marks	10 marks	50 marks

Note: The internal assessment marks for DSC and DSE theory paper shall be **twenty** marks and for SEC theory paper shall be 10 marks. Internal assessment marks for practicals will be **ten**.

Note: The candidate should produce the certified journal at the time of each semester examination.

In case the candidate fails to submit the certified journal, the laboratory supervisor should give the certificate in this regard. However, no marks shall be given for such certificates.

Semester I

CHEMISTRY-
ATOMIC STRUCTURE, CHEMICAL PERIODICITY, BONDING, GENERAL
ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS
(Credits: Theory-04, Practicals-02)

DSC- CHEM- 1A:

Theory: 60 Lectures

Section A: Inorganic Chemistry-I (30 Periods)

Atomic Structure: Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra.

Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s . Shapes of s , p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Chemical Periodicity

Introduction, periodic laws, long form of periodic table, cause of periodicity, recurrence of properties classification of elements in to s , p , d and f blocks. Periodic properties- atomic radius, ionic radius, covalent radius, Vander Wall's radius, ionization energy, electron negativity and electron affinity. Variation of the periodic properties along a period and along a group, explanation for the observed trends and factors determining ionization energies

(14 Lectures)

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for $s-s$, $s-p$ and $p-p$ combinations of atomic orbitals, nonbonding combination

of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+ . Comparison of VB and MO approaches.

(16 Lectures)
(30 Periods)

Section B: Organic Chemistry-I

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

(8 Lectures)

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis-trans* nomenclature; CIP Rules: R / S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

(10 Lectures)

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); *cis* alkenes (Partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions:* *cis*-addition (alk. KMnO_4) and *trans*-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis and oxidation with hot alk. KMnO_4 .

(12 Lectures)

Reference Books:

- Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
- Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

CHEMISTRY LAB: DSC- CHEM- 1A LAB:
ATOMIC STRUCTURE, CHEMICAL PERIODICITY, BONDING, GENERAL
ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS 60 Lectures

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.
6. Estimate the amount of Zn by EDTA solution
7. Estimate the amount of Ca by Standard EDTA solution.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)

- (a) identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
- (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

Semester II

CHEMISTRY- DSC - CHEM- 1B:
CHEMICAL ENERGETICS, EQUILIBRIA S- BLOCK ELEMENTS & FUNCTIONAL ORGANIC CHEMISTRY- I

(Credits: Theory-04, Practicals-02)

Theory: 52 Lectures
(30 Lectures)

Section A: Physical Chemistry-I
Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

(10 Lectures)

Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

(12 Lectures)

Section B: Inorganic Chemistry-2

(08 Lectures)

s-block elements:

Alkali metals: Comparative study of properties of Group 1 elements with respect to their physical properties- electronic configuration, Hardness and softness, melting point and boiling point, density, metallic character, ionization energy, electropositive character, oxidation states, flame colouration. Chemical properties with respect to halides, oxides, super oxides, hydroxides and peroxides.

Alkaline earth metals: Comparative study of properties of group 2 elements with respect to their physical properties- electronic configuration, hardness, softness, densities, melting point and boiling point, metallic character, oxidation states, flame colouration. Chemical properties with respect to hydrides, halides, oxides, super oxides, hydroxides and peroxides.

Section C: Organic Chemistry-2

(30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

(8 Lectures)

Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (S_N1 , S_N2 and S_Ni) reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides **Preparation:** (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by $-OH$ group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

(8 Lectures)

Alcohols, Phenols and Ethers (Upto 5 Carbons)

Alcohols: **Preparation:** Preparation of 1° , 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation **Diols:** (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, NaHSO₃, NH₂-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf Verley reduction.

(14 Lectures)

Reference Books:

- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

CHEMISTRY LAB- CHEMICAL ENERGETICS, EQUILIBRIA S- BLOCK ELEMENTS & FUNCTIONAL ORGANIC CHEMISTRY- I

DSC - CHEM- 1B LAB:

60 Lectures

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO₃, NH₄Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of H .

Ionic equilibria

pH measurements

- a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
- b) Preparation of buffer solutions:
 - (i) Sodium acetate-acetic acid
 - (ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Surface Tension and Viscosity (Use carcinogenic solvents excluded)

1. Determine the viscosity of a given liquid using Ostwald's viscometer and determine the density of given liquid
2. Determine the surface tension of a given liquid sample/compound using stalagmometer and determine the density of liquid

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.
Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
 - (a) Bromination of Phenol/Aniline
 - (b) Benzoylation of amines/phenols
 - (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Reference Books

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

Semester III

CHEMISTRY- DSC - CHEM- 1C:
SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY,
p-BLOCKS ELEMENTS & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II
(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Section A: Physical Chemistry-2

(30 Lectures)

Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

(8 Lectures)

Phase Equilibrium

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $\text{FeCl}_3\text{-H}_2\text{O}$ and Na-K only).

