



Department of Pure and Applied Chemistry

University of Kota, Kota

M.Sc. III Semester Chemistry

Lecture Plans for Academic Session 2018-19

Common Papers for All Specializations

Paper-3.1: CHEM-631: Chromatography

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: General Introduction of Separation:		
1.	Nature of separation process,	1
2.	classification of separation methods	
Chromatography:		
3.	General introduction, principles and types of chromatography,	2-3
4.	physical state of mobile phase,	4
5.	mechanism of separation and techniques involved	5
Paper Chromatography:		
6.	Principle, types, choice of paper and solvent,	6-8
7.	location of spot, development, visualization, measurement of R_f values,	9-11
8.	applications	12
Supercritical Fluid Chromatography (SFC):		
9.	Principle, instrumentation, qualitative and quantitative analysis	13-15
Unit-II: Thin Layer Chromatography (TLC):		
10.	Principle, advantage over paper chromatography,	16
11.	types,	17
12.	preparation of thin layer,	18
13.	choice of sorbent and solvent,	19
14.	development, detection	20
15.	applications	21
High Performance Thin Layer Chromatography (HPTLC):		
16.	Principle, advantage over TLC,	22
17.	instrumentation,	23-25
18.	choice of sorbent and solvent,	26-27
19.	development, detection	28-29
20.	applications	30
Unit-III: Column Chromatography:		
21.	Principle, resolution, stationary phase,	31
22.	column efficiency,	32-33
23.	factors influencing column efficiency,	34-35
24.	experimental set up and applications;	36
25.	principle and application of flash chromatography	37
Gas Chromatography (GC):		
26.	Principle, instrumentation,	38
27.	column efficiency,	39
28.	solid supports, liquid phase,	40
29.	column temperature,	41

30.	detectors,	42-43
31.	chromatographic identification,	44
32.	multi-dimensional GC, fast GC,	
33.	applications	45
Unit-IV: High Performance Liquid Chromatography (HPLC):		
34.	Principle, instrumentation,	46
35.	identification of peaks,	47
36.	effect of temperature and packing material,	
37.	types of HPLC: partition, adsorption, ion-exchange, size-exclusion or gel;	48-49
38.	derivatization in HPLC: post and pre-columns,	50
39.	applications	51
Ion-Exchange or Ion Chromatography (IC):		
40.	Principle, types, regeneration,	52
41.	ion-exchange resins and their capacity,	53-55
42.	retention, selectivity,	56
43.	factors affecting separation,	57
44.	bonded phase chromatography (BPC),	58
45.	high performance ion chromatography (HPIC),	59
46.	applications	60
Unit-V: Electrophoresis:		
47.	Theory and classification,	61
48.	factors affecting mobility,	62
49.	macromolecular size and charge interactions with supporting electrolyte, pH and concentration discontinuities, factors affecting,	63-64
50.	electrophoresis phenomena: electrolysis, electro-osmosis, temperature and supporting media;	65-66
51.	instrumentation, methodology,	67
52.	preparation of gel-staining and de-staining,	68
53.	preparative zone electrophoresis,	69
54.	continuous electrophoresis,	
55.	applications	70
Capillary Electrophoresis (CE):		
56.	Principle, theory,	71
57.	instrumentation,	72
58.	sample preparation and applications,	73
59.	capillary electro-chromatography	74
60.	miscellar electro-kinetic capillary chromatography	75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Chromatography: Basic Principles, Sample Preparations and Related Methods* by Elsa Lundanes, Leon Reubsaet, Tyge Greibrokk, John Wiley and Sons
- *Introduction to Modern Liquid Chromatography* by Lloyd R. Snyder, Joseph J. Kirkland and John W. Dolan, Wiley
- *Practical HPLC Method Development* by Lloyd R. Snyder, Wiley-Interscience
- *Principles & Practices of Chromatography* by R. P. W. Scott, Library for Science
- *Fundamentals of Analytical Chemistry, VIII Edn.*, D. A. Skoog, D. M. West, F.J. Holler and S.R. Crouch, Thomson Brooks/Cole Publishers.
- *Principles of Instrumental Analysis* by D.A. Skoog, F.J. Holler and T.A. Nieman, 5th Edition, Harcourt Brace & Company, Florida.
- *Instrumental Methods of Chemical Analysis*, B. K. Sharma, Goel Publishing House, Meerut.
- *Instrumental Methods of Chemical Analysis*, Chatwal and Anand, Himalaya Publishing House, Meerut.
- *Basic Gas Chromatography 2nd Edition* by Harold M. McNair, James M. Miller, John Wiley and Sons.

