

- 500/1696/16/2018

UNIVERSITY OF SARGODHA, SARGODHA

NOTIFICATION

No. UOS/Acad/569

Dated: 19.06.2017

On the recommendation of Academic Council dated 23.08.2016, the Syndicate in its 1/2017 meeting held on 15-16.05.2017 has approved the revised curriculum of M.Sc Chemistry (Annual System) for implementation from Fall 2017 admission. Copy of approved curriculum is annexed herewith.

23/6/17
ACF - II
AMJAD HUSSAIN JANJUA
Deputy Registrar (Acad)
for Registrar
19/6/17

Distribution:

- Chairman, Department of Chemistry
- Controller of Examinations
- Web-Developer *(for uploading on university web-site)*
- Principals of Affiliated College

C.C:

- Dean, Faculty of Science
- Secretary to the Vice-Chancellor
- P.A to Registrar
- Notification file

1- DUES ✓
2. ACET ✓
20/6

Scheme of Studies M.Sc. (Chemistry)
(Annual System) w.e.f. 2016 & onwards session

M.Sc. program consists of two parts namely Part-I and Part-II. The Scheme of study, Syllabi and Courses of Reading for the M.Sc. (Chemistry) Part-I and Part-II are given below:

M.Sc. (CHEMISTRY) ANNUAL SYSTEM (2 YEARS PROGRAM)

M.Sc. (Part-I)

Paper No	Title	Marks
Paper-I	Physical Chemistry (written)	100
Paper-II	Inorganic Chemistry (written) <i>Some part</i>	100
Paper-III	Organic Chemistry (written)	100
Paper-IV	(i) Biochemistry (written) or (ii) Analytical Chemistry (written)*	100
Paper-V	Basic Mathematics and statistics	100
Paper-VI	Physical Chemistry (practical)	75
Paper-VII	Inorganic Chemistry (practical)	75
Paper-VIII	Organic Chemistry (practical)	75
Paper-IX	(i) Biochemistry (practical) or (ii) Analytical Chemistry (practical)*	75

Total: 800

* Only (i) or (ii) will be offered depending on the availability of faculty and facilities.

In M.Sc. Part-II the student will opt or be allotted one "major subject" out of the following: (which he /she studied in M.Sc. Part-I)

- A. Physical Chemistry
- B. Inorganic Chemistry
- C. Organic Chemistry
- D. Biochemistry
- E. Analytical Chemistry


The papers to be studied in Part-II will be as follows:

Paper No	Title	Marks
Paper-I	Special Paper (written) (of the major subject)	100
Paper-II	Additional Paper (written) (of the major subject)	100
Paper-III	Practical (of the major subject)	100
Paper-IV	Environmental & Industrial Chemistry (Compulsory) ✓	100
Paper-V	Research (Thesis) or (Elective Subject)	200

Total: 500

The numbering of papers in various major subjects would be as follows:

- | | |
|-------------|----------------------------------|
| Paper I-A | Physical Chemistry (Special) |
| Paper II-A | Physical Chemistry (Additional) |
| Paper III-A | Physical Chemistry (Practical) |
| Paper I-B | Inorganic Chemistry (Special) |
| Paper II-B | Inorganic Chemistry (Additional) |
| Paper III-B | Inorganic Chemistry (Practical) |
| Paper I-C | Organic Chemistry (Special) |
| Paper II-C | Organic Chemistry (Additional) |
| Paper III-C | Organic Chemistry (Practical) |
| Paper I-D | Biochemistry (Special) |


Chairman
Department of Chemistry
University of Sargodha
SARGODHA

Paper II-D	Biochemistry (Additional)
Paper III-D	Biochemistry (Practical)
Paper I-E	Analytical Chemistry ¹ (Special)
Paper II-E	Analytical Chemistry (Additional)
Paper III-E	Analytical Chemistry (Practical)

Those students who would not be allotted research (due to lack of facilities in the Institution) will opt / be allotted an "elective subject" instead of research and this elective subject will comprise of theory and practical of the same subject (additional paper) other than his own specialization.

Note: The Institute will undertake the teaching / research in the major as well as elective subjects provided the facilities are available in regard to teachers and equipment.

Details of M.Sc (Chemistry) Courses for annual system

M.Sc. Part I

Paper-I Physical Chemistry (written)

Chemical Thermodynamics: (Review of first law of thermodynamics. Second law of thermodynamics and its applications. Clausius inequality. Nernst heat theorem and its applications. Third law of thermodynamics and determination of absolute entropy. Entropy of mixing. Partial molal quantities).

Kinetic theory of gases: (Maxwell's law of distribution of velocities and derivation of average velocity, most probable velocity and root mean square velocity from the law. Significance of Maxwell's law. Derivation of Maxwell's distribution for kinetic energy. Barometric formula, effect of altitude, temperature and molecular mass on vertical distribution of particles)

Chemical Kinetics: (Concept of order of reaction. Kinetics of third order reactions with different concentration and molecular identity. Kinetics of opposing, reversible, consecutive and parallel reactions. Kinetics of thermally excited chain reactions. Theories of reactions).

Atomic and molecular structure: (Schrodinger's wave equation. Postulates of quantum theory. Operators. Eigen value. Eigen function, orthogonality and normalized wave functions. Motion of particle in three dimensional box and idea of degeneracy. Mathematical treatment of rigid rotator and calculation of bond length of simple molecule).

Statistical thermodynamics: (Stirling approximation. Probability. Statistical treatment of entropy. The Boltzmann distribution law and partition function.

Physical significance of partition function. Separation of partition function. Partition function and thermodynamics functions like internal energy and entropy. Translational, rotational, vibrational and electronic partition function and their comparison).


Electrochemistry: (Concept of conductance of electrolytes. Debye-Huckel equation and limiting law. Ionic strength, weak electrolytes and Debye-Huckel theory. Activity and activity coefficients of electrolytic solutions. Determination of activities. Concentration cells. Determination of e.m.f. of concentration cells with and without transference. Fuel cells and hydrocarbon fuel cells).

RECOMMENDED BOOKS

1. Atkins P. W., "Physical Chemistry" 6th Ed. ELBS Oxford University Press. UK (1997).
2. Alberty R. and Silvey, A. "Physical Chemistry" 7th Ed. John Wiley & Sons. NY (1992).
3. Barrow G. M., "Physical Chemistry" 5th Ed. McGraw Hill, Inc. CA (1998).
4. Castellan G. W., "Physical Chemistry" 3rd Ed. Norasa Publishing House, Delhi (2004).
5. Gurddeep R., "Advanced Physical Chemistry" (3rd Ed), Krishna Prakashan Media (P) Ltd. (2000)

Paper-II Inorganic Chemistry (written)

Chemistry of Lanthanides and Actinides: Structure, occurrence and preparation, Separation and electronic configuration, oxidation states, spectral and magnetic properties, Complex formation, Applications and uses of elements and their compounds.


 Chairman
 Department of Chemistry
 University of Sargodha
 SARGODHA

Chemistry of Coordination Compounds: Introduction of d – block elements, Nomenclature, Werner’s theory, Valence bond theory. Crystal field and Ligand field theory, Molecular orbital theory, Jahn-Teller Theorem, Magnetic properties, the spectrochemical series and color of metal complexes, Isomerism and Stereochemistry of coordination compounds. Geometry of complexes having coordination number 2 to 6. Applications of coordination compounds in chemistry, life and industry.

Non – aqueous Solvents: Introduction, classification of solvents, Types of reactions in non-aqueous solvents, effect of physical and chemical properties of solvents, study of reactions in liq. NH₃, liq. SO₂, liq. HF and liq. BrF₃, Reactions in molten salt system.

