PERIYAR UNIVERSITY

SYLLABUS FOR

M.Sc. ANALYTICAL CHEMISTRY

DEGREE OF MASTER OF SCIENCE

CHOICE BASED CREDIT SYSTEM

(For candidates admitted in the colleges affiliated to Periyar University from 2021 - 2022 onwards)

REGULATIONS

1. OBJECTIVES OF THECOURSE:

The objectives of this course are the following:

(a) To impart knowledge in advanced concepts and applications in various fields of Chemistry and to acquire deep knowledge in the study of Analytical Chemistry

(b) To provide wide choice of elective subjects with updated and new areas in variousbranchesofChemistrytomeettheneedsofallstudents.

2. COMMENCEMENT OF THISREGULATION:

These regulations shall take effect from the academic year 2021-2022, that is, for students who are admitted to the first year of the course during the academic year 2021-2022 and thereafter.

3. ELIGIBILITY FORADMISSION:

A candidate who has passed B.Sc., Chemistry degree of this University or any other University accepted by the Syndicate equivalent thereto, subject to such condition as may be prescribed therefore are eligible for admission to M.Sc., Degree Programme and shall be permitted to appear and qualify for the Master of Science (M.Sc.) Degree Examination in Analytical Chemistry of this University.

4. DURATION OF THECOURSE:

The programme for the degree of Master of Science in Chemistry shall consist of two Academic years divided into four semesters.

5. EXAMINATIONS:

The examination shall be of three hours duration for each course at the end of each semester. The candidate failing in any subject(s) will be permitted to appear in the subsequent examination.

The practical / project should be an individual work. The University examination for practical / project work will be conducted by the internal and external examiners jointly at the end of every year.

COURSE OF STUDY AND SCHEME OF EXAMINATION

S.No.	Course (Paper)	Subject Title	Hours / Week	Work Loadper Semester (Hrs)	Exam Hours	University Examination			Credits
						Internal (25%)	External (75%)	Total	
I SEMESTER									
1.	Core -I	Organic Chemistry - I	5	75	3	25	75	100	5
2.	Core - II	Inorganic Chemistry -I	5	75	3	25	75	100	5
3.	Core - III	Physical Chemistry - I	5	75	3	25	75	100	5
4.	Elective - I	PolymerChemistry/ Nano and GreenChemistry	5	75	3	25	75	100	4
5.	Core Practical - I	Organic Chemistry Practical-I	4	60	-		-	-	-
6.	Core Practical - II	InorganicChemistry Practical-I	3	45					-
7.	Core Practical - III	Physical Chemistry Practical - I	3	45					-
		TOTAL	**30**	**450**				400	**19**
II SEMESTER									
1.	Core - IV	Organic Chemistry -II	5	75	3	25	75	100	5
2.	Core - V	Inorganic ChemistryII	5	75	3	25	75	100	5
3.	Core - VI	Physical Chemistry- II	5	75	3	25	75	100	5
4.	EDC	Extra Disciplinary course	4	60	3	25	75	100	4
5.	Core Practical - I	Organic Chemistry Practical-I	3	45	6	40	60	100	3
6.	Core Practical - II	Inorganic Chemistry Practical -I	3	45	6	40	60	100	3
7.	Core Practical - III	Physical Chemistry Practical - I	3	45	6	40	60	100	3
8.	Common Paper	HumanRights	2	30	3	25	75	100	-
9.	Add-on Course	Internship Training	-	-	-	-	-	-	-
		TOTAL	**30**	**450**				**800**	**28**

Course (Paper)	Course Title	Hours/ Week	Work Load per sem (Hours)	Exam Hours	Marks		Total	Credit
					Internal	External		
SEMESTER III								
Core VII	Analytical Chemistry - I	5	75	3	25	75	100	5
Core VIII	Analytical Chemistry -II	5	75	3	25	75	100	5
Elective II	Spectroscopy	5	75	3	25	75	100	4
Elective III	Electroanalytical Techniques	5	75	3	25	75	100	4
Core Practical IV	Analytical Chemistry Practical – I	4	60	6				-
Core Practical V	Analytical Chemistry Practical – II	3	45	6				-
Core Practical VI	Analytical Chemistry Practical - III	3	45	6				-
	Total	**30**	**450**				**400**	**18**
SEMESTER IV								
Core IX	Analytical Chemistry – III	5	75	3	25	75	100	5
Elective IV	Analysis of materials	5	75	3	25	75	100	4
Core Practical IV	Analytical Chemistry Practical - I	3	45	6	40	60	100	3
Core Practical V	Analytical Chemistry Practical -II	3	45	6	40	60	100	3

Core Practical VI	Analytical Chemistry Practical – III	3	45	6	40	60	100	3
Project	Dissertation /Project work	**11**	165	-	-	-	200	7
	Total	**30**	**450**				**700**	**25**
	Grand Total	**120**	**1800**	**-**	**-**	**-**	**2300**	**90**

NOTE:I

Core Papers : 9
Core Practicals : 6
Elective papers : 4
EDC : **:1**
Human Rights :1
Internship Training :1
Project :1

NOTE : II

Distribution of Marks

Theory Distribution of Internal Assessment mark

Test : 10 marks
Attendance : 5 marks
Assignment : 5 marks
Seminar : 5marks

Total 25marks

Passing Minimum : Internal Assessment : 50% - 12 marks
Passing Minimum : External Assessment : 50% - 38 marks
Total Passing Minimum : 50% - 50 makrs

PRACTICALS

University Examination (External) - 60 marks
InternalAssessment - 40marks

Calculation of Internal Assessment mark

Number of Experiments : 10 marks
Experimental skill : 10marks
Test : 20marks

Total : 40 marks

Passing Minimum : Internal Assessment : 50%- 20 marks
Passing Minimum : External Assessment : 50% - 30 marks
Total Passing Minimum - 50 marks

Everything should be supported by proper record separate passing minimum is necessary for Internal and External

QUESTION PAPER PATTERN

Theory

Time: 3Hours

Part - A: 15X1 = 15

(Answer all questions)

(Three multiple choice questions from each unit)

Part - B: 2X5 = 10

(Answer any two questions)

(one question from each unit)

Part – C: 5X10=50

(Answer all questions)

(one question from each unit with internal choice)

Max. marks : 75

Distribution of marks for practical

Experiment	:	45 marks
Viva-voce in practical	:	10 marks
Record	:	5 marks
Total	:	60 marks
Duration	:	6 Hours

Project

Dissertation / Project	:	150 marks
Viva - voce	:	50 marks
Total	:	200 marks

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER I
CORE I - ORGANIC CHEMISTRY – I
(75 Hours)

OBJECTIVES

1. To learn about the stereochemistry of organic compounds and ORD and CD.
2. To learn about the formation, stability and structure of intermediates and the mechanism of aliphatic electrophilic substitution.
3. To learn about the effect of structure on reactivity.
4. To learn about the mechanism of aliphatic nucleophilic substitution reactions
5. To learn about the structural elucidation of alkaloids, flavones, isoflavones and anthocyanins.

Unit I Stereochemistry, ORD and CD (15 Hours)

Wedge, Fischer, Newmann and Saw-horse formulae and their inter conversion, R and S notation, axial chirality (biphenyls, allenes and spiranes), planar chirality(cyclophanes, ansa compounds and trans cyclooctene), chirality due to helical shape, stereo selective and stereo specific reactions, asymmetric synthesis-Cram's rule. Homotopic, enantiotopic and diastereotopic atoms, groups in organic molecules. ORD & CD curves, octant rule, cotton effect, axial halo ketone rule and its applications

UNIT II Reaction intermediates and aliphatic electrophilic substitution (15 Hours)
Reaction intermediates - Formation, stability and structure of carbonium ions, carbanions,carbenes, nitrenes and free radicals
Aliphatic electrophilic substitution- SE1,SE2 and SEi mechanisms and electrophilic substitution by double bond shift, hydrogen electrophile-keto-enol tautamerism, halogen electrophile-halogenation of aldehydes and ketones, nitrogen electrophile- aliphatic diazonium coupling, sulphur electrophile-sulphonation and carbon electrophile- Stork-enamine reaction

Unit III Effect of structure on reactivity (15 Hours)
Resonance and field effects, resonance and steric effects, quantitative treatment-the Hammett equation- linear free energy relationship, substituent constant and reaction constant and limitation of Hammett equation. Taft equation, thermodynamically and kinetically controlled reactions, Hammond's postulate, Non- kinetic methods of determining mechanism- isolation,trapping

and detection of intermediates, isotopic labeling, crossover experiments, product analysis, stereo chemical evidence, kinetic method -kinetic isotope effect

Unit IV Aliphatic nucleophilic substitution (15 Hours)

The SN1, SN2, SNi and neighbouring group mechanisms, the neighbouring group participation by pi and sigma bonds, Non classical carbocations, nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon. Reactivity- effect of substrates structure, attacking nucleophile, leaving group and reaction medium. Ambident nucleophile, Swain-Scott, Grunwald-Winstein relationship, phase transfer catalysis.

Unit V Alkaloids and Anthocyanins (15 Hours)

Synthesis and structural elucidation of morphine, quinine, papaverine and reserpine. General nature of anthocyanins, structure of anthocyanidins, synthesis of pelargonidin chloride, cyanidin chloride, delphinidin chloride and peonidin chloride. Synthesis and structural elucidation of flavones and isoflavones.

