KUVEMPU UNIVERSITY

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Chemistry Syllabus for B.Sc. Course- 2016

(SEMESTER SCHEME)

(w.e.f. June - 2016)

2016

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PREFACE

Science and Science education plays an important role in the development of any modern society. An effective science education can be imparted at the undergraduate level only by revamping the present curriculum and teaching to make it effective and meaningful. For this, the curriculum should be composed, giving emphasis to various aspects such as the creativity of students, awareness of basic knowledge of science, especially chemistry because chemistry is a border science to biology, physics and engineering and many other branches of science. Hence the syllabus of undergraduate courses in chemistry is prepared to give sound knowledge, understanding of chemistry. The goal of the syllabus is to make the study of chemistry stimulating, relevant and interesting. The syllabus is prepared with a view to equipping the students to contribute their knowledge and skills to academic and industrial environments and also will expose students to various fields in chemistry and in the related disciplines. The emphasis is given in the syllabus for training the students in laboratory skills and instrumentation.

This new syllabus has been prepared in a participatory manner, after discussions with a number of faculty members in the subject and also after evaluating the existing syllabi of B.Sc., the new syllabi of XI and XII standards and U.G.C. model curriculum and the syllabi of other Universities. The units of the syllabus are well defined and the scope of each is given in detail. The number of contact hours required for each unit is also given. A list of reference books is provided at the end of each unit.

OBJECTIVES

- To expose students into various fields in chemistry and to understand basic facts and concepts in Chemistry, to develop interest in the study of chemistry, and advanced aspects of related disciplines.
- To acquire the knowledge of terms, facts, concepts, techniques and principles of the subject and to develop the ability to apply skills in the proper handling of apparatus and chemicals.
- To develop problem solving skills.
- To be familiarized with the emerging areas of Chemistry their applications in various areas of Chemical sciences and empower students to meet the challenges of tomorrow.

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Pattern and Scheme of Examination under Semester Scheme approved by UG-BOS in Chemistry held on 25-11-2015.

: SYLLABUS PATTERN :	
First Semester: **Paper-I; CHEMISTRY - I (60 hours)** **(15 hours/unit, 04 hours/week)** **Theory:** Unit-I: Analytical Chemistry Unit-II: Inorganic Chemistry Unit-III: Organic Chemistry Unit-IV: Physical Chemistry **Practical:** Paper-I (03 hours/week)	**Second Semester:** **Paper-II; CHEMISTRY - II (60 hours)** **(15 hours/unit, 04 hours/week)** **Theory:** Unit-I: Analytical Chemistry Unit-II: Inorganic Chemistry Unit-III: Organic Chemistry Unit-IV: Physical Chemistry **Practical:** Paper-II (03 hours/week)
Third Semester: **Paper-III; CHEMISTRY - III (60 hours)** **(15 hours/unit, 04 hours/week)** **Theory:** Unit-I: Analytical Chemistry Unit-II: Inorganic Chemistry Unit-III: Organic Chemistry Unit-IV: Physical Chemistry **Practical:** Paper-III (03 hours/week)	**Fourth Semester:** **Paper-IV; CHEMISTRY - IV (60 hours)** **(15 hours/unit, 04 hours/week)** **Theory:** Unit-I: Analytical Chemistry Unit-II: Inorganic Chemistry Unit-III: Organic Chemistry Unit-IV: Physical Chemistry **Practical:** Paper-IV (03 hours/week)
Fifth Semester: **Paper-V; CHEMISTRY - V (45 hours)** **(15 hours/unit, 03 hours/week)** **Theory:** Unit-I: Analytical Chemistry Unit-II: Inorganic Chemistry Unit-III: Organic Chemistry **Practical:** Paper-V (03 hours/week)	**Fifth Semester:** **Paper-VI; CHEMISTRY - VI (45 hours)** **(15 hours/unit, 03 hours/week)** **Theory:** Unit-I: Physical Chemistry Unit-II: Analytical Chemistry Unit-III: Inorganic Chemistry **Practical:** Paper-VI (03 hours/week)
Sixth Semester: **Paper-VII; CHEMISTRY - VII (45 hours)** **(15 hours/unit, 03 hours/week)** **Theory:** Unit-I: Organic Chemistry Unit-II: Physical Chemistry Unit-III: Analytical Chemistry **Practical:** Paper-VII (03 hours/week)	**Sixth Semester:** **Paper-VIII; CHEMISTRY - VIII (45 hours)** **Theory:** Unit-I: Inorganic Chemistry Unit-II: Organic Chemistry Unit-III: Physical Chemistry **Practical:** Paper-VIII (03 hours/week)

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Examination Pattern

: EXAMINATION PATTERN :											
THEORY						PRACTICALS					Grand Total
Semester	Paper	Duration	Max. Marks	IA	Total	Paper	Duration	Max. Marks	IA	Total	
I	Paper-I	3 hours	50	10	60	Paper-I	3 hours	40	-	40	100
II	Paper-II	3 hours	50	10	60	Paper-II	3 hours	40	-	40	100
III	Paper-III	3 hours	50	10	60	Paper-III	3 hours	40	-	40	100
IV	Paper-IV	3 hours	50	10	60	Paper-IV	3 hours	40	-	40	100
V	Paper-V Paper-VI	3 hours 3 hours	50 50	10 10	60 60	Paper-V Paper-VI	3 hours 3 hours	40 40	-	40 40	200
VI	Paper-VII Paper-VIII	3 hours 3 hours	50 50	10 10	60 60	Paper-VII Paper-VIII	3 hours 3 hours	40 40	-	40 40	200

Theory (Final exam)	Internals	Practical	Total Marks:
400	80 (For each paper, two IA's (Tests) per semester, each carrying 20 marks and averaged to 10 marks)	320	I to VI SEMESTER 800

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Question paper pattern for FIRST to FOURTH Semesters

***Instructions*:**

a) The question paper contains three parts, Part-A, B, C and D.

b) Part-A (1 mark questions), Part-B (2 marks questions), Part-C (4 marks questions) and Part-D (8 marks questions).

c) Examination duration = 3 hours; Maximum marks = 50.

PART-A

Answer the following in a word, phrase or a sentence. 8×1=8

Q. 1. a
b
c
d
e
f
g
h

PART-B

Answer any FIVE of the following questions. 5×2=10

Q. 2. a
b
c
d
e
f
g
h

PART-C

Answer Any FOUR of the following questions. 4×4=16

Q. 3.
Q. 4.
Q. 5.
Q. 6.
Q. 7.
Q. 8.

PART-D

Answer Any TWO of the following questions. **2×8=16**

Q. 09.

Q. 10.

Q. 11.

Q. 12.

NOTE: Question paper setting pattern (Instructions to question paper setters)

Part-A & B: Question no. 1 and 2: TWO questions shall be selected from each Unit.

Part-C: Minimum ONE question shall be selected from each Unit. Each Question carries 4 Marks.

Part-D: One question shall be selected from each Unit. Each question carries 8 Marks. Subdivisions, if required, should not exceed a) & b) with a marks distribution of 3+5 or 4+4.

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Question paper pattern for FIFTH and SIXTH Semesters

***Instructions*:**

a) The question paper contains three parts, Part-A, B, C and D.

b) Part-A (1 mark questions), Part-B (2 marks questions), Part-C (4 marks questions) and Part-D (8 marks questions).

c) Examination duration = 3 hours; Maximum marks = 50.

PART-A

Answer the following in a word, phrase or a sentence. 8×1=8

R. 1. a
b
c
d
e
f
g
h

PART-B

Answer any FIVE of the following questions. 5×2=10

Q. 2. a
b
c
d
e
f
g
h

PART-C

Answer Any FOUR of the following questions. 4×4=16

Q. 3.
Q. 4.
Q. 5.
Q. 6.
Q. 7.
Q. 8.

PART-D

Answer Any TWO of the following questions. **2×8=16**

Q. 09.

Q. 10.

Q. 11.

Q. 12.

NOTE: Question paper setting pattern (Instructions to question paper setters)

Part-A & B: Question no. 1 and 2: Minimum TWO questions shall be selected from each Unit.

Part-C: Minimum ONE question shall be selected from each Unit. Each Question carries 4 Marks.

Part-D: Minimum ONE question shall be selected from each Unit. Each question carries 8 Marks. Subdivisions, if required, should not exceed a) & b) with a marks distribution of 3+5 or 4+4.

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FIRST SEMESTER

PAPER-I: CHEMISTRY - I — Total Hours: 60

UNIT - I: ANALYTICAL CHEMISTRY — Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Theory of Titrimetric Analysis — 12 hours (16 marks weightage)

Introduction, principles of titrimetric analysis, requirement of titrimetric analysis, definition of equivalent weight, acidity, basicity, primary and secondary standards. Requirement of a primary standard solution, units of standard solutions (normality, molarity, molality, mole fraction, ppm).
Classification of titrimetric analysis-Acid base titration: Types-explanation with titration curves, indicators used in acid base titrations, Ostwald's theory of acid-base indicator taking phenolphthalein and methyl orange as examples, choice of acid-base indicator.
Redox titration- theory of redox indicators with reference to diphenylamine, roll of o-phosphoric acid in redox titration,
Complexometric titrations-Definitions, metal indicators, principles and theory, types of EDTA titrations, estimation of Zn^{2+} using EDTA.
Iodometric titrations-principle, applications-estimation of copper, estimation of available chlorine in bleaching powder.

Chapter-2: Introduction to qualitative analysis of inorganic salts

3 hours (04 marks weightage)

Common ion effect, solubility products, principle. Application of common ion effect and solubility products, principle in qualitative analysis.

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch VIII Edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, V Ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, VI Edition, 1993, Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, VI Edition, Third Indian Reprint. 2003. Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, II Edition, Saunders College Publishing, California, 1990.