(8 Lectures)

Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

(6 Lectures)

Electrochemistry

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G , H and S from EMF data.

Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

(8 Lectures)

(06 Lectures)

Section B: Inorganic Chemistry-3

p-block elements :

Compounds of Boron : Preparation, properties, structure and uses of borazole, and diborane

Halogens: Interhalogens - Preparation, properties. Structure and uses of interhalogens of the type AB , AB_3 , AB_5 and AB_7 .

Pseudo halogens - Preparation and properties of cyanogens and thiocyanogen

Section C: Organic Chemistry-3

(24 Lectures)

Amines and Diazonium Salts

Amines (Aliphatic and Aromatic): (Upto 5 carbons)

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2 , Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: *Preparation:* from aromatic amines.

Reactions: conversion to benzene, phenol, dyes.

Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of $-COOH$ group, acetylation of $-NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.

(10 Lectures)

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

(8 Lectures)

Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry* 7th Ed., W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

**CHEMISTRY LAB-
SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY,
p-BLOCKS ELEMENTS & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II**

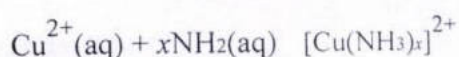
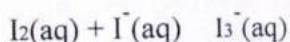
DSC- CHEM- - 1C LAB:

60 Lectures

Section A: Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method:



Phase equilibria

- Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
- Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
- Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

- Determination of cell constant
- Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- Perform the following conductometric titrations:
 - Strong acid vs. strong base
 - Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:

- Strong acid vs. strong base
- Weak acid vs. strong base
- Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II

- Separation of amino acids by paper chromatography
- Determination of the concentration of glycine solution by formylation method.
- Titration curve of glycine
- Action of salivary amylase on starch
- Effect of temperature on the action of salivary amylase on starch.
- Differentiation between a reducing and a nonreducing sugar.

Reference Books:

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press.

Semester IV

CHEMISTRY- DSC- CHEM- 1D: COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS (Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Transition Elements (3d series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

(12 Lectures)

Coordination Chemistry

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Drawbacks of VBT. IUPAC system of nomenclature.

(8 Lectures)

Crystal Field Theory

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonal distortion of octahedral geometry.

Jahn-Teller distortion, Square planar coordination.

(10 Lectures)

Section B: Physical Chemistry-3

(30 Lectures)

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO₂.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

(8 Lectures)

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

(6 Lectures)

Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

(8 Lectures)

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

(8 Lectures)

Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.

- Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
- Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
- Rodgers, G.E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd., 2008.

CHEMISTRY LAB- DSC- CHEM- 1D LAB:
COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS

60 Lectures

Section A: Inorganic Chemistry

Semi-micro qualitative analysis of mixtures (using H₂S) - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH₄⁺, Pb²⁺, Ag⁺, Bi³⁺, Cu²⁺, Cd²⁺, Sn²⁺, Fe³⁺, Al³⁺, Co²⁺, Cr³⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺

Anions : CO₃²⁻, S²⁻, SO₃²⁻, S₂O₃²⁻, NO₃⁻, CH₃COO⁻, Cl⁻, Br⁻, I⁻, NO₂⁻, SO₄²⁻, PO₄³⁻, BO₃³⁻, C₂O₄²⁻, F⁻

(Spot tests should be carried out wherever feasible)

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximate) nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Draw calibration curve (absorbance at λ_{max} vs. concentration) for various concentrations of a given coloured compound (KMnO₄/ CuSO₄) and estimate the concentration of the same in a given solution.
3. Determine the composition of the Fe³⁺-salicylic acid complex solution by Job's method.
4. Estimation of (i) Mg²⁺ or (ii) Zn²⁺ by complexometric titrations using EDTA.
5. Estimation of total hardness of a given sample of water by complexometric titration.
6. Determination of concentration of Na⁺ and K⁺ using Flame Photometry.

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

- a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

- a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
 - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
 - b. Saponification of ethyl acetate.
 - c. Compare the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate
 - d.