Bonding Models for Non-transition elements: (VSEPR model followed by VB Theory for determination of geometries of molecules and ions containing sigma bond as well as pi- bonds, Band theory of metallic bonding (Conductors, Insulators and Semiconductors), Bonding in electron deficient compounds, Hydrogen bonding).

pi – Acceptor Ligands: (Transition metal carbonyls (Mononuclear, Binuclear, Polynuclear), The eighteen electron rule as applied to metal carbonyls. Evaluation of structures based on spectroscopic evidence, Chemistry of metal carbonyls. Applications of metal carbonyls and their derivatives to catalysis and organic synthesis).

Organic Reagents used in Inorganic Analysis: (Types of reagents, their specific nature and methods of applications with specific examples, Complex metric titrations involving various reagents (EDTA etc), Chelates and chelate effect, Role of organic reagents in different analytical techniques).

RECOMMENDED BOOKS

1. Cotton, F.A. and Wilkinson, G. *Advanced Inorganic Chemistry*. 5th Edition. John Wiley, NY (1988).
2. Greenwood, N.N. and Easnow, A. *Chemistry of the Elements*. 2nd Edition, Pergamon NY (1984).
3. Joly, W.L. *Principles of Inorganic Chemistry*. McGraw Hill. (1985).
4. Sharpe, A.G. *Inorganic Chemistry*. 2nd Edition. John Wiley, NY (1987).
5. deLavis, R. *Principles of Quantitative Chemical Analysis*. 1st Edition, WCB/McGraw Hill, NY (1997).
6. Harris, D.C. *Quantitative Chemical Analysis*. Freeman, NY (2003).
7. Shaheen, M.A. *Advanced Topics in Inorganic Chemistry*. Jilani Notes, Sargodha (2015), in Press
8. Huheey, J. E., Keiter, E. A. and Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th Ed., Harper and Row, New York, (2001).
9. Kotz, J. C. and Treichel, P. *Chemistry and Chemical Reactivity*. 4th Edition. Saunders College Publishing, NY (1999).

Paper-III Organic Chemistry (written)

Basic concepts: Nomenclature of aliphatic, alicyclic, aromatic, heterocyclic organic compounds, concept of aromaticity.

Stereochemistry of organic compounds: Conformational Isomerism in Acyclic Compounds, Cyclobutane, Cyclopentane, Cyclohexane, Mono-substituted, Di-substituted Cyclohexanes and condensed rings. Geometrical Isomerism: E/Z Nomenclature, Cis/Trans & Syn/Anti Nomenclature, Determination of configuration. Optical Isomerism: Chirality and Symmetry, Optical isomerism of Compounds upto three Asymmetric Centers, Relative and Absolute configuration, R/S nomenclature, Racemization, Resolution of racemic mixture, Optical isomerism in biphenyls, allenes and spiro compounds, Asymmetric Synthesis, Stereospecificity and Stereoselectivity.

Structure and Reactivity: The effect of structure & medium and steric effects on the strength of acids and bases and on acid-base equilibria. Resonance and inductive effects on acidity and basicity. Linear free energy relationships.

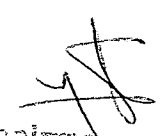
Introduction to reactive intermediates: Structure, methods of generation, reactions and synthetic applications of carbenes, nitrenes and arynes.

Reaction mechanism I: (Introduction to reaction mechanism, Methods of determination of reaction mechanism, Comprehensive study on the mechanism of different types of substitution, addition and elimination reactions with emphasis on their determination).

Oxidation and Reduction (Oxidation: Oxidation of saturated hydrocarbons, olefinic double bonds, aromatic rings, systems containing oxygen such as alcohols, aldehydes, ketones and dicarbonyl compounds, oxidative decarboxylation of acids, Oxidation of systems containing nitrogen such as amines, hydrazines and hydrazones.

Reduction: Reduction of cycloalkanes, alkenes, conjugated olefins, alkynes and aromatic rings, Hydrogenolysis, reduction of benzylic and allylic systems, aldehydes and ketones, alcohols, pinacols, epoxides, acids and their derivatives, Reduction of systems containing nitrogen such as imines, oximes and nitro compounds).

Active Methylene Compounds: (Alkylation, arylation and acylation of active methylene compounds, Acid and base catalysed aldol condensations, Conditions, mechanism and synthetic applications of the following reactions, Claisen


Chairman
Department of Chemistry
University of Sargodha
SARGODHA

reaction, Claisen-Schmidt reaction, Knoevenagel reaction, Perkin reaction, Reformatsky reaction, Stobbes condensation, Darzen'sglycidic ester synthesis, Mannich reaction and Wittig reaction).

Recommended books

1. Streitwieser, A., Heathcock, C. and Kosower, E. M. *Introduction to Organic Chemistry*, Macmillan, New York (1998).
2. Pine, S. H., *Organic Chemistry*, (5th Edition) McGraw-Hill, NY. (1987).
3. Solomons, T.W.G., *Fundamentals of Organic Chemistry*, Wiley, NY (2003).
4. Kemp, W., *Organic Spectroscopy*, Macmillan, London (1990).
5. Morrison, R.T. and Boyd, R.N. *Organic Chemistry*, Allyn & Bacon, Boston (1987)

Paper-IV Biochemistry (written)

History and Scope of Biochemistry, Origin and nature of biomolecules.

Carbohydrates: (Definition and Classification, Monosaccharides: Pyranose and Furanose ring structures. Stereoisomerism and Optical isomerism. Disaccharides; Structures. Polysaccharides, starch, Glycogen and Cellulose. Modified Carbohydrates. Glycoproteins and Glycolipids).

Proteins: (Amino acids, classification and properties, Stereochemistry, Primary, Secondary, Tertiary and Quaternary structures Biological functions of proteins and peptides. Protein folding and Stability).

Enzymes: (Chemical Nature, Nomenclature and Classification, Enzyme activity, Coenzymes and immobilized enzymes, Specificity of Enzymes, Enzyme Inhibition, Regulation of Enzyme activity).

Lipids: (Structures and classification of Fatty Acids, essential and non-essential fatty acids, Phospholipids, Fats and oils; Hydrogenation, Oxidation and Rancidity, Beta-oxidation of fatty acids, Lipid Bilayer, Lipid Mobility).

Nucleic Acids: (Purines and pyrimidines, nucleosides and nucleotides, Structural and functional differences between DNA and RNA, Types of DNA and RNA, their functions in biological systems, Central Dogma and its significance, Fundamentals of DNA Replication, Transcription and Translation).

Vitamins: (Introduction, classification, chemistry and biological significances of vitamins A, B, C, D, E and K).


Forensic Chemistry: This subject will integrate the concept and techniques developed in chemistry, physiology and biochemistry and apply them to the pharmacology and detection of drugs and toxins. Most important topics in forensic science are fingerprinting, forensic serology, hair and fiber analysis, explosive residues, glass comparisons, drug analysis, bullet and cartridge analysis, DNA analysis, Forensic botany and forensic toxicology.