TEXT BOOKS

1. Jerry March, Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Fourth Edition, John Wiley & Sons1992
2. Ernest L. Eliel, Stereochemistry of Carbon Compounds, T.M.H Edition, Tata McGrawHill Publishing Company,1995.
3. P.S. Kalsi, Stereochemistry – Conformation and Mechanism, 6th Edition, WileyEastern Limited,2005
4. Gould, Mechanism and structure in organic chemistry, Rinehart and Winston, INC,1960.
5. Francis A. Carey, Organic Chemistry, Third Edition, The McGraw-Hill Companies, Inc.,1996
6. P.S. Kalsi, Organic Reactions and Mechanisms, Second Edition, New Age International Publishers,2002.
7. I.L.Finar, Organic Chemistry, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd.,2000
8. Jagdamba singh and Yadav, Advanced Organic Chemistry, Pragati Prakashan Publications, 6thEdition,2010.
9. O.P. Agarwal,Chemistry of Organic Natural Products, Volume I and II, Goel Publishing House,1988

REFERENCE BOOKS

1. P.S. Kalsi, Stereochemistry and Mechanism through solved problems, Second Edition, New Age International Publishers,1994.
2. D. Nasipuri, Stereochemistry of Organic Compounds, 2nd Edition, New Age International Publishers,1994.
3. S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, 1st Edition, Macmillan,1976.
4. R.T.MorrisonandR.N.Boyd,OrganicChemistry,6thEdition,Prentice-Hall,1992.
5. R.O.C. Norman, Principles of Organic Synthesis, Second Edition, Chapman and Hall,1978.
6. R.M. Acheson, Introduction to Chemistry of Heterocyclic Compounds, 2nd Edition, Interscience Publishers,1967.

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER I
CORE II - INORGANIC CHEMISTRY-I
(75 Hours)

Objectives

1. To understand the basic concepts of Inorganic chemistry.
2. To learnabout the structure and bonding of the molecule.
3. To learn the basics of nuclear chemistry and different types of nuclear reactions

UNIT I Structure and Bonding (15 Hours)

Hard and Soft acids and bases-classifications, Acid-Base strength, hardness, symbiosis, Theoretical basis of Hardness and Softness, applications of HSAB.

Rings-Phosphazenes-Structure, Craig and Peddock model, Dewar model,polyorganophosphazenes, Polysulphur –nitrogencompounds.

Inorganic polymers-Silicates-structure,Pauling's rule, properties, correlation andapplication; Molecularsleves.

Polyacids- Isopolyacids of V, Cr, Mo and W; Heteropolyacids of Mo and W (only structural aspects)

UNIT II Boron compounds and Clusters (15 Hours)

Boron hydrides – polyhedral boranes, hydroborate ions – a general study of preparation, properties and structure, styx numbers, Wade's rules.

Carboranes –types such as closo and nido– preparation, properties and structure.Metallocarboranes – a generalstudy.

Metal clusters – Chemistry of low molecularity metal clusters only–structure ofRe_2Cl_8; multiple metal – metalbonds.

UNIT III Solid State (15 Hours)

Types of solids-close packing of atoms and ions-bcc, fcc and hcp, voids and their types-Goldschmidt radius ratio-derivation-its influence on structures.

Structures of NaCl, NiAs, CdI_2, Pervoskite, rutile, fluorite and antifluorite-zinc blende and wurtzite.

Defects in solids- Point defects, line defects and surface defects; Dislocations-Non-stoichiometric compounds; Use of X-ray powder data in identifying inorganic crystalline solids

UNIT IV Nuclear Chemistry– I (15 Hours)

The nucleus-subatomic particles and their properties-mass defect - binding energy - n/ p ratio in stable and metastable nuclei-Different types of nuclear forces-Liquid drop model and shell model.

Modes of radioactive decay-Theory of alpha decay, beta decay and gamma radiation, Orbital electron capture, nuclear isomerism-internal conversion.

Detection and determination of activity-GM, Scintillation and Cherenkov counters

Particle Accelerators: Linear accelerator- cyclotron, synchrotron, betatron and bevatron

UNIT V Nuclear Chemistry - II (15 Hours)

Nuclear Reactions: Q-value,columbic barrier-nuclear cross section-different types of Nuclear reactions-projectile capture-particle emission, spallation, fission and fusion-product distributions - Theories of fission, use of fission products, fissile and fertile isotopes - U-238, U-235, PU-239, Th232 -stellar energy-synthesis of new elements.

Radio-Isotopes: Applications-isotopes as tracers - neutron activation analysis and isotopic dilution analysis - uses in structure and mechanistic studies - Carbon dating – Radio pharmacology, Radiation protection and safety precautions - Disposal of nuclear waste.

TEXT BOOKS

1. F.A Cotton & Wilkinson, AdvancedChemistry
2. Emelius and Sharpe, Modern Aspects of InorganicChemistry.
3. A.R.West, Basic Solid State Chemistry, JohnWiley,1991
4. J.D. Lee, Concise InorganicChemistry.
5. S.F.A. Kettle, Physical Inorganic Chemistry, OxfordUniversity
6. J.E.Huheey, E.A.Keiter and R.L.Keiter, Inorganic chemistry-principlesof structure and reactivity, 4th edition, Pearson-Education,2002
7. H.J.Arnikar,Essentials of nuclear Chemistry,2nd edition,Wiley easternCo.,1987.
8. S. Glasstone, Source Book on AtomicEnergy

REFERENCE BOOKS

1. H.A.O. Hill and P.Day, Physical methods in advanced Inorganic chemistry, John Wiley,1986.
2. G.S. Manku, Inorganic Chemistry, T.M.H. Co.,1984.
3. K.F.PurcellandJ.C.Kotz,InorganicChemistry,WBSaundersCo.,USA1977.
4. A.K. Srivatsava and P.C. Jain, Elements of Nuclear Chemistry, S.Chand and Co.,1989.
5. G. Friedlander, J.W.Kennedy and J.M. Miller, Nuclear and Radio Chemistry, Wiley.,1964.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER I

CORE-III PHYSICAL CHEMISTRY-I

(75 Hours)

OBJECTIVES

1. To study in detail the basic concepts of classical thermodynamics and statistical thermodynamics
2. To gain knowledge about theories of reaction rates and kinetics of complex and fast reactions
3. To understand the principles of quantum chemistry and group theory

UNIT I Classical Thermodynamics – I (15 Hours)

Concept of chemical Potential-Determination of chemical potential -Direct Method and Method of Intercepts –variation of chemical potential with temperature and pressure-Fugacity –Methods of determination of fugacity – Variation of fugacity with temperature and pressure. Standard states for gases, liquids, solids and components of solutions. Solution of electrolytes – Concept of ionic strength-.mean ionic activity and mean ionic activity coefficient – determination of activity coefficient from freezing point, EMF and solubility measurements

UNIT II Statistical and Irreversible Thermodynamics (15Hours)

Concept of thermodynamical and mathematical probabilities –Distribution of distinguishable and non–distinguishable particles.-microstates and macrostates.

Ensembles -Maxwell's distribution law of molecular velocities –Evaluation of average velocity, root mean square velocity and most probable velocity from distribution law of molecular velocities - Maxwell–Boltzmann, Bose- Einstein and Fermi-Dirac statistics -comparisons

Partition functions – rotational, vibrational, translational and electronic partition functions- Expression of thermodynamic properties in terms of partition function – Einstein and Debye theory of heat capacities of solids.

UNIT III Chemical Kinetics – I (15 Hours)

Theories of reaction rates – Arrhenius theory, Hard sphere collision theory and transition state theory of reaction rates– Comparison of collision theory and activated complex theory – Lindemann and Hinshelwood theories of unimolecular reaction rates. Reactions in solutions – comparison between gas phase and solution reactions – influence of solvent, ionic strength, and pressure on reactions in solution.

Kinetics of complex reactions– reversible reactions, consecutive reactions – Parallel reactions and Chain reactions – Rice–Herzfeld mechanism for hydrogen- bromine, gas phase pyrolysis of methane and formation of phosgene reactions- explosion limits. Study of fast reactions: Relaxation methods-temperature and pressure jump methods - Stopped flow technique, flash photolysis and Crossed molecular beam method.

UNIT IV Quantum Chemistry – I (15 Hours)

Planck's theory of black body radiation–Photoelectric effect; de–Broglie equation– Heisenberg uncertainty principle– Compton effect- quantum mechanical postulates – Schrodinger equation and its solution to the problem of a particle in one and three dimensional boxes – the harmonic oscillator-Application of Schrödinger equation to rigid rotator and hydrogen atom –origin of quantum numbers – probability distribution of electrons. Approximation methods – Perturbation and Variation methods – Slater determinant -application to hydrogen and helium atom – Spin - orbit interaction – LS coupling and JJ coupling – ground state term symbols for simple atoms.

UNIT V Group Theory – I (15 Hours)

Symmetry elements and symmetry operations – Point groups – identification and representation of groups –comparison of molecular and crystallographic symmetry –Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences–Character table and its uses.

TEXTBOOKS

1. S.Glasstone, Thermodynamics for chemists, Affiliated East West press, New Delhi, 1960.
2. J. Rajaram and J.C. Kuriacose, Thermodynamics for students of chemistry, Lal Nagin Chand, New Delhi,1986.
3. J.Rajaram and J.C. Kuriacose, Kinetics and mechanism of chemical transformation, Macmillan India Ltd.,1993.
4. D.N Bajpai, Advanced Physical Chemistry, S.Chand publishing Compan New Delhi, 1992
5. R.K.Prasad,QuantumChemistry,WileyEastern,NewDelhi,1992.
6. V.Ramakrishnan and M.S.Gopinathan, Group theory in chemistry, Vishal Publications,1988.
7. K.V.Raman, Group theory and its application to chemistry, Tata McGraw Hill Publishing Co.,1990.
8. Gurudeepraj,AdvancedPhysicalChemistry,GoelPublishingHouse,Meerut

REFERENCE BOOKS

1. W.J. Moore, Physical Chemistry, Orient Longman, London, 1972.
2. J.W. Moore and R.G. Pearson, Kinetics and Mechanism, 1981.
3. G.M.Harris,ChemicalKinetics,D.C.HeathandCo.,1966.
4. A.K.Chandra,IntroductoryQuantumChemistry,TataMcGrawHill.
5. P.W.Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford.,1983
6. I.N.Levine, Quantum chemistry, Allyn and Bacon, Boston,1983

M.Sc. ANALYTICAL CHEMISTRY
SEMESTERI ELECTIVEI

Paper I - POLYMER CHEMISTRY (75 Hours)

OBJECTIVES

1. To study the basic concepts in Polymer chemistry.
2. To study the determination of molecular weight and properties of polymers.
3. To know about the polymer processing and polymerization techniques.
4. To learn about the synthesis and applications of commercial polymers and conducting polymers.