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

Semester V

CHEMISTRY- BASIC ANALYTICAL CHEMISTRY (Credits: 02)

SEC- CHEM- - 1
30 Lectures

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement. Complexometric titrations, Chelation, Chelating agents, use of indicators

- a. Determination of pH of soil samples.
- b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

- a. Determination of pH, acidity and alkalinity of a water sample.
- b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

- a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
- b. Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

- a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).
- b. To compare paint samples by TLC method. **Ion-**

exchange: Column, ion-exchange chromatography etc.

Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Suggested Instrumental demonstrations:

- Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
- Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
- Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

Reference Books:

- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry* 6th Ed., Saunders College Publishing, Fort Worth (1992).
- Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
- Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
- Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
- Freifelder, D. *Physical Biochemistry* 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
- Vogel, A. I. *Vogel's Qualitative Inorganic Analysis* 7th Ed., Prentice Hall.
- Vogel, A. I. *Vogel's Quantitative Chemical Analysis* 6th Ed., Prentice Hall.
- Robinson, J.W. *Undergraduate Instrumental Analysis* 5th Ed., Marcel Dekker, Inc., New York (1995).

CHEMISTRY-

SEC- CHEM- - 2

PHARMACEUTICAL CHEMISTRY (Credits: 02)

Theory: 30 Lectures

Drugs & Pharmaceuticals

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin. (iii) Lysine. Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Practicals

- Preparation of Aspirin and its analysis.
- Preparation of magnesium bisilicate (Antacid).

Reference Books:

- G.L. Patrick: Introduction to *Medicinal Chemistry*, Oxford University Press, UK.
- Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi.
- William O. Foye, Thomas L., Lemke, David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi.

CHEMISTRY-

DSE- CHEM- 1 :

ANALYTICAL METHODS IN CHEMISTRY

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

1. Qualitative and quantitative aspects of analysis:

Evaluation of Analytical Data:

Introduction, errors, accuracy and precision, classification of errors, systematic or determinate errors, random or indeterminate errors, minimization of errors, significant figures and computations, mean, median and standard deviations, reliability of results, rejection of results, Methods of reporting analytical data.

10 lectures

2. Gravimetric Analysis:

General principles, completion of precipitation. co-precipitation and post-precipitation, digestion (ageing), filtration, washing of precipitates, drying and igniting precipitates cooling and weighing of the product Precipitate. Types of filter papers, types of crucibles, general errors and precautions in gravimetric analysis, a few common gravimetric determinations-iron as ferric oxide in ferrous ammonium sulphate solution, sulphate as barium sulphate in ammonium sulphate solution.

10 Lectures

3. Spectroscopic analysis:

Introduction, advantage of spectroscopic methods. Principle, and applications of UV-VIS, IR, NMR spectroscopy in organic analysis. Meaning of the terms chromophore, auxochromophore, bathochromic and hypsochromophoric shifts with examples. Functional, Equivalent and non-equivalent protons, chemical shift, spin-spin coupling, (n+1) rule, Shielding and deshielding of protons in NMR spectroscopy

8 lectures

4. Organometallic Compounds :

The Grignard reagent : synthesis and application of methyl magnesium iodide. Reformatsky reaction

03 lectures

5. Organo Sulphur Compounds :

Thiol: Nomenclature, methods of formation and chemical reactions of thiols (Ethane thiol may be taken as example).

Thioethers- Nomenclature, methods of preparation and chemical reactions (Diethyl sulphide may be taken as example).

04 lectures

6. Heterocyclic Compounds :

Definition and classification, methods of synthesis and reactions (nucleophilic and electrophilic substitute reactions) of furan, thiophene pyrrole and pyridine. Aromatic character of the above compounds (with molecular orbital picture).

05 lectures

7. Colligative properties :

Definition and examples

Osmosis and Osmotic Pressure: Semi permeable membrane, natural and artificial semi permeable examples. Osmosis and osmotic pressure- determination of osmotic pressure by Berkeley and Hertley's method. Theory of dilute solutions. Laws of osmotic pressure. relationship between molecular mass and osmotic pressure, isotonic solutions.

Lowering of vapour Pressure : Concept of vapour pressure, Raoult's Law, relative lowering of vapour pressure of solvent, its determination by dynamic method (Oswald's & Walker). Calculation of molecular mass from relative lowering of vapour pressure.

Elevation in boiling point: definition and its relationship with relative lowering of vapour pressure (to be derived from Clepeyron-Clausius equation). Ebullioscopic constant of solvent, relationship between molar mass and elevation in boiling point. Determination of molar mass of solute by Land Berger's method. .