Recommended books

1. Bell, S. *Forensic Chemistry*, 1st Edition, Prentice Hall, NY (2006).
2. Jackson, A.R.W. and Jackson, J.M. *Forensic Science*, 1st Edition, Prentice Hall, NY (2004)
3. Khan, J., Kennedy, T.J. and Christian, D.R., Jr. *Basic Principles of Forensic Chemistry*, Humana Press, NJ (2009).
4. Eckert, W.G. *Introduction to Forensic Sciences*, 2nd Edition, Elsevier, NY. (1992).
5. Genge, N.E. *The Science of Crime Scene Investigation: The Forensic Casebook*, Ballentine Books, NY. (2002).
6. Lehninger, A.L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
7. Voet, D. and Voet, J.G. *Biochemistry*, John Wiley & Sons, New York. (2001).
8. Murray, R.K., Mayes, P.A., Granner D.K. and Rodwell, V.W. *Harper's Biochemistry*, Appleton and Lange, UK (2000).
9. Zubay, G. *Biochemistry*, 4th Edition, Macmillan Publishing Co. NY (1999).
10. Stryer, L. *Biochemistry*, Freeman & Co. NY (1994).
11. Bryce, C.F.A. *Microcomputers in Biochemistry: A practical approach*, Oxford University Press, UK (2002).

Paper-IV Analytical Chemistry (written)

Introduction to Analytical Chemistry: Sampling: Types of samples, Techniques/ Steps involved in sample preparation, Drying and ignition, Weighing, Analytical balance, its construction working volumetric glassware, Errors in measurements, Calibration of glassware, Steps involved in chemical analysis, System for units of measurements and their inter conversion, Chemical concentration and preparation of solutions, Calibration and treatment of analytical data: Precision, accuracy and types of errors, Sample, Population, Mean, Average, Median, Range, Standard Deviation, Variance, Significant figures, Chemical Equilibrium and its types.


Chairman
Department of Chemistry
University of Sargodha
SARGODHA

Basic Chromatography Techniques: Classifications of Chromatographic Techniques, Paper and Thin Layer Chromatographic Techniques: their instrumentation, applications and limitations.

Column Adsorption Chromatography,
Introduction to Spectroscopy / Spectrophotometry: Introduction to Molecular spectroscopy, absorption in UV and Visible range; Basic principle of Spectrophotometry: Beer-Lambert's law; Deviations; Instrumentation and application of UV/Visible spectroscopy.

Recommended books

1. Skoog, D. A. West, D. Holler, J. M.F., Crouch S. R. *Fundamentals of Analytical Chemistry*. 8th ed. Saunders College Publishing, Philadelphia. (2003).
2. Christian, G.D. *Analytical Chemistry*, John Wiley & Sons, NY (2005).
3. Harris, D.C. *Quantitative Chemical Analysis*, Freeman, NY (2003).

Paper-V BASIC MATHEMATICS and STATISTICS FOR CHEMIST

Mathematics: Introduction: Review of basic algebra. Graphs and their significance in chemistry. Trigonometric, Logarithmic and exponential functions. Differentiation, partial differentiation, differential equations and their use in chemical problems. Concept of maxima and minima. Integration. Determinants and Matrices, their properties and use in chemical problems. Solutions of linear equations (simple, determinant and matrices methods), operator theory, Theeigen value problem and curve fitting.

Statistics: Introduction: Definition. Descriptive and inferential statistics. Population, Sample. Data collecting, Graphical Representation

- Simple Bar chart
- Multiple Bar chart
- Rectangle Sub-divided Chart
- Histogram
- Frequency Polygon
- Histogram
- Pi- Chart

Central Tendencies (A.M., G.M. Median, Mode, H.M. for Ungrouped Data)

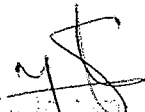
1. Quantiles with Interpretation (for ungrouped data)
- Quartiles
- Percentiles
- Deciles
2. Measures of dispersion (Mean Deviation, Variance, Standard Deviation, Coefficient of Variation)
3. Basic Probability Theory
4. Regression: Definitions of Simple linear regression, multiple regression (for two independent variables) and Correlation
5. Estimation: Point estimate, interval estimates, Confidence Interval for Single Mean, Difference of Mean
6. Testing of Hypothesis: t- test for single mean for paired samples and for Independent samples
7. ANOVA, Multiple Comparison Test. (LSD and DUCANSAN)
8. Chi Square for Association

Recommended Books

1. Ronald E. Walpo. *Probability & Statistics for Engineers & Scientists* 9th Ed. 2011. Prentice Hal. New York (2011).
2. William Navidi. *Statistics for Engineers and Scientists* 3rd Ed 2010. Prentice Hal. New York (2010)
3. Paul M. "Maths for Chemistry" Edition 1st. Oxford University Press, UK (2006).
4. Ghram D. "Mathematics in Chemistry" Edition 1st. Prentice Hall, NY (1996)
5. Tebutt P., "Basic Mathematics for Chemists" 2nd Edition. John Wiley & Sons, NY (1998).

Paper-VI Physical Chemistry (practical)

1. Determination of specific and molar rotations of optically active substance in solution polarimetrically.
2. Percentage by refractometer.


Head of Department of Chemistry
University of Burdwan
BURDWAN

3. Verification of Beer-Lambert's law, and determination of unknown concentration of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ solution by colorimeter.
4. Determination of distribution coefficient of I_2 between H_2O and CCl_4 .
5. Preparation of buffer solution and measurement of exact pH - Value by pH meter.
6. Determination of pK_a and K_a value of a weak acid.
7. Molecular mass determination of non-electrolyte solute by cryoscopic method.
8. Determination of number of associated molecule of Benzoic acid in Benzene and to determine the Distribution coefficient of Benzoic acid between H_2O and Benzene.
9. Determination of unknown concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ solution spectrophotometrically.
10. Determination of percentage purity of an optically active compound.

Recommended Book

1. Jaffar M. "Experimental Physical Chemistry" University Grants Commission (1989).
2. Levitt B.P. "Findlay's Practical Physical Chemistry" 9th ed., Longman Group Limited (1978).
3. Shoemaker D. "Experiments in Physical Chemistry" 5th ed., McGraw Hill Publishing Company Limited (1989).
4. Shaheen, M.A., Manual of Practical Chemistry, Vol.I, Jilani Notes, Sargodha (2012).
5. Halpern, Arthur M. "Experimental Physical Chemistry: A Laboratory Textbook" 2nd ed., Prentice Hall (2003).

Paper-VII Inorganic Chemistry (practical)

1. Qualitative Analysis of inorganic mixture comprising of six radicals by micro and semimicro techniques.
2. Estimation of Halide ions (Cl^- , Br^- , I^-) by adsorption indicator
3. Complexometric titrations using EDTA
4. a. Ni , Ca (II) and Mg (II) in a mixture. b. Mg (II), Mn (II) and Zn (II) in a mixture.
5. Gravimetric Estimations a. Barium ions. b. Oxalate ions
6. Redox titrations. a. Cu (II) by Potassium iodate. b. Fe (II) by Ceric sulphate
7. Preparation of four Inorganic compounds in pure state using different techniques of synthesis
8. a. *tris* - Etylenediamine Ni (II) chloride hydrate. b. Pot. Trioxalatoaluminate (III). c. Ammonium Ni (II) sulphate. Hexaquo chromium (III) chloride

Recommended Books

1. Vogel, A. Vogel's Quantitative Inorganic Analysis, 5th Edition, 2003, Pearson Educational Ltd, London
2. Shaheen, M.A., R.N., Jilani Manual of Practical Chemistry, Vol.III, 2012, Jilani Notes, Sargodha

Paper-VIII Organic Chemistry (practical)

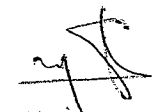
Separation & Identification of two and three component mixture of organic compounds by physical and chemical methods. Estimation of phenol & acetone, amino groups, synthesis of azodyes, iodobenzene, iodoform, sulphanilic acid, cinnamic acid, benzil & benzilic acid, ethyl benzene.