UNIT1 Basic Concepts (15 Hours)

Monomers, repeat units, degree of polymerization, Linear, branched and network polymers, Addition polymerization, Condensation polymerization, Mechanism of free radical, cationic and anionic polymerization and co-ordination polymerization. Ziegler-Natta catalyst. Kinetics of free radical, cationic, anionic and co-polymerisation. Determination of Reactivity ratio, Reactivity ratio and co-polymerisation behavior.

UNIT2 Molecular Weight and Physical Properties (15Hours)

Concept of Average molecular weight, number- average, weight- average molecular weight and viscosity- average molecular weights. Determination of molecular weight - viscosity, light scattering, osmotic and ultracentrifugation methods. Physical properties- crystalline melting point, glass transition temperature, relationship between Tm and Tg and Determination ofTg.

UNIT3 Polymer Processing and Polymerization Techniques (15Hours)

Polymers processing- Plastics, elastomers and fibres. Compounding, Processing techniques- calendaring, die casting, injection molding, thermofoaming and fibre spinning. Polymerization techniques- Bulk polymerization, solution polymerization, suspension polymerization, emulsion polymerization and melt polycondesation.

UNIT 4 Commercial Polymers (15 Hours)

Synthesis and applications of polyethylene, polyvinyl chloride, polyamide, polyester, phenol resins, epoxy resins, silicone polymers, polybenoxazoles, polyimidazole, polyurethane,polymethylmethacrylate,poly(tetrafluoroethylene)andpolyacrylonitrile.

UNIT5 Conducting Polymers (15Hours)

Conducting polymers- Introduction, Electrochemical doping, Electrochemical synthesis and applications of polypyrrole, polythiophene, polyindole, polyaniline, polyacetylene and poly(p-phenylene).

REFERENCE BOOKS

1. F.W. Billmeyer, Textbook of Polymer Science, Wiley Student Edition, 3rdEdition.
2. L. Gupta, Polymer Science, Pragathi PrakashanPublication.
3. V.R. Gowariker, N.V. Viswanathan, J. Sreedhar,Polymer Science, New Age International Private Limited,1986.
4. P.J. Flory, Principles of Polymer Chemistry, Asian Books,1st Edition,2006.
5. George Odian, Principles of Polymerization, John Wiley, 4th Edition,2007.
6. V.K.Ahluwalia & Anuradha Mishra, Polymer Science: A Text Book, Ane Books, 1stEdition,2008.
7. A. Skotheim, L. Elsenbaumer, R. Reynolds, Handbook of Conducting Polymers, Second Edition,1997.
8. Hari SinghNalwa, Textbook of Organic Conductive Molecules and Polymers.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER I

ELECTIVE I

Paper II - NANO AND GREENCHEMISTRY

(75 Hours)

OBJECTIVES

1. To learn about the synthesis, properties and applications of Nanomaterials.
2. To learn the tools for Characterisation of Nanomaterials.
3. To understand the green concept of organic reactions.

UNIT I Introduction and Synthesis of Nano materials (15 Hours)

Definition - Classification –Historical perspective -synthetic approaches –physical methods – electric arc method –laser ablation – physical vapour deposition – sputtering-chemical methods–reduction of metalions-solvothermal synthesis – photo chemical synthesis – electrochemical methods (anodic and cathodic process) –thermolysis – sonochemical routes –synthesis of semiconductor nano materials–sol–gel methods and biological methods of synthesis.

Unit II Properties and applications of Nanomaterials (15 Hours)

Nanoclusters-Catalytic, electrical and optical and magnetic properties of nanomaterials. Applications- Nano catalyst-Nano sensors-Nano medicines-Bioimaging with quantum dots, Cancer Therapy-nano particles in environmental remedy-Removal of toxins- water treatment.

UNIT III Tools for Characterisation of Nano Materials (15 Hours)

Electron microscope –SEM –TEM –STM –AFM – X-ray Diffraction.

Spectroscopy: UV-visible spectroscopy- FTIR –Raman spectroscopy-x-ray photo electron spectroscopy-Luminescence-Photoluminescence

Tools for nano structures: Nanolithography-Electron beam-Ion beam- Nano sphere-self-assembled monolayers –Coreshell–Nanoshells

Unit IV Introduction to Green chemistry (15 Hours)

Choice of starting materials, Choice of reagents, Choice of catalysts- biocatalyst, polymer supported catalysts, Choice of solvents. Synthesis involving basic principles of green chemistry, examples- Synthesis of Adipic acid, Methyl methacrylate, Paracetamol. Ultrasound assisted reactions-Esterification, Reductions, Coupling reactions, Strecker synthesis and Reformatsky reactions.

Unit V Solvent free organic synthesis (15 Hours)

Reactions on solid supports, Phase transfer catalysis, Solvent free esters saponifcation, Reactions without support or catalyst- examples, Microwave assisted reactions in water- Oxidation of toluene to benzoic acid, Microwave assisted reactions in organic solvent- Diel's - Alder reaction, Coupling reactions (Stille, Suzuki, Heck, Sonogashira), Solvent free microwave assisted organic synthesis, Microwave activation and heating, Advantages of microwave exposure and specific effects of microwaves, Organic synthesis under microwaves- benefits and limitations.

REFERENCE BOOKS

1. T. Pradeep, NANO:TheEssentials, Tata McGraw Hill Education Private Limited,2012

2. B. S. Murty, P. Shankar et al, Textbook of Nanoscience and Nanotechnology, Universities Press (INDIA) Private Limited ,2012

3. SulabhaK.Kulkarni,Nanotechnolgy:PrinciplesandPractices,Springer,2015

4. RashmiSanghi, M.M.Srivastava, Green chemistry, Environment friendly Alternatives, Narosa Publishing house,2007.

5. V. Kumar, An Introduction to Green chemistry, Vishal Publishing Co. Jalandhar,2007.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER II

CORE IV - ORGANIC CHEMISTRY – II

[75 Hours]

OBJECTIVES

1. To learn the basic concept of aromaticity and the mechanism of elimination reactions.
2. To learn about the mechanism of Aromatic electrophilic and nucleophilic substitution.
3. To know the effects of light in organic chemistry and the basic concepts of pericyclic reactions.
4. To study the mechanism of addition to carbon-carbon and carbon-hetero multiple bonds.
5. To study the structure of steroids steroidal, hormones and uses of reagents.

Unit I AromaticityandElimination (15 Hours)

Aromaticity- Huckel's theory of aromaticity, NMR concept of aromaticity and antiaromaticity, systems of 10 electrons and more than 10 electrons (10,12,14,16 and 18 Annulunes) Elimination- The E1, E2 and EICB mechanisms, Hofmann and Zaitsev's rules, Competition between elimination and substitution, Mechanism of pyrolytic elimination, Chugaev and Cope elimination reactions.

UnitII Aromatic Electrophilic and Nucleophilic substitution (15Hours)

Aromatic Electrophilic substitution- The arenium ion mechanism, orientation and reactivity in mono substituted benzene ring. Ortho, meta and para directing groups, ipso attack, Vilsmeier-Hack, Jacobson and Scholl'sreactions.

Aromatic Nucleophilic substitution- The SNAr, SN1, and Benzne mechanisms. Reactivity- Effect of substrate structure, leaving group and attacking nucleophiles

Unit III Organic Photo Chemistry and Pericyclic reactions (15 Hours)

Organic Photo chemistry- Jablonski diagram, Norrish type I and type II reactions, Photo reduction of ketones, Paterno-Buchi reaction and photo isomerisation.

Pericyclic reactions- Basic concept of orbital symmetry, Woodward- Hofmann rules, Electrocyclic reactions and cycloaddition reactions- correlation diagram and FMO approach. Sigmatropic migration of hydrogen and carbon, Cope and Claisen rearrangements.

Unit IV Addition to carbon- carbon and carbon- hetero multiple bonds and Molecular rearrangement (15 Hours)

Study of the following reactions- Michael addition, 1,3- dipolar addition, carbene and their addition, Benzoin, Wittig and Prins reactions.
Molecular rearrangement- A detailed study of the mechanism of the following rearrangements- Wagner-Merwin, Favorski, Von-Richter, Neber and Hofmann-Martius.

Unit V Steroids, Steroidal Hormones and Reagents in organic Synthesis. (15 Hours)

Steroids and Steroidal Hormones-Structural elucidation of cholesterol and Oesteron, Conversion of Cholesterol into Oesteron, Testosterone and Progesterone.
Reagents in organic Synthesis- Uses of DIBAL, 9-BBN, 1,3- dithiane (umpolung), Baker's yeast and Gilman's reagent.

TEXT BOOKS

1. Jerry March, Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Fourth Edition, John Wiley & Sons1992
2. Francis A. Carey, Organic Chemistry, Third Edition, The McGraw-Hill Companies, Inc.,1996.
3. P.S. Kalsi, Organic Reactions and Mechanisms, Second Edition, New Age International Publishers,2002.
4. V.K. Ahluwalia, Organic Reaction Mechanism, Narosa Publishing House, 4thEdition,2013.
5. I.L. Finar, Organic Chemistry, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd.,2000.
6. Jagadamba Singh & L.D.S. Yadav, Advanced Organic Chemistry, Pragati Prakasam Publishers, 6th Edition,2007.
7. R.K.Bansal, Organic Reaction Mechanism, Tata McGraw Hill Publications, 3rdEdition,2006.