Depression in freezing point: Definition and its relationship to the lowering of vapour pressure, cryoscopic constant of the solvent ,relation between depression in freezing point and molecular mass of solute(to be derived from Clepeyron- Claussius equation), determination of molecular mass of solute by cryoscopic method.

10 Lectures

8 Thermodynamics - II:

Limitation of First law (need of second law). Spontaneous process

With examples. Different statements of second law of thermodynamics. Carnot's cycle, efficiency of the heat engine, carnot's theorem , concept of entropy, entropy as a state function, Gibb's and Helmholtz free energy functions, Gibb's free energy function - useful work, significance of free energy change - Derivation of Gibb's Helmholtz equation. Clapeyron - Clausius equation and its applications. Third law of thermodynamics, Nernst heat theorem, statement and concept of residual entropy.

10 Lectures

PRACTICALS-
ANALYTICAL METHODS IN CHEMISTRY

DSE - CHEM- LAB:

60 Lectures

I Inorganic Chemistry :

Gravimetric estimations:-

1. Estimation of iron as ferric oxide in ferrous ammonium sulphate solution.
2. Estimation of barium as barium sulphate in barium chloride solution
3. Estimation of sulphate as barium sulphate in ammonium sulphate solution.

4. Estimation of nickel as nickel dimethyl glyoximate in nickel sulphate solution.
5. Estimation of Magnesium as oxinate in magnesium sulphate solution.
6. Estimation copper as cuprous thiocyanate in copper sulphate solution.

II Spectrophotometry

1. Determination of pK_a values of indicator using spectrophotometry.
2. Structural characterization of compounds by infrared spectroscopy.

III Instrumental methods of analysis - I

1. Conductometric titration of mixture of acids against strong base
2. Conductometric precipitation titration of sodium chloride against silver Nitrate
3. Determination of amount of cu^{+2} in $CuSO_4$ solution and verify Beer Lambert's law.
4. Determine the specific and molar refractivity of two given liquids by Abbe refractometer and determine the densities of two given liquids.
5. Estimation of HCl by titrating with standard NaOH potentiometrically.
6. Estimate the amount of iron in ferrous ammonium sulphate by titrating with std. Potassium dichromate solution potentiometrically.
7. Potentiometric titration of dibasic acid with strong base.
8. Determination of amount of sodium chloride in the given solution potentiometric titration against silver nitrate
9. Determine the specific rotation of cane sugar solution using polarimeter.

Reference Books:

- Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Christian, Gary D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, Daniel C: *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
- Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

Semester VI

CHEMISTRY-

SEC- CHEM- 3

FUEL CHEMISTRY (Credits: 02)

30 Lectures

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pour point) and their determination.

Reference Books:

- Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
- Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

CHEMISTRY-

CHEMISTRY OF COSMETICS & PERFUMES (Credits: 02)

SEC CHEM- 4

30 Lectures

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practicals

1. Preparation of talcum powder.

2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
- P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

CHEMISTRY-

DSE- CHEM -2 :

INDUSTRIAL CHEMICALS AND ENVIRONMENT

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

UNIT : I : INDUSTRIAL CHEMISTRY

1. Cement:

06 Lectures

Introduction, definition, raw materials, grades of cement. Manufacture of Portland cement (by dry and wet process). Mechanism of setting of cement. Types of cement and their uses. R C C

2. Ceramics, Refractories and glass:

07 Lectures

Ceramics: Introduction, classification –clay definition, properties and uses.
Refractories : classification – acid, base and neutral refractories

Glass: Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical glasses and polycarbonate glass, safety glass, fire and bullet proof glass.

3. Paints, Pigments and Varnishes:

07 Lectures

Paints : Introduction, requirement of paints, constituents of paints, formulation of paints, failure of paints films (reasons), emulsion paints, manufacture of white lead using Dutch process and uses.

Pigments: Red pigments, white pigments.

Varnishes: Spirit and Oil Varnishes.

UNIT : II : ORGANIC CHEMISTRY

1. Oils, Fats , Soaps And Detergents :

04 Lectures.

Composition of oils and fats. Determination of saponification value and iodine value of oils and fats. Manufacture of soaps (hydrolyser process). Synthetic detergents (Syndets) manufacture of sodium lauryl sulphate and sodium do decyl benzene sulphonate. Cleansing action of soaps.

2. Synthetic Polymers :

02 Lectures

Classification with examples, synthesis and uses of low density and high density polyethene, poly vinyl chloride, nylon 6, nylon 6,6, bakelite and terylene.