Recommended Books

3. Vogel, A. Vogel's Practical Organic Chemistry, 5th Edition, 2003, Pearson Educational Ltd, London
4. John Leonard, Barry Lygo, Garry Procter, 2012, Medical Organic Chemistry, 2013 CRC Press, USA
5. Shaheen, M.A., Paracha, R.N., Jilani, Manual of Practical Chemistry, Vol.III, 2012, Jilani Notes, Sargodha

Paper-IX (i) Biochemistry (practical)

1. Safety Lab Practices


 Lecturer in Chemistry
 University of Sargodha
 Sargodha

2. Standard Buffer preparation and use of pH meter.
3. Operation and use of micropipettes
4. Qualitative Tests for carbohydrates (Mono-, Di-, and polysaccharides, Pentoses and Hexsoses).
5. Quantitative Determination of Reducing Sugars by using Calorimetric Method (Spectrometric).
6. Enzymatic Hydrolysis of Glycogen and Starch.
7. Phenyl Hydrazine Test for Reducing Sugars (Osazone Test).
8. Effect of Alaklies on Sugars.
9. Qualitative tests for fats, Sterols and Phospholipids
10. Saponification Tests and Iodine Values of Fat.
11. Isolation of DNA by from Plants and Animal Tissues
12. Qualitative tests for Amino Acids.
13. Estimation of protein by Kjeldahl, Lowery methods.
14. Separation of Amino Acids using Paper Chromatography and Thin Layer Chromatography (TLC).
15. Determination of Ash Contents of Food.
16. Determination of Percentage Moisture Contents of Dry Mass in Food
17. Determination of Ascorbic acid in Lemon Juice.
18. Use of Online available Protein Databases.
19. Determination of Secondary structure of Proteins using online available software.

Recommended Books


1. Lehninger, A. L. *Principles of Biochemistry*. Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet, *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Murray, R. K., P. A. Mayes, D. K. Granner and V. W. Rodwell. *Harper's Biochemistry*, Appleton and Lange(2000).
4. Shaheen, M.A., Mahmood, T., A Manual of Practical Chemistry, Vol(IV), Jilani Notes, Sargodha (2014).
5. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co (1999).
6. Stryer, L. *Biochemistry*, Freeman & Co.(1994).
7. Bryce, C. F. A.. *Microcomputers in Biochemistry: A practical approach*, Oxford University Press.(2010)

Paper-IX (ii) Analytical Chemistry (practical)

1. Calibration of glass ware (Pipette, Burette, Flask) used for volumetric Analysis
2. Use of Analytical balance and calculation of standard deviation
3. Use of pH meter for plotting acid - base titration curve and assay of commercial caustic soda
4. Plotting of first differential curve for titration of acetic acid and commercial soda
5. Measurement of solubility products of sparingly soluble salts
6. Determination of HCl by titrating with NaOH and plotting of a titration curve.
7. Packing of chromatographic column and separation of mixture of dyes.
8. Separation of various components of plant extract by column chromatography.
9. Separation of mixture of dyes by Radial chromatography.
10. Separation of mixture of Amino acids by paper chromatography
11. Coating of TLC plates and separation of mixture of dyes.
12. Separation of mixture of Amino acids by TLC.

Recommended Books

1. D.Skoog and D.M.West. *Fundamentals of Analytical Chemistry*. Holt Reinhart Inc, London
2. G.D.Christian, *Analytical Chemistry*, John Wiley & Sons
3. D.C. Harris . *Quantitative Chemical Analysis*, Freeman, N. Y.


Chalman
 Department of Chemistry
 University of Sargodha
 SARGODHA

M.Sc. Part II

Paper I-A Physical Chemistry (Special major)

MOLECULAR SPECTROSCOPY: Classification of spectroscopy. Rotational spectra of rigid linear molecules and determination of bond lengths. The Stark-effect. Harmonic and anharmonic oscillator models for the energy of a diatomic molecule. Types of vibrational modes. Interpretation of IR spectra of simple molecules. Fermi resonance, applications and sampling techniques. Types of electronic transition. H – atom spectrum, energies of atomic orbital, electronic angular momentum and the fine structure. Idea of Raman scattering, Rayleigh scattering and molecular polarizability. Rotational Raman spectra of linear molecules. Symmetric top molecules and spherical top molecules, vibrational Raman spectra. Nuclear magnetic resonance spectroscopy.

POLYMERS AND PHOTOCHEMISTRY: Classification of polymers. Kinetics of condensation, addition and copolymerisation reactions. Molecular mass determination by different methods laws of photochemistry. Quantum efficiency and its determination. Photochemical reactions. Photosensitised reactions. Phosphorescence, fluorescence, chemiluminescence, Lasers.


RECOMMENDED BOOKS

1. Castellan G. W. "Physical Chemistry" 3rd Ed. Norasa Publishing House. Delhi (2004).
2. Fried. V., Hamaker, H.F. and Blukis, U.U. "Physical Chemistry". Macmillan Publishing Co., Inc., New York (1987).
3. Laidler K.J. and Meiser, J.H. "Physical Chemistry". Benjamin/Cummings Publishing Company, Inc., NY (1998).
4. Kaufman E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company, NY (1966).
5. Colin N. Banwell and Elaine M. McCash "Fundamentals of Molecular Spectroscopy", Edition 4th, The Bath Press Avon, UK (1994).
6. Gurdeep R. "Advanced Physical Chemistry" 3rd Ed. Krishna Prakashan Media (P) Ltd. Delhi (2008)
7. Atkins, P.W. "Physical Chemistry" 6th Ed. ELBS Oxford University Press, UK (1997).
8. Alberty, R. and Silvey, A. "Physical Chemistry" 7th Ed. John Wiley & Sons, NY (1992).
9. Castellan, G. W. "Physical Chemistry" 3rd Ed. Norasa Publishing House. Delhi (2004).
10. Fried, V., Hamaker, H.F. and Blukis, U.U. "Physical Chemistry". Macmillan Publishing Co., Inc., New York (1987).
11. Akin, P.W. "Elementary Physical Chemistry" 2nd Edition. Freeman NY (1998).
12. Scott, S. K. "Beginning Mathematics for Physical Chemistry" Oxford University Press. UK (1996).

Paper II-A Physical Chemistry (Additional minor)

Surface tension, adsorption isotherms: Freundlich, Langmuir and BET isotherms. Adsorption at liquid surface, surfactants, micellization. Methods of preparation of gels and emulsions. Classification structure of gels. Thixotropy. Precipitation in gels. Liesegang rings. Emulsifiers. Properties of emulsions. Breaking of emulsions. Orientation theory. Emulsification and wetting. Significance. Sols and their preparation, properties of suspensions optical properties of sols. Determination of particle size. Kinetic properties of sols. Sedimentations of suspensions, electrical properties of sols, electrophoresis and electroosmosis. Stability of suspensions. Precipitation of sols. Molecular weight determination of macromolecules. The cause of semi-permeability. Mechanism of osmotic pressure. Determination of the molecular weight by osmometry.

Advanced approach of homogeneous and heterogeneous kinetics: Liquids and gaseous systems of inorganic and organic reactions. Single systems, double systems. Study of reactions on solid surfaces. Single reacting gas, retardation by reaction products. Two reacting gases, retardation by reactants, adsorption-heterogeneous reaction, Reactions in solution. Influence of solvents involving ions, primary and secondary salt effect on kinetics of the reactions. Comparison between homogeneous and heterogeneous kinetics.