REFERENCE BOOKS

1. S. H. Pine, J.B. Hendrickson, D.J. Cram and G.S. Hammond, Organic Chemistry, IV Edn., McGraw Hill Company,1980.

2. R.T. Morrison and R.N. Boyd, Organic Chemistry, Prentice-Hall,1992.

3. R.O.C. Norman, Principles of Organic Synthesis, Second Edition, Chapman and Hall,1978.

4. S.M.Mukherji and S.P. Singh, Reaction Mechanism in Organic Chemistry, III Edn. 1984.MacMillan.

5. L.F. Fieser and M. Fieser, Organic Chemistry, Asis Publishinng House, Bombay,2000.

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M.Sc. ANALYTICAL CHEMISTRY
SEMESTER II
CORE V - INORGANIC CHEMISTRY -II
[75 Hours]

OBJECTIVES

1. To learn the various theories of coordination compounds
2. To study the various reaction of coordination compounds
3. To understand the basics behind the origin and principle of electronic spectra

Unit I Theories ofcoordinationcompounds: (15 Hours)

VB theory-CFT-Splitting of d orbital in ligand field and different symmetries-CFSE-Factors affecting the magnitude of 10 Dq-Evidence for crystal field stabilization(Structural and thermodynamic effects) - Spectro chemical series –Site selection in spinels - tetragonal distortion from octahedral symmetry-JohnTeller distortion- Nephelauxetic effect-MO theory octahedral-tetrahedral and Square planar complexes-pi bonding and molecular orbital theory-experimental evidence for pibonding.

UNIT II Stability and Stereochemical Aspects (15 Hours)

Stability of complexes-thermodynamic aspects of complex formation, factors affecting stability, stability correlations, statistical and chelate effects; Determination of stability onstants-polarographic, photometric and potentiometric methods. Stereochemical aspects-stereoisomerism in inorganic complexes, isomerism arising out of ligand distribution and ligand conformation,chirality.

Macrocyclic ligand types - porphyrins, corrins, Schiff bases, crown ethers, cryptates and catenands. (simplecomplexes).

UNIT III Reaction Mechanism of transitionmetalcomplexes (15 Hours)

Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitutions, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reactions. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

UNIT IV Electronic Spectra of Complexes (15 Hours)

Spectroscopic Term symbols for d_n ions – derivation of term symbols and ground state term symbol, Hund's rule; Selection rules – break down of selection rules, spin-orbit coupling, band intensities, weak and strong field limits- correlation diagram; Energy level diagrams; Orgel and Tanabe - Sugano diagrams; effect of distortion and spin orbit coupling on spectra; Evaluation of Dq and B values for octahedral complexes of Nickel; Charge transfer spectra. Spectral properties of Lanthanides and Actinides.

UNIT V Bonding in Organometallic Complexes and metal carbonyls (15 Hours)

Definition of organometallic compound - 18 electron rule - effective atomic number rule - classification of organometallic compounds - the metal carbon bond types –ionic bond – sigma covalent bond - electron deficient bond - delocalised bond -dative bond -metal carbonyl complexes -synthesis - structure and reactions of metal carbonyls - the nature of M-CO bonding- binding mode of CO and IR spectra of metal carbonyls - metal carbonyl anions – metal carbonyl hydrides - metal carbonyl halides-metal carbonyl clusters–Wades rule and isolobal relationship.

TEXT BOOKS

1. J.E. Huheey, E.A. Keiter and R.L. Keiter, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson – Education, 2002.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Eastern, 5thEdition,1988.
3. S.F.A. Kettle, Coordination compounds, ELBS, 1973.
4. Basic organometallic chemistry, J. Haiduc and J. J. Zuckerman, Walter de Gruyter, Brelin,1985.
5. A.W.Adamson and P.Fleischauer, Concepts of Inorganic Photochemistry,Wiley, 1975.
6. K.F.PurcellandJ.C.Kotz,InorganicChemistry,WB.SandersCo.USA.1977.
7. D.F. Shriver, P. W. Atkins and C.H. Longford, Inorganic Chemistry, ELBS, 2nd Edition,1994.
8. C.N.R. Rao and J.R. Ferraro, Spectroscopy in Inorganic Chemistry, Vol I and Vol II, Academic Press,1970.

REFERENCE BOOKS

1. Organometallics 1, complexes with transition metal-carbon -bonds, Bockmann,Oxford science publications, Oxford,1996.

2. Organometallics 2, complexes with transition metal-carbon -bonds, Bockmann, Oxford science publications, Oxford,1996.

3. G.W. King, Spectroscopy and Molecular Structure, Holt Rienehart and Winston, 1964.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER II

CORE VI - PHYSICAL CHEMISTRY – II

[75 Hours]

OBJECTIVES

1. To impart knowledge on quantum chemistry, group theory and spectroscopy
2. To study the concepts and principles of surface chemistry andcataysis
3. To understand theoretical electrochemistry and to learn the applications of electrochemical cells

UNIT I Quantum Chemistry – II (15 Hours)

Theory of chemical bonding – Born – Oppenheimer approximation – LCAO-MO approximation for hydrogen molecule ion and hydrogen molecule – Valence Bond theory of hydrogen molecule – Concept of hybridisation – sp, sp^2 and sp^3 – hybridisation – Huckel Molecular orbital (HMO) theory for conjugated π- systems application to ethylene, butadiene and benzene – Self consistent field approximation –Hartree and Hartree – Fock self consistant field theory .

UNIT II Group Theory – II (15 Hours)

Symmetry selection rules for vibrational, Electronic and Raman Spectra –determination of vibrational modes in non-linear molecules such as H_2O, NH_3, CH_4, XeF_4, – symmetry of hybrid orbitals in non-linear molecules (H_2O, NH_3, CH_4, XeF_4,PCl_5) -Electronic spectra of formaldehyde.

Spectroscopy

Rotational spectroscopy-Rigid Rotor – Intensity of spectral lines- Effect of isotopic substitution on the rotation spectra. Vibrational spectroscopy – harmonic oscillator –an harmonic oscillator – Hot bands – selection rules – Overtones and combination frequencies – Fermi Resonance. Raman spectroscopy – Raman effect (quantum theory) - Rotational and Vibrational Raman Spectra – Mutual Exclusion Rule. Electronic spectroscopy – Electronic spectra of diatomic molecules – vibrational coarse structure – Franck – Condon Principle-

UNIT III Surface Chemistry and Catalysis (15 Hours)

Adsorption-Physical and chemical adsorption–adsorption isotherms–Langmuir, Freundlich and B.E.T adsorption isotherms–measurement of surface area from BET; Catalysis-acid–basecatalysis–

heterogeneous catalytsis-Enzyme catalysis–effect of substrate concentration- Michaelis – Menton equation-effect of pH and temperature.

UNIT IV Electrochemistry – I (15 Hours)

Ions in solutions – Debye – Huckel theory of strong electrolytes – Debye – Huckel –Onsager equation – verification and limitation – Debye – Huckel limiting law and its extension. Electrode – Electrolyte interface - adsorption at electrified interface –electrokinetic phenomena – Tiselius method of separation of proteins – Membrane potential- Lippmann capillary equation – Electrical double layers – Helmholtz Perrin,Gouy- Chapman and Sternmodels.

UNIT V Electrochemistry – II (15 Hours)

Polarisation and over voltage – Butler Volmer equation- diffusion current-exchange and equilibrium current density-Hydrogen and oxygen evolution reactions. Corrosionand passivation of metals – Pourbaix and Evans diagrams – Prevention of corrosion - Electrochemical energy systems – Primary and secondary batteries – (dry cells, lead acid storage batteries, silver- zinc cell- nickel- cadmium battery) –Fuel cells - Electrodeposition –principles and applications.

TEXT BOOKS

1. R.K.Prasad, Quantum Chemistry, Wiley Eastern, NewDelhi,1992.

2. M.W. Hanna, Quantum Mechanics in Chemistry, W.A. Benjamin Inc, London1965.

3. K.V.Raman, Group theory and its application to chemistry, Tata McGrawHill Publishing Co., 1990.

4. K. Veera Reddy, Symmetry and Spectrocopy of molecules, New Age Science, 2nd edition2010

5. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Mc Graw Hill,Newyork, 1966.

6. K.J.Laidler, Chemical Kinetics, Harper and Row, Newyork, 1987.

7.S. Glasstone, Introduction to Electrochemistry, Affiliated East West Press,New Delhi,1960.

8. D.R. Craw, Principles and applications of Electrochemistry, Chapman andHall, 1991.

9. J. Robbins, Ions in solution – An Introduction to Electro chemistry, ClarendonPress, Oxford(1972).

REFERENCE BOOKS

1. A.K. Chandra, Introductory Quantum Chemistry, Tata McGrawHill.

2. D.A. McQuarrie, Quantum Chemistry, University Science Books, MillValley, California(1983).

3. P.W. Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford,1983.

4. Raymond chang, Basic Principles of Spectroscopy, McGraw Hill Ltd., New York(1971).

5. G.M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, New York,1962.

6. J.O.M. Bockris and A.K.N. Reddy, Electrochemistry, Vols, 1 and 2, Plenum, New York. 1977.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER II
CORE PRACTICAL-I
ORGANIC CHEMISTRY PRACTICAL-I

OBJECTIVES

To develop analytical skillin

1. Separation of organic mixture
2. Organic qualitative analysis
3. Preparation of organic compound involving in single stage.

I. Identification of components in a two component mixture and preparation of their derivatives. Determination of boiling point/melting point for components and melting point for their derivatives.

II. Preparation.

1. Beta naphthyl methyl ether from betanaphthol
2. s-Benzyl isothiuronium chloride from benzylchloride
3. Beta glucose penta acetate from glucose
4. ortho-Benzoyl benzoic acid from phthalicanhydride
5. Resacetophenone from resorcinol
6. para-nitrobenzoic acid from para-nitrotoluene
7. meta-nitroaniline from meta-dinitrobenzene
8. Methyl orange from sulphanilic acid
9. Anthraquinone from anthracene
10. Benzhydrol from benzophenone

REFERENCE BOOKS:

1. B.S.Furniss, A.J.Hannaford, P.W.G.Smith and A.R.Tatchell, Vogel's Practical Organic Chemistry.5th Edn., ELBS,1989.
2. Raj K.Bansal, Laboratory manual of Organic Chemistry, III Edn., New Age International (P)Ltd.1996.
3. Gnanpragasam, Ramamurthy, Organic lab Manual, Viswanathan, S., Printers & Publishers Pvt Ltd, 2009.

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER II
COREPRACTICAL-II
INORGANIC CHEMISTRY PRACTICAL-I

OBJECTIVES

1. To improve the skill in the qualitative analysis of mixture of four cations containing two common and tworare.
2. To impart the skill in estimation of metal ions by colorimetric method.