- *Comprehensive two dimensional gas chromatography, Volume 55 (Comprehensive Analytical Chemistry) by Lourdes Ramos, Elsevier*
- *Forensic Applications of Gas Chromatography 1st Edition by Michelle Groves Carlin, John Richard Dean, Taylor & Francis*
- *Analytical Gas Chromatography 2nd Edition by Phillip Stremple, Elsevier*
- *Electrophoresis by Duncan J. Shaw. Academic Press*
- *Gel Electrophoresis-Advanced Techniques Edited by Sameh Magdeldin. InTech.*
- *Capillary Electrophoresis Guidebook: Principles, Operation, and Applications by Kevin D. Altria. Springer Science & Business Media.*

Paper-3.2: CHEM-632: Spectroscopy

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Ultraviolet-Visible (UV-VIS) Spectroscopy :		
1.	Electromagnetic radiation and spectroscopy,	1
2.	principles of absorption spectroscopy,	
3.	nature of electronic excitations,	2
4.	chromophores, auxochromes,	
5.	origin of UV bands,	3
6.	absorption and intensity shifts,	
7.	types of absorption bands,	4
8.	factors affecting the position of UV bands,	
9.	calculation of λ_{\max} of simple organic compounds,	5-7
10.	visible spectra,	8
11.	qualitative and quantitative applications	
Infrared (IR) Spectroscopy:		
12.	IR regions,	9
13.	molecular vibrations,	
14.	force constant and bond strengths,	10
15.	calculation of vibrational frequencies,	
16.	Fermi resonance, combination bands, overtones, hot bands,	11
17.	factors affecting the band positions and intensities,	12
18.	sample handling,	13
19.	anharmonicity,	
20.	group frequencies,	14
21.	applications	15
Unit-II: Nuclear Magnetic Resonance (NMR) Spectroscopy:		
22.	Nuclear angular momentum, nuclear spin,	16
23.	magnetization & nuclear precession,	
24.	free induction decay,	17
25.	population densities of nuclear spin states,	
26.	types of NMR spectrometers,	18
27.	basic theory,	
28.	equivalence & non-equivalence protons,	19
29.	shielding and de-shielding of nuclei,	
30.	chemical shift and its measurements,	20
31.	factors influencing chemical shift.	
32.	spin-spin interactions: theory, types, factors influencing coupling constant "J".	21-22
33.	typical ^1H NMR absorption signals of various type of compounds.	23
34.	spin systems & classification of spectra	