Chairman
Department of Chemistry
University of Sargodha
SARGODHA

Recommended books

1. Kaufman, E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company, NY (1966).
2. Aktin, P.W. "Elementary Physical Chemistry" 2nd Edition, Freeman NY (1998).
3. Scott, S.K. "Beginning Mathematics for Physical Chemistry" Oxford University Press, UK (1996).
4. Tebutt, P., "Basic Mathematics for Chemists" 2nd Edition. John Wiley & Sons, NY (1998).
5. Gurdeep, R. "Advanced Physical Chemistry" 3rd Ed. Krishna Prakashan Media (P) Ltd. Delhi (2008)
2. Alberty, R. and Silvey, A. "Physical Chemistry" 7th Ed. John Wiley & Sons, NY (1992).
3. Barrow, G. M. "Physical Chemistry" 5th Ed. McGraw Hill, Inc. CA (1998).
4. Castellani, G.W. "Physical Chemistry" 3rd Ed. Norasa Publishing House, Delhi (2004).
5. Fried, V., Hameka, H.F. and Blukis, U.U. "Physical Chemistry". Macmillan Publishing Co., Inc., New York (1987).
6. Laidler, K.J. and Meiser, J.H. "Physical Chemistry" Benjamin/Cummings Publishing Company, Inc. NY (1998).

Paper III-A Physical Chemistry (Practical)

1. Determination of heat of solution of a substance by solubility method.
2. Determination of empirical formula of Ferric-salicylic acid complex colorimetrically.
3. Determination of order of reaction and the rate constant of a given reaction.
4. Verification of Freundlich isotherm for organic acids.
5. To prepare As_2S_3 sol.
6. Determination of activity coefficients by measuring electromotive force.
7. Determination of Molar extinction coefficient.
8. Determination of equilibrium constant of reversible reaction $I_2 + I^- \rightleftharpoons I_3^-$ and to evaluate ΔG^0 .
9. Determination of molecular mass of polymer by viscosity method.
10. Determination of flocculation value of electrolytes and to verify Hardy-Schultz rule.
11. Determination of activation energy of a chemical reaction.
12. Study of variation of conductance of solution of weak and strong electrolytes with
concentration (a) pure solvents (b) binary mixture of Solvents
13. Determination of heat of solution of a substance from solubility measurements and to determine thermodynamic quantities like ΔG^0 , ΔH^0 , ΔS^0 of the solution.
14. Potentiometric titration

Recommended Books

1. Kaufman E.D., "Advanced Concepts in Physical Chemistry". McGraw Hill Book Company (1966).
2. Aktin P.W., "Elementary Physical Chemistry" 2nd Edition (1998).
3. Scott S. K., "Beginning Mathematics for Physical Chemistry" Oxford University Press (1996).
4. Tebutt P., "Basic Mathematics for Chemists" 2nd Edition. (1998).
5. Gurdeep R., "Advanced Physical Chemistry" (3rd Ed). Krishna Prakashan Media (P) Ltd. (2008)

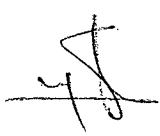
Paper I-B Inorganic Chemistry (Special major)

Organometallics

- (a) Nature of metal-carbon bonds: Compounds with Metal-Carbon single bonds; Compounds with Metal-Carbon π -bonds; Classification of organometallic compounds and 18-electron rule.
- b) Compounds of transition metals: Single, double and triple bonds to carbon. (compound types: Acyls, Alkylidene complexes and alkylidyne complexes), delocalized hydrocarbon systems. (alkene, olefins, allyl and Butadienes), Alkyne complexes, Cyclic π complexes (four, five and six member rings).
- c) Fundamental Process in Reactions of Organotransition Metal Complexes: Ligand Coordination & dissociation; Oxidative addition & reductive Eliminations; Insertion & Extrusion reactions; Reaction of Coordinated ligands. Applications of organometallic compounds in synthetic chemistry and industry.

Bio-Inorganic chemistry:

Essential elements. Biochemistry of iron (iron storage and transport), Haemoglobin and myoglobin. Cytochromes, other natural oxygen carrier, Biochemistry of other metals (Zn, Cu, Co, Cr, Ni and V), Metal based drugs.


Chairman
Department of Chemistry
University of Jargodha
SARGODHA

Inorganic Polymers: Molecular species (polymeric Sulphur nitrogen compounds, Borazines, Phosphazines, Boranes, Carboranes, and Silicones), Polyionic species (Isopoly and heteropoly anions of transition elements, polysilicates, and polyphosphates), Metal cluster compounds

Inorganic Reactions Mechanism: Rate law, Stationary State approximation, Inert and labile complexes, Substitution reaction

- i) Octahedral Complexes (Acid hydrolysis, Acid catalyzed equation, Anation reactions, Base hydrolysis, Attack on ligands, Steric effects of inert ligand)
- ii) Square planar Complexes (Nucleophilic reactivity, Trans effect, Cis effect, effect of leaving group, Electron transfer processes (outer and inner sphere reactions), Complimentary and Non - Complimentary reactions.

RECOMMENDED BOOKS

1. Huheey, J.E., Keiter, E.A. and Keiter, R.L. "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, (2001).
2. Garry L., Miessler, D. and Tarr, A. "Inorganic Chemistry" 3rd Edition, Pearson Education, Inc. NY (2004).
3. Purcell K.F. and Kotz, J.C. "An Introduction to Inorganic Chemistry" Saunders, College, Philadelphia (1980).
4. Shaheen, M.A. Advanced Topics in Inorganic Chemistry, Jilani Notes, Sargodha (2015), in Press
5. Jordan, R.B. *Reaction Mechanisms of Inorganic and Organometallic Systems*, 2nd Edition, Oxford University Press, UK (1998).
6. Angelici, R. J. *Synthesis and Technique in Inorganic Chemistry*, 1st Edition, University Science Books, CA (1986).

Paper II-B Inorganic Chemistry (Additional minor)

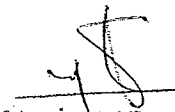
Stereochemistry, periodicity & nuclear chemistry: Concepts of Stereochemistry and Periodicity (Introduction, VSEPR model, Hybridization, three center bonds, Molecular Orbital correlation diagrams, First and Second row anomalies, the use of d-orbitals by non-metals, Reactivity and d-orbital participation, The use of p-orbitals in pi-bonding, Periodic anomalies of non-metals and post transition metals).

Nuclear Chemistry: (Introduction, classification of Nuclides, Radioactivity and radioactivity series, Artificial radioactivity, units of radioactivity, Determination of Half- life, Nuclear Fission and Fusion reactions, Applications of radio Isotopes as traces).

Homogeneous Catalysis by Transition metal complexes: Reaction of CO and Hydrogen (Hydroformylation, Reductive Carbonylation, Reduction of CO by hydrogen, Synthesis gas and the water gas shift reaction) Carbonylation reaction (Synthesis of methanol and methyl acetate, Adipic ester, other Carbonylation reactions, Decarbonylation reactions) Catalytic addition of molecules to C - C multiple bonds (Homogeneous hydrogenation, Hydrocylation and Hydrocynyation)

Recommended books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, (2001).
2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., "Basic Inorganic Chemistry", 3rd Ed., Wiley, New York (1995).
3. Atkins, P. and Jones, L., "Chemicals Principles" Freeman & Co., NY (2002).
4. Cotton, F.A., Wilkinson, G., Murillo C.A. and Bochmann, M. "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, (1999).
5. Shaheen, M.A. Advanced Topics in Inorganic Chemistry, Jilani Notes, Sargodha (2015), in Press
6. Bassette, J., Denney, R.C., Jefery, G.H. and Mendham, J. "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis", 4th Edition, English Language Book Society, UK (1981).