Part I

Semi micro qualitative analysis of mixtures containing the following cations to be tested

W, Tl, Pb, Se, Te, Mo, Cu, Bi, Cd, Tl, Ce, Th, Zr, V, Cr, Fe, Ti, Zn, Ni, Co, Mn,

Ca, Ba, Sr, Li and Mg.

Part II

Colorimetric analysis

Visual and Photometric determination of Iron, Nickel, Manganese and Copper

REFERENCES BOOKS

1. G. Svehla, Vogel's qualitative Inorganic analysis,VIEdition,OrientLongman,1987.
2. V.V. Ramanujam, Inorganic Semimicro Qualitative analysis, National Publishing Co.,1971.

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER II
CORE PRACTICAL-III
PHYSICAL CHEMISTRY PRACTICAL-I

OBJECTIVES

To develop analytical skill in Kinetics, Phase diagram, Distribution method, Polarimetry, Viscosity and Adsorption experiments.

Chemical kinetics

1. Study the kinetics of acid hydrolysis of ethyl acetate and determine the temperature coefficient and activation energy of thereaction
2. Study the kinetics of the reaction between acetone and iodine in acid medium and determine the order with respect to iodine and acetone.
3. Study the kinetics of the reaction between potassium persulphate and potassium iodide and determine order, temperature coefficient and activation energy of the reaction.
4. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion).

Phase diagram

5. Construct a phase diagram for a simple binary system (naphthalene - phenanthrene or benzophenone -diphenylamine).

Distribution method

6. Determine association factor of benzoicacidinbenzeneandwater.

Polarimetry

7. Study the inversion of cane sugar in the presence of acid.

Viscosity

8. Study the variation of viscosity of liquids with temperatures.
9. Determine the partial molar volume of glycine/ methanol/ formic acid/ sulphuric acid by graphical method and determine densities of the solutions of different concentrations.
10. Study the surface tension - concentration relation of solutions (Gibb's equation).

REFERENCE BOOKS

1. B.P.Levitt (Ed.). Findlay's Practical Physical Chemistry, 9th Edn., Longman, London,1985.
2. J.N.Gurtu and R.Kapoor, Advanced Experimental Chemistry, Vol I.S.Chand& Co. Ltd., New Delhi,1980.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER II

EXTRA DISCIPLINARY COURSES

LIST OF EXTRA DISCIPLINARY COURSE PAPERS

I. IndustrialChemistry

II. Agricultural Chemistry

III. Food and Medicinal Chemistry

IV. Water Chemistry

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER II
EXTRA DISCIPLINARY COURSE
PAPER-I- INDUSTRIAL CHEMISTRY
(60 Hours)

OBJECTIVES

1. To learn the basic concepts of Glass, Ceramics and Cement and its manufacture.
2. To gain the knowledge of Dyes, Paints, Synthetic fibers, Plastics, Oils, Fats and Waxes and their applications.

UNITI Glass and Ceramics (12Hours)

Glass: Introduction- Raw materials, manufacture and applications. Some special glasses-fused silica glass, optical glass, glass wool, photosensitive glass-composition and uses.

Ceramics: Definition- Manufacture and applications.

UNITII Cement (12Hours)

Cement: Introduction, Types of cement- High alumina cement, Slag cement, Acid resisting cement, White cement, Types of Portland cement, Raw materials, Manufacture of cement, Setting of cement, factors affecting quality of cement, Cement industries in Tamilnadu.

UNITIII Dyes and Paints (12Hours)

Dyes: Classifications of dyes, application of dyes in other areas-medicine, chemical analysis, cosmetics, colouring agents, Food and beverages.

Paints: Constituents of paints, Manufacture of paints, Setting of paints, requirement of a good paint, paint failure.

UNIT IV Synthetic fibres and Plastics (12Hours)

Synthetic fibres: Difference between natural and synthetic fibres, Synthesis and applications of Viscose rayon, Terylene, Nylon and Taflon.

Plastics: Classification, properties and applications of plastics.

UNTIV Oils, Fats and Waxes (12Hours)

Classification of oils, fats and waxes, distinction between oils, fats and waxes, Uses of essential oils and fats. Soap and its manufacture-toilet and transparent soaps, cleansing action of soap. Detergent–classification and uses.

TEXT BOOKS

1. B.K.Sharma,IndustrialChemistry,GoelPublishingHousePvtLtd.1999.
2. M.G. Arora and M. Singh, Industrial Chemistry. Anmol Publications, 1st edition, 1994.
3. G.N.Pandey, A Textbook of Chemical Technology, Vol. I and I I, Vikas Publishing House Pvt Ltd.1997.

REFERENCE BOOKS

1. B.K. Chakrabarty, Industrial Chemistry, Oxford &IBM Publishing CO. Pvt Ltd. 1991.
2. V. Subrahmaniyan, S. Renganathan. K.Ganesan, S.Ganesh. Applied Chemistry. Scitcch Publications,1998.
3. J.E.KuriaCose and J.Rajaram, Chemistry in Engineering & Technology.Vol.1 &II , Tata Mc Craw Hill.1984.

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER II
EXTRA DISCIPLINARY COURSE
PAPER- II AGRICULTURAL CHEMISTRY
(60 Hours)

OBJECTIVES

1. To learn the Analysis of Water and Soil.
2. To gain the knowledge of Soil treatment, Irrigation, Fertilizer, Pesticides and Insecticides.

UNITI Water analysis and water treatment (12hours)

Water analysis and water treatment-acidity, alkalinity, pH, Biological oxygen demand (BOD). Chemical oxygen demand (COD) and their determinations, Recycling of water and water management.

UNITII Chemistry of soil (12Hours)

Definition, classification and properties of soil, Soil fertility, Soil organic matter and their influence on soil properties, Soil reactions- soil pH, acidity, alkalinity, buffering of soils and its effect on the availability of N, P, R. Ca and Mg.

UNITIII Soil treatment and Irrigation (12Hours)

Soil treatment-Soil erosion- causes and prevention, soil reclamation, alkali soil, saline soils, methods for soil reclamation, Environmental degradation- causes and prevention, Methods of irrigation and Irrigation projects.

UN1T IV Fertilizers (12 Hours)

Fertilizers: Effect of Nitrogen, potassium and phosphorous on plant growth. Secondary nutrients – micronutrients- their functions in plants, classification of fertilizers, natural fertilizers, artificial fertilizers, phosphate fertilizers; Manufacture of urea and triple super phosphate

Manures: Bulky organic manures- Farm yard manure- handling and storage, oil cakes. Blood meal, fish manures.

UNIT V Pesticides and Insecticides (12Hours)

Pesticides; Classification of Insecticides, fungicides herbicides as organic and inorganic, general methods of application and toxicity, safety measures when using pesticides. Insecticides-Plant products-Nicotine, pyrethrin, Inorganic pesticides-borates. organic pesticides - D.D.T and BHC. Fungicide: Sulphur compounds, copper coumpounds, Bordeaux mixture. Herbicides, Acaricides, Rodenticides, Attractants-Repellants, Preservation of seeds.

TEXT BOOKS

1. N.C. Brady, The nature and properties of soils, Eurasia publishing House, New Delhi.1977.
2. V.S,Jones.Fertilizersandsoilfertility,PrenticeHallofIndia,NewDelhi,1993.
3. D.E.H.Freer,Chemistryofpesticides,D.VanNostrandCo,Reinhold,1969.
4. A.K. De. Environmental Chemistry, Wiley Eastern.1989.

REFERENCE BOOKS

1. A. Sankara. SoilsScience.
2. R.C. Palful. K. Goel. R.K. Gupta, Insecticides, Pesticides and Agro based Industries.
3. B.K.Sharma,IndustrialChemistry,GoelPublishingHousePvtLtd.1999

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER II
EXTRA DISCIPLINARY COURSE
PAPER- III FOOD AND MEDICINAL CHEMISTRY
(60 Hours)

OBJECTIVES

1. To understand the importance of Food, its constituents, Food poisoning, Food preservatives, Vitamins and Minerals.
2. To gain the knowledge of various types of Drugs, AIDS and Medicinal plants.

UNII FOOD ANDITSCONSTITUENTS (12Hours)

Sources of food, types, advantages and disadvantages, constituents of foods, carbohydrates, proteins, fats and oils, colours, flavours, natural toxicants. Food poisoning - Sources, causes and remedy. Causes and remedies for acidity, gastritis, indigestion and constipation. Food preservation - Food spoilage, causes of food spoilage, types o flood spoilage, food preservation.

UNITII Vitamins and minerals (12 Hours)

Vitamins: Sources, requirement,deficiency diseases of A,B,C,HandK.
Minerals: Mineral elements in food-principal mineral elements - Source- Function - Deficiency and daily requirements- Na, K, Mg, Fe, S, P and I.

UNITIII Antibiotics, sulphonamides and Analgesics (12Hours)

Antibiotics: Definition, Classification as broad and narrow spectrum, mode of action and uses of penicillin, Chloramphenicol, tetracyclines, ciphalosporin, ampicillin and erythromycin. Sulphonamides: Mechanism and action of sulpha drugs, preparation and uses of sulphadiazine, sulphathiazole, sulphapyridine and sulphafurazole.

Analgesics- definition- narcotic and non-narcotic- morphine and its derivatives- pethidine and methodone - pharmacological action- uses and abuses. Heroin and codinine. Antipyretic analgesics- Preparation and uses of aspirin and paraacetamol.

UNITIV Antiseptics, Disinfectants and Anaesthetics (12Hours)

Antiseptics and disinfectants- definition and distinction- phenol coefficient, phenol as disinfectant, chlorhexidinc, formaldehyde and nitrofurazone-uses.

Anaesthetics- definition- classification- local and general- volatile, nitrous oxid, ether, chloroform, cyclopropane- uses and disadvantages- nonvolatile- intravenous- thiopental sodium, methohexitone, propanidid, local anaesthetics-

cocaine and benzocaine- uses and disadvantages.

UNITV (12Hours)

Drugs affecting CNS- Definition and one example for tranquilisers, sedatives, hypnotics, psychedelic drugs- chlorpromazine and barbitone-uses

Hypoglycemic agents- Diabetes- types- causes- symptoms- Insulin- uses. Oral hypoglycemic agents- sulphonyl ureas- action and uses.