35.	splitting patterns of AX, ABX, AMX, ABC, A ₂ B ₂ , etc. spin systems	24-26
36.	simplification of spectra: shift reagents and spin decoupling;	27
37.	proton exchange,	28
38.	nuclear overhauser effect,	
39.	basic idea about NMR studies of nuclei other than proton viz. ¹¹ B, ¹⁵ N, ¹⁹ F & ³¹ P	29
40.	applications of NMR spectroscopy	30
Unit-III: Carbon-13 NMR Spectroscopy:		
41.	Carbon-13 nucleus, operating frequency,	31
42.	carbon-13 chemical shifts and their calculation,	32
43.	spin-spin coupling: proton-coupled, proton-decoupled and off-resonance carbon-13 spectra	33-34
44.	applications of ¹³ C NMR spectroscopy	35
Electron Spin Resonance (ESR) Spectroscopy:		
45.	Basic principles,	36
46.	zero field splitting and Kramer's degeneracy,	37
47.	factors affecting the 'g' value,	38
48.	hyperfine splitting,	39-40
49.	isotropic and anisotropic hyperfine coupling constants,	41
50.	spin-orbit coupling,	42
51.	significance of g-tensor,	43
52.	spin Hamiltonian, spin densities and McConnell relationship,	44
53.	measurement techniques and applications	45
Unit-IV: Mass Spectrometry :		
54.	Basic principles,	46
55.	production of ions by electron impact, chemical ionization and field desorption techniques,	47-48
56.	separation and detection of ions	49-50
57.	mass spectrum: molecular ion peak, base peak, isotopic peak, metastable peak;	51
58.	fragmentation patterns of organic molecules with examples of various classes of compounds,	52-53
59.	McLafferty rearrangement,	54
60.	factors affecting the fragmentation and governing the reaction pathways,	
61.	identification of molecular ion peaks,	55
62.	determination of molecular weight and molecular formula of compounds,	
63.	hydrogen deficiency index, nitrogen rule,	56-57
64.	negative ion mass spectrometry,	
65.	introduction to high resolution mass spectrometry (HRMS) and combined or hyphenated techniques likes GC-MS, LC-MS, IC-MS, CE-MS, ICP-MS;	58-59
66.	applications mass spectrometry	60
Unit-V: Structure Elucidation:		
67.	An integrated problem solving approach based on analytical data including CHNS/O percentage, spectral data (UV, IR, NMR, MS, etc.) and hyphenated technique data (GC-MS, LC-MS, ICP-MS, LC-NMR, etc.) including reaction sequences for structure elucidation of organic compounds	61-75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Encyclopedia of Spectroscopy and Spectrometry, Three-Volume Set: Encyclopedia of Spectroscopy and Spectrometry, Second Edition: 3 volume set*
- *NMR Spectroscopy: Basic Principles, Concepts, and Applications in Chemistry, Harald Günther, Wiley; 2 edition, 1995.*

- *Carbon-13 NMR spectroscopy*, Hans-Otto Kalinowski, Stefan Berger, Siegmund Braun, Wiley, 1988.
- *Introduction to Spectroscopy*, Donald L. Pavia, Cengage Learning, 2009
- *Pulse methods in 1D and 2D liquid-phase NMR* Wallace S. Brey, Academic Press, 1988.
- *Organic Structure Determination Using 2-D NMR Spectroscopy: A Problem-Based Approach*, Jeffrey H. Simpson, Academic Press, 2008.
- *High-Resolution NMR Techniques in Organic Chemistry*, Timothy D. W. Claridge, Elsevier, 1999
- *Identification of Organic Compounds*, R. M. Silverstein, G. C. Hassler and T. C. Morill, John Wiley.
- *Organic Spectroscopy*, Jag Mohan, Narosa Publication.
- *Spectroscopy of Organic Compounds*, P. S. Kalsi, New Age International.
- *NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry*, R. V. Parish, Ellis Harwood.
- *Physical Methods in Chemistry*, R. S. Drago, Saunders College.
- *Introduction to Magnetic Resonance*, A. Carrington and A. D. MacLachlan, Harper & Row.
- *Gas Chromatography and Mass Spectrometry: A Practical Guide, Second Edition* by O. David Sparkman
- *Instrumental Methods of Chemical Analysis*, Gurdeep Raj Chatwal and Shaym Anand, Himalaya Publications

Only for Organic Chemistry Specialization (Paper 3.3 & 3.4)