Chairman
Department of Chemistry
University of Sargodha,
SARGODHA

7. Vogel, A.I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. NY (1995).

Paper III-B Inorganic Chemistry (Practical)

a) Conductometry

1. Titration of Strong acid and Weak acid with a Strong base
2. Precipitation Titration involving AgNO_3 and KCl
3. Determination of Dissociation Constant (K_a) for Acetic Acid

b) Spectrophotometry (Colorimetry)

1. Microdetermination of Cr (III) by diphenylcarbazide
2. Determination of Fe (II) by 1:10 - Phenanthroline
3. Determination of Nitrites
4. Determination of Fe (III) by 8 - hydroxyquinoline

c) Potentiometry

1. Determination of K_1 , K_2 , and K_3 for H_3PO_4
2. Determination of Chloride in the presence of Iodide and evaluation of K_{sp} of AgI and AgCl
3. Determination of Co (II)
4. Determination of Fe (II)

d) Use of some organic reagents for the estimation of various elements (at least any 04 of the following)

1. 8-Hydroxyquinoline Al (III) and Fe (III), Nitron (NO_3^-)
2. Salicyladoxine Ni (II) in presence of Cu (II)
3. Anthranilic Acid Co (II) and Zn (II)
4. Pyrogallol, Bi^{3+}

e) Chromatographic Techniques - Column, Thin layer and Paper chromatographic techniques for the qualitative separation of inorganic compounds

f) Applications of Solvent extraction and ion exchange techniques

g) Synthesis of at least six Inorganic compounds / Complexes in a pure state and determine their state of purity

1. $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}$
2. $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
3. $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}$
4. $[\text{Co}(\text{en})_3]\text{Cl}_3$


Recommended Books

1. Harris, D. C., Quantitative Chemical Analysis, 4th Edition, W.H. Freeman, (1995).
2. Holzbecher, Z. L., Divis, M., Kral, L., Sucha and F. Vlacil, Hand book of Organic Reagents in Inorganic analysis, Longman, UK (2003)
3. Feigl, F., V. Anger and R. Oesper, Spot tests in inorganic analysis, W.H. Freeman, (1995).
4. A.I.V. Quantitative in organic analysis, 2003, Longmans, England (2003)
5. Shaheen, M.A., Jilani Manual of Practical Chemistry, Vol.V, Jilani Notes, Sargodha, (2014).
6. deLavis, R., Principles of Quantitative Chemical Analysis, 1st Edition, WCB/McGraw Hill, (1997).

Paper I-C Organic Chemistry (Special major)

Molecular Rearrangements: Classification of molecular rearrangements. Mechanism of intramolecular 1, 2 - shifts involving migration of a group from carbon to carbon, carbon to nitrogen and carbon to oxygen. Mechanism and examples of Wagner - Meerwein, Pinacol - Pinacolone, Benzidine-Benzillic acid, Favorski, Wolf, Beckmann, Hofmann, Curtius, Lossen, Schmidt, Baeyer - Villiger, Dakin and Fries rearrangements

Pericyclic Reactions: Introduction, Hoffman theory, Fukui theory, Mobius Huckle theory of electrocyclic reactions, cycloaddition reactions, Pericyclic reactions involving 2, 4, 6 π electrons, sigmatropic rearrangements


Department of Chemistry
University of Sargodha
Sargodha

Free radicals: Generation, Detection and Reactions. Application of free radical in industry. Role of free radicals in nature and environment.

Organic synthesis: Introduction to retrosynthesis. Retrosynthetic analysis, Functional group inter-conversion(FGI), C – C, C – N and C – O bond formation. Applications to the synthesis of various target molecules. Difunctionalized compounds. Role of crown ethers and quaternary ammonium salts in organic synthesis. Protective groups. Recent trends in organic synthesis.

Organometallics: Preparation and uses of organoLi, organoMg(Grignard's reagent), organoSn, organoCu, organoZn and organoPd in synthetic organic chemistry with special focus on stereochemical outcome. Brief introduction of organoB, organoSi and organoS chemistry

Recommended books

1. Smith M.B. and March, J. *March's Advanced Organic Chemistry*, 5th Edition, John Wiley, NY. (2001).
2. Gould, E. S. *Mechanism and Structure in Organic Chemistry*. Holt, Rinehart & Winston, NY (1970).
3. Morrison, R. T. and Boyd, R. N. *Organic Chemistry*. Allyn & Bacon, Boston (1987).
4. House, H. O. *Modern Synthetic Reactions*, Benjamin, California (1972).
5. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry" 1st Edition, Oxford University Press, UK (2001).

Paper II-C Organic Chemistry (Additional minor)

Spectroscopic methods in organic chemistry

UV/VIS Spectroscopy: Basic principle, instrumentation & sample handling, Woodward Fieser rule for conjugated dienes and α,β -unsaturated carbonyl systems. Absorption by aromatic compounds. Applications of UV-Visible spectroscopy

IR Spectroscopy: Basic Principle, Instrumentation and sample handling, Interpretation of IR spectra, Applications of IR spectroscopy.

Mass Spectrometry: Basic Principle, Instrumentation, Modes of fragmentation of various organic molecules, Determination of molecular mass, molecular formula and molecular structure, Interpretation of Mass spectrum.

NMR Spectroscopy: Basic Principle, Spin flipping, Spin relaxation, The Chemical shift, Instrumentation and Sample handling, Spin-spin splitting and coupling constant, Interpretation of NMR spectra, Structure elucidation of organic compounds by joint applications of IR, UV, NMR spectroscopy and Mass spectrometry.


Chemistry of natural products: Introduction to natural products, classification, isolation, biosynthesis and structure elucidation of steroids, terpenoids, alkaloids, carotenoids, vitamins and flavonoids.

Recommended Books

1. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry" Edition 1st, Oxford University Press, 2001.
2. Huheey, J.E. "Inorganic Chemistry", Harper and Row, (Latest Edition)
3. Garry L. Miessler, Donald A. Tarr, "Inorganic Chemistry" 3rd Edition, Pearson Education, Inc. (2004).
4. Williams, D. and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, McGraw-Hill, New York, (2004)
5. Younas, M., *Organic Spectroscopy*, A. H. Publisher, Lahore (2005)
6. Silverstein, R. M., G. C. Bassler and T. C. Morrill, *Spectrometric Identification of Organic Compounds*, Wiley, New York (2006)
7. Kemp, W., *Organic Spectroscopy*, Macmillan, London, (2006).

Paper III-C Organic Chemistry (Practical)

1. Experimental techniques e.g. distillation, solvent extraction, chromatography etc.
2. Multi-step synthesis of some organic compounds
3. Estimation of glucose and number of acetyl groups


Chairman
Department of Chemistry
University of Sargodha
SARGODHA

4. Multistep synthesis of different types of organic compounds. Purification of the products by chromatographic and other techniques.
5. Isolation and purification of some natural products.
6. Conformation of the products by different techniques e.g. elemental analysis, spectroscopy etc.