Antineoplastic drugs- Causes of cancer, Antineoplastic agents, cytotoxic. anti-metabolites, plant products, harmones- one example and uses

AIDS-causes, prevention and control.

Indian medicinal plants and uses- tulasi, kilanelli, mango, semparuthi, adadodai and thoothuvalai.

TEXT BOOKS

1. Seema Yadav. Food Chemistry. Anmol publishing (P) Ltd, NewDelhi.
2. B.Srilakshmi, Food Science, New Age InternationalPublisher
3. 3.T.C.Daniels and E.C.Jorgensen,Text book of organic medicinal and Pharmaceutical chemistry, J.B. Lippincott, Philadelphia. 1997.
4. AshutoshKar, Medicinal Chemistry, New Age International,1996.

REFERENCE BOOKS

1. S. Lakshmi. **Pharmaceutical Chemistry,** Sultan Chand & Sons, NewDelhi.
2. A. Singh and V.K. Kapoor, **Organic PharmaceuticalChemistry.**
3. I.L. Firnar, **Organic Chemistry,**VoI-II.
4. Albert Lehninger. **BioChemistry.**
5. G.R. Chatwal, **Pharmaceutical Chemistry Organic.**Vol-II,
6. G.R. Chatwal, **Pharmaceutical Chemistry Inorganic,**Vol-I.

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER II
EXTRA DISCIPLINARY COURSE
PAPER-IV WATER CHEMISTRY
(60 Hours)

OBJECTIVES

To gain the knowledge of Characteristics of water, Analysis of water, Treatment of industrial water and Treatment plants

UnitI Introduction (12Hours)

Sources of Water; Physical and chemical characteristics of water; Water analysis; Potable water–WTO standard: uses of water

UnitII Water Pollution (12Hours)

Water pollution – wastewater generation- classification of water pollutants; constituents and characteristics of wastewater; measurement techniques – sampling, colour & odour, dissolved oxygen, BOD, COD, TOC, N & P, suspended solids and bacteriological measurements.

Unit III Waste water Treatment (12 Hours)

Wastewatertreatment:Pretreatment–screening,gritremovalandpre-chlorination; Primary treatment – settling and sedimentation; Secondary treatment – trickling filter process, activated sludge process; Aeration.

Unit IV Industrial Wastewater Treatment (12 Hours)

Industrial waste water treatment: Activated sludge treatment plants–mass balances, with and without recycle plants; Types of plants – single tank, contact stabilization, biosorption plants.

Biofilters: Hydraulic film diffusion, two component diffusion; Types of plants – trickling filters, submerged filters and rotating disc; removal of particulate organic matter.

Unit V Treatment Plants (12Hours)

Treatment plants for nitrification – mass balances, nitrifying plants and types of plants.Treatment plant for denitrification - mass balances, denitrifying plants and types of plants; redox zones in the biomass.

TEXT BOOKS

1. B.K.Sharma,IndustrialChemistry,GoelPublishingHousePvtLtd.1999
2. A.K.De, Environmental Chemistry, Wiley Eastern,1989.
3. S.K.Banerji, Environmental Chemisty, Prentice Hall of India, New Delhi,2003.

REFERENCE BOOKS

1. L.Winther, Wastewater Engineering, PolytekniskForlag, Lyngby,1978.
2. M.Henze, P.Harremoes, J.C.Jansen and E.Arvin, (Ed.), Wastewater treatment, Springer Verlag, New York,1995.
3. P.Harremoes, Water Chemistry, Polyteknisk Forlag, Lyngby, 1989.

M.Sc. CHEMISTRY
SEMESTER II
Internship Training

Objectives

1. Students should undergo Internship training to enrich their knowledge about Industry.
2. Students can select nearby Industry/Soil testing/Water testing/Research Laboratory for their internship training under the guidance of Faculty members.
3. The training will commence soon after second semester Examinations.
4. Industry/Laboratory for the internship training must be confirmed before the commencement of second semester.
5. Student has to spend minimum of 15 working days in the Industry/Laboratory.
6. Students should maintain a work dairy and prepare report of their internship training.
7. Students should submit their report with a letter of completion from the organization duly signed by the authorities.
8. The reports will be used to evaluate the students performance.

M.Sc. ANALYTICAL CHEMISTRY SEMESTER III
CORE-VII ANALYTICAL CHEMISTRY – I

[75 Hours]

OBJECTIVES

1. To understand the fundamentals of sampling, deta handling tritimetric, thermal and radio chemical analyses
2. To understand the basic concepts of x-ray methods, microwave and Raman Spectroscopy

Unit I Sampling and Datahandling (15 Hours)

Classification of Analytical methods- Types of samples, preparation of sample for analysis, sample treatment, moisture in sample, procedure of sampling of solids, liquids and gases, Errors and Evaluation- Accuracy, precision, sensitivity, detection limits, significant figures, rounding off. Types of errors- determinate and indeterminate errors. Ways of expressing accuracy, absolute and relative errors. Significant figures and propagation of errors. Confidence limit, Test of significance- the F- test and T- test. The statistical Q- test for rejection of a result, statistics for small data sets. Linear least squares method. The correlation coefficient. Calculation for the above parameters.

Unit II TitrimetricAnalyses **(**15 Hours)

Redox titrations-Redox potentials, theory and feasibility of redox titrations, calculation of potential at different stages of titrations, redox indicators, their choice and application. Complexometric titrations- Theory, stepwise and overall formation constants, titrations involving monodendate (Cl-,CN-) and multi dentate ligands (EDTA), Metallochromic indicators- theory and choice. Masking and demasking methods. Direct, indirect (including substitution) titrations and applications

UnitIII Thermal and Radiochemical methods of analyses (15 Hours)

Thermal method of Analysis- Thermogravimetry, Differential Thermal Analysis and Differential Scanning Calorimetry, instrumentation. Method of TG, DTA and DSC. Application of TG to study of oxalates and chromates. Determination of Glass transition, Heat capacity Determination, Evolved gas analysis. Thermometric titrimetry- theory, instrumentation and applications. Radio chemical method of analysis- Radioactive tracer techniques and its application, isotope dilution analysis, neutron activation analysis. Radiometric titrations- principle, theory and applications

Unit IV X-ray methodsofanalyses (15Hours)

X-ray Diffraction- Xrays and their generation- choice of radiation, Experimental methods- Powder and single crystal methods, Advantages and limitations of X-ray diffraction. X-ray Absorption method- Principle, radiographic non-dispersive X-ray Absorptiometers. X- ray Fluorescence method- Instrumentation, applications, advantages and limitations.

UnitV Microwave and Raman Spectroscopy (15 Hours)

Microwave Spectroscopy- Theory, instrumentation- source, monochromators, detectors, sample handling, qualitative analysis and applications. Raman Spectroscopy-Theory, instrumentation and applications, Resonance Raman Spectroscopy.

REFERENCE BOOKS

1. F.W. Finfield&D.Kealey,Principles and practice of Analytical chemistry, 5th Edition. Blackwell Science,2000.
2. Gary D. Christian, Analytical Chemistry,6th Edition, John Wiley and sons. Inc., New York1994.
3. Willard, Merit, Dean,Instrumental Methods of Analysis,6th Edition,CBS Publishers and Distributors,1986
4. Vogel's Textbook of Quantitative analysis- CJ Jeffery, J Bassett et al, 5th Edition, Longmann ELBS Publications,2000.
5. D.A. Skoog and D.M. west,Fundamental of Analytical Chemistry, Holt Rinehart and Winston Publications, 4th Edition,1982.
6. H.Kaur,InstrumentalMethodsofChemicalanalysis,PragatiPublishers,2006..
7. B.K. Sharma, Instrumental Methods of Chemical Analysis, Goel Publications, 15thEdition,1996.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER III

CORE – XIII ANALYTICAL CHEMISTRY-II

(75 Hours)

OBJECTIVE

i) To study in detail about Basic separation techniques, Chromatographic techniques, Computers in chemistry, surface chemistry and Superconductors

Unit I Basic separation techniques- I (15Hours)

General aspects of separation techniques- Role of separation technique in analysis, Classification choice of separation method distribution processes, discrete and continuous equilibrium, distribution behavior and chemical structure, errors resulting from separation process. Extraction- Distribution law and derivation, solvents and their choice, techniques- batch and continuous, multiple extraction, column and their choice, extraction of solids and their applications. Precipitation and crystallization- Theory and mechanism of fractional precipitation and crystallization, Variables and control of variables, type of precipitation and their applications.

Unit II Chromatographic Techniques-I (15Hours)

Thin layer chromatography- Techniques and applications, Modified stationary phases. Ion- exchange chromatography- Techniques and applications. Gas chromatography- Types and nature of stationary and mobile phase, solid supports and their choice, columns- packed, open and capillary, sampling methods, instrumentation, detectors and applications

Unit III Chromatographyic Techniques-II (15Hours)

Gel permeation chromatography- Instrumentation, heterogeneity factor, determination of molecular weights- weight average and number average, analytical and industrial applications.

Liquid chromatography- High pressure liquid chromatography- Theory and equipment, types of pumps and their choice, types of columns, large scale separation, applications in analytical and in industry.

New development in chromatography- Plasma chromatography and super critical fluid chromatography

Unit IV Computers in Chemistry (15 Hours)

Computers in chemistry-Basic structure of a computer, input/ output devices, memory and storage systems, central processing unit, peripherals, computer codes and arithmetic, binary number systems, floating point representations, floating point arithmetic and computational errors. Programming in BASIC only for calculation of equilibrium constants, pH of a buffer, Potentiometric titrations and standard deviation.

Unit V Surface Chemistry and Superconductors (15Hours)

Surface chemistry - Mechanism of catalytic reactions on the surfaces- diffusion of reactants to the surfaces, adsorption of reactants, reaction within the absorbed layer, desorption of the products, diffusion of the products away from the surface. The mechanism of chemisorption on metal, the formation of chemisorption layer, the character and nature of the chemisorption bond. Superconductors- Discovery of Superconductors, Meissner effect, Type I and II conductors, High Tc superconductors and their applications.