Paper-3.3: CHEM-633: Organic Synthesis

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Disconnection Approach-I:		
1.	Introduction, synthons and synthetic equivalents,	1
2.	functional group inter-conversions,	2
3.	order of events,	3
4.	one and two group C-X disconnections,	4
5.	chemoselectivity,	5-6
6.	reversal of polarity,	7-8
7.	cyclization reactions,	9-10
8.	amine synthesis.	11
9.	Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups,	12-14
10.	simple practices / exercises	15
Unit-II: Disconnection Approach-II:		
11.	One group C-C-disconnections involving alcohols and carbonyl compounds,	16-17
12.	stereoselectivity,	18-19
13.	regioselectivity,	20-21
14.	alkene synthesis,	22
15.	use of acetylenes.	23
	Two group C-C disconnections in Diels-Alder reactions, 1,3-difunctionalised compounds and α - β -unsaturated carbonyl compounds,	24-26
16.	control in carbonyl condensations,	27
17.	1,5-difunctionalised compounds,	28
18.	Michael addition and Robinson annelation	29-30
Unit-III: Oxidation:		
19.	Introduction, different oxidative processes,	31
20.	hydrocarbons: alkenes, saturated C-H groups (activated and inactivated), aromatic rings;	32-35
21.	alcohols and diols;	36-37
22.	aldehydes and ketones, ketals,	38-40
23.	carboxylic acids,	41-42
24.	amines, hydrazines and sulfides;	43

25.	oxidations with ruthenium tetroxide, iodobenzene diacetate and thallium (III) nitrate	44-45
Unit-IV: Reduction:		
26.	Introduction, different reductive processes,	46
27.	hydrocarbons: alkenes, alkynes and aromatic rings;	47-50
28.	carbonyl compounds: aldehydes, ketones;	51-54
29.	acids and their derivatives;	55-56
30.	epoxides;	57
31.	nitro, nitroso, azo and oxime groups;	58-59
32.	hydrogenolysis	60
Unit-V: Molecular Rearrangements:		
33.	General mechanistic considerations,	61
34.	nature of migration,	
35.	migratory aptitude,	62
36.	memory effects,	
37.	Pinacol-pinacolone rearrangement,	63
38.	Wagner-Meerwein rearrangement,	64
39.	Tiffeneu-Demjanov rearrangement,	65
40.	Dienone-Phenol rearrangement,	66
41.	Wolff rearrangement;	67
42.	Beckmann rearrangement,	68
43.	Hoffman rearrangement,	69
44.	Curtius rearrangement,	
45.	Lossen rearrangement,	70
46.	Schmidt rearrangement,	
47.	Baeyer-Villiger rearrangement,	71
48.	Benzil-Benzilic acid rearrangement,	72
49.	Favorskii rearrangement,	73
50.	Neber rearrangement,	
51.	Wittig rearrangement,	74
52.	Fries rearrangement,	
53.	Benzidine rearrangement	75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Organic Synthesis: The Disconnection Approach*, Stuart Warren, John Wiley & Sons.
- *Organic Synthesis through Disconnection Approach*, P. S. Kalsi
- *Organic Synthesis*, Smith M. B. McGraw Hill
- *Modern Organic Synthesis*, G. S. Zweifel and M. H. Nantz, Freeman and Company, New York.
- *Modern Synthetic Reactions*. H.O. House, W.A. Benjamin.
- *Some Modern Methods of Organic Synthesis*, W. Carruthers, Cambridge Univ. Press.
- *Structure and Mechanism in Organic Chemistry*, C.K. Ingold, Cornell University Press.
- *Organic Chemistry*, Clayden, Nick Greeves and Stuart Warren, Oxford University Press
- *Principles of Organic Synthesis*, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professiona.
- *Advanced Organic Chemistry, Reactions Mechanisms and Structure*, J. March. John Wiley.
- *Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg* Plenum Press.
- *Rodd's Chemistry of Carbon Compounds*. Ed. S. Coffey, Elsevier