UNIT - II: INORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Atomic structure 9 hours (12 marks weightage)

Wave nature of electron-de Broglie equation. Heisenberg uncertainty principle. Schrodinger wave equation (no derivation). Significance of Ψ and Ψ^2 –atomic orbitals, Eigen values and eigen function, radial angular wave function and probability distribution curve for 1s,2s,2p,3s and 3p orbitals.

Quantum numbers and their significance. Shapes of s, p and d-orbitals and their nodal planes. Assigning of quantum number to a given electron in an atom (I and II period elements) in the periodic table. Energy level diagrams of polyelectron system, shielding or screening effect of inner shell electron on valence electron, factors affecting the magnitude of screening effect, effective nuclear charge, applications of effective nuclear charge, screening effect based on Slater's rule- problems to be solved.

Chapter-2: Periodic properties 6 hours (8 marks weightage)

Ionization energy: Explanation, factors affecting the magnitude of ionization energy, variation of ionization energy in a group and period. Successive ionization energies, effect of ionic size and electronic configuration (III period), applications.

Electron affinity: Definition, factors affecting the magnitude of electron affinity, variation of electron affinity in a group and period, explanation for the observed trend, applications.

Electronegativity: Definition, explanation, factors influencing electronegativity variation in a group and period, explanation for the observed trend, Anomalies to be accounted, Pauling scale and Mulliken's scale of electronegativity (Problems to be solved), applications.

References:

1. Principles of Inroganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
2. Advanced Inorganic Chemistry by Gurudeep Raj and Chatwal Anand.
3. Modern Inorganic Chemistry by R.D. Madan.
4. Advanced Inorganic Chemistry by Sathyaprakash.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, IV Edition, Pearson Education, India, 2006.
6. F. A. Cotton, G. Wilkinson, C. M. Murillo and M. Bochmann, Advanced Inorganic Chemistry, VI Edn, John Wiley and Sons, Inc., New York, 1999.

UNIT - III: ORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Structure and bonding in organic molecules. 4 hours (5 marks weightage)

Nature of chemical bonding, covalent, ionic, hydrogen bonding with examples. Orbit and orbital, shapes of s and p orbital's. Concept of hybridization in carbon atom. Shape, structure, bond length, bond angle, bond energies of methane and ethane, ethene and ethyne.

Chapter-2: Basic concepts in mechanism of organic reactions

5 hours (7 marks weightage)

Types of reactions: addition, elimination, substitution, rearrangement reactions with suitable examples. Types of reagents: electrophilic reagents, nucleophilic reagents. Electronic effects: inductive, electromeric, mesomeric, hyper conjugation. Resonance-rules for writing resonance. Arrow notation: curved arrow, single headed, double headed, and half headed arrow. Cleavage of bond- homolytic and heterolytic with example.

Reactive intermediates- formation, structure and stability of free radicals, carbocation, carbanion, carbene, nitrene with examples.

Chapter-3: Alkanes. 3 hours (4 marks weightage)

Nomenclature.Methods of preparation- Kolbe's synthesis, Corey-House synthesis, from Grignard reagents. Mechanism of chlorination of ethane.

Chapter-4: Cycloalkanes. 3 hours (4 marks weightage)

Nomenclature.Methods of preparation- Freund's method, Wisticenus method.

References:

1. Organic Chemistry, Bahl and Arun Bahl, S. Chand and Sons, New Delhi, 2005.
2. Organic Chemistry, R. T. Morrison and R. N. Boyd, VI Edition, Printice-Hall of India Limited, New Delhi, 1992.
3. Organic Chemistry, B. Y. Paula, III Edition, Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002.
4. Textbook of Organic Chemistry, P S Kalsi, Mac Millan, 2000.

UNIT - IV: PHYSICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter - 1: Mathematical Concepts in Chemistry (*A brief review*)

3 hours (3 marks weightage)

Logarithmic relations, Definitions: Some important relations like log (m×n), log (m/n), log (base changing), application in the calculation of *p*H. Differentiation of functions like e^x, x^n, sinx, logx; maxima and minima. partial differentiation. Exact & in-exact differentials. Examples from internal energy, enthalpy, Partial differentiation – explanation using H = U + PV and G = H – TS., Integration –meaning and integrals of some important functions like x, dx, 1/x, x^2, x^n, 1/x, $1/x^2$, $1/x^3$, $\sqrt{x}$, nx^2, e^x, sinx, cosx, simple problems from I and II order kinetics. A brief introduction to Factorials and Probability, examples from atomic orbitals, wave functions and entropy.

Chapter-2: Gaseous State and Critical Phenomenon 5 hours (8 marks weightage)

Postulates of kinetic theory of gases, Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Calculation of root mean square velocity, average velocity and most probable velocity and relationship between them.

Critical Phenomenon: Critical temperature, Critical pressure, critical volume. PV isotherms of carbon dioxide, Derivation of van der Waal's equation of State, relationship between critical constants and van der Waal's constants. Reduced temperature, pressure and volume. Law of corresponding states.

Chapter-3: Liquid State and Solutions 7 hours (9 marks weightage)

Liquid State: Intermolecular forces (qualitative description). Structural differences between solids, liquids and gases.

Liquid Mixture: Review of Raoult's law, ideal and non-ideal solutions. Completely miscible liquids-Critical solution temperature, Effect of addition of salt on CST of phenol-water system. Immiscible liquids-Steam distillation and its applications.

Dilute solutions:- Review of colligative properties; Lowering of vapour pressure, elevation in boiling point, osmotic pressure, depression in freezing point and derivation of the relationship with molecular mass of non-volatile solute and elevation in boiling point. Determination of molecular mass of a solute by: (i) Beckmann's method (ΔT_f) and (ii) Walker-Lumsden method (ΔT_b). Berkeley-Hartley's method (π); (ii) Beckmann's method (ΔT_f) and (iii) Walker-Lumsden method.

References:

1. Applications of mathematics in Chemistry, Kishor Arora and Poonam Sinha.
2. Introductory Maths for Chemists, J. E. Parker.
3. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing House.
4. Essential of Physical Chemistry; Arun Bahl, B.S. Bahi and G.D. Tuli, S. Chand and Co.
5. Physical Chemistry through Problems, S.K. Dogra.
6. Physical chemistry; R. L. Madan, G. D. Tuli, S. Chand & Co.
7. Elements of Physical Chemistry - Glasstone and Lewis - Macmillan.
8. Text book of Physical Chemistry - S. Glasstone- Macmillan (India) Ltd.
9. Numerical Problems on Physical Chemistry- Gashal, Books and Allied (P) Ltd.,
10. Physical Chemistry, P. C. Rakshit, V Edition (1988), Fourth Reprint (1997), Sarat Book House, Calcutta.
11. W. Kauzmann, Kinetic Theory of Gases (Thermal Properties of Matter, Vol I), Benjamin, Reading, MA, 1966.

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SECOND SEMESTER

PAPER-II: CHEMISTRY - II Total Hours: 60

UNIT - I: ANALYTICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Evaluation of Analitycal Data 12 hours (16 marks weightage)

Role of analytical chemistry. Classification of analytical methods, types of instrumental, analytical methods on the basis of sample size. Errors- types of errors – determinate and indeterminate errors, accuracy and precision. Distribution of random errors- frequency distributions, normal error curve. Statistical treatment of finite samples. Measures of central tendency- mean, median, range, average deviation, relative average deviation, standard deviation. Accuracy and precision, significant figures, rounding off, determinate and indeterminate errors, ways of expressing accuracy, standard deviation, significant errors and propagation of errors, Gaussian distribution curve for error control charts, the confidence limit, test of significance, rejection of a result, Q. Test.

Chapter 2: Sampling methods 3 hours (04 marks weightage)

Sampling and sample handling, preparation of sample, sample storage, sampling techniques of solid, liquid and gaseous samples. Hazards in sampling.

List of Text books:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch VIII Edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, V Edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, VI Edition, 1993 Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, VI Edition, Third Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, II Edition, Saunders College Publishing, California, 1990.

UNIT - II: INORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Chemical bonding 6 hours (8 marks weightage)

Ionic bond: Definition, lattice energy, factors controlling lattice energy, Born-Haber cycle taking NaCl as example, Born-Lande equation (no derivation), significance of the equation, calculations of the lattice energy on the basis of Born- Lande equation, inter nuclear distance between oppositely charged ions, predictive power of thermochemical calculations on ionic compounds, Covalent character in predominantly ionic compounds, Conductivity in ionic solids, solubility of ionic solids and its dependence on lattice energy, polarization, polarizing power, polarizability of ions, variation of polarizing power of cations and anions along a period and down a group, Fazan's rule and its applications.

Chapter-2: Covalent Bond 4 hours (5 marks weightage)

Definition, factors favoring the formation covalent compounds, VBT- formation of H_2 molecule- (taking Ψ wave functions of atomic orbitals) σ and π bonds with their characteristics, postulates of valance bond theory-electronegativity, polar and non-polar bonds, electronegativity differences, variation of percentage ionic character of the bond-Hanny and Smith equation (problems to be solved). Shapes of simple inorganic molecules and ions based on valence shall electron pair repulsion (VSEPR) theory to NH_3, SF_6, CIF_3 and H_2O.

Concept of hybridization, Rules for obtaining hybrid orbitals, extent of d-orbital participation in molecular bonding (SO_2, PCl_5, SO_3)

Chapter-3: Molecular orbital theory 5 hours (7 marks weightage)

LCAO method, symmetry of molecular orbitals, applications of MOT to homo and hetero-nuclear diatomic molecules, molecular orbital energy level diagrams for N_2, O_2, O_2^+,O_2^{2-}, CO, NO, CN^- (prediction of magnetic properties of these species)

References:

1. Principles of Inroganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
2. Advanced Inorganic Chemistry by Gurudeep Raj and Chatwal Anand.
3. Modern Inorganic Chemistry by R D Madan.
4. Advanced Inorganic Chemistry by Sathyaprakash.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, IV Edition, Pearson Education, India, 2006.
6. F. A. Cotton, G. Wilkinson, C. M. Murillo and M. Bochmann, Advanced Inorganic Chemistry, VI Edition, John Wiley and Sons, Inc., New York, 1999.