REFERENCE BOOKS

1. H. Kaur, An Introduction to Chromatography, Pragati Publishers2006,
2. Willard, Merit Dean and Settle, Instrumental Method of Analysis, CBS Publishers and Distributors, IV Edition,1989.
3. D.A. Skoog and D.M. West, Fundamentals of Analytical Chemistry, Holt Rinehart and Winston Publications, IV Edition,1982.
4. Vogel's Textbook of Quantitative analysis- CJ Jeffery, J Bassett et al, 5th Edition, Longmann ELBS Publications,2000.
5. B.K.Sharma, Instrumental Methods of Chemical Analysis, Goel Publications, 15thEdition,1996.
6. K.V. Raman, Computers in chemistry, Tata Mc Graw Hill, New Delhi, 1993.
7 Joi, Khachan& Stephen,Superconductivity.

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER III
ELECTIVE PAPER –II
SPECTROSCOPY

(75 Hours)

OBJECTIVES

1. To study in detail about UV-VIS, IR,NMR, 13C NMR, EPR, Mossbauer spectroscopic and Mass spectrometry techniques
2. To develop problem solving skills from various type of spectra

UNIT I UV-VIS ANDIRSPECTROSCOPY (15Hours)

UV-VIS- The nature of the electronic excitations, origin of UV band structure and the principle of absorption, chromophores and auxochromes, factors affecting intensity- solvent effects and position of absorption bands- dienes, polyenes and enones Woodward- Fisher rules for dienes, enones and aromatics-calculation of λ_{max} for organic molecules- applications of UV-spectroscopy.

IR- IR absorption process, modes of stretching and bending vibrations, bond properties and their relations to absorption frequencies, Characteristic group frequencies of aliphatic and aromatic organic molecules, carbonyl, carboxylic acid, ester, alcohol, phenol and amides. Factors influencing vibrational frequencies, interpretation of IR spectra of organic molecules- applications of IR-spectroscopy.

UNIT II NMR SPECTRSCOPY–I (15 Hours)

^{1}H NMR- principle - Shielding and deshielding - chemical shift, factors influencing chemical shift – magnetic anisotropy- Spin – spin splitting- (n+1rule), Coupling constant –Pascal's triangle, calculation of coupling constants, mechanism of coupling (one bond, germinal, vicinal and long range coupling), First order & non first order spectra - Chemical & magnetic equivalence, shift reagents, NMR instrumentation– Applications

UNIT III NMR SPECTROSCOPY – II (15 Hours)

^{13}C NMR - The ^{13}C nucleus – Chemical shifts –Modes of couplings and multiplicity-proton coupled ^{13}Cspectra, Homonuclear and heteronuclear decoupling–NOE-Broad band decoupling – Off resonance decoupling –intensity of signals, Chemical shift equivalence, equivalent carbons, chemical shifts of 13C nuclei, DEPT technique, comparison of 1H and ^{13}C NMR, 2D NMR-COSY and HETCOR techniques-simple molecules and applications of ^{13}C NMR.

UNIT IV EPR AND MOSSBAUER SPECTROSCOPY (15Hours)

EPR- introduction- factors affecting the g-value, limitations , instrumentation, electron nucleus interaction, hyperfine interactions-isotropic and anisotropic coupling constants – spin Hamiltonian-applications

Mossbauer spectroscopy – Principle, Instrumentation, Doppler shift, Isomer shift, Quadrupole splitting, Magnetic interaction, Magnetic hyperfine splitting and selection rules. Instrumentation and its Applications-Mossbouer spectra of high and low spin Fe and Sn compounds.

UNIT V MASS SPECTROMETRY AND SPECTROSCOPIC APPLICATIONS (15 Hours)

Mass spectra- Basic principle, molecular ion peak, base peak, meta stable ion peak, isotopic peaks, Nitrogen rule, ring rule, Mc-Lafferty rearrangement, rules for fragmentation pattern, Examples of mass spectral fragmentation of organic compounds (alkanes, aromatic hydrocarbons, alkyl halides, aldehydes, ketones, alcohols, acids and esters).

Spectroscopic applications: Structural elucidation of simple organic molecules using UV-VIS, IR, Proton NMR spectroscopy and Mass spectrometry

REFERENCE BOOKS

1. WilliamKemp,OrganicSpectroscopy,3rdedition,ELBSPublications,1975.
2. JagMohan,OrganicSpectroscopy,NarosaPublishingHouse,2ndEdition,2009.
3. B.K. Sharma, Spectroscopy, Goel Publishing House,2011
4. G.W.Ewing,Instrumentalmethodsofchemicalanalysis,McgrawHillpub,1975
5. P.S.Kalsi, Spectroscopy, New Age International (P) Ltd, reprint 2009
6. D. L. Pavia, G.M. Lampman & G.S.Kriz Introduction to Spectroscopy, 3rd Edition, Brooks/Cole Publications,2008,
7. R.M. Silverstein, F.X. Webster, Spectrometric Identification of Organic Compounds, 6th Edition, John Wiley Publications,2009.
8. R.S. Drago, Physical Methods in Inorganic Chemistry, Reinhold Saunders College Publishing,1977

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER III
Elective – III
Electroanalytical Techniques

(75 Hours)

OBJECTIVES

1) To learn about the basic concept of electroanalytical chemistry

2) To study the principle, instrumentation and applications of various analytical techniques

UnitI D.C.Polarography and Voltametry (15 Hours)
Polarography- Theory, instrumentation, DME, diffusion and kinetic and catalytic currents, current- voltage curves for reversible and irreversible systems, qualitative and quantitative applications of polarography to organic and inorganic systems. Derivative polarography, Test polarography, Pulse polarography- Normal and derivative, square wave polarography and AC polarography. Linear sweep and cyclic voltametry, acidic and cathodic stripping voltametry.

Unit II Amperometric titrations (15 Hours)
Amperometric titrations- Theory, instrumentation, types of titration curves, successive titrations and two indicator electrodes- applications. Technique of amperometric titrations with the dropping mercury electrode - Titration with the rotating platinum micro electrode. Examples of amperometric titrations using a single polarized electrode, biamperometry- Theory and applications.

Unit III Coulometric and Electrogravimetric Analysis (15 Hours)
Coulometric Analysis - Theory, Faraday's laws, Coulometers - types of macro and micro techniques, Coulometric titrations, external and insitu generation, coulogravimetry and applications, Elementary aspects of chrono coulometry. Electrogravimetry- Theory, order of deposition, over potential, polarization curves, constant potential and consecutive deposition, selective deposition, constant current deposition, assembly of electrode and deposition of complex ions. Micro electrode deposition including radioactive metal ions and its applications.

Unit IV Fluorimetry, Phosphorimetry, Nephelometry and Turbidimetry(15 Hours)
Fluorimetry and Phosphorimetry-Theory of Fluorescence and Phosphorescence, Instrumentation and applications of Fluorimetry and Phosphorimetry.
Nephelometry and Turbidimetry-Tyndall, Rayleigh and Raman scattering.
Theory, instrumentation and applications.

Unit V Electrophoresis and Magnetic method of Analysis (15 Hours)

Electrophoresis- Introduction, PaperElectrophoresis-Principle, instrumentation and applications. Capillary Electrophoresis-Principle,instrumentation and applications. Magnetic method of Analysis- Magnetic susceptibility and its measurements, Guoy's, Quink's, Currie's and Ranking's balances. Applications to simple compounds and transition metal complexes.

REFERENCE BOOKS

1) Willard, Merit Dean and Settle, Instrumental Methods of Analysis, CBS Publishers and Distributors, IV Edn,1986.

2) A.I. Vogel, Text Book of QuantitativeInorganic Analysis, ELBS III and IV Edn.

3) D.A. Skoog and D.M. West, Fundamentals of Analytical Chemistry, Holt Rinehart and Winston Publications, IV Edn,1982.

4) F.W. Finfield & D.Kealey, Principles and Practice of Analytical chemistry, 5th Edition. BlackwellScience,2000.

5) Gary D. Christian, 6th Edition, . Analytical Chemistry, John Wiley and sons. Inc., New York1994.

6) H.Kaur,InstrumentalMethodsofChemicalanalysis,PragatiPublishers,2006.

7) B.K.Sharma, Instrumental Methods of Chemical Analysis, Goel Publications, 15th Edition,1996.

8) Skoog, Holler, Niemann, Principal of Instrumental Analysis, 5th Edition, Harcourt College Publishers,1998,

9) Z. Smith, Heinemann Chromatographic and Electrophoresis Techniques, Interscience,1960,

10) Electrophoresis M.A.L. Melvin, John Wiley & Co,987.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER IV

CORE – IX ANALYTICAL CHEMISTRY–III

OBJECTIVES

To study in detail about Surface imaging and other analytical techniques

Unit I Surface Analysis chemistry (15 Hours)

Surface imaging-Principle, Instrumentation and applications. Scanning Electron Microscopy (SEM), Secondary Auger Microscopy (SAM), Scanning Probe Microscopy (SPM), Scanning Tunneling Microscopy (STM) and Transmission Electron Microscopy (TEM) - Principle, Instrumentation and applications.

Unit II Polari meter and Refractometry (15 Hours)

Polarimeter-Theory, Instrumentation, specific and molecular rotations and applications, SpectroPolarimeter, Refractometry- Theory, Instrumentation, specific and molecular refraction, Abbe, Pulfrich and Immersion types and applications.

Unit III Atomic Absorption Spectroscopy and Atomic Emission Spectroscopy

(15 Hours)

Atomic Absorption Spectroscopy - Principle, Instrumentation and applications. Atomic Emission Spectroscopy - Principle, Instrumentation, Source of excitation and applications.

Unit IV Photo Acoustic Spectroscopy and Electron Spectroscopy for chemical analysis (15Hours)

Photo Acoustic Spectroscopy-Principle, Instrumentation and applications. Electron Spectroscopy for Chemical Analysis (ESCA) - Principle, Chemical shift and analytical applications.