Recommended books

1. Williams, D. and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, McGraw-Hill, New York.
2. Younas, M., *Organic Spectroscopy*, A. H. Publisher, Lahore (2006).
3. Shaheen, M.A., Paracha, R.N., *Manual of Practical Chemistry*, Vol.III, Jilani Notes, Sargodha (2014).
4. Silverstein, R. M., G. C. Bassler and T. C. Morrill, *Spectrometric Identification of Organic Compounds*, Wiley, New York (2005).
5. Kemp, W., *Organic Spectroscopy*, Macmillan, London (1990).
6. Finar, I.L., *Natural Product Chemistry*, Vol-I, Longman, London. (2001)
7. Streitwieser, A., Heathcock, C. and Kosower, E.M. *Introduction to Organic Chemistry*, Macmillan, New York. (1998).
8. Shaheen, M.A., R.N., Paracha, *Manual of Practical Chemistry Vol(III)*, Jilani Notes, Sargodha (2014).
9. Clayden, J., Greeves, N., Warren, S. and Wothers, P. "*Organic Chemistry*" Edition 1st, Oxford University Press, UK (2001).

Paper I-D Biochemistry (Special major)

Microbiology & industrial fermentations: Scope of Microbiology and fermentation, General morphology and cytology of microorganisms, Microscopic Examination of Microorganism, Classification and methods of isolation of microorganisms, General effects of environments on microorganisms, nutrition of microorganisms, Growth (Normal growth Cycle and Continuous Culture) and Reproduction, Pure culture Study.

Introduction to industrial microbiology: Research Methodology Bioeneragenatic of microorganism for the industries pupose, oxygen transfer, Industrial Uses of Bacteria, Molds, Yeast and viruses Application of chemostate and trubidostate, Microbial production of Alcohol, Citric acid and Acetic acid with mechanism; Antibiotic, enzyme production, Fermented Foods Vinegar production, Amino Acid, Petroleum Microbiology and Deterioration of Materials. (Paper, Textile and Cordage, Painted Surface) and Analytical Microbiology.


Chemotherapy and immunology: Chemotherapeutic Agents and Chemotherapy, Historical Highlight of chemotherapy, Characteristic of Antibodies that Qualify them as Chemotherapeutic agents, Antibiotic and their mode of action, Antifungal, Antiviral and Antitumor Antibiotic Microbiological Assay of antibiotic, antipyretics, analgesics, antimalarials, sulpha drugs and antibiotics with special reference to penicillin mechanisms of drug resistance, Non-medical uses of Antibiotic, Principles of immunology, antigens, antibodies, characteristics of antigens and antibody reaction, allergy and hypersensitivity, the compliment System, Blood groups (A, B, O, MNO and Rh factor), Acquired immunity and Immuno-deficiencies.

Enzyme Structure and Functions: Chemical nature, nomenclature and classification of enzymes, Cofactors, effect of different factors on enzyme activity, Kinetics Studies of substrate reactions. (MICHAELIS- MENTEN EQUATION and LINEWEAVER-BURKE PLOT) Quantitative assay of enzyme activity, substrate specificity, Enzyme substrate interactions and nature of the active site, Models Of enzyme substrate complex Mechanism of enzyme action with specific reference to Chymotrypsin and nuclease, Inhibition, Competitive, uncompetitive, non competitive and irreversible inhibition, Regulatory enzymes; Allosteric enzymes, Multi-enzyme systems, Zymogens, Isoenzymes Non-Protein Biocatalysis Ribosome's, (RNA as Enzyme), Enzymatic control of Metabolic pathways, Therapeutic uses of Enzyme and Immobilized enzymes.

Nutrition: Classification of Food, Source of Nutrients, Repiration, Caloric value of food, Calorimetry, Respiratory Quotient, Basal metabolic rate (BMR) and General Factor, chemical composition, functions, deficiency symptoms and requirements of Nutrients and their biological values, Balanced diet, Role of nutrition in growth, development and Chronic disease.

Recommended books

1. Lehninger, A.L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and Voet, J.G. *Biochemistry*, John Wiley & Sons, New York. (2001).
3. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co, NY (1999).
4. Stryer, L. *Biochemistry*, Freeman & Co, NY (1994).


Chairman
Department of Chemistry
University of Sargodha
SARGODHA

5. Dawis, B.D., Dulbecco, R., Eisen, H.N. and Ginsbery, H.S. *Microbiology*, Harper & Row, NY (2002).

Paper II-D Biochemistry (Additional minor)

Metabolism and bioenergetics: Methods of metabolism study. Biological oxidation – reduction including respiratory carriers, Cell Bioenergetics, ATP cycle, Oxidative phosphorylation, Energy metabolism including caloric value of foods, Calorimetry, RQ and BMR. Anabolism and Catabolism), Metabolism of Carbohydrates, Lipid Metabolism, Metabolism of Proteins and Amino acids. Carbohydrates Biosynthesis in Plants & Bacteria and conversion of Amino acids to specialized products.

Molecular biology & physical techniques:

i) **Molecular dogma, Biosynthesis** of RNA and DNA nucleosides, DNA polymerases, nucleosides catabolism, DNA as a genetic material, replication, Transcription, Translation Genetic coding, Gene and mutation units, Structure of Chromation and its functions, Gene activation, Virus replication and its protein regulation.

ii) **Spectrophotometer Electrophoresis**, centrifugation, Electron microscopy, PCR, DNA sequencer X-ray diffraction, Spectroscopy as applied to biological compounds etc. Use of isotopes in biochemistry. Endocrine System – Introduction, Chemical nature of Hormones, common characteristics, mode of action, chemistry, metabolism and biological functions of Pituitary, Adrenal, Thyroid, Parathyroid, Pancreatic and gondal hormones.

iii) **Endocrine System** – Introduction, Chemical nature of Hormones, common characteristics, mode of action, chemistry, metabolism and biological functions of Pituitary, Adrenal, Thyroid, Parathyroid, Pancreatic and gondal hormones.

iv) **Biochemistry and body fluids** – Composition and function of Blood, blood plasma, Blood proteins, Red blood cells, Haemoglobin, White blood cells, Platelets, Blood coagulation and blood pressure, Antibodies, Antigens and blood groups, Composition of Urine, Extra-cellular fluid like cerebrospinal fluid, Lymph sweats tears, Synovial fluid and interstitial fluid.

Recommended books

1. Lehninger, A. L. *Principles of Biochemistry*, Worth Publisher, New York (2001).
2. Voet, D. and J. G. Voet, *Biochemistry*, John Wiley & Sons, New York, (2001).
3. Zubay, G. *Biochemistry*, 4th Edition Macmillan Publishing Co, NY (1999).
4. Stryer, L. *Biochemistry*, Freeman & Co, NY (1994).
5. Dawis, B.D., Dulbecco, R., Eisen, H.N. and Ginsbery, H.S. *Microbiology*, Harper & Row, NY (2002).


Paper III-D Biochemistry (Practical)

Molecular Lab Handling, Biological pH and Buffering System and electrodes, Techniques for the sample preparation, CBP, (Dialysis, Ultracentrifugation Lyophilization) Glycation, Biosensors, Cell Fractionation, Planar Chromatography, (Paper and Thin-Layer) Ion Exchanger Chromatography, Amino acid Analyzers, HPLC and FPLC, Perfusion Chromatography, Gel Exclusion Chromatography, Column, and Affinity Chromatography ELISA, RIA and Centrifugation in Biological Research.

Methods for the isolation of DNA and RNA, (Blood serum and plant Samples) Electrophoresis (Verticals and Horizontal), Pulsed Field Gel Electrophoresis, Capillary Electrophoresis, Immuno-electrophoresis, PCR, DNA Sequencer, Primer Designer, Southern, Northern Western blotting technique, Electrophoresis of plasma proteins, polyacrylamide gel electrophoresis, Agarose electrophoresis of DNA and RNA, . Dialysis ultra filtration and lyophilization.