3. Synthetic Dyes :

02 Lectures

Introduction, classification based on structure, chromophore theory of colour and constitution, Synthesis of congo red, bismarck brown, malachite green and alizarin.

4. Alkaloids :

03 Lectures

Introduction, classification with examples, general methods of structural elucidation, Hofmann exhaustive methylation with pyridine as example. Synthesis and elucidation of structure of nicotine. Structural formula and uses of Quinine and Atropine.

5. Terpenes :

03 Lectures

Occurrence, classification, Isoprene rule, special Isoprene rule, isolation of Terpenes, synthesis and general methods of structural elucidation, structural elucidation of Citral. Structural formula and uses of menthol, α -pinene and camphor.

6. Hormones and Vitamins :

04 Lectures.

Hormones: Introduction, classification with examples. Hormone secreting glands. Synthesis and importance of Adrenaline and thyroxin. Biological importance of insulin and oxytocin.

Vitamins: Introduction, classification with examples, synthesis of vitamin C.

Biological importance of vitamins A, B1, B2, B6, C, and D

7. Protection and deprotection :

02 Lectures.

Protection and deprotection of the following functional groups amino, hydroxyl, carboxyl and carbonyl groups (one reagents for each group).

UNIT : III : PHYSICAL CHEMISTRY.

1 Molecular spectroscopy:

13 Lectures.

Electromagnetic radiation, regions of the spectrum. Basic features of different spectrometers, statement of Born-Oppenheimer approximation, degrees of freedom.

Rotational spectrum: Diatomic molecule, energy levels of a rigid rotator (semi-classical principles), spacing of spectral lines, selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution), determination of bond length, qualitative description of non-rigid rotator, isotopic effect. Problems.

Vibrational spectrum: Infrared spectrum:-Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant, qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum. Problems. Raman spectrum: Pure rotational and pure vibrational Raman spectra of diatomic molecules.

1. Electrochemical energy sources.

03 Lectures

Primary cell (Dry cell) Secondary cell (lead storage cell and Nickel-cadmium cell), Fuel cells, construction and working of Hydrogen- oxygen fuel cell and its importance.

2. Radiation Chemistry:

04 Lectures

Introduction, units of radiation, dosimeters-Fricke dosimeter and Ceric sulphate dosimeter. Isotopes - Use of radio Isotopes in Tracer technique, Agriculture, Medicine, Food Preservation, and carbon dating.

CHEMISTRY PRACTICAL - LAB: INDUSTRIAL CHEMISTRY

DSE - CHEM- 2:

60 Lectures

Organic Chemistry:

Qualitative analysis of binary mixture containing two solid compounds, separation using NaHCO_3 , NaOH and HCl . Identification of mixture, separation of mixture and analysis of any one component with preparation of derivative.

Acids-Benzoic, Salicylic, Cinnamic and phthalic acid.

Phenols:- 1-Naphthol, 2-Naphthol and resorcinol.

Bases:-P-Toluidine, O-Toluidine, m-Toluidine, Nitro anilines

Neutral:-Naphthalene, Diphenyl, m-dinitrobenzene, Acetanilide.

The mixture is of A+B, A+N, P+B, P+N and B+N

Physical Chemistry :

Instrumental methods of Analysis - II

1. Determination of degree of dissociation of weak electrolyte.
2. Determination of dissociation constant (K_a) of weak electrolyte.
3. Determination of equivalent conductance at infinite dilution of strong electrolyte.
4. Determination of solubility and solubility product of a sparingly soluble salt (say BaSO_4 , AgCl , AgBr) by conductance method.
5. Determine the amount of Iron in FeCl_3 solution and verify the Beer-Lambert's law.
6. Determine the percentage composition of liquid mixture (carbon tetrachloride and benzene) by formula method using Abbe refractometer.
7. Determine the percentage composition of liquid mixture (carbon tetrachloride and benzene) by graphical method using Abbe refractometer.
8. Determine the pH of the following biological juices
(i) milk (ii) orange juice (iii) lime water (iv) citrus acid solution
and (v) sodium carbonate
9. Prepare a standard 0.2M Na_2HPO_4 and 0.1M citric acid solution, hence prepare Different buffer solutions and determine pK_a values of these unknown solutions.
10. Determine the pK_a values of given acid by pH metric titration with strong base.
11. Determine the percentage of cane sugar or tartaric acid solution using polarimeter.