Unit V AdvancedMassSpectrometry (15Hours)

Mass Analyzers - Quadruple, Ion traps and Time of flight (TOF) Mass analyzers, Mass Spectrometry - Tandem Mass Spectrometry - Instrumentation and applications. Hyphenated Techniques – GC-MS- Principle, Instrumentation and applications. LC-MS - Principle and Instrumentation. ICP-MS - Principle, Instrumentation and applications.

REFERENCE BOOKS

1. D.A. Skoog and D.M. West, Fundamentals of Analytical Chemistry, HoltRinehart and Winston Publications, IV Edition,1982.
2. D.A. Skoog, Principles of Instrumental Analysis, Saunders College Pub. Co, III Edition,1985.
3. A.I. Vogel, Text Book of Quantitative Inorganic Analysis, ELBS III and IVEdition.
4. Willard, Merit Dean and Settle, Instrumental Methods of Analysis, CBS Publishers and Distributors, IV Edn,1986.
5. F.W. Finfield & D.Kealey, Principles and practice of Analytical chemistry, 5th Edition, Blackwell Science,2000.
6. Gary D. Christian, Analytical Chemistry, 6th Edition, John Wiley and sons. Inc., New York,1994.
7. H.Kaur,InstrumentalMethodsofChemicalanalysis,PragatiPublishers,2006.
8. B.K. Sharma, Instrumental Methods of Chemical Analysis, Goel Publications, 15thEdition,1996.
9. Robert A.W.Johnstone and Molcolm. E. Rose, Mass SpectrometryforChemist and Biochemist, 2ndEdition.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER IV
ELECTIVE PAPER - IV - ANALYSIS OF MATERIALS

[75 Hours]

OBJECTIVE

To study in detail about analysis of water, drinking water, sewage water, soil, fertilizers, pesticides, food, food additives and clinical analysis.

Unit I Analysis of water **(15Hours)**

Analysis of water- Dissolved solids, Acidity, Alkalinity, Estimation of dissolved chloride, fluoride, calcium, magnesium, manganese, zinc, dissolved oxygen, BOD,COD and Bacterial examination of water.

Unit II Drinking water and Sewage water treatment-

Drinking water treatment - Estimation of temporary and permanent hardness, Characteristics of water, WHO and Indian standards, Removal of coarse, dispersed and colloidal impurities from water, Coagulation of water, Sterilisation and disinfection of water- Chemical and Physical methods of sterilization. Sewage Water Treatment- Properties of sewage water, Decomposition of sewage- Types of Aerobic biological Oxidation plants and Anaerobic biological Oxidation, plants.

Unit III Agricultural Analysis **(15 Hours)**

Soil Analysis- Determination of soil moisture, pH, conductivity, total organic matter, nitrogen, phosphorus, potassium, sulfur, manganese and other metals in soil

Analysis of Fertilizers-Determination of moisture by Karl Fischer titration methods. Determination of Ammonical nitrogen and Ammonical nitrate nitrogen.

Analysis of Pesticides-Analysis of organophosphorus pesticides. Determination of Malathion, Methyl malathion and DD residues in vegetable and food grains.

Unit IV Analysis of Food and Food additives **(15Hours)**

Food adulteration, common adulterants in food, Contamination of food stuffs. Microscopic examination for food adulterants. Chemical and Instrumental Analysis of food additives- Preservatives, Food colorants, Antioxidants, Sweeteners, stabilizers, Thickeners, Clarifying and Bleaching agents.

Unit V Clinical Analysis (15 Hours)

Analysis of Carbohydrates and their significances- Fasting, random and post pandrial glucose tests, Estimation of glucose in serum, Analysis of lipids andtheirsignificances- Testforcholesterol.Analysisofproteinandtheirsignificances- Estimation of total protein in serum. Analysis of major metabolites and their significances- Determination of blood urea and creatinine in urine. Analysis of ions and their significances- Estimation of Na, K, Ca, bicarbonates and phosphate in serum. Analysis of Hormones and their significances-ELISA and RIA.

REFERENCE BOOKS

1. B.K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut,
2. S.M.Khopkar, Environmental Pollution Analysis, Wiley EasternLimited,1995,
3. HLS Tandon, Methods of Analysis of Soil, Plants, water and Fertilizers- Ed, FDCO Publications, New Delhi,1999,
4. ShaliniSehgal, A Laboratory Manual of Food Analysis.
5. S.S.Nielsen, Introduction to Chemical Analysis of Food.
6. Kenneth. A. Connors, Text Book of Pharmaceutical Analysis- John Wiley & sons,1999,
7. P.Primoo, PharmaceuticalAnalysis-CBSPublishers.NewDelhi,1999.
8. G.D. Christan, Analytical Chemistry, J. Willey.
9. A.I. Vogel, Text Book of Quantitative Inorganic Analysis, ELBS III and IVEdn.

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER IV
CORE PRACTICAL - IV
ANALYTICAL CHEMISTRY PRACTICAL – I

OBJECTIVES

To understand and apply the concepts of electrochemistry in Conductometry and Potentiometry experiments.

Conductometric experiments

1. Determination of equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculation of the dissociation constant of the acid.
2. Determination of equivalent conductivity of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.
3. Conductometric titrations of a mixture of HCl and CH_3COOH against Sodium hydroxide.
4. Compare the relative strength of acetic acid and monochloroacetic acid by conductivity method.

Potentiometric experiments

5. Determination of the activity coefficient of an electrolyte at different molalities by emf measurements.
6. Determination of the dissociation constant of acetic acid by titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
7. Determination of the strength of a given solution of KCl using differential potentiometric titration technique.
8. Determination of the PH of a given solution by emf method using hydrogen electrode and quinhydrone electrode.
9. Determination of the formation constant of silver ammonia complex and stoichiometry of the complex potentiometrically.
10. Solubility and solubility products by emf method.
11. Determination of the activity coefficient of Zinc ions in the solution of 0.002M Zinc sulphate using Debye-Huckel Limiting law.

12. Determination of solubility product of Silver bromide and calculate its solubility in water and 0.1 M and 0.01 M $KBrO_3$using Debye-Huckel limiting law.
13. Determination of the electrode potentials of Zn and Ag electrodes in 0.1 M and 0.001M solutions at 298 K and find the standard potentials for these electrodes and test the validity of Nernst equations.
14. Determination of Hardness of water by titrimetric method.
15. Determination of COD and BOD.

M.Sc. ANALYTICAL CHEMISTRY

SEMESTER IV

CORE PRACTICAL - V

ANALYTICAL CHEMISTRY PRACTICAL – II

OBJECTIVE

To develop analytical skill in Estimation of organic compounds, Extraction of natural products, Separation of mixture of compounds by Chromatographic techniques, Quantitative analysis of complex materials, Analysis of Ores and Alloys.

I ORGANICESTIMATION

Estimation of the following organic compounds:

1. Phenol
2. Aniline
3. Methyl Ketone
4. Glucose
5. Iodine value of an oil
6. Saponification value of an oil

IIEXTRACTIONOFNATURAL PRODUCTS

1. Caffeine from tealeaves.
2. Citric acid from lemon.

III CHROMATOGRAPHICSEPARATIONS

1. Column chromatography : separation of a mixture of ortho and para-Nitroanilines.
2. Thin layer – Chromatography: separation of a mixture of ortho and para– Nitroanilines.
3. Paper chromatography – identification of natural alpha aminoacids.

IV Quantitative analysis of complex materials

A) Quantitative analysis of the following mixture

1. Iron and magnesium
2. Iron and nickel
3. Copper and nickel
4. Copper and Zinc

B) Analysis of Ores

1. Determination of percentage of calcium and magnesium indolomite.
2. DeterminationofpercentageofMnO2inpyrolusite
3. Determination of percentage of lead ingalena.

C) Analysis of Alloys

1. Determination of tin and lead in solder
2. Determination of copper and zinc in brass.
3. Determination of Chromium and nickel in stainless steel.

REFERENCE BOOKS

1. G.Svehla,Vogel'sPracticalorganicchemistry,ELBS,IVEdition1985.
2. Gnanpragasam, Ramamurthy, Organic lab Manual, Viswanathan, S., Printers & Publishers Pvt Ltd, 2009.
3. Vogels's Qualitative Inorganic analysis, VI Edition, orient Longmax(1987).
4. J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham, Vogel's Text book of quantitative inorganic Analysis, ELBS, IV Edition.1985.
5. W.G. Palmer, Experimental Inorganic Chemistry, Van Nostrand Reinhold Co., London.1972.
6. D.N. Grindley, An advanced course in practical Inorganic Chemistry, Butterworths 1964.
7. J.N. Gurtu & Gurtu, Advanced Physical chemistry experiments, Pragati Publishers,2006.

M.Sc. ANALYTICAL CHEMISTRY
SEMESTER IV
CORE PRACTICAL - VI
ANALYTICAL CHEMISTRY PRACTICAL – III

OBJECTIVES

To develop analytical skill in operating techniques such as Chromatography, Flame optometry, Nephelometry, Biamperometry, Bipotentiometry, Polarimetry and Spectrophotometry.

I. CHROMATOGRAPHICTECHNIQUES

1. Column chromatography – Separation of chlorophyll
2. Thin layer chromatography–Separation of cation and anions, dyes in ink.
3. Paper chromatography – Separation of cations
4. Ion-exchange chromatography – Separation of Zn and Mg Separation of Cd and Zn.
5. Ring–oven Technique–Separation of cations and inorganic complex.

II. FLAMEPHOTOMETRY

1. Determination of sodium, potassium and calcium.
2. Determination of potassium in combined fertilizer.
3. Determination of calcium in wine.

III. NEPHELOMETRY

1. Determination of sulphate.
2. Determination of halides

IV. BIAMPEROMETRY &BIPOTENTIOMETRY

1. Iodine – hypo titration
2. Fe(II) vs. Ce (IV)titration
3. Estimation of nitrite
4. Determination of copper.

V POLARIMETRY

1. Study the inversion of canesugar in presence of acid.

VI. SPECTROPHOTOMETRY

1. Determination of Iron/Cobalt.
2. Determination of dissociation constant of an indicator
3. Determination of binary mixture
4. Determination of Mn in steel.