

Curriculum Revision 2016-2017

Department of chemistry , Subcampus Osmanabad.

M. Sc. ANALYTICAL AND DRUG CHEMISTRY I Year (SEMESTER I)								
Sem	Course	Code	Subject Title	Credit	Teaching Hrs/Week	Marks		Total
						Internal	Final	
I	Common	IC-100	Introduction to the Indian Constitution	2	2	10	40	50
	Core	CHEC-101	Inorganic Chemistry	4	4	20	80	100
		CHEC-102	Organic Chemistry	4	4	20	80	100
		CHEC-103	Physical Chemistry	4	4	20	80	100
	Foundation	CHEF-104	Analytical Chemistry	4	4	20	80	100
	Laboratory	CHEL-105	Laboratory Course-I	4	8	NA	100	100
		CHEL-106	Laboratory Course-II	4	8	NA	100	100
	Total				26	34	90	560
M. Sc. ANALYTICAL AND DRUG CHEMISTRY I Year (SEMESTER II)								
II	Research	CHER-200	Research Methodology	2	2	10	40	50
	Core	CHEC-201	Inorganic Chemistry	4	4	20	80	100
		CHEC-202	Organic Chemistry	4	4	20	80	100
		CHEC-203	Physical Chemistry	4	4	20	80	100
	Foundation	CHEF-204	Applications of Organic Spectroscopy	4	4	20	80	100
	Laboratory	CHEL-205	Laboratory Course-III	4	8	NA	100	100
		CHEL-206	Laboratory Course-IV	4	8	NA	100	100
	Total				26	34	90	560
M. Sc. DRUG CHEMISTRY II Year (SEMESTER III)								

III	Core	CHECD-301	Applications of Molecular Spectroscopy	4	4	20	80	100	
		CHECD-302	Bio-Organic & Green Chemistry	4	4	20	80	100	
		CHECD-303	Organic Reactions & Rearrangements	4	4	20	80	100	
	Elective	CHEED-304	Applied Organic Chemistry OR	4	4	20	80	100	
		CHEED-304	Heterocyclic Chemistry	4	4	20	80	100	
	Laboratory	CHELD-305	Laboratory Course-V	4	8	NA	100	100	
		CHELD-306	Laboratory Course-VI	4	8	NA	100	100	
	Service		Service Course	4	4	20	80	100	
	Total				28	36	100	600	700
	M. Sc. DRUG CHEMISTRY II Year (SEMESTER IV)								
IV	Core	CHECD-401	Introduction to Medicinal Chemistry	4	4	20	80	100	
		CHECD-402	Drug Synthesis	4	4	20	80	100	
		CHECD-403	Drug Action & Development	4	4	20	80	100	
	Elective	CHEED-404	Pharmaceutical & Industrial Practices OR	4	4	20	80	100	
		CHEED-404	Drug Regulatory Affairs	4	4	20	80	100	
	Research	CHERD-405	Research Literature & Seminar	4	8	NA	100	100	
		CHERD-406	Research Project (Experimental)	4	8	NA	100	100	
		CHERD-407	Research Project (Dissertation & Presentation)	4	8	NA	100	100	
	Total				28	40	80	620	700
	Grand Total				108	144	360	2340	2700

M. Sc. I & II Year (ANALYTICAL CHEMISTRY)								
Sem	Course	Code	Subject Title	Credit	Teaching Hrs/Week	Marks		Total
						Internal	Final	
	Common	IC-100	Introduction to the Indian	2	2	10	40	50

I			Constitution					
	Core	CHEC-101	Inorganic Chemistry	4	4	20	80	100
		CHEC-102	Organic Chemistry	4	4	20	80	100
		CHEC-103	Physical Chemistry	4	4	20	80	100
	Foundation	CHEF-104	Analytical Chemistry	4	4	20	80	100
	Laboratory	CHEL-105	Laboratory Course-I	4	8	NA	100	100
		CHEL-106	Laboratory Course-II	4	8	NA	100	100
	Total				26	34	90	560
I	Research	CHER-200	Research Methodology	2	2	10	40	50
	Core	CHEC-201	Inorganic Chemistry	4	4	20	80	100
		CHEC-202	Organic Chemistry	4	4	20	80	100
		CHEC-203	Physical Chemistry	4	4	20	80	100
	Foundation	CHEF-204	Applications of Organic Spectroscopy	4	4	20	80	100
	Laboratory	CHEL-205	Laboratory Course-III	4	8	NA	100	100
		CHEL-206	Laboratory Course-IV	4	8	NA	100	100
	Total				26	34	90	560
III	Core	CHECA-301	Applications of Molecular Spectroscopy	4	4	20	80	100
		CHECA-302	Environmental Chemistry	4	4	20	80	100
		CHECA-303	Organic Reactions & Rearrangements	4	4	20	80	100
	Elective	CHEEA-304	Analytical Methods in Chemical Analysis OR	4	4	20	80	100
		CHEEA-304	Advanced Analytical Techniques-I	4	4	20	80	100
	Laboratory	CHELA-305	Laboratory Course-V	4	8	NA	100	100
		CHELA-306	Laboratory Course-VI	4	8	NA	100	100
	Service		Service Course	4	4	20	80	100

			Total	28	36	100	600	700	
IV	Core	CHECA-401	Applied Analytical Chemistry-I	4	4	20	80	100	
		CHECA-402	Applied Analytical Chemistry-II	4	4	20	80	100	
		CHECA-403	Applied Analytical Chemistry-III	4	4	20	80	100	
	Elective	CHEEA-404	Pharmaceutical, Clinical & Forensic Analysis OR	4	4	20	80	100	
		CHEEA-404	Advanced Analytical Techniques-II	4	4	20	80	100	
	Research	CHERA-405	Research Literature & Seminar	4	8	NA	100	100	
		CHERA-406	Research Project (Experimental)	4	8	NA	100	100	
		CHERA-407	Research Project (Dissertation & Presentation)	4	8	NA	100	100	
				Total	28	40	80	620	700
				Grand Total	108	144	360	2340	2700

M. Sc. First Year (Second Semester)

CHER 200 : RESEARCH MENTHODOLGY

50 Marks

30 Hours

1. Research:

Meaning and objective of research, types of research (basic, applied and patent oriented research), selecting a problem & preparing a research proposal for different types of research as mentioned above.

2. Literature survey and documentation:

Methods of Literature survey, Use of library, books, journals, e journals, thesis, chemical abstracts and patent data base, techniques of documentation, importance of documentation, uses of computer packages in documentation.

3. Technical writing:

Research report, paper, thesis writing [Title, abstract, key words, methodology, results, discussion, conclusion, acknowledgement, references, errata, foot notes], types of research paper [review article, research papers and short communications and meeting report], detailed study of 'Instruction to Authors' of IJPS journal, a thorough understanding of steps involved in submitting articles electronically to IJPS [registration, new article submission, tracking the process, submitting revised articles]. Impact factor, Rating, Indexing and citation etc.

4. Presentation: (Specially for oral)

Importance, types different skills, contained, format of model, introduction & ending, posture, gestures, eye contact, facial expressions, stage, fright, volume, pitch, speed, pause & language, visual aids & seating, questionnaire.

5. Research organizations and procurement of research grants:

Introduction to various research organization (DST, DBT, AICTE, UGC, CSIR, DRDO, ICMR) along with their function in India, sources for procurement of research grants.