UNIT - III: ORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Alkenes 5 hours (6 marks weightage)

Nomenclature. Methods of preparation- dehydration of alcohols, dehydrohalogenation of alkyl halides, partial hydrogenation of alkynes. Addition of HBr to propene - MarkowniKoff's rule-mechanism. Peroxide effect, mechanism. Reactions- oxidation with acidic $KMnO_4$, lead tetra acetate, Bayer's reagent.

Dienes:

Nomenclature and classification of dienes. Preparation of butadiene from 1,4-diols, n-butane. Addition of HBr to butadiene with mechanism. Diel's-Alder reaction with mechanism.

Chapter-2: Alkynes 2 hours (3 marks weightage)

Nomenclature. Preparation from vicinal and gem dihalides. Alkylation of acetylene. Acidity of alkynes. Reactions with ammonical $AgNO_3$, Cu_2Cl. Addition reaction: Addition of H_2O, mechanism of addition of HCl to ethyne.

Chapter-3: Arenes and aromaticity 2 hours (3 marks weightage)

Molecular orbital structure of benzene, Huckel's rule of aromaticity, anti aromatic, non-aromatic with example. Non-benzonoid aromatic compounds- cyclopentadienyl anion, cycloheptatrienylcation.

Chapter-4: Substitution and elimination reactions 6 hours (8 marks weightage)

a) Aliphatic substitution reaction. S_N^1, S_N^2 reactions with mechanism, stereochemistry and solvent effect.

b) Aromatic substitution reactions. Nitration, bromination, sulphonation, Friedel-Craft alkylation and acylation with mechanism.

   Orienting influence on aromatic substation reaction. Ring activating and deactivating groups.

c) E_1, E_2 reaction with mechanism. Hoffmann elimination and Satzeff reaction.

References:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, VI Edition, Printice-Hall Of India Limited, New Delhi, 1992.
2. B. Y. Paula, Organic Chemistry, III Edition, Pearson Education, Inc. (Singapore), New Delhi, reprint, 2002.
3. Jerry March, Advanced Organic Chemistry, IV Edition, John Wiley & Sons, New York, 1992.
4. Paula YurkanisBruice, Organic chemistry, III Edition, Pearson Education, Inc. (Singapore), New Delhi, reprint, 2002.
5. E. S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 1964.
6. Peter sykes, A Guide book to mechanism in Organic Chemistry, Pearson Education India
7. P.S. Kalsi., Stereochemistry and mechanism through solved problems, New Age international publications.
8. Organic Chemistry, Bahl and Arun Bahl,, S. Chand and Sons, New Delhi, 2005.

UNIT - IV: PHYSICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Solid State and Crystallography 6 hours (8 marks weightage)

Classification of solids – Isotropic and anisotropic crystals. Elements of symmetry – plane, axes and center of symmetry. Definition of unit cell & space lattice. Laws of crystallography: – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Representation of planes – Miller Indices, Weiss indices and its calculations using simple examples.

X-ray diffraction by crystals, derivation of Bragg's equation. Determination of crystal structure of NaCl. Liquid Crystals: difference between solids, liquids and liquid- crystals, types of liquid crystals, Classification of liquid crystals into Smectic and Nematic. Applications of Liquid Crystals.

Chapter-2: Ionic equilibria 3 hours (4 marks weightage)

Hydrolysis of salts of weak acids and weak bases. Ionic product of water. Degree of hydrolysis. Effect of temperature and dilution on degree of hydrolysis. pH of solutions. Common-ion effect, buffers, buffer action, Henderson's equation. Solubility product and ionic product in precipitation and in qualitative analysis.

Chapter-3: Phase Equilibria 6 hours (8 marks weightage)

Introduction to the terms: phase, component, degrees of freedom. Statement and derivation of Gibbs phase rule, phase equilibria of one component system, water and Sulphur system. Two component systems: KI-water system. Freezing mixture- definition, examples. Explanation for Congruent melting maximum, congruent melting minimum. Solid solutions – compound formation with congruent melting point (Mg-Zn) and incongruent melting point, ($FeCl_3$-H_2O) system.

References:

1. Physical chemistry; R. L. Madan, G. D. Tuli, S. Chand & Co.
2. Solid State Chemistry, D.K. Chakrabarty, New Age international.
3. Crystal Engineering: A Textbook, Gautam R. Desiraju, Jagadese J. Vittal, IISc Press
4. Solid State Chemistry and Its Applications, Anthony R. West, John Wiley & Sons.
5. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.
6. A Textbook of Physical Chemistry, Volume 2, K L Kapoor, Mc. Millan publishers India Limited.
7. Physical Chemistry, K. J. Laidler and J. M. Meiser, III Edition, Houghton Mifflin Comp., New, York, International Edition(1999).
8. Physical Chemistry, V Edition, G. M. Barrow, Tata McGraw Hill.
9. Physical Chemistry G. K. Vemulapalli, , Prentice-Hall India Pvt. Ltd.
10. Physical Chemistry, T.W. Atkins, Oxford University Press
11. Physical Chemistry - Walter J. Moore - Orient Longman.
12. Physical Chemistry, K. K. Padmanabha, Lakshmi Printing & Publishing House, Mysore.

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THIRD SEMESTER

PAPER-III: CHEMISTRY - III — Total Hours: 60

UNIT - I: ANALYTICAL CHEMISTRY — Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Solvent extraction — **8 hours (12 marks weightage)**

Definition, types, principle and efficiency of extraction, sequence of extraction process, factors affecting extraction-pH, oxidation state, modifiers, synergistic, masking and salting out agents, techniques-batch, continuous extraction and counter current extraction, applications.

Ultracentrifugation — **5 hours (06 marks weightage)**

Centrifugation, centrifugal force, sedimentation, centrifugal decantation, centrifuges, selection of centrifuge tubes, preparative, density gradient and isopycinic centrifugation. Analytical sedimentation, sedimentation coefficient, sedimentation velocity-Application of the technique in biological separation; membrane separation-principle and applications.

Ultrafiltration Zone refining techniques — **2 hours (02 marks weightage)**

Principles, instrumentation and applications.

References:

1. Introduction to Instrumental Analysis – R.D. Braun.
2. Instrumental method of chemical analysis – B.K. Sharma, Goel publishing House, Meerut.
3. Instrumental method of analysis – Willard, merit and Dean, VII Edition .
4. Analytical Chemistry- Gray D. Christian, V edition John Wiley and Sons, Inc.
5. Instrumental Methods of Chemical Analysis- B.K. Sharma, Goel publishing House, Meerut'
6. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, IV Edition, Pearson Education, India.
7. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, VI Edition.

UNIT - II: INORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Glass, Cement and paints 4 hours (6 marks weightage)

Glass : Raw materials, manufacture by tank furnace method, colouring agents, annealing of glass, types of glass – soda glass, potash glass, flint glass, pyrex glass (their composition and uses).

Cement: Raw materials, manufacture by dry process, mechanism of setting. Role of water and gypsum in setting process.

Paints: Constituents and their functions, manufacture of white lead by chamber's process and electrolytic process

Chapter-2: p-block elements 5 hours (7 marks weightage)

BF_3- Preparation, properties, electron acceptor character, applications.

Hydrides of Boron; Diborane - Preparation, properties, structure and bonding and uses.

Borazine - Preparation, properties, structure and uses.,

Carbon and silicon – Stuctural features of diamond and graphite, CO_2 and SiO_2 – Correlation of their properties with structure.

Fullerenes- Introduction, preparation, properties and uses.

Silicates – Types, structure, ultramarine and zeolites

Chapter-3: d-block and f-block elements 6 hours (7 marks weightage)

d-Block elements: Electronic configuration, general characteristics of transition elements, oxidation states, atomic size, ionization potential, colour, complex formation, magnetic properties and acidic & basic properties of oxides- explanation with reference to 3d-series.

f-Block elements: Lanthanide series**-**Definition, electronic configuration, oxidation states, colour, complex formation and magnetic properties, lanthanide contraction, its causes and consequences, separation of lanthanides by ion-exchange method, applications of lanthanides.

References:

1. Principles of Inroganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
2. Advanced Inorganic Chemistry by Gurudeep Raj and Chatwal Anand
3. Modern Inorganic Chemistry by R D Madan
4. Advanced Inorganic Chemistry by Sathyaprakash.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, IV Edition, Pearson Education, India, 2006.
6. F. A. Cotton, G. Wilkinson, C. M. Murillo and M. Bochmann, Advanced Inorganic Chemistry, VI Edition, John Wiley and Sons, Inc., New York, 1999.

UNIT - III: ORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Alcohols 7 hours (9 marks weightage)

Monohydric alcohol- Classification, nomenclature, preparation from alky halides, aldehydes, ketones. Distinguish test between 1^0, 2^0, 3^0 by Victor-Meyer method. Lucas method. Test for hydroxyl alcohol- formation of alkoxide, esterification with mechanism, oxidation.

Dihydric alcohol- Nomenclature, preparation of glycol from alkene. oxidative cleavage using lead tetra acetate, periodic acid.Uses of ethylene glycol. Pinacol - Pinacolone rearrangement with mechanism.

Trihydric alcohol- Nomenclature. manufacture of glycol from Spent lye. Synthesis from propene. Reactions of glycol with oxalic acid at different temperatures, reaction with PCl_5, with fatty acids.

Uses of glycerol, preparation of nitroglycerine, composition and uses of Cordite and dynamite.

Chapter-2: Phenols 6 hours (8 marks weightage)

Classification, nomenclature, Methods of preparation from Cumene, Dow process, from diazonium salts.