Paper-3.4: CHEM-634: Heterocyclic Chemistry

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Nomenclature of Heterocycles:		
1.	Trivial, systematic (Hantzsch-Widman system), fusion, replacement systems of nomenclature for monocyclic, fused, spiro and bridged heterocycles	1-3
Aromatic Heterocycles:		
2.	General chemical behavior,	4
3.	classification (structural type),	
4.	aromaticity in heterocycles: relationship with carbocyclic aromatic compounds,	5
5.	criteria of aromaticity (structural, electronic, energetic and magnetic criteria);	6-7
6.	heteroaromatic ring systems,	8
7.	heteroaromatic reactivity and tautomerism in aromatic heterocycles	
Non-aromatic Heterocycles:		
8.	Strain, bond angle strain and torsional strain and their consequences of in small ring heterocycles,	9-10
9.	conformation of flexible heterocycles: five-membered & six-membered heterocycles	11-12
10.	stereo-electronic effects in saturated six-membered heterocycles: anomeric and related effects;	13-14
11.	attractive interactions through space (hydrogen bonding and nucleophilic-electrophilic interactions)	15
Unit-II: Three- and Four-membered Heterocycles :		
12.	Three-membered heterocycles with one heteroatom: Syntheses and reactions of aziridines, azirines, oxiranes, thiiranes.	16-20
13.	Three-membered heterocycles with two heteroatom: Syntheses and reactions of diaziridines, diazirines, oxaziridines.	21-24
14.	Four-membered heterocycles with one heteroatom: Syntheses and reactions of azetidines, azetidinones, oxetanes, oxetanones, thietanes	25-30
Unit-III: Five-membered Heterocycles:		
15.	Five-membered heterocycles with one heteroatom: structure, stability, basicity, aromaticity, reactivity, synthesis and reactions of pyrrole, furan, thiophene.	31-33
16.	Benzo-fused five-membered heterocycles with one heteroatom: synthesis, reactions and some medicinal importance of benzopyrroles.	34-37
17.	Five-membered heterocycles with two heteroatoms: structure, reactivity, synthesis, reactions and some medicinal importance of 1,2-diazoles (pyrazoles and isoxazoles) and 1,3-diazoles (imidazoles and oxazoles).	37-40
18.	Benzo-fused five-membered heterocycles with two heteroatoms: synthesis, reactions and some medicinal importance of benzimidazoles.	42-43
19.	Five-membered heterocycles with more than two heteroatoms: synthesis, reactions and some medicinal importance of tetrazoles.	44-45
Unit-IV: Six-membered Heterocycles-I:		
20.	Six-membered heterocycles with one and two nitrogen heteroatom: synthesis, reactions and some medicinal importance of azines (pyridines), diazines (pyradizine, pyrimidine and pyrazine) and triazines (s-triazines).	46-52
21.	Benzo-fused six-membered heterocycles with one and two nitrogen heteroatom: synthesis, reactions and some medicinal importance of quinoline, isoquinoline, quinazoline and quinoxaline.	53-60
Unit-V: Six-membered Heterocycles-II:		
22.	Six-membered heterocycles with one oxygen heteroatom: synthesis and	61-63

	reactions of pyrylium salts and pyrones.	
23.	Benzo-fused six-membered heterocycles with one oxygen heteroatom: synthesis, reactions and some medicinal importance of coumarins and chromones.	64-67
	Seven-membered Heterocycles	
24.	Synthesis and some medicinal importance of benzodiazepines, benzoxazepines and benzothiazepines.	68-73
	Large-membered Heterocycles:	
25.	Synthesis and some medicinal importance of azocines and oxocines	74-75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag.*
- *The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.*
- *Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Blackhall.*
- *Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.*
- *Contemporary Heterocyclic Chemistry, G.,R. Newkome and W.W. Paudler, Wiley-Inter Science.*
- *An Introduction to the Heterocyclic Compounds, R.M. Acheson, John Wiley.*
- *Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press*

Only for Analytical Chemistry Specialization (Paper 3.3 & 3.4)