Reference Books:

1. Research In Education- John V. Best, John V. Kahn 10th edition
2. Presentation skills - Michael Hallon- Indian Society for Institute education
3. Thesis projects in Science & Engineering - Richard M. Davis.
4. Thesis & Assignment - Jonathan Anderson
- 5 Writing a technical paper- Donald Menzel
6. Protection of industrial Property rights- P. Das & Gokul Das
7. Preparation for publication - King Edward Hospital Fund for London
8. Manual for the preparation of industrial feasibility studies

M. Sc. First Year (Second Semester)

CHEF 204 : APPLICATIONS OF ORGANIC SPECTROSCOPY

100 Marks

60 Hours

Unit I: Ultraviolet-Visible Spectroscopy

07 Hrs.

Various Electronic transition, Chromophores, Auxochromers, Bathochromic and Hypsochromic Shifts, Effect of solvent on electronic transitions, Woodward–Fieser rules dienes, enones and aromatic compounds, Applications.

Unit II: Infrared Spectroscopy

10 Hrs.

Instrumentation and sample handling, Various vibrational transitions, Characteristic vibrational frequencies of alkenes, alkynes, aromatic compounds, Carbonyl compounds, hydroxyl compound and amines. Factors affecting IR group frequencies, overtone, combination bands and Fermi resonance. Applications

Unit III: Nuclear Magnetic Resonance Spectroscopy

15 Hrs.

Elementary Ideas, Chemical Shifts, Factors affecting chemical shifts, Spin–Spin coupling constants (J) Instrumentations, Different types of coupling, Factors affecting coupling constant, Karplus equation, Spin system (AB, AX, ABX, AMX, etc), Rate processes, Spin decoupling, Shift reagents, Nuclear over Hauser effect (NOE).

Unit IV: C¹³-NMR Spectroscopy

10 Hrs.

Elementary Ideas, Instrumental aspects, chemical shift (Aliphatic, Olefinic, Alkyne, Aromatic, Heteroaromatic & carbonyl carbon), Effects of constituents on chemical shifts. Two dimensional (2D) NMR techniques: COSY, NOESY, DEPT, APT, INEPT & INADQUATE.

Unit V: Mass Spectrometry

8

Hrs.

Introduction, Ion production (EI, CI, FD & FAB), Ion analysis, Ion abundance, Factors affecting fragmentation, Fragmentation of different functional groups, Molecular ion peaks, Metastable peaks Nitrogen rule, McLafferty rearrangement, Retro-Diels Alder reaction.

Unit VI: Problems based on joint application of UV, IR, NMR & Mass spectroscopy

10 Hrs.

Reference Books:

1. Spectrometric Identification of Organic Compounds, R.M. Silverstein- 6th Edition
2. Spectroscopy of Organic Compounds, V.M. Parikh.
3. Organic Spectroscopy, P.S. Kalsi
4. Introduction to Spectroscopy, D.L. Pavia, G.M. Lampman, G.L. Nelson.
5. Mass Spectroscopy, K.G. Das & James.
7. Spectroscopy Methods in Organic Chemistry D. H. Williams and I. Fleming

M. Sc. Second Year (*Third Semester*) Drug Chemistry

CHECD 301: APPLICATIONS OF MOLECULAR SPECTROSCOPY

100 Marks

60 Hours

Unit I: General Introduction of Spectral Methods

05 Hrs.

Characterization of electromagnetic radiations, Regions of the spectrum, Interaction of radiations with matter—absorption, emission, transmission, reflection, dispersion, polarization and representation of spectra, Basic elements of practical spectroscopy, Resolving power, Signal to noise ratio, Uncertainty relation and natural line width, Natural line broadening, Intensity of spectral lines, Energy levels, Selection rules, Components of spectrometer and their functions.

Unit II: Microwave spectroscopy

05 Hrs.

Rotation of molecules, Rotational spectra, Diatomic molecules—rigid diatomic molecules, Intensities of spectral lines, Effect of isotopic substitution, Non—rigid rotator, The spectrum of non—rigid rotator, Polyatomic molecules, Technique and instrumentation in outline, Applications, Numericals.

Unit III: Vibrational Spectroscopy

15 Hrs.

A. Infrared spectroscopy – Review of linear harmonic oscillator, The vibrating diatomic molecule, The simple harmonic oscillator, The anharmonic oscillator, The diatomic vibrating rotator, Vibration— rotation

spectrum of carbon monoxide, Breakdown of Born–Oppenheimer approximation, The vibration of polyatomic molecules, Overtones and combination frequencies, The influence of rotation of the spectra of polyatomic molecules the influence of nuclear spin, Symmetric top molecules analysis by infra–red technique–Group frequencies, Outline of technique and Instrumentation.

B. Raman spectroscopy –Classical and Quantum of theory of Raman effect, Pure rotational, vibration and vibrational–rotational Raman spectra, Rule of mutual exclusion, Overtone and combination vibrations Rotational fine structure, Outline of technique and instrumentation, Applications.

C. IR & Raman Studies of Complexes

Origin of Molecular Spectra, Origin of Infrared and Raman Spectra, Modes of vibrations, Selection Rules for Infrared and Raman Spectra, Normal modes of vibrations in AB_2 (Linear/Bent), AB_3 , AB_4 , AB_5 , Octahedral AB_6 molecules with factors affecting band frequencies.

Unit IV: X–ray Diffraction

05 Hrs.

Generation of X–rays, Interaction of X–rays with matter, Bragg’s law, Miller indices, Diffraction methods (Laue/Single crystal and Powder/Debye–Scherrer methods), General instrumentation, Factors affecting X–ray intensity calculations, Identification of unit cells from systematic absences, Structure factor and its relation to electron density and intensity, Indexing of lattice planes in cubic system, Structure of NaCl and KCl, Avogadro’s number from cubic lattice dimensions, Applications.

Unit V: Electronic Spectroscopy

10Hrs.

A. Atomic spectroscopy: Energies of atomic orbitals, Vector representation of momenta and vector coupling, Spectra of hydrogen and alkali metal atoms.

B. Molecular spectroscopy: Energy levels, Molecular orbitals, Vibronic coupling, Vibrational progression, Franck–Condon principle, Electronic spectra of polyatomic molecules.

C. Photoelectron spectroscopy: Basic principle, photoelectric effect, ionization process, Koopman theorem, Instrumentation (Sources for ESCA & AES, Vacuum System, Specimen & its manipulation, Analyzers, Detectors), Satellite peaks, Spectral splitting ESCA, Chemical shifts, PES spectra of simple molecule, Applications, Auger effect (KLL effect).

Unit VI: Mossbauer Spectroscopy**08 Hrs.**

Principle of Mossbauer spectroscopy, Instrumentation, Isomer shift and its factors affecting, Quadrupole splitting, Temperature Dependence of MB parameters, Zeeman Splitting (Six fingered MB lines), MB spectra of iron and tin compounds, Applications, Numerical.

Unit VII: Electron Spin Resonance Spectroscopy**12 Hrs.**

Introduction, Principle of ESR Spectroscopy, Instrumentation, Presentation of spectrum, Hyperfine splitting in some simple systems, Hyperfine splitting in various structure (Naphthalene anion radical, Pyrazine anion radical, Isomers of Xylene anion radicals, VO^{2+} , Quinoline radical, Isoquinoline radical, Quinoxaline radical, Anthracene radical, Phenanthracene radical, Pyrene radical, Alkyl halide radicals, Quinone & Isoquinone anion radicals, nitrogen/deuterium containing radicals), Hyperfine splitting diagram, 'g' value, g-marker, Factors affecting the magnitude of 'g' values, Determination of g-value, Zero field splitting, Karmers's degeneracy, Applications, Numericals.