Acidity of phenols- resonance, stabilization of phenoxide ion, compare the acidity of alcohol and phenol. Effect of substituent's on acidity of phenols, electron withdrawing groups ($-NO_2$, -Cl, -CN, -CHO, -COOH), electron donating groups ($-CH_3$, $-OCH_3$, $-NH_2$).

Reactions of phenols.Fries, Claisen, Reimerr-Tiemann, Leader-Manase reactions with mechanism.

Synthesis of phenolphthalein, salicylaldehyde, vanillin, o-benzoquinone.

Chapter-3: Ethers and epoxides 2 hours (3 marks weightage)

Chemical reactions of ethers- Cleavage and auto-oxidation. Ziesel's method.

Synthesis of epoxides: acid and base catalyzed ring opening reaction, reactions of epoxides with Grignard and organolithium reagents.

References:

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. B.S. Bahl and Arun Bahl, Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
3. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
4. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.
5. E. S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 964.
6. Peter Sykes, A Guide book to mechanism in Organic Chemistry., Pearson Education India.
7. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, III Edition, Plenum Press, New York, 1990.
8. S. K. Ghosh, Advanced General Organic Chemistry, Book and Allied (P) Ltd, 1998.

UNIT - IV: PHYSICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Chemical Kinetics and Catalysis 8 hours (11 marks weightage)

Review of terms – Rate, Order and Molecularity, comparison between rate order and molecularity. Derivation of expression for the rate constant of a second order reaction with a = b and a ≠ b. Arrhenius equation, concept of activation energy. Theories of reaction rates: collision theory, transition state theory. Steady state approximation and Lindemann's hypothesis. Experimental determination of kinetics of inversion of cane sugar by polarimetric method.

Catalysis: Types of Catalysis; Homogeneous, Heterogeneous Catalysis, characteristics of catalytic reactions. Brief discussion on theories of Catalysis: The Intermediate Compound Formation Theory, The Adsorption Theory. Enzyme Catalysis: Mechanism of Enzyme Catalysis; Michaelis - Menten equation.

Chapter-2: Electrochemistry-I: 7 hours (9 marks weightage)

Electrolytes, electrolytic conductance. Debye-Huckel theory of strong electrolytes; asymmetry effect and electrophoretic effect. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only), Transport number, definition and determination by Hittorf's method.

Kohlrausch's law; its applications: determination of degree of dissociation, determination of equilibrium constants of weak electrolytes, determination of solubility product of sparingly soluble salt. Conductometric titrations: Strong acid v/s strong base, weak acid v/s strong base, mixture of acid vs. strong base.

References:

1. Physical chemistry; R. L. Madan, G. D. Tuli, S. Chand & Co.
2. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.
3. A Textbook of Physical Chemistry, Volume 2, K L Kapoor, Mc. Millan publishers India Limited.
4. Chemical Kinetics and Reaction Dynamics, Upadhyay**,** Santosh K.
5. A Textbook of Physical Chemistry, A. S. Negi, New age
6. Chemical Kinetics, K.J. Laidler, III Edition, Pearson Education Pvt. Ltd., New Delhi,
7. An Introduction to Chemical Kinetics, Margaret Robson Wright, John Wiley.
8. Kinetics and Chemical Reactions, S. K. Jain, Vishal Publishing Co.
9. Electrochemistry, B.K. Sharma , Krishna Prakashan Media (p) Ltd,
10. An Introduction to Electrochemistry, Samuel Glasstone, Litton Educational Publishing, Inc., New York.
11. Physical Chemistry, K. J. Laidler and J. M. Meiser, III Edition, Houghton Mifflin Comp., New, York, International Edition.
12. Industrial Electrochemistry, D. Pletcher and F.C. Walsh, Chapman and Hall, II Edition, 1984.
13. Engineering chemistry, Jain and Jain, Dhanpal and sons.
14. Physical Chemistry, T.W. Atkins, Oxford University Press.
15. Physical Chemistry, K. K. Padmanabha, Lakshmi Printing & Publishing House, Mysore.

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FOURTH SEMESTER

PAPER-IV: CHEMISTRY - IV Total Hours: 60

UNIT - I: ANALYTICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Chromatography 5 hours (8 marks weightage)

General description of chromatography- classification, chromatograms, migration rates of solutes, retention time, capacity factor, selectivity factor, band broadening and column efficiency, plate theory and rate theory. Theory of band broadening, van-Deemter's equation, column resolution, factors influencing resolution.

Chapter-2: Planar Chromatography 4 hours (4 marks weightage)

Paper and thin layer chromatography, stationary and mobile phase, various techniques of development, visualization and evolution of chromatograms, applications.

Chapter-3: Gas Chromatography 4 hours (5 marks weightage)

Introduction and overview of GSC and GLC: Instrumentation, sample injection systems, columns, detectors- TCD, FID, β-ray ionization detectors, temperature programming, applications- quantitative and qualitative analysis.

Chapter-4: HPLC 2 hours (3 marks weightage)

Introduction, superiority of HPLC, instrumentation and applications,

References:

1. Vogel's Text book of Quantitative Chemical Analysis- Revised by G. H. Jaffery, J. Bassett, J. Mendham and R. C. Denny ELBS, V Edition (1996)
2. Introduction to Instrumental Analysis – R.D. Braun 1986.
3. Instrumental method of chemical analysis – B.K. Sharma, Goel publishing House, Meerut 2000.
4. Instrumental method of analysis – Willard, merit and Dean, VII Edition 1998.
5. Analytical Chemistry- Gray D. Christian, V Edition John Wiley and Sons, Inc.
6. Instrumental Methods of Chemical Analysis- B.K. Sharma, Goel publishing House, Meerut, 2000.
7. Quantitative Chemical Analysis- D. C. Harris, W. M. Freeman and Co., NY, USA, IVED, 1995

UNIT - II: INORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Metallurgy 9 hours (13 marks weightage)

Thermodynamics of metallurgy, Ellingham's diagrams- features, applications and limitations, extraction of lead - self-reduction process and nickel from pentalendite, extraction of manganese from pyrolusite from allumino thermite process extraction of gold by hydrometallurgical process, refining of gold by quartation process, beryllium from beryl via sodium beryllium fluoride, Thorium from Monazite sand and Uranium from Pitch blende by aid digestion process.

Chapter-2: Solvents 6 hours (7 marks weightage)

Classification, comparative account of water and liquid ammonia as solvents (striking similarities and factors which make them good polar solvents).Reactions in liquid ammonia and water, acid-base neutralisation, oxidation-reduction, complex formation, ionisation of acetic acid. Solvolysis, solvation, Solubility of ionic solids – its dependence of lattice energy and solvation energy. Solutions of alkali metals in liquid ammonia, advantages and disadvantages of liquid NH_3 as solvents.

References:

1. Principles of Inroganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
2. Advanced Inorganic Chemistry by Gurudeep Raj and Chatwal Anand.
3. Modern Inorganic Chemistry by P L Sony.
4. A text book of Industrial Chemistry by B K Sharma.

UNIT - III: ORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Aldehydes and Ketones 5 hours (7 marks weightage)

Nomenclature. Structure and reactivity of carbonyl groups in aldehydes, ketones. Methods of preparation of chloral, acrolein, crotonaldehyde.

Reactions of aldehydes and ketones with hydroxyl amine, hydrogen cyanide, 2,4-DNP. Reaction Mechanism of Aldol, Perkin's, Benzoin, Cannizaro, Knoevenagel reaction. Clemmenson reduction, Wolff-Kishner reduction.

Chapter-2: Carboxylic acids 4 hours (6 marks weightage)

Nomenclature of mono and dicarboxylic acids. Acidity of carboxylic acids. Effect of substituents on acidity. Comparative study of:

(i) Acetic acid and formic acid.
(ii) Acetic acid and benzoic acid.
(iii) Acetic acid and monochloro acetic acid.
(iv) 2-chloro butanoic acid and chlorobutanoic acid.

Hydroxy acid, effect of heat on α, β and γ – hydroxy acids.

Derivatives of Carboxylic acids: Preparation and reactions of (i) acid chlorides, (ii) acid amides, (iii) acid anhydrides.

Chapter-3: Amines 3 hours (4 marks weightage)

Nomenclature, Classification with examples. Synthesis of amines by reduction of nitro compounds. Hoffmann's degradation methods with mechanism. Basicity of amines. Comparative study of:

(i) Methyl amine, dimethyl amine and trimethyl amine.
(ii) Methyl amine and aniline.
(iii) Aniline and p-nitroaniline and p-toluidine.
(iv) Aniline, N-methyl aniline and N, N-dimethyl aniline.

Separation of amines by alkylation, nitrous acid method and Heinsberg's method.

Chapter-4: Organosulphur compounds 3 hours (3 marks weightage)

Aromatic sulphonic compounds- thio alcohols, nomenclature and general chemical properties, sulphonal and thioethers. Aromatic sulphonic acids- Nomenclature, general methods of preparations, general chemical properties. Reactions due to SO_3H group and benzene ring.

Synthesis of Saccharin, Chloramine-T and Dichloramine-T.

References:

1. S.H. Pine, Organic Chemistry, 5th Edition, Mcgraw Hill International Edition, Chemistry Series, New York, 1987.
2. I. L. Finar, Organic Chemistry, VI Edition, ELBS, 1990.
3. Bahl and Arun Bahl, Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
4. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand.
5. V. K. Ahluwalia , Textbook of Organic Chemitry, Viva Books Private Limited, 2012.
6. S. K. Ghosh, Advanced General Organic Chemistry, Book and Allied (P) Ltd, 1998.

UNIT - IV: PHYSICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Electrochemistry-II 6 hours (8 marks weightage)

Definition of EMF of a cell, standard electrode potential, IUPAC sign convention; Types of reversible electrodes with examples: gas-metal ion, metal-ion, metal insoluble salt-anion electrode, Redox electrode with examples – Quinhydrone electrode (To be mentioned). Reference electrodes – Construction and working of SHE and calomel electrode. Concentration cell – Derivation of EMF using Nernst equation for electrolytic concentration cell without transference. Liquid junction potentials, elimination of liquid junction potential. Potentiometric titration involving only redox systems ($K_2Cr_2O_7$ vs. FAS).