Paper-3.3: CHEM-633: Advanced Analytical Techniques

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Extraction Methods:		
1.	Basic principles, classification of extraction systems,	1
2.	factors affecting extraction process,	2-3
3.	mechanism of extraction,	4
4.	extraction of liquids,	
5.	extraction by chelation, extraction by solvation, extraction by ion-pair formation, extraction by sonication	5-7
6.	extraction equilibria for chelates, extraction equilibria for solvation,	8-9
7.	separation of metals by extraction,	10
8.	solid-phase extraction (SPE),	11
9.	supercritical fluid extraction (SFE),	12
10.	supramolecular extraction,	13
11.	centrifugation and ultra-centrifugation,	14
12.	membrane separation,	15
Unit-II: Isolation and Purification Techniques:		
13.	Filtration (simple, micro, etc.),	16-17
14.	recrystallization (in aqueous & non-aqueous solutions, at low temperature, in inert atmosphere, semi-micro & micro),	18-20
15.	use of decolourising carbon,	21-22
16.	difficulties in recrystallization,	
17.	drying of liquids,	23
18.	freezing, sublimation,	
19.	distillation (simple, steam, fractional, vacuum, high vacuum or molecular, etc.),	24-25
20.	nucleation and crystal growth,	26
21.	crystal hydrates and solvates,	27
22.	chemical methods for separation,	28

23.	determination of physical constants (mp, mixed mp, bp, m. wt., density, optical rotator power, RI, etc.)	29-30
Unit-III: High Frequency Titrations:		
24.	Principle, Instrumentation-Cells, oscillator circuit and high frequency titrimeters,	31-34
25.	theory,	35
26.	correlation of high frequency titration curves with low frequency titration curves.	36-38
27.	Applications-acid base, complexometric, measurement of dielectric constant and analysis of mixture of organic compounds	39-43
28.	Advantages and disadvantages of high frequency methods	44-45
Unit-IV: Polarography:		
29.	Principles, classification of polarographic techniques,	46-47
30.	types of polarographic currents,	48
31.	instrumentation,	49-50
32.	factors affecting polarographic wave, pulse polarography, and differential pulse polarograph.	51-52
Potentiometry:		
33.	Metal electrodes for measuring the metal's cation, metal-metal salt electrodes, redox electrodes, calomel electrode,	53-54
34.	measurement of potential,	55
35.	determination of concentrations, residual liquid-junction potential,	56-57
36.	accuracy on direct potentiometric,	58
37.	glass pH electrode,	59
38.	ion-selective electrodes	60
Unit-V: Voltammetry:		
39.	Voltammetric principles,	61
40.	hydrodynamic voltammetry, stripping voltammetry, cyclic voltammetry,	62-65
41.	criteria of reversibility of electrochemical reactions,	66-67
42.	quasi-reversible and irreversible processes,	68-69
43.	qualitative and quantitative analysis	70
Amperometry		
44.	Principles and amperometric titration techniques: Dropping mercury electrode, rotating platinum microelectrode and dead stop	71-75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Introduction to Instrumental Analysis, R. D. Braun, McGraw-Hill Book Company, New Delhi*
- *Vogel's Textbook of Quantitative Chemical Analysis, 6th Edn. Pearson Education Asia*
- *Analytical Chemistry, An Introduction, D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch, 7th. Edn., Saunders College publishing, N. Y.*
- *Principles of Instrumental Analysis, D. A. Skoog and J. J. Leary, 4th Edn., N. Y.*
- *The Principles of Electrochemistry, A. Duncan, Mac Innes Dover Publication Inc. N. Y.F. Scholz, Electroanalytical methods, Springer, 2002.*
- *P. Monk, Fundamentals of electroanalytical chemistry, Wiley, 2001.*
- *A.P.F. Turner I. Karube, I. G. Wilson, Biosensors- Fundamentals and applications. Oxford University Press, New York, 1987.*
- *Organic electro chemistry by Henning Lund & Ole Hammerich, , 4th edition, Publisher: Marcel Dekker, Inc, New York.*

Paper-3.4: CHEM-634: Analysis of