Reference Books

1. Physical Methods in Chemistry, IInd Edition, R. S. Drago.
2. P.H. Rieger, Electron Spin Resonance: Analysis & Interpretation, RSC Publishing, 2007.
3. B. Simovic, Introduction to the Technique of ESR Spectroscopy. 2004.
4. Lund, M. Siotani, S. Shimada, Principles and Applications of ESR Spectroscopy, Springer.
5. P. Gutlich, E. Bill, A.X. Trautwein, Mossbauer Spectroscopy & Transition Metal Chemistry, Springer Publications, 2011.
6. K. Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part A & Part B, John Wiley & Sons Publishers.
7. Mossbauer Spectroscopy: Principles and Applications of the Techniques, A.G. Maddock.
8. An introduction to Electron Paramagnetic Resonance, *M. Bersohn & J.C. Baird*, W.A. Benjamin, Inc N.Y.
9. High resolution ESR Spectroscopy, F.Gerson (John Wiley & sons)
10. The Determination of Molecular Structure, P. J Wheatly
11. Physical Chemistry, G. M. Barrow
12. Instrumental Methods of Chemical Analysis, Chatwal Anand
13. A Text book of Physical Chemistry, A. S. Negi & S.C. Anand
14. Instrumental Methods of Chemical Analysis, Willard, Merritt, Dean & Seale

15. Instrumental Methods of Chemical Analysis, B. K. Sharma
16. Instrumental Methods of Chemical analysis, R.D. Braun
17. Principles of Instrumental Analysis, Skoog and West
18. Fundamental of Molecular Spectroscopy, Banwell
19. Atomic and Molecular structure, Manas Chanda
20. Molecular Spectroscopy, B. D Acharya
21. Molecular Spectroscopy, Dyer
22. Spectroscopy Methods in Organic Chemistry D. H. Williams and I. Fleming

M. Sc. Second Year (*Third Semester*) Analytical Chemistry

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6. K. Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part A & Part B, John Wiley & Sons Publishers.
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17. Principles of Instrumental Analysis, Skoog and West
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19. Atomic and Molecular structure, Manas Chanda
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21. Molecular Spectroscopy, Dyer
22. Spectroscopy Methods in Organic Chemistry D. H. Williams and I. Fleming

M. Sc. Second Year (*Third Semester*) Analytical Chemistry

CHECA 302: ENVIRONMENTAL CHEMISTRY

100 Marks

60 Hours

Unit I: Air Pollution

10 Hrs.

General consideration, Sources and sinks of air pollutants, Classification of air pollutants, Effect of air pollutants on living and non-living things, Sources and control of air pollution, Air quality standards and Sampling. Analysis of air pollutants (CO, CO₂, NO_x, SO_x, H₂S, NH₃, Hydrocarbons and particulates). Green house effect, Acid rain, Ozone depletion and their consequences on environment. Effects of air pollution, Photochemical smog and monitoring of air pollution.

Unit II: Water pollution

15 Hrs.

A. General: Origin of wastewater, Types of water pollutants and their effects, Sources of water pollution: domestic, industrial, agricultural soil and radioactive wastes as sources of pollution. Water quality parameters & standards, Sampling methods & prevention, Objective of analysis, Parameters for analysis: colour, turbidity, total solid, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen. Heavy metal pollution, public health significance of Cadmium, Chromium, Copper, Zinc Lead, Manganese, Mercury and Arsenic.

B. Analysis & Treatment of Waste Water

General survey of instrumental techniques for the analysis of heavy metals in aqueous systems. Oxygen content of water and aquatic life. Measurements of Dissolved oxygen (DO), Biological Oxygen Demand

& Chemical oxygen demand and their significance as pollution indicators., Monitoring techniques & methodology with special reference to Ammonia, Chloride, Fluoride, Nitrate, Nitrite, Cyanide, Lead, Cadmium, Mercury. Sewage composition & treatment.

Unit III: A. Chemical Toxicology

10 Hrs

Toxic chemicals in environment, Impact of toxic chemicals on enzymes, Biochemical effects of Arsenic, Cadmium, Lead, Mercury, Chromium, Carbon monoxide, Sulphur dioxide, Pesticides.

B. Analysis of Pesticides

Introduction and classification of pesticides

- i) Legislation & recent amendments with respect to the pesticides materials
- ii) Application dosage of different pesticides
- iv) Analysis of DDT, BHC, Gammexane, Endosulphan, Zinab, Ziram, Malathion, Thiram, Thiometon, Simazine and Chloridane.

Analysis of Phosphatic fertilizers for ammonium sulphate, Analysis of Superphosphate, Analysis of water soluble phosphate (or available phosphate).

Analysis of Potassium by Perchlorate method, Cobaltnitrite method and Flame Photometric method.

Unit IV: Industrial pollution

A. Noise Pollution

10 Hrs

Introduction, Difference between sound & noise pollution, Sources, Noise level measurements, Sonic boom, Anaerobic chamber & Reverberating of sound, Effects & Control.

B. Effluent Analysis

Pollution due to cement industry, Distillery, pharmaceutical (drug) industries, Sugar industry, Paper and Pulp industries, Thermal power plants, Nuclear power plants, Metallurgical industries, Polymer industries, Recycle, reuse, recovery, disposal, and management of solid industrial waste.

Unit V Soil and Fertilizer Analysis :

15 Hrs

Fundamentals, Soil Sampling, Determination of soil moisture (Gravimetric, Electrical Conductivity, Tensitometer), pH determination of Soil (Colorimetric, Potentiometric methods)

Determination of lime & liming materials in soil, Determination of silica and Phosphorus in soil,

Determination of total manganese in soil, Determination of soluble salts (alkali salts) in soil. Factors

affecting fertility of soil, Analysis of organic content in soil samples include total carbon by Wet method, total nitrogen by Wet & Kjeldahl methods.

Classification of fertilizers (Nitrogenous, Phosphatic and Potassic fertilizers),

Analysis of Nitrogenous fertilizers for ammonium sulphate (titrimetric, Spectrophotometric),

Microdetermination of nitrogen (Duma's method), Determination of ammonical and Nitrate nitrogen.

Reference Books

1. A.K. De, Environmental Chemistry, Wiley Eastern Ltd. New Delhi.
2. R.K. Trivedi, P.K. Goel, Chemical and Biological Methods for Water Pollution Studies Environmental publication.
3. S.C. Santara, Environmental Science, Central Publications.
4. S.L. Chopra, J.S. Kanwar, Analytical & Agriculture Chemistry, Kalyani publications.
5. S.M. Khopkar, Environmental Chemistry.
6. V.Subramanim, Environmental Science, Narosa Publishing House.
7. E. Bhatucha, Environmental Studies, UGC Press.
8. D.E. Newton, Chemistry of the Environment, Infobase Publishing-New York, 2007.
9. S.E. Manahan, Environmental Chemistry, Lewis Publishers.
10. A. Sharma & A. Kaur, Environmental Chemistry, Krishna publishers.
11. S.M. Khopkar, Environmental Pollution Analysis, Wiley Eastern Ltd. New Delhi.
12. Environmental Toxicology, Eds. J. Rose, Gordon and Breach Science Publications.
13. Atmospheric Pollution, W. Buch, McGraw Hill, New York.
14. Fundamentals of Air Pollution, S.J. Williason, Addison-Wesley Publishers.
14. Analytical Aspect of Environmental Chemistry, D.F.S. Natush and P.K. Hopke
15. J.W. Vanloon, Environmental Chemistry, Oxford University Press.
16. B. Pani, Environmental Chemistry
17. B. Ghosh, M.S. Ranganathan, S. Sridhar, Enzyme and Food Biotechnology, Wisdom Press.