Chapter-2: Photochemistry 5 hours (7 marks weightage)

Laws of photochemistry- Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield and explanation for Photochemical reactions of hydrogen-iodine, hydrogen-chlorine and hydrogen-bromine. Qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, inter-system crossing), Jablonski diagram. Photosensitized reactions - simple examples, chemiluminescence, bioluminescence.

Chapter-3: Colloids 4 hours (5 marks weightage)

Definition of colloids, classification of colloids; Lyophilic and Lyophobic Colloids. Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy—Schulze law, gold number. Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier. Liquids in solids (gels): preparation and properties, association colloids (micelles). General application of colloids.

References:

1. Physical chemistry; R. L. Madan, G. D. Tuli, S. Chand & Co.
2. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.
3. Textbook of Physical Chemistry, Gurdeep Raj, Goel Publications
4. Elements of Physical Chemistry, B.R. Puri, L.R. Sharma, M.S. Pathania, I Edition, Vishal Publishing House, Jalandhar, India, 2013.
5. Electrochemistry, B.K. Sharma , Krishna Prakashan Media (p) Ltd,
6. An Introduction to Electrochemistry, Samuel Glasstone, Litton Educational Publishing, Inc., New York.
7. Physical Chemistry, K. J. Laidler and J. M. Meiser, III Edition, Houghton Mifflin Comp., New, York, International Edition.
8. Industrial Electrochemistry, D. Pletcher and F.C. Walsh, Chapman and Hall, II Edition, 1984.
9. Photochemistry, Gurdeep Raj, Goel Publications.
10. Photochemistry, J. G. Calvert and J. N. Pitts, Wiley, New York.
11. Fundamentals of Photochemistry, K. K. Rohatgi - Mukherjee, New Age International Pub., Reprint 2006.
12. Molecular Energy Transfer, R. Levine and J. Jortner, eds., J. Wiley, New York.
13. A Textbook of Physical Chemistry, Volume 2, K L Kapoor, Mc. Millan publishers India Limited.
14. Physical Chemistry, T.W. Atkins, Oxford University Press.
15. Physical Chemistry, K.K. Padmanabha, Lakshmi Printing & Publishing House, Mysore.

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FIFTH SEMESTER

PAPER-V: CHEMISTRY - V — Total Hours: 45

UNIT - I: ANALYTICAL CHEMISTRY — Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Gravimetry — 7 hours (13 marks weightage)

General principles, condition for precipitations, choice of precipitation, advantages of using organic precipitants, factors influencing the solubility of the precipitate, theories of precipitation, co-precipitation, post-precipitation, effect of digestion, PFHS, pH change, ion releasing reagents, change in oxidation states (taking Fe, Cu and Al as examples), use of mixed solvents and analytical applications

Chapter-2: UV-Visible spectroscopy — 4 hours (7 marks weightage)

Range, frequency and energy of UV radiations, interaction of UV radiation with organic molecules, types of transitions, allowed and non-allowed transitions, Concept of chromophores and auxochromes, bathochromic shift and hypso chromic shift, hyper chromic effect and hypo chromic effect.

Comparison of λ_{max} organic compounds taking following examples giving reasons

1. CH_3CHO and C_6H_5CHO
2. Ethylene and 1,3-butadiene
3. Cis and transstilbene
4. Cis-trans cinnamic acid

Chapter-3: IR spectroscopy — 4 hours (7 marks weightage)

Range, frequency and energy of IR radiations, interaction of IR radiation with organic molecules, molecular vibrations – stretching and bending vibrations, Hook's law, finger print region, Stretching frequency of functional groups in benzaldehyde, acetophenone, ethyl acetate, aniline and methyl amine.

References:

1. Vogel's Text book of Quantitative Chemical Analysis- Revised by, G. H. Jaffery, J. Bassett, J. Mendham and R. C. Denney, ELBS V Edition (1989), John Wiley and Sons. Inc. New York.
2. Introduction to Instrumental Analysis – R.D. Braun 1986.
3. Instrumental method of chemical analysis – B.K. Sharma, Goel publishing House, Meerut 2000.
4. Instrumental method of analysis – Willard, merit and Dean, VII Edition, 1998.
5. Analytical Chemistry- Gray D. Christian, V Edition, John Wiley and Sons, Inc.
6. Instrumental Methods of Chemical Analysis-B.K. Sharma, Goel publishing House, Meerut, 2000.
7. Quantitative Chemical Analysis- D. C. Harris, W. M. Freeman and Co., NY, USA, IV Edition, 1995.

UNIT - II INORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Electroplating 10 hours (18 marks weightage)

Theory, purpose of electroplating, nature of good deposit, factors influencing electroplating (concentration of metal ion, pH, temperature, current density), electroplating of chromium and gold.

Ceramics-Raw materials and their role, varieties of clay, production of ceramic ware, glazing insulators.

Refractories-Classification, properties, hardness, pyrometric cone equivalent values.

Abrasives- Classification, properties, hardness of abrasives, Moh's scale, manufacture and importance of carborundum.

Chapter-2: Alloys 5 hours (9 marks weightage)

Definition, purpose of making alloys, preparation of alloys by electro deposition method and powder metallurgy method, advantages of powder metallurgy, influence of carbon, manganese, nickel, chromium, tungsten, silicon and cobalt on the properties of steel, heat treatment of steel, hardening, tempering and annealing, case hardening of steel-carbiding and nitridins.

References:

1. Advanced Inorganic Chemistry, V Edition, F.A. Cotton and G. Wilkinson; John Willey and sons, 1988.
2. Inorganic Chemistry; Principles of structure and reactivity, III Edition, James E Huheey, Ellen E. Keither and Richard L. Keither, Harper Collins college Pub., 1983.
3. Inorganic Chemistry 3rd ed., Shriver and Atkins, Oxford University Press, 1999.
4. Organometallic Chemistry, A Unified approach R.C. Mehrotra and A. Singh. Willey Eastern, New Delhi.
5. A text book of Industrial Chemistry by B.K. Sharma
6. A concise Inorganic Chemistry, J .D. Lee, ELBS Ed., 1991
7. Modern aspects of Inorganic Chemistry, H. J. Emeleus and A. G. Sharpe, ELBS.
8. Theoretical Principles of Inorganic Chemistry, IV ed., G. S. Manku, Tata, McGraw Hill, 1990

UNIT - III: ORGANIC CHEMISTRY **Total Hours: 15**

Chapter-1: Purification of organic compounds **4 hours (7 marks weightage)**

Methods for purification of solids- crystallization, fractional crystallization and sublimation. Methods for purification of liquids- Distillation, Fractional distillation, distillation under reduced pressure, steam distillation. Criteria of purity- Melting point and boiling point.

Chapter-2: Heterocyclic compounds **4 hours (7 marks weightage)**

Preparation and reactions of pyrrole, furan, thiophene, pyridine, pyrimidine, indole, quinoline, isoquinoline. Aromaticity of pyrrole, furan, thiophene. Basicity of pyrrole and pyridine.

Chapter-3: Dyes **3 hours (5 marks weightage)**

Classification of dyes with example. Chromophore theory, Modern theory. Synthesis of, Congo Red, Malachite Green, Methyl Orange and Indigo. Structural elucidation and synthesis of Alizarin.

Chapter-4: Polymer Chemistry **4 hours (7 marks weightage)**

Classification of polymers-Types of polymerization, Mechanism of Free radical and ionic polymerization. Examples for addition polymers and condensation polymers.Zeigler-Natta catalyst. Thermoplastics and thermosetting plastics. Synthesis of Styrene, Teflon, Nylon-6, Nylon-6,6, Backelite, PVC, polythene and Natural rubber.

References:

1. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand.
2. Paula YurkanisBruice, Organic chemistry, III Edition, Pearson Education, Inc. (Singapore), New Delhi, reprint, 2002.
3. GurdeepChatwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002.
4. R. K. Bansal, Heterocyclic Chemistry.
5. S. H. Pine, Organic Chemistry, 5th Edition, Mcgraw Hill International Edition, Chemistry Series, New York, 1987.
6. Bill meyerText Book of Polymer Science, F.W. Jr. John Wiley & Sons 1984.
7. Gowarikar. V.R. Viswanathan, N.V. JayaderSreedhar. “Polymer Science”.
8. Sharma.B.K., Polymer Chemistry, Goel Publishing House, Meerut- 1989.
9. Arora M.G. Vadar M.S., Polymer Chemistry. Anmol Publications Pvt. Ltd., New Delhi 1989.

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FIFTH SEMESTER

PAPER-VI: CHEMISTRY - VI Total Hours: 45

UNIT - I: PHYSICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter- 1: Thermodynamics - I 8 hours (14 marks weightage)

Review of the thermodynamics terms; system, surroundings etc, types of systems, state and path functions. Work done in isothermal expansion and compression of an ideal gas. Heat capacity of a gas at constant pressure and constant volume: relationship between C_p and C_v. Derivation of Kirchoff's equation. Limitations of I law of thermodynamics with illustrations. Need for II-law of thermodynamics, different ways of stating II-law with respect to heat and spontaneity. Heat engine - Carnot's cycle and derivation of the expression for its efficiency. II-law in terms of efficiency (η). Concept of entropy and its physical significance. Entropy changes in reversible isothermal process. Entropy changes of an ideal gas in different processes; entropy of mixing, standard entropies. Free energy: Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities. Variation of G and A with pressure, volume and temperature.

Chapter-2: Fundamentals of Molecular Spectroscopy 7 hours (13 marks weightage)

Electromagnetic radiation and its interaction with matter, regions of the EM spectrum, Origin of molecular spectra: Born-Oppenheimer approximation. Types of molecular spectra-rotation, vibration, electronic, Raman (to be mentioned).