Recommended Books

1. Keith W., Walker, J. Principles and techniques of practical biochemistry (5th Ed.), Cambridge University Press, UK (1991).


Chairman
Department of Chemistry
University of Sargodha
SARGODHA

Paper I-E Analytical Chemistry (Special major)

Advanced chromatographic Techniques : Gas – Liquid chromatography, concepts of theoretical plates, Van – deemter equation. High–performance liquid chromatography, instrumentation and applications of these techniques.

FTIR&Raman spectroscopy: Origin of Molecular spectra, Origin of infrared and Raman spectra, Normal coordinate and normal vibrations. Symmetry of normal vibration and selection rules, selection rule for infrared and Raman spectra, Metal isotope spectroscopy, vibrational spectra in gaseous phase and inert gas matrices, comparison of Raman with Infrared spectroscopy. Quantitative/Qualitative analysis, Instrumental detail and their use as analytical tool.

Electron Spin Resonance: Instrumentation, Samples and sample holder, ESR spectra and Hyperfine interaction, Applications, Spin labels and spin traps.

Surface Analysis: Introduction, Electron spectroscopy techniques. X-Rays photoelectron spectroscopy, Instrumentation for XPS, Sample introduction and handling for surface analysis. Analytical applications of XPS.

Recommended Books

1. Christian, G.D. Analytical Chemistry, John Wiley & Sons, NY (2005)
2. Harris, D.C. *Quantitative Chemical Analysis*, Freeman, NY (2003)
3. Skoog, D.A. West, D. Holler, J. M.F., Crouch S. R. *Fundamentals of Analytical Chemistry*, 8th ed. Saunders College Publishing, Philadelphia (2003).

Paper II-E Analytical Chemistry (Additional minor)

Advanced spectroscopy – I: Atomic Spectrometry: Atomic Absorption and Flame Emission Spectrometry, instrumentation and applications. Emission Spectrometry with plasma and electrical discharge sources, UV/Visible Spectrophotometry: basic principle, instrumentation and applications.


Advance spectroscopy –II: Mass Spectrometry: Principle of Mass spectrometry, Instrumentation in details, Quantitative and Qualitative application in analytical chemistry. X-rays Spectrometry: Nature and production of X-rays, X-rays absorption, X-rays emission, Instrumentation, X-rays fluorescence analysis. Diffraction studies single crystal analysis

Recommended books

1. Christian, G.D. Analytical Chemistry, John Wiley & Sons (2005)
2. Harris, D.C. *Quantitative Chemical Analysis*, Freeman, N. Y. (2003)
3. Skoog, D. A. West, D. Holler, J. M.F., Crouch S. R. *Fundamentals of Analytical Chemistry*, 8th ed. Saunders College Publishing, Philadelphia. (2003).

Paper III-E Analytical Chemistry (Practical)

1. Measurement of λ_{max} and calculation of Molar absorptivity of potassium permagnate.
2. Plotting of calibration graph and measurement of unknown sample concentration.
3. Use of standard addition method in Spectrophotometry.
4. Determination of iron (II) using 1,10-phenanthroline method.
5. Determination of iron (III) using thiocyanate method involving solvent extraction.
6. Determination of phosphate by Spectrophotometry using molybdenum blue method.
7. Determination of Sodium in tap water sample by using Flame photometer.
8. Determination of Potassium in tap water sample by using Flame photometer.
9. Determination of Calcium in chalk sample by using Flame photometer.
10. Determination of Calcium in drinking water by EDTA.
11. Identification of free salicylic acid in aspirin by using TLC.
12. Determination of Methylene blue value of activated charcoal.
13. Determination of iron in tap water by AAS.
14. Determination of copper content in milk samples by AAS.
15. Verification of deviations from Beer-Lambert's law.


Chairman
Department of Chemistry
University of Borgobna
ORSCODHA

16. Determination of chloride content in drinking water samples by mercury(II) thiocyanate spectrophotometric method.
17. Determination of copper in various food samples by diethyldithiocarbamate spectrophotometric method.
18. Determination of aspirin in pharmaceutical preparation and caffeine in tea and coffee by U.V Visible Spectrophotometry involving extraction.
19. Analysis of analgesic by HPLC.
20. Quantitative and qualitative analysis of different fruit juices for vitamin C by HPLC.
21. Estimation of Sodium and Potassium in biological fluids by flame photometry.
22. Determination of calcium in milk samples by flame photometry.
23. Determination of Magnesium in tap water, food, leaves etc by AAS.
24. Determination of manganese content in tea leaves by AAS.
25. Determination of sulphate and phosphate in commercial samples by complexometric titrations using EDTA.
26. Determination of iron in pharmaceutical samples by redox titration.
27. Determination of Sodium bicarbonate contents in baking Soda powder by conductometric titration with HCl.

Recommended books

1. Christian, G.D. Analytical Chemistry, John Wiley & Sons (2005)
2. Harris, D.C. *Quantitative Chemical Analysis*, Freeman, N. Y. (2003)
3. Skoog, D. A. West, D. Holler, J. M.F., Crouch S. R. Fundamentals of Analytical Chemistry, 8th ed. Saunders College Publishing, Philadelphia. (2003).
4. Shaheen, M.A.. Manual of Practical Chemistry, Vol.II, Jilani Notes, Sargodha (2012)

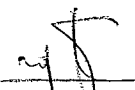
Paper-IV Environmental & Industrial Chemistry (Compulsory)

Environmental Chemistry: The Human Environment, The litho, bio and hydrosphere. The nature and composition of natural waters. Water pollution, Chemistry of soil. Composition of the atmosphere. Oxides of carbon, sulphur and nitrogen in air pollution. Atmospheric Monitoring. Instrumental methods of environmental chemistry. Ozone demolition. Acid rain, Green House Effect

Industrial Chemistry: Chemical processes i.e. unit operations, unit process, Chemical process control and instrumentation, Safety; Hazards such as fire or toxic materials. Research and development, Important modern industries, their chemistry and technology, like pharmaceutical, polymer, paper, petroleum, oil, fats and waxes, water conditioning, flavors and food additives, sugar and starch, steel, soap and detergent etc.

Recommended books

1. Kumar, A. *Environmental Chemistry*, Wiley Eastern, New Delhi (2005).
2. Moore, J.W. & Moore, E.M. *Environmental Chemistry*, Academic Press, New York (2004).
3. Banerji, S. K. *Environmental Chemistry*, Tata Publisher, Delhi (2006).
4. Manahan, S. E. *Environmental Chemistry*, Brooks, California (2005).
5. Neil, P.O. *Environmental Chemistry*, Chapman, London (2004).
6. Baird, C. *Environmental Chemistry*, Freeman, New York (2003).
7. Eckenfelder, W.W. *Industrial Water Pollution control*, McGraw Hill Book Co. NY. (2000).
8. Durney, L.J. *Graham's Electroplating Engineering Handbook*, CBS Publishers and Distributors, New Delhi (1997).
9. Witcoff, H.A. and B.G. Reuben. *Industrial Organic Chemicals*, Wiley, NY (1996).
10. Kent, J.A. *Riegel's Handbook of Industrial Chemistry*, CBS Publishers and Distributors, New Delhi, (1997).
11. Kovacs, M. *Pollution Control and conservation*, Ellis Harwood Ltd., Chichester. (1985).
12. McGhee, T.J. *Water Supply and Sewerage*, McGraw Hill Book Co. NY. (1991).
13. Shreve, R.M. *Chemical Industry Processes*, McGraw Hill Publishing Co., NY (1967).


 Shaheen
 Department of Chemistry
 University of Sargodha
 Sargodha