18. M. Pansu, J. Gautheyrou, Handbook of Soil Analysis (Mineralogical, Organic and Inorganic Methods), Springer Publications, 2010.

19. B.K. Sharma, Analytical Chemistry.

20. Chopra and Kanwar, Analytical Agriculture Chemistry, Kalyani Publications.

M. Sc. Second Year (*Third Semester*) Analytical Chemistry

CHECA 303 : ORGANIC REACTIONS AND REARRANGEMENTS

100 Marks

60 Hours

Unit I : Organic Reactions

15 Hrs

Reaction, Mechanism and applications of following reactions: Gabriel synthesis, Strecker amino acid synthesis, Ullmann, Mitsunobu, Favorski, Hofmann-Löffler-Freytag, Shapiro, Dakin, Von Richter, Henery, Mukaiyama reaction, Sonogishira reaction.

Unit II: Organic Rearrangements

15 Hrs

Introduction

(A) Migration to Electron deficient Carbon: i) Pinacol-Pinacolone, ii) Wagner-Meerwein, iii) Demjanov, iv) Wolf, v) Benzil-Benzilic acid rearrangement.

(B) Migration to Electron deficient Nitrogen: i) Beckmann, ii) Hoffmann, iii) Curtius, iv) Lossen, v) Schmidt rearrangement.

(C) Migration to Electron deficient Oxygen: i) Favorskii, ii) Neber, iii) Dakin rearrangement.

(D) Electrophilic Rearrangement: i) Stevens, ii) Wittig, iii) Smile rearrangement.

Unit III: Pericyclic Reactions

15 Hrs

Introduction, Classification, Molecular Orbital Conservation Approach

(A) Cycloaddition reaction: Cycloaddition reactions and their stereochemical aspects, Woodward-Haffman rule, Selection rule for cycloaddition reaction, Details with examples of Diels-Alder reaction, (2+2) cycloaddition, (1, 3) polar cycloaddition, Cycloaddition of alkenes with OsO₄ and ozone, Cheletropic reactions, Analyses of cycloaddition by FMO, Mobius-Huckel and Correlation diagram methods.

(B) Electrocyclic Reaction: Electrocyclic reactions and their stereochemical aspects, Selection rule of electrocyclic reaction, Con-rotations and dis-rotations, Methods of analyses of the electrocyclic reactions: FMO, Mobius-Huckel and Correlation diagram approaches.

(C) Sigmatropic rearrangements: Sigmatropic rearrangements and their stereochemistry, Rules for Sigmatropic rearrangements, Examples on (1, 3), (1, 5), (1, 7), (3, 3), (2, 3) Sigmatropic shifts, Claisen, Cope, Oxy-cope, Aza-cope, Sommelet-Hauser rearrangements, Ene reaction, Methods of analyses of the rearrangements: FMO, Mobius-Huckel and Correlation diagram approaches.

Unit IV: Photochemical Reaction

10 Hrs

(A) Photochemistry of Alkenes: Intermolecular reactions of the Olefinic Bond-Geometrical Isomerism, Cyclization reactions, Rearrangement of 1, 4- and 1, 5-dienes.

(B) Photochemistry of Carbonyl compounds: Intermolecular reactions of the Carbonyl compounds-saturated, Cyclic and acyclic, β , γ -gamma unsaturated and α , β -unsaturated compounds, Cyclohexadienones, Intermolecular Cycloaddition reactions, Dimerizations and Oxetane formation.

(C) Photochemistry of Aromatic Compounds: Isomerization, Additions and Substitutions.

Unit V: Protecting Groups

5 Hrs

Introduction, Principle, Protecting groups for alcohols, carbonyl, carboxylic acids, amino groups.

Reference Books:

1. Designing Organic Synthesis: S. Warren, Wiley.
2. Organic Chemistry: J. Clayden, N. Greeves, S. Warren and P. Wothers
3. Protective Groups in Organic Synthesis: T. W. Greene, G. M. Wuts.
4. Organic Synthesis: Jagdama Singh and L. D. S. Yadav
5. Advanced organic Chemistry: Part A & B, Reactions and Synthesis, F. A. Carey and R. J. Sundberg.
6. Organic Synthesis: M. B. Smith.
7. Principle of organic synthesis: Norman and Coxon
8. Advanced organic chemistry: Jerry March
9. Organic Photochemistry: Robert Kan

M. Sc. Second Year (Third Semester) Analytical Chemistry

CHEEA 304: ANALYTICAL METHODS IN CHEMICAL ANALYSIS

100 Marks

60 Hours

Unit I Atomic Absorption & Flame Emission Spectroscopy

15 Hr

Flame Emission Spectroscopy: Elementary theory of flame photometry, Instrumentation and experimental techniques. Interferences & Methods for their Overcoming, Types of FES and Applications.

Atomic absorption spectrometry (AAS): Introduction, Principles, Advantages of AAS over FES, Instrumentation, Flame & Non-flame atomization. Sources of AAS (EDL, TGL, HCL), Interferences and Applications, Comparison of atomic absorption with flame emission spectroscopy, Numericals.

Unit II Thermal Analysis

10Hr

General introduction, Classification of thermal methods of analysis,

Thermogravimetric analysis: Principles, Thermobalance, Factors affecting thermal curve, Derivative thermogravimetric analysis, Applications TGA for quantitative analysis (TG analysis of $\text{CaC}_2\text{O}_4\cdot\text{H}_2\text{O}$, $\text{CuSO}_4\cdot 5\text{H}_2\text{O}$, dolomite ore etc.)

Differential thermal analysis: Principles, Instrumentation, Factors affecting DTA curve, Applications (DT analysis of sulfur, $\text{CuSO}_4\cdot 5\text{H}_2\text{O}$, mixture of polymer, $\text{CaC}_2\text{O}_4\cdot\text{H}_2\text{O}$)

Differential scanning calorimetry: Principles, DSC vs DTA, Instrumentation, Applications (DCS curve of polyethylene terphthalate, DSC curve for isothermal crystallization of polyethylene, DSC of phenacetin), Thermometric titrations, Numericals.

Unit III:

15Hr

(a) Fluorescence and phosphorescence Spectrophotometer

Difference between delayed fluorescence and phosphorescence, Quenching of fluorescence, Formation

of excimer and examples. Structural factors, Phosphorescence intensity as related to concentration, Instrumentation for fluorescence and phosphorescence measurements, Problems.

(b) Coulometry Introduction, Principle, Techniques, Coulometer at constant & controlled current and Potential Coulometer, Primary & Secondary coulometric titrations, Errors in coulometric titrations, and Applications.

(c) Chemical & Bio- Sensors

Introduction, Sensor Design, Detection Methods, Sensing Principle of sensors, Various Chemical sensors include Oxygen gas sensors, pH sensors, Acidic/basic gas sensors using pH sensitive dyes, Cationic sensors, Anionic sensors, Biosensors.

Unit IV: (a) Polarography and Cyclic Voltammetry.