Electronic spectroscopy: Qualitative description of electronic transition in σ, π and n molecular orbitals and their energy levels, selection rules and Franck-Condon principle.

Raman Spectroscopy:

Concept of Polarizability. Raman spectra, Stokes and anti Stokes lines, selection rules. Instrumentation. Applications of Raman spectroscopy, comparison of Raman and IR spectroscopies.

References:

1. Physical chemistry; R. L. Madan, G. D. Tuli, S. Chand & Co.
2. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.
3. Textbook of Physical Chemistry, Gurdeep Raj, Goel Publications House, New Delhi.
4. Elements of Physical Chemistry, B.R. Puri, L.R. Sharma, M.S. Pathania, I Edition, Vishal Publishing House, Jalandhar, India, 2013.
5. Molecular Structure and Spectroscopy, Aruldas, Printice Hall, India Pvt. Ltd.
6. A Textbook of Physical Chemistry, Volume 2, K.L. Kapoor, McMillan Publishers, India Limited.
7. Physical Chemistry, K. J. Laidler and J. M. Meiser, III Edition, Houghton Mifflin Comp., New, York, International Edition.
8. Molecular Energy Transfer, R. Levine and J. Jortner, eds., J. Wiley, New York.
9. A Textbook of Physical Chemistry, Volume 2, K L Kapoor, McMillan McMillan Publishers, India Limited.

10. Physical Chemistry, T.W. Atkins, Oxford University Press.
11. Physical Chemistry – A Molecular Approach, Donald A. McQuarrie, John D. Simon, III Edition (Viva Student Edition), Viva Books Pvt. Ltd., New Delhi.
12. Thermodynamics, Kinetic Theory, and Statistical Thermodynamics, Francis W. Sears Gerhard L. Salinger, III Edition, Narosa Publishing House, New Delhi.
13. Principles of Physical Chemistry, S. H. Maron, C. F. Prutton, Mc. Milan.
14. J. D. Lambert, Vibrational and Rotational Relaxation in Gases, Oxford University Press, Oxford, 1977.
15. Advanced Physical Chemistry, D. N. Bajpai, S. Chand & Co.

UNIT - II: ANALYTICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Microwave spectroscopy 4 hours (6 marks weightage)

Spectrum of electromagnetic radiations, interaction of electromagnetic radiations with molecules, quantisatiation of different forms of energies in molecules. Condition for energy absorption by molecules (emissions and absorption spectrum). Spectroscopic terms, classification, types of molecules, (microwave active and microwave inactive), Linear molecules, spherical top molecules, symmetric top molecules, asymmetric top molecules. Applications of Microwave spectroscopy

Chapter-2: NMR Spectroscopy 6 hours (12 marks weightage)

Introduction to NMR spectroscopy: instrumentation, theory and types of NMR active nuclides. Relaxation process - Spin-Spin relaxation, Spin-lattice relaxation, number of signals, shielding and deshielding effects, influencing chemical shifts. [Inductive effect, van der Waal's deshielding, anisotropic effects, hydrogen bonding]

Solvents used, spectra of CH_3OH, C_2H_5OH, and $C_6H_5CH_3$, peak area and proton counting, splitting of the signals (Pascal's triangle), spin-spin coupling, splitting signal by proton. Calculating the ratio in the heights of the signals. Applications of NMR spectroscopy.

Chapter-3: Mass Spectroscopy 5 hours (9 marks weightage)

Basic principles- Theory of mass spectroscopy, instrumentation, mass spectrum, the molecular ion peak, determination of molecular formula, Mc-Lafferty rearrangement. Metastable ion peaks and their importance. Nitrogen rule. General transformation modes. Homolytic cleavage-heterolytic cleavage. Retro-Deil's Alder reactions. Important features of mass spectra of hydrocarbons - alkanes, alkenes and cycloalkenes.

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch VIII Edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, V Edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, VI Edition, 1993 prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, VI Edition.
5. Analytical Chemistry Principles, John H. Kennedy, II Edition, Saunders College Publishing, California, 1990.
6. Instrumental Methods of Analysis by H.H. Willard, L.L. Merritt and J.A. Dean,VII Edition, CBS Publishers, New Delhi, 1988.
7. Principles and Practice of Analytical Chemistry, F. W. Fifield and Kealey III Edition, 2000, Blackwell Sci., Ltd. Malden, USA.
8. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.
9. Introduction to Instrumental Analysis, Braun, Pharm. Med. Press. India.

UNIT - III: INORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Co-ordination Chemistry 10 hours (18 marks weightage)

Double salts, complex salts, definition of terms-complex ion, ligand, co-ordination number, co-ordination sphere. Types of ligands with example-monodentate, bidentate, polydentate, Ambidentate and macro cyclic ligands (crown ethers, porphyrins).

Methods of detection of complex formation- conductivity, pH, colour, EAN rule for Stabilising of Complexs. Nomenclature of complex compounds. Isomerism in complex compounds: a) Structural isomerism-Ionization isomerism, hydrate isomerism, linkage isomerism and co-ordinate isomerism, b) Optical and geometrical isomerism in complex compounds with co-ordination number 4 and 6.

Stability of complex compounds- Stepwise stability constant, overall formation constant, factors influencing the stability of complexes-Nature of metal ion, nature of ligands, chelation and macrocyclic effects. Applications of complex formation in (a) Metallurgy (in the extraction of nickel and gold) (b) Qualitative and quantitative analysis.

Valance Bond Theory (VBT)

Valence bond theory as applied to complexes- inner and outer orbital complexes. The structure and geometry of the following complexes to be discussed:

1. $[Fe(CN)_6]^{2-}$ 2. $[Fe(H_2O)_6]^{2+}$ 3. $[MnCl_4]^{2-}$ 4. $[Ni\ (CO)_4]^{2-}$ 5. $[Cu\ (NH_{3)})_4]^{2+}$

Modification of VBT :Electroneutrality principle of $[Be(H_2O)]^{2+}$ and back bonding effect with respect to $[Ni(CO)_4]^{2-}$.

Crystal Field Theory (CFT)

Splitting of d-orbitals in octahedral and tetrahedral fields, effect of weak and strong field ligands, spectrochemical series of ligands, crystal field stabilization energy and calculation of CFSE for different systems.

Chapter-2: Metal Carbonyls 5 hours (08 marks weightage)

Definition, Preparation of chromium, iron, Manganese, Cobalt carbonyls, stability of carbonyls based on 18 electron rule, Structure and bonding of $Cr(CO)_6$, $Fe(CO)_5$, $Mn_2(CO)_{10}$, Uses of metal Carbonyls

References:

1. Principles of Inroganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
2. Advanced inorganic Chemistry by Gurudeep Raj and ChatwalAnand
3. Modern Inorganic Chemistry by R D Madan
4. Advanced inorganic Chemistry by Sathyaprakash ,Vol-2

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SIXTH SEMESTER

PAPER-VII: CHEMISTRY - VII — Total Hours: 45

UNIT - I: ORGANIC CHEMISTRY — Total Hours: 15

Chapter - 1: Stereochemistry of organic compounds — 9 hours (17 marks weightage)

Concept of isomerism, Optical isomerism, elements of symmetry, molecular chirality. Enantiomers, properties of enantiomers, optical isomerism in Lactic acid and tartaric acid. R and S notations. Optical activity due to helecity.

Diastereomers. Threo and erythrodiastereomers. Racemisation, resolution of racemic modifications (chemical and biological methods), Walden inversion, asymmetric synthesis.

Geometrical isomerism: Geometric isomerism in maleic acid and fumaric acid. Determination of their configurations. E and Z notations. Geometrical isomerism of oximes, Determination of configuration of oximes. Beckmann rearrangement. Conformational isomers of ethane, 1,2-dichloroethane and cyclohexane.

Chapter-2: Drugs — 3 hours (5 marks weightage)

Classification of drugs.Synthesis of aspirin, paracetamol, tetracyclin.Use of choroquin.

Chapter-3: Retrosynthesis — 3 hours (5 marks weightage)

Retrosynthesis of benzocaine, 4-methoxy acetophenone, saccharin. Disconnection approach. General terms: synthon, synthetic equivalents and target molecule. General guidelines for disconnection.

References:

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. Alex V. Ramani, Leo A. Stanley, C. Mani, Stereochemistry, MJP Publishers.
3. Introduction to stereochemistry – K. Mislow.
4. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
5. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.
6. E. S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 1964.
7. Peter Sykes, A Guide book to mechanism in Organic Chemistry, Pearson Education India.
8. P.S. Kalsi, Stereochemistry and mechanism through solved problems, New Age International Publications.
9. Stuart Warren, Paul Wyatt, Organic Synthesis: The Disconnection Approach, John Wiley & Sons.
10. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, III Edition, Plenum Press, New York, 1990.
11. D. Nasipuri, Stereochemistry of Organic Compounds, II Edition, Wiley Eastern Limited, New Delhi, 1991.
12. S. K. Ghosh, Advanced General Organic Chemistry, Book and Allied (P) Ltd, 1998.

UNIT - II: PHYSICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter - 1: Physical Properties and Chemical Constitution

6 hours (10 marks weightage)

Additive properties, constitutive properties, additive-constitutive properties (definitions). Polarization: Induced, orientation and molar polarization. Clausius - Mossotti equation. Dipole moment and structure of molecules - planar and non-planar, differentiating between cis and trans isomers. Parachor: meaning and its use in determining chemical constitution and molecular structure. Molar refraction and its application in elucidating molecular structure. Brief account of magnetic properties - paramagnetic, diamagnetic and ferromagnetic systems. Magnetic susceptibility and its importance.

Chapter-2: Nanomaterials and Polymers 4 hours (8 marks weightage)

Nanomaterials: General characteristics, a brief and elementary account of synthetic methods; bottom-up method, top-down method, examples (detailed mechanism is not required), general applications of nanomaterials.