20 Hrs.

Introduction, Theory (include Ilkovic equation, Reversible & Irreversible electrode processes, Reversible polarographic waves), Instrumentation(DME, HDME), Modified Polarography techniques (include Sinusoidal AC Polarography, Square wave polarography, Oscillographic polarography, Rapid scan Polarography), Pulse Polarography, Chronopotentiometry & its practical aspects, Applications in qualitative and quantitative analysis,

Principle of cyclic voltammetry, Instrumentation, cyclic voltamogram of $K_3[Fe(CN)_6]$, criteria of reversibility of electrochemical reaction, quasi reversible and irreversible process.

(b) Ion Selective Electrodes: Terminology, Types and construction of electrodes, Glass electrode, Solid state and Precipitate electrode, Liquid-liquid membrane electrodes, Enzyme & Gas electrodes, Applications.

(c) Electrogravimetry and Electrophoresis

Electrogravimetry: Introduction, type of electrogravimetry, term used in electro-gravimetric analysis, completeness of deposition, electro-analytical separation of metal, application.

Electrophoresis :Introduction, Paper electrophoresis and its advantages with limitations, Techniques in paper electrophoresis, Calculation of electrophoretic mobility, Factors affecting migration of the ions, Continuous electrophoresis, Thin layer electrophoresis, Density gradient electrophoresis, Zone electrophoresis, Curtain electrophoresis, Reverse Osmosis, Electrodialysis, Capillary electrophoresis or Capillary zone electrophoresis & its applications, Applications of paper electrophoresis.

Reference Books

1. D.K. Gosser (Jr.), Cyclic Voltammetry: Simulation and Analysis of Reaction Mechanisms, VCH Publishers, 1994.
2. K. Zutshi, Introduction to Polarography and Allied Techniques, New Age Publications, 2006.
3. Comprehensive Analytical Chemistry, Eds. D. Barcelo, Elsevier Publications, 2006.
4. Modern Instrumental Analysis, Volume 47. Eds. S. Ahuja, N. Jespersen, Elsevier Publications, 2006.
5. Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition, G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, John Wiley & Sons, 1989.
6. A.J. Bard, L.R. Faulkner, Electrochemical Methods: Fundamentals and Applications, John Wiley & Sons.
7. Fundamentals of Photochemistry, Rohatgi – Mukherjee.
8. Photochemistry, J.G. Calvert and J.N. Pitts.
9. Photo-luminescence of solutions, C.A. Parrker
10. Photochemistry, A. Singh and R. Singh
11. F.J. Welcher, Standards Methods of Chemical Analysis
12. Quantitative Analysis, 6th Eds., R.A. Day Jr., A.L. Underwood
13. Fundamental of Analytical Chemistry, 8th Eds., D.A. Skoog, D.M. West, F.J. Holler, S.R. Crough.
14. Analytical Chemistry, 6th Eds. G D. Christian.
15. Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.O. Barnes, M. Thomas, B. Sivasankar.
16. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt Jr., J.A. Dean, F.A. Settle Jr.
17. Basic Concepts in Analytical Chemistry, S.M. Khopkar,
18. Quantitative Analytical Chemistry, 2nd Eds. James S Fritz and George H. Schenk Jr.
19. Handbook of Instrumental Methods for Analytical Chemistry, F. Settle.
20. Treatise on Analytical Chemistry: Vol. I to Vol. II–I .M. Kolthoff.
21. Modern Instrumental Analysis, Volume 47. Edited by S. Ahuja, N. Jespersen, Elsevier
22. Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition, G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, John Wiley & Sons, 1989

OR

M. Sc. Second Year (Third Semester) Analytical Chemistry

CHEEA 304: ADVANCED ANALYTICAL TECHNIQUES- I

100 Marks

60 Hours

Unit-I Molecular Luminescence Spectrometry:

10Hr

Theory of fluorescence and phosphorescence, Instruments for measuring fluorescence and phosphorescence, Applications and photoluminescence methods, Chemiluminescence

Unit-II Surface Characterization by Spectroscopy and Microscopy:

12Hr

Introduction to the study of surfaces, Spectroscopic surface methods, Ion spectroscopic techniques, Surface photons spectroscopic methods, Electron stimulated microanalysis methods, Scanning probe microscopes

Unit-III

12Hr

- a) Properties of Supercritical Fluids, Supercritical Fluid Chromatography, Supercritical Fluid Extraction.
- b) Principle, Instrumentation and Application of the followings-
High performance thin layer chromatography, Ultra performance liquid chromatography, Advanced flash chromatography

Unit-IV

12Hr

- a) Radioactive Nuclides, Instrumentation, Neutron activation methods, Isotope dilution methods
- b) Atomic X-ray spectrometry- Fundamental principles, Instrument components, X-ray fluorescence methods, X-ray absorption methods

Unit-V

12Hr

- a) Introduction, Need for hyphenation, Possible hyphenation, Interfacing devices and applications of the following: LC-MS, GC-IR, GC-MS, ICP-MS, MS-MS.
- b) Principle of automation, Flow – injection Analysis, Microfluidics, Discrete automatic systems

Reference Books

- a) Instrumental Methods of Analysis–Willard, Merritt, Dean & Settle.
- b) Instrumental Analysis- Skoog, Holler, Crouch.
- c) Principles of Instrumental Analysis–Skoog, F.J.Holler&J.A.Nieman
- d) Instrumental Methods of Chemical Analysis–Galen W. Ewing.

- e) Analytical Chemistry – Gary D. Christian, 6th edition
- f) Handbook of Instrumental Techniques for Analytical Chemistry –Frank Settle,Editor
- g) Introduction to Instrumental Analysis-R.D. Braun, McGraw Hill.

M. Sc. Second Year (*Third Semester*) Analytical Chemistry

CHELA 305 : LABORATORY COURSE V

(PART A: ANALYTICAL CHEMISTRY PRACTICAL-I & PART B: ANALYTICAL CHEMISTRY PRACTICAL-II)

100 Marks

120 Hours

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PART A: ANALYTICAL CHEMISTRY PRACTICAL-I

(50 Marks)

PART B: ANALYTICAL CHEMISTRY PRACTICAL-II

(50 Marks)

M. Sc. Second Year (*Third Semester*) Analytical Chemistry

CHELA 306 : LABORATORY COURSE-VI

(PART A: Organic Spectral interpretation & PART B: Analytical Spectral interpretation)

100 Marks

120 Hours

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PART A: Organic Spectral interpretation

(50 Marks)

1. UV-Visible
2. ^1H NMR
3. ^{13}C NMR
4. Mass Spectroscopic

PART B: Analytical Spectral interpretation

(50 Marks)

1. XRD
2. Mossbauer Method
3. ESR
4. Polarographic methods

M. Sc. Second Year (*Fourth Semester*) Analytical Chemistry

CHECA 401: APPLIED ANALYTICAL CHEMISTRY-I

(Ores, Alloys, Explosive and Cosmetic)

100 Marks

60 Hours

Unit I: (a) Analysis of Ores and Alloys

12Hrs.

Constituents and Analysis of the following ores: Iron ore for total iron by volumetric and gravimetric method (Hematite), Manganese ore for total Manganese by gravimetric & volumetric method Pyrolusite), Chromium ore for chromium by volumetric and gravimetric method (Chromite), Aluminium ore for aluminium by volumetric method (Bauxite), Titanium ore for titanium by volumetric and colorimetric method (Ilmenite), Monazite ore for thorium & its oxides, Copper ores (Malachite Green), Dolomite, Galena ores.