Polymers: Definition, classification, degree of polymerization, expressions for number average and weight average molecular weights. Determination of molar mass of polymers by viscosity method (Ostwald's viscometric method).

Chapter-3: Surface and Interfacial Chemistry 5 hours (9 marks weightage)

Adsorption; types of adsorption and adsorption isotherms, Solid-liquid interfaces: Gibbs adsorption isotherm (expression only). Solid-gas interfaces. – Langmuir isotherm (derivation), Temkin and BET isotherm (expression only). Determination of surface concentration of adsorbents using BET isotherm. Kinetics of enzymatic reactions: Michaelis-Menten equation, effect of temperature and pH.

References:

1. Physical chemistry; R. L. Madan, G. D. Tuli, S. Chand & Co.
2. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing House, Jalandhar, India, 2014.
3. Textbook of Physical Chemistry, Gurdeep Raj, Goel Publications
4. Elements of Physical Chemistry, B.R. Puri, L.R. Sharma, M.S. Pathania, I Edition, Vishal Publishing House, Jalandhar, India, 2013.
5. A Textbook of Physical Chemistry, Volume 2, K L Kapoor, Mc.Millan Publishers India Limited.
6. Physical Chemistry, T.W. Atkins, Oxford University Press.
7. Physical Chemistry – A Molecular Approach, Donald A. McQuarrie, John D. Simon, III Edition (Viva Student Edition), Viva Books Pvt. Ltd., New Delhi.
8. Principles of Physical Chemistry, S. H. Maron, C. F. Prutton, Mc.Millan Publishers India Limited.
9. Electrochemistry, B.K. Sharma , Krishna Prakashan Media (p) Ltd.
10. An Introduction to Electrochemistry, Samuel Glasstone, Litton Educational Publishing, Inc., New York.

11. New Directions in Solid State Chemistry, C.N.R.Rao, J. Gopalakrishna, Cambridge University Press.
12. Introduction to nanoscience, Gabor L. Hornyak, Joydeep Dutta, Harry F.Tibbals, Anil K. Rao, CRC Press.
13. Nanotechnology, S.Shanmugam, MJP Publishers, Chennai (2010).
14. A Handbook on Nanochemistry, Patrick Salomon, Dominant Publishers and Distributers, New Delhi.
15. Nanotechnology: Importance and applications, M.H. Fulekar, IK International.
16. Supramolecular chemistry- Concepts and Perspectives, J.M. Lehn, Wiley-VCH.
17. Physical Chemistry, K. K. Padmanabha, Lakshmi Printing & Publishing House, Mysore.

UNIT - III: ANALYTICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Radio Chemical Methods of Analysis 8 hours (10 marks weightage)

Radiation dose, G-value primary and secondary processes, radiolysis of water vapour, Dosimeter-Fricke dosimeter and ceric sulphate dosimeter, Introduction, nature of radioactivity, radiometric units, detection and measurement of radioactivity, disintegration, rate of disintegration, radioactive traces, tracer techniques, applications in analytical chemistry, isotopic dilution analysis, activation analysis, radiometric analysis and applications.

Chapter-2: Thermal methods of analysis 4 hours (10 marks weightage)

Introduction, thermogravimetric analysis (TGA), types of thermogravimetric analysis, principle and method. Automatic thermogravimetric analysis, instrumentation, types of recording thermobalances, Introduction, instrumentation and application of DSC and DTA.

Chapter-3: Kinetic methods of analysis 3 hours (6 marks weightage)

Kinetics- the basics, Enzyme Catalysis properties of enzymes, enzyme inhibitors and activators, some examples of enzyme analysis.

References:

1. Vogel's Text book of Quantitative Chemical Analysis- Revised by G. H. Jaffery, J. Bassett, J. Mendham and R. C. Denny ELBS, V Edition (1996).
2. Introduction to Instrumental Analysis – R.D. Braun 1986.
3. Instrumental method of chemical analysis – B.K. Sharma, Goel publishing House, Meerut 2000.
4. Instrumental method of analysis – Willard, merit and Dean, VII Edition 1998.
5. Analytical Chemistry- Gray D. Christian, V Edition John Wiley and Sons, Inc.
6. Instrumental Methods of Chemical Analysis-B.K.Sharma, Goel publishing House, Meerut, 2000.
7. Quantitative Chemical Analysis- D. C. Harris, W. M. Freeman and Co., NY, USA, IVED, 1995.

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SIXTH SEMESTER

PAPER-VIII: CHEMISTRY - VIII Total Hours: 45

UNIT - I: INORGANIC CHEMISTRY Total Hours: 15

Chapter-1: Inorganic polymers 5 hours (9 marks weightage)

Silicones: Types, preparation (Linear, branched and cyclic), properties and applications. Fluorocarbons: Definition, examples, properties, manufacture of Teflon and uses. Phosphazenes: Preparation, properties and nature of bonding in triphosphazenes. S-N ring compounds (S_4N_4 and S_2N_2): Preparation, properties and uses.

Chapter-2 3 hours (5 marks weightage)

Organometallic Compounds

Definition, Classification, Based on Hepticity and Based on Group,18 electron rule, Structure of ferrocene and Chromocene.

Chapter-3: Bio-inorganic Chemistry 7 hours (13 marks weightage)

Elements in biological systems- metals and nonmetals, bulk metals and trace metals. Iron: Co-ordination environment in Heame, Role of haemoglobin in oxygen transportation. Zinc: Zinc containing metalloenzymes- role of carbonic anhydrase and carboxy peptidase. Magnesium: Co-ordination environment in chlorophyll, skeletal structure of chlorophyll, role of chlorophyll in photosynthesis.Cobalt: Vitamin B_{12} , Molybdenum: Nitrogenase.

References:

1. Principles of Inroganic Chemistry (UGC Syllabus), B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2008.
2. Advanced Inorganic Chemistry by Gurudeep Raj and Chatwal Anand.
3. Modern Inorganic Chemistry by P L Sony.
4. A text book of Industrial Chemistry by B K Sharma.
5. A text book of Bioinorganic chemistry by Hussain Reddy.

UNIT - II: ORGANIC CHEMISTRY Total Hours: 15

Chemistry of Natural products.

Chapter-1: Carbohydrates 5 hours (8 marks weightage)

Classification and nomenclature of carbohydrates. Monosaccharides- Mechanism of formation of osazone from glucose and fructose. Inter-conversion of glucose and fructose. Chain lengthening and chain shortening of aldoses, configuration of glucose and fructose. Epimerization (conversion of glucose into mannose).Formation of glycosides. Determination of ring size of D(+) glucose. Elucidation of cyclic structure of D(+) glucose. Constitution of D(+) Fructose. Determination of ring size of D(-) Fructose (six membered ring). Mechanism of mutarotation.

Disaccharides- Elucidation of structure of maltose and sucrose. Polysaccharides- Structure of starch and cellulose.

Chapter-2: Amino acids and proteins **4 hours (7 marks weightage)**

Definitions and classification of amino acids, synthesis of amino acids by Gabriel phthalimide, malonic ester and Strecker's method of synthesis.

Properties and reactions- Zwitter ion and isoelectric points. Ninhydrin and Biuret tests.

Peptides: peptide bond, carbobenzoxy method of synthesis of peptides.

Proteins: Classification based on composition and structure: primary and secondary structures of proteins. Denaturation of proteins.

Chapter-3: Alkaloids **2 hours (4 marks weightage)**

Definition, method of isolation, structural elucidation of nicotine and its synthesis by Spath process. Structure and uses of atropine and cocaine.

Chapter-4: Terpenes **2 hours (4 marks weightage)**

Classification and isolation. isoprene rule, structure of menthol, camphor, geraniol, α-terpineol and zingiberene. Structural elucidation of citral and its synthesis from methyl heptenone.

Chapter-5: Enzymes and nucleic acids **2 hours (4 marks weightage)**

Classification, active site, factors affecting activity of enzymes with explanation. Mechanism of enzyme catalysis (chymotrypsin as example).

Synthesis of nucleosides and nucleotides.Hydrogen bonding in DNA.

References:

1. O. P. Agarwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002.
2. Gurdeep Chatwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002.
3. Bahl and Arun Bahl, Advanced Organic Chemistry, S. Chand and Sons, New Delhi, 2005.
4. Lubert Stryer, Biochemistry, W. H. Freeman and company, New York, 1975.
5. Robert L.Caret, Katherine J. Denniston, Joseph J. Topping, Principles and Applications of organic and biological chemistry, WBB publishers, USA, 1993.
6. J. L. Jain, Biochemistry, Sultan Chand and Co.1999
7. A. Mazur and B. Harrow, Text book of Biochemistry, 10th Edition, W.B. Saunders Co., Philadelphia, 1971.
8. Paula Yurkanis Bruice, Organic Chemistry, III Edition, Pearson Education, Inc. (Singapore), New Delhi, reprint, 2002.

UNIT - III: PHYSICAL CHEMISTRY Total Hours: 15

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Thermodynamics-II: 6 hours (10 marks weightage)

Clausius-Clapeyron equation (derivation) and its applications. Nernst heat theorem; statement and concept of residual entropy, evaluation of absolute entropy. Third law of thermodynamics. Partial molar quantities; Concept of chemical potential, variation of chemical potential with temperature and pressure, derivation of Gibbs-Duhem equation, Duhem-Margules equation and its application.

Chapter-2: Elementary Quantum Mechanics 4 hours (7 marks weightage)

Physical interpretation of the wave function. Postulates of quantum mechanics, Schrödinger wave equation based on the postulates of quantum mechanics and its importance. Eigen values and Eigen functions, Hamiltonian operator. Application of Schrödinger equation to Particle in a one dimensional box (derivation).

Chapter-3: Statistical Thermodynamics 5 hours (9 marks weightage)

Energy states: macro and microstates, Limitation of classical thermodynamics, Distinguish between classical mechanics and statistical mechanics. Sterling approximation, derivation of Maxwell–Boltzmann statistics, statistical interpretation of entropy, application of statistics to gases-monoatomic ideal gas (No derivations). Partition functions and thermodynamic parameters, expressions for translational, rotational, vibrational and electronic partition functions, enthalpy, energy, Gibbs free energy.