Analysis of Alloys Analysis of major & minor components of the following Alloys: Brass, Bronze, Monel-Metal, Types-metal, Solder, Silver-coin, Steel, Stainless steel

Unit II:

12Hrs.

(a) Analysis of Cement and building materials: Types of cement, Sampling, Analysis of- Silicon dioxide, Aluminum oxides, Ferric oxides, Calcium oxide, Magnesium oxide, Sodium and potassium oxide.

(b) Analysis of Glass: Types of glasses, Determination of lead and lead glass.

(c) Explosive : Explosion, Detonation, Classification of explosives, Propellant, Fulminates, Detonators, blasting-cap, Thermochemistry, Hygroscopicity of explosives, Moisture by Karl-Fisher titration, Isolation from debris, Qualitative test, Cation & anion analysis by capillary electrophoresis, EDXRF, Analysis by TLC, HPLC, IR, GC-TEA method.

Unit III:

12Hrs.

(A) Fuels:

Introduction, calorific value. Determination of calorific value. Modern concept of fuels. Classifications of fuels, criterion of selection of fuels, properties of fuels. Method of processing. Solids fuels, Natural solid fuels, Artificial solid fuels, Industrial solids fuels. Formation of coal properties of coal, Classification of coal, coking and non-coking coals. pulverised coal. Role of sulphur and ash in coal, approximate analysis, Ultimate analysis. Numerical.

(B) Petroleum:

Occurrence, mining of petroleum. Prospecting colour and consistency. Origin composition, classification terms related to petroleum. Distillation of crude petroleum. Treatment of the residual liquid, Determination of flash point. Determination of aniline point. Knocking and Anti-knocking compounds. Octane number. Cetan number, Numericals

Unit IV: (a) Analysis of Paints & Pigments

12Hrs.

Introduction, Determination of non-volatile & volatile components, Flash points, Separation, Isolation & Determination of pigments and thinners of solvent types coating, Types of Pigments, Isolation & Determinations of binders (IP method).

(b) Analysis of Soap & Detergents: Soap: Introduction, Types of soap, Manufacturing steps of soap (such as Boiling, Graining/Salting out, finishing), Cleansing action of soap.

Detergents: Introduction, Raw materials for detergents, Types of Detergents, Comparison of cleansing action between soaps and detergents.

Unit V: Cosmetic Analysis:**12 Hr**

- (a) **Cosmetic** : Introduction, Evaluation of cosmetic material and raw material and additive . formulation, standard and methods of analysis
- (b) **Deodorants and antiperspirants** : Al, Zn, Zr, Boric acid, chloride , sulphate, hexachlorophene, ethanamine , phenolsulphonates and urea.
- (c) **Face powder** : Fats, fatty acid, boric acid, Ca. Mg, BaSO₄, Ti, Fe, Oxides of TL, Fe and Al
- (b) **Hair tonic** : Hair tonic: 2,5-diaminotoluene, potassium bromates, sodium perborate, pyrogallol, resorcinol, salicylic acid, dithioglycollic acid (in permanent wavers)
- (c) **Creams and lotions** : types of emulsions, chloroform soluble material, glycerol, pH emulsion, ash analysis, non volatile matter by IR spectroscopy.
- (d) **Lipsticks**: General analysis, determination of nonvolatile matter, ash analysis determination of lakes and fillers, trichloroethylene – acetone soluble contents.

References Books

1. S.K. Jain, Introduction to Metallurgical Analysis: Chemical Analysis and Instrumental.
2. F.J. Welcher, Standards Methods of Chemical Analysis.
3. Harry's Cosmetology, Longman scientific co.
4. Formulation and Function of cosmetics, Sa Jellineck.
5. Cosmetic Technology, Saggarin
6. Modern cosmetics, E. Thomessen Wiley Inter science
7. Hillenbrand Lhundel, Bright and Hoffman, Applied inorganic analysis, John Wiley.
8. Snell and Biffen, Commercial methods of analysis.
9. P. G. Jeffery, Chemical methods of rock analysis, pergamon.
10. Rieche, Outline of industrial organic chemistry, Butter worth.
11. Kent, Rieg's Industrial chemistry, Rain hold
12. P. G. Jeffery and. J. Hatchinsion, Chemical methods of rock analysis.
13. F. J. Welcher Standard methods of chemical analysis, A series of volume Robert and Krigeger Publishing Company.
14. Metallurgical analysis by S. K. Jain and K. K. Jain.
15. www.dghs.gov.in

M. Sc. Second Year (Fourth Semester) Analytical Chemistry

CHECA 402: APPLIED ANALYTICAL CHEMISTRY II

(Food, Oils & Fats)

100 Marks

60 Hours

Unit I: (A) General Concepts of Food Analysis

15 Hrs.

- i) Food contamination & spoilage: Causes, Microbial spoilage of fish, Bacterial spoilage of meat & its products, spoilage of milk & its products
- ii) Food safety considerations. Appearance, Texture, Flavor
- iii) Legislation related to food & recent amendments

(B) Methods of Food Analysis

- i) Food sampling for analysis
- ii) Proximate composition of food: Water, Ash mineral matter, Nitrogen & crude nitrogen, Carbohydrates, Lipids/Fats, Proteins.
- iii) Chemical characteristics & constituents.

Unit II Analysis of Food Additives

15Hrs.

- i) Food Preservatives: Definition, Preservation methods (Temperature control, Moisture control), Organic/Inorganic Chemicals as a preservatives (Benzoic acid, Sorbic Acid, Parabens, Sulfites, Nitrates, Nitrites, Sodium Chloride, Hydrogen Peroxides)
- ii) Food Emulsifiers: Algin, Alginates in foods, Detection of alginates in foods
- iii) Food Adulterants: Definition, Adulteration of juice, soft drinks, milk.
- iv) Food stabilizers: Definition, Extraction of gum from fruits and vegetable products.
- v) Sweeteners: Definition, Different artificial sweeteners (Saccharin, Aspartame, Cyclamate, Dulcin, Acesulfame-K, Sucralose)

Unit III: Oil and Fat Analysis in Food

15 Hrs.

- A) Introduction, General Classification of lipids (natural fats & oils) Components of Fats and Oils, Structure of triglycerides, Smoke point, Flash point, Fire point, Cloud point, Acid Value, Saponification Value, Iodine Value, Peroxide Value, Unsaponifiable matter, Water Content, Phosphorus Content, Colorimetric Value, Hexane in extraction meal, Crude Fibre in meal, Protein in meal, Ash, Solid Fat content, Dilatation (Solid fat Index).
- B) Analysis :, Solvent extraction methods (Continuous, Semicontinuous, Discountious), Nonsolvent Wet extraction methods.

Unit IV: (A) Protein Analysis in Food**15 Hrs.**

Introduction, Analysis by Dumas method, Biuret method, Lowry method, Dye-binding method, Bicinchonic method

(B) Carbohydrate Analysis in Food

Introduction, Analysis of total Carbohydrates by Phenol-Sulfuric acid method, Total Reducing Sugar by Somogyi-Nelson method, Analysis of Total Starch.

(C) Vitamin Analysis in Food

Importance of Analysis, Vitamin Units, Methods for Vitamin Assay (Bioassay, Microbiological assay, Physicochemical assay). Analysis of the following Vitamins: Vitamin A, Vitamin E (Tocopherols and Tocotrienols), Vitamin C by titrimetric and microfluorometric methods, Vitamin B₁ by thiochrome fluorometric method, Vitamin B₂ by fluorometric method.

References Books

1. S. Suzanne Nielsen, Food Analysis, Springer Publications, 2009.
2. Handbook of Food Analytical Chemistry, Eds. By R.E. Wrostad, T.E. Acree, E.A. Decker, M.H. Penner, D.S. Reid, S.J. Schwartz, C.F. Shoemaker, D. Smith, P. Sporns, Wiley-Interscience Publs.
3. L. Amsel, L. Hirsch, Food Science and Security, Nova Science Publishers, 2009.
4. J.M. deMan, Principles of Food Chemistry, ASPEN Publications, 1999.
5. K.V. Ramesh, Food Microbiology, MJP Publishers.
6. S.N. Mahindru, Food Science and Technology, APH Publishing Corporation.
8. M. Bennion, Introductory Foods, Prentice Hall, Inc.
9. M. Bockisch, Fats and Oils Handbooks, AOCS Publications, 1998.
- S. Suzanne Nielsen, Food Analysis, Springer Publications, 2009.

M. Sc. Second Year (*Fourth Semester*) Analytical Chemistry

CHECA 403: APPLIED ANALYTICAL CHEMISTRY III

(Nanomaterials, Polymers and Catalysis)

100 Marks

60 Hours

Unit I: Chemistry of Nanomaterials

25 Hrs.

a) General Introduction, Historical background

b) Synthesis

Chemical Methods include Reduction method for Metal Nanoparticles, Solvothermal method, Photochemical Synthesis, Electrochemical Synthesis, Arrested Precipitation, Sol-gel, Langmuir-Blodgett, Micelles-Microemulsions.

c) Characterization Techniques

Electron Microscopy (TEM & SEM), Probe Microscopy (STM & AFM), Diffraction Techniques (XRD & NRD), UV-Visible-NIR spectroscopy.

d) Properties of Nanoparticles

Mechanical, Optical, Magnetic, Electronic properties

e) Examples of Nanomaterials

Carbon nanostructures include Carbon Nanotubes and graphene, Mesoporous materials include Metal oxides (Titania and ZnO) and Zeolites, Carbon-based Composites, Smart materials.

f) Applications

Electronics, Energy, Automobiles, Sports & toys, Textile, Cosmetics, Domestic appliances, Sensors, Biotechnology & medical field, Space & Defence, Catalysis, Nanotechnology & environment

Unit II: Polymer Chemistry

20 Hrs.

i) Introduction (Monomer, Co-monomer, Mesomer, Homopolymer, Heteropolymer, Co-polymer)

ii) Classification of polymers, Different types of polymerizations (Condensation polymerization, Addition polymerization-Cationic/Ionic/Free radical/Coordination, Chain polymerization, Coordination polymerization, Ring opening polymerization, Group transfer polymerization) & their mechanism, Chain transfer reaction, Ionic copolymerization.

iii) Molecular weight of polymers and their determination by end group analysis, Osmometric, Viscometric, Light Scattering & Sedimentation method.

iv) Synthesis, Properties & Applications of following Polymers:

Polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyacrylonitrile, polyester, polyethylene glycols, polyvinyl alcohol, polytetrafluoroethylene, silicone polymer, urea-formaldehyde resin, polyurethanes, epoxy resins.

Unit III: Catalysis

15 Hrs

Introduction, Catalyst and its types, General features of Catalysts (Catalytic efficiency, Catalytic cycles, Selectivity, Energetic, Life time).

Homogeneous Catalysis:

Various catalytic steps (Ligand co-ordination & dissociation, Insertion & elimination, Nucleophilic attack of co-ordinated ligands, Oxidation & reduction, Oxidative addition & reductive elimination), Illustrative examples include Hydrogenation of alkene, hydroformylation of alkenes, Oxidation of alkenes (Wacker process), Carbonylation of methanol to acetic acid (Monsanto process).

Heterogeneous Catalysis:

Nature of heterogeneous catalysts (Surface area, Porosity, Surface acidic and basic sites, Surface metal sites), Various catalytic steps such as chemisorption and desorption surface migration, Illustrative examples include hydrogenation of alkene, Ammonia synthesis, SO₂ oxidation, Interconversion of aromatic Zeolites, Photocatalysis by TiO₂.

Reference Books

1. G.B. Sergeev, Nanochemistry, Elsevier Publications, 2006.
2. Nanomaterials Chemistry: Recent Developments and New Directions, Edited by C.N.R. Rao, A. Muller and A.K. Cheema, Wiley-VCH, 2007.
3. C.N.R. Rao, P.J. Thomas, G.U. Kulkarni, Nanocrystals: Synthesis, Properties and Applications, Springer-Verlag Berlin Heidelberg, 2007.
4. Nanoparticles: From Theory to Applications, Edited By G. Schmid, Wiley-VCH, 2010.
5. G. Cao, C. J. Brinker Annual Review of Nano Research, Vol.1, World Scientific Publishing.

7. V.R.Gowarikar, N. V. Vishwanathan & J. Sreedhar, Polymer Science, Wiley Eastern.
8. D.D. Deshpande, Physical Chemistry Polymers, Tata McGraw Hill.
9. P.J. Flory, Principles of Physical Chemistry, Cornell University Press.
10. R.B. Seymour, Introduction to Polymer Chemistry by McGraw Hill.
11. E.K. Ridder & H.S.Taylor Catalysis: Theory and Practices.
- 12.Green chemistry and catalyst, R. A. Sheldon, Isabella Arends, Ulf Hanefeld Wiley VCH verlag GmbH & co.
13. Sustainable residential development: planning and design for green neighborhoods. Avi Friedman, McGraw Hill professional
- 14.Text Book of polymer science By F.W.Billmeyer, New York: Wiley
- 15.Physical polymer science by L.H .Sperling wiley –Interscience New York
- 16.Fundamentals of polymer science & Engineering By A Kumar &S.K.Gupta,Tatamcgraw Hill
- 17.Introduction to polymer science ,V.R.Gowarnikar, N.V.Vishwanathan& J.
- 18.Industrial Chemistry, B. K. Sharma, Goel publishing House Meerut.
- 19.Kent, Rieg’s Industrial chemistry, Rain hold.
- 20.Handbook of Instrumental Techniques for analytical chemistry. Frank Settle, editor 1st Indian print 2004.
- 21.Polymer science by Vasant Govarikar, Wiley Earstewen. New York.
- 22.Principle of polymer science, Behadhar and Sastri, Narosa Publishing house.

M. Sc. Second Year (Fourth Semester) Analytical Chemistry

CHEEA 404 : PHARMACEUTICAL, CLINICAL AND FORENSIC ANALYSIS

100 Marks

60 Hours

Unit I: Quality Assurance

12 Hrs.

- i) Basic terminology: Quality, QA, QC, Good laboratory practices (GLP) and Good Manufacturing practices (GMP)
- ii) Pharmacopeia standards: BP, IP, USP, NF, EP.
- iii) Different Drug Regulatory Authorities: FDA, NIBSC, TGA, MCC
- iv) Drug Development and Regulatory Process: Introduction, Identification of New Molecules, Preclinical Research, Formulation & Development, Regulatory issues, Clinical trials, New Drug Applications.
- v) Official method of analysis: Sources of impurities in pharma/food products, Limit test of As, Pb, Fe, Cl, SO₄, Stability studies.
- vi) Concept of online analysis: Raw material, Documentation, Finished product, Record keeping

Unit II: Microbiological Analysis

12

Hrs.