References:

1. Physical chemistry; R. L. Madan, G. D. Tuli, S. Chand & Co.
2. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co.
3. A Textbook of Physical Chemistry, Volume 2, K L Kapoor, Mc. Millan publishers India Limited.
4. A Textbook of Physical Chemistry, A. S. Negi, New age
5. Physical Chemistry, K. J. Laidler and J. M. Meiser, III Edition, Houghton Mifflin Comp., New, York, International Edition.
6. Industrial Electrochemistry, D. Pletcher and F.C. Walsh, Chapman and Hall, II Edition, 1984.
7. Physical Chemistry, T.W. Atkins, Oxford University Press
8. Advanced Physical Chemistry, D. N. Bajpai, S. Chand & Co.
9. Quantum Chemistry, R.K. Prasad, 4th Edition, New Age International Publishers, New Delhi.
10. Quantum Mechanics for Chemists, David O. Hayward, The Royal Society of Chemistry, UK.
11. Quantum Chemistry, John P. Lowe, Kirk A. Peterson, III Edition, Academic Press, London, UK.
12. Quantum Chemistry, Donald A. McQuarrie, I Indian Edition, Viva Books Pvt. Ltd., New Delhi.
13. Quantum Chemistry, Ira N. Levine, V Edition, Pearson Education Pvt. Ltd., New Delhi.

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KUVEMPU UNIVERSITY

PRACTICALS FOR B.Sc. COURSE (CHEMISTRY)- 2016

FIRST SEMESTER - PRACTICALS (3 HOURS PER WEEK)

PAPER - I: VOLUMETRIC ANALYSIS

1. Calibration of pipette, burette, standard flask (100mL).
2. Preparation of standard solution of Sodium carbonate, standardization of HCl and estimation of NaOH.
3. Preparation of standard solution of potassium biphthalate, standardization of sodium hydroxide solution and estimation of HCl/H_2SO_4.
4. Preparation of standard solution of oxalic acid, standardization of $KMnO_4$ solution and estimation of Mohr's salt solution.
5. Preparation of standard Mohr's salt solution, standardization of $K_2Cr_2O_7$ and estimation of Ferric chloride solution (diphenylamine indicator).
6. Preparation of standard solution of $ZnSO_4$,standardization of EDTA and estimation of hardness of water.
7. Preparation of standard solution of $K_2Cr_2O_7$, standardization of sodium thiosulphate solution and estimation of copper in copper sulphate solution.
8. Estimation of available chlorine in bleaching powder.
9. Determination of acetic acid in commercial vinegar using NaOH.
10. Determination of alkali content – antacid tablet using HCl.
11. Estimation of calcium content in a sample Eg., chalk as calcium oxalate.

Note: A minimum of EIGHT experiments must be performed and recorded.

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SECOND SEMESTER - PRACTICALS (3 HOURS PER WEEK)

PAPER - II: Inorganic Qualitative Analysis

Systematic Semi-Micro Inorganic Qualitative Analysis of a salt mixture containing Two Cations and Two Anions.

The following radicals may be given:

BASIC RADICALS: (from amongst) Pb^{2+}, Bi^{3+}, Cd^{2+}, Al^{3+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, and NH_4^{+}.

ACID RADICALS: (from amongst) CO_3^{2-}, HCO_3^{-}, SO_3^{2-}, S^{2-}, NO_2^{-}, F^{-}, Cl^{-}, Br^{-}, I^{-}, NO_3^{-}, SO_4^{2-}, BO_3^{3-}, PO_4^{3-} .

Experiment A: Preliminary Tests for acid and basic radicals in given samples.

Experiment B: Wet tests for Acid and Basic radicals in given samples.

Experiment C: Confirmatory tests.

Note:

1. At least 10 unknown samples are to be analyzed by each student during the laboratory session.
2. The students have to write the equation and proper explanation wherever necessary.

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THIRD SEMESTER - PRACTICALS (3 HOURS PER WEEK)

PAPER – III: Organic Qualitative Analysis

Qualitative analysis of Organic compounds [Monofunctional group]

The following compounds may be given:

1. Urea
2. Oxalic acid
3. Aniline
4. o-Cresol
5. Benzoic acid
6. Benzaldehyde
7. Acetophenone
8. Chlorobenzene
9. Benzamide
10. Nitrobenzene
11. Toluene

Note: A minimum of EIGHT experiments must be performed and recorded.

Chemical equations have to be discussed for all tests.

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FOURTH SEMESTER – PRACTICALS (3 HOURS PER WEEK)

PAPER – IV: Chemistry Practicals - IV

1. Determination of density using specific gravity bottle and viscosity of the given liquid by using Ostwald's viscometer.
2. Determination of density and surface tension of the given liquid by drop weight method using stalagmometer.
3. Determination of molecular weight of non volatile solute by Walker-Lumsden method.
4. Determination of percentage of given electrolyte in phenol water system by miscibility temperature method.
5. Determination of percentage of given binary mixture (Glycerol-water) by viscosity method.
6. Determination of rate constant of Fe^{3+} catalyzed decomposition of H_2O_2.
7. Determination of rate constant of saponification of ethyl acetate.
8. Determination of critical solution temperature of phenol water system.
9. Determination of transition temperature of given hydrate salt ($Na_2S_2O_3.5H_2O$).
10. Identification of the given amino acid by paper chromatography.
11. Determination of rate constant of inversion of cane sugar by polarimeter method.

Note: A minimum of EIGHT experiments must be performed and recorded.

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FIFTH SEMESTER - PRACTICALS (3 HOURS PER WEEK)

PAPER – V: Gravimetric Analysis

1. Estimation of Barium (from barium chloride solution) as Barium sulphate.
2. Estimation of Iron (from Mohr's salt solution) as Iron oxide.
3. Estimation of Aluminium (from potash alum solution) as Aluminium oxide.
4. Estimation of Nickel (from Nickel ammonium sulphate solution).as Nickel dimethylglyoximate.
5. Estimation of Copper (from copper sulphate solution).as Cuprous thiocyanate.
6. Estimation of Zinc (from zinc sulphate solution) as Zinc oxinate..
7. Estimation of sulphate (from barium chloride solution) as Barium sulphate.
8. Estimation of Magnesium (from magnesium sulphate solution) as **Magnesium oxinate.**

Note: All the above experiments must be performed and recorded.

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V SEMESTER – PRACTICALS (3 HOURS PER WEEK)

PAPER – VI: Organic preparation and estimation

Part-A: Preparation

1. Preparation of acetanilide from aniline.
2. Preparation of m-dinitro benzene from nitrobenzene. (Example for nitration reaction)
3. Preparation of benzoic acid from benzaldehyde. (Example for oxidation reaction)
4. Preparation of p-bromo acetanilide from acetanilide. (Example for bromination reaction)
5. Preparation of azo dye from aniline. (Example for coupling reaction)

Note: A minimum of FOUR experiments must be performed and recorded.

Part-B: Estimation

1. Determination of Phenol.
2. Determination of Aniline.
3. Determination of Glycine.
4. Determination of Citric acid.
5. Determination of Amide.

Note: A minimum of FOUR experiments must be performed and recorded.

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SIXTH SEMESTER - PRACTICALS (3 HOURS PER WEEK)

PAPER – VII: Chemistry Practicals - VII

Part-A

1. Determination of percentage composition of a binary mixture of organic liquids by using Abbe's Refractometer
2. Determination of rate constant of inversion of cane sugar by Polarimeter.
3. Determination of cell constant (0.1N KCl solution to be prepared by students) and determine the equivalent conductance of the given electrolyte solution by using conductivity bridge.
4. Determination of cell constant (0.1N KCl solution to be prepared by students) and determine the equivalent conductance at infinite dilution for weak electrolyte of given
   solution.
5. Potentiometric titration of Mohr's salt solution v/s Potassium dichromate/Potassium
   permanganate solution
6. Potentiometric titration of Hydrochloric acid v/s Sodium hydroxide.

Note: A minimum of FOUR experiments must be performed and recorded.

Part-B

1. Conductometric titration of Sodium hydroxide vs Hydrochloric acid
2. Conductometric titration of Mixture of weak acid and strong acid vs Sodium hydroxide.
3. Determine the pH of mixture of acetic acid and sodium acetate at different concentrations and determination of dissociation constant of acid by using pH meter.
4. Estimation of Cu(II) in the given solution by colorimetric method.
5. Estimation of Fe(III) in the given solution by colorimetric method.
6. Conductometric titration of tertiary mixture of $CuSO_4$ + Acetic acid + HCl using NaOH solution.

Note: A minimum of FOUR experiments must be performed and recorded.

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SIXTH SEMESTER – PRACTICALS (3 HOURS PER WEEK)

PAPER – VIII: Inorganic Complex Preparation and Estimation

Part - A: Preparation and estimation

1. Preparation of chloropentamminecobalt(III) chloride.
2. Preparation of nitropentammine cobalt(III) chloride
3. Preparation of tetraamminecopper(II) sulphate.
4. Preparation of potassium trisoxalatoferrate(III) hydrate.
5. Preparation of tristhioureazinc(II) complex.
6. Preparation of Hexaminenickle(II)chloride complex.

Note: A minimum of FOUR experiments must be performed and recorded.

Part - B: Ore Analysis

1. Estimation of calcium carbonate in limestone by oxalate method.
2. Estimation of amount of iron present in haematite ore.
3. Estimation of MnO_2present in the given pyrolusite ore.
4. Estimation of amount of nitrite present in sodium nitrite ore solution.
5. Estimation of amount of magnesium present in gypsum ore.
6. Estimation of amount of chromium present in chromite ore.

Note: A minimum of FOUR experiments must be performed and recorded.

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