- i) Introduction to micro-organism: Bacteria, Fungus.
- ii) Isolation & identification of important group of Bacteria by plate count method.
- iii) Determination of cell mass by direct & indirect method.
- iv) Microbial growth & Factor affecting it : Temperature, pH, Media & Humidity
- v) Counting techniques:
 - Sterilization: definition, various methods (Chemical/thermal/Radiation)
 - Disinfection: definition & various methods, Evaluation of antimicrobial agent & disinfects
 - Aseptic condition & Sterling test (HEPA filter).
- vi) Microbiological test for Antibiotics standard preparation and unit of activity, test organism and Inoculums, Cylindrical-plate assay receptacles , Turbidimetric assay receptacles, assay designs, Cylinder plate or Cup plate method, plate count method, test for sterility.
 - Pyrogen Test.

Unit III: Clinical Analysis and Blood Gas Analysis

12 Hrs.

(a) Clinical Analysis

- i) Introduction of blood : Composition, collection & Preservation of blood samples
- ii) Analysis of blood sample for the followings :Glucose (Follin-Wu method), Urea (Diacetyl monoxime method & modified Diacetyl monoxime thiosemicarboxime method), Blood urea nitrogen, Serum uric acid, Total Proteins (Albumin ,Globulin, & A.G. Ratio), Biuret method, specific gravity method, Serum Barbiturates, Spectroscopic method, Serum alkaline phosphate
Serum acid phosphate

(b) Blood Gas Analysis

- I. Introduction
- II. Processes of obtaining arterial blood sample
- III. Blood gas symbols
- IV. Blood gas instrumentation
- V. Arterial blood gases
- VI. Determination of Partial pressure of CO₂ (P CO₂), Oxygen saturation (SO₂), Oxygen contents (O₂), Partial Pressure Of Oxygen (PO₂), CO₂ contents Or total CO₂ contents, Blood p^H

Unit IV: Forensic Analysis

12 Hrs.

(a)Vegetable drugs analysis: Sampling , foreign organic matter, ash value , acid soluble ash, acid insoluble ash, sulphated ash, extraction of alkaloids.

(b) Sources of Impurities in pharmaceutical raw material and finishing product:

Raw material , Method of manufacture , atmospheric contaminations, cross contamination, microbial contamination, container contamination, packing error, chemical instability, temperature effect and physical changes , self life pharmaceutical product and its determination.

(c) Forensic analysis:

Special features for forensic analysis, Sampling, Sample storage, Sample dissolution, Classification of poisons, Lethal dose, Significance of LD50 & LC50

Toxicology: Isolation, Identification and determination of followings

Narcotics: Heroin, Morphine

Stimulants: Caffeine, cocaine, Amphetamines

Depressant: Barbiturates, Benzodiazepine pines.

Unit V: Drug Analysis

12Hrs

Classification of drug , classification according to effect methods of screening and investigating the drugs , chemical methods, complexometric method of titration, acid base titration in non aqueous

media, express analysis , physicochemical methods , optical methods , refractometry , polarimetry , fluorimetry, some determinations by fluorimetry , spectrophotometry , electrochemical methods , potentiometry, polarography , chromatographic methods , thin layer chromatography, separation of vitamins by thin layer chromatography. Paper chromatography, separation of amino acid by paper chromatography, ion exchange chromatography, gas chromatography, separation of amino acid by gas chromatography , high performance liquid chromatography (HPLC), biological method , radioimmunoassay (RAI) methods.

Reference Books

1. P. Konieczka, J. Namiesnik, Quality Assurance and Quality Control in the Analytical Chemical Laboratory, CRC Press, 2009.
2. Quality Assurance of Pharmaceuticals, WHO, 2007.
3. B.W. Wenclawiak, M. Koch, E. Hadjicostas, Quality Assurance in Analytical Chemistry, Springer Publications, 2010.
4. J.B. Crippin, Explosive and Chemical Weapons Identification, Taylor & Francis Publications, 2006.
5. M.M. Houck, Forensic Science: Modern Methods of Solving Crime, Library of Congress Publications, 2007.
6. A. Mozayani, C. Noziglia, The Forensic Laboratory Handbook Procedures and Practice, Springer-Humana Press, 2011.
7. S. Suzanne Nielsen, Food Analysis, Springer Publications, 2009.
8. Indian pharmacopeia Volume I and II
9. Practical pharmaceutical chemistry third edition value 1
10. By A. H. Beckett and J.B. Stenlake
11. Remington's Pharmaceutical Sciences.
12. Ansels Pharmaceutical Analysis.

OR

M. Sc. Second Year (*Fourth Semester*) Analytical Chemistry

CHEEA 404 : ADVANCE ANALYTICAL TECHNIQUE II

100 Marks

60 Hours

Unit I: Radiochemical Methods

12 Hrs.

Elementary working, Principles of Geiger Muller, Ionization, proportional and I-ray counters. Radiotracer techniques, Application of radiotracers in analytical Chemistry.

Neutron activation analysis (NAA): Principle, technique and applications in preparation of some commonly used radioactive isotopes. Isotopic Dilution Analysis (IDA), Substoichiometric IDA, Experimental technique and applications of IDA, Advantages and limitations of IDA and comparison of IDA with NAA. Principle of Radiometric titrations, Types, Experimental techniques and its applications. Carbon dating. Numericals.

Unit II: Online Analyzers

12 Hrs.

Introduction, Classification of automated methods, Principles and techniques of auto-analyzers employed for microanalysis with emphasis on the basis sequences in operational modes in segmented and non-segmented flow and applications. Selection of online analyzers.

Flow Injection Analysis: Introduction, Principal, theoretical aspects of FIA, Techniques, Pretreatment of sample in packed reactions, Components of FIA apparatus, Factors affecting FIA and applications for the determination F^- , Cl^- , PO_4^{3-} , NO_2^- , NO_3^- , SO_4^{2-} , BO_3^{3-} , Ca^{2+} , Mg^{2+} , Al^{3+} , Mn^{2+} , Cr^{6+} , Fe^{3+} in water.

Unit III: Atomic Emission spectroscopy

12Hrs.

Introduction, Arc and spark atomization, spectra from higher energy sources, emission spectroscopy based upon plasma sources, atomic fluorescence method based upon plasma atomization. Emission spectroscopy based upon arc and spark sources. X-ray fluorescence and its principle.

Unit IV: Neutron & Electron diffraction

12 Hrs.

Neutron Diffraction: Introduction, NRD vs. XRD, Instrumentation, Magnetic Scattering, Applications.

Electron Diffraction: Scattering intensity Vs scattering angle, Wierl equation, Measurment techniques, Elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surface.

Unit V: Optical Rotatory Dispersion (ORD) and circular Dichroism (CD) 12 Hrs.

Definition, cotton effect, deduction of absolute configuration, octant rule for ketones.

M. Sc. Second Year (*Fourth Semester*)

CHELA 405 : RESEARCH LITERATURE & SEMINAR

100 Marks

120 Hours

M. Sc. Second Year (*Fourth Semester*)

CHELA 406 : RESEARCH PROJECT EXPERIMENTAL

100 Marks

120 Hours

M. Sc. Second Year (*Fourth Semester*)

CHELA 407 : RESEARCH PROJECT DISSERTATION & PRESENTATION

100 Marks

120 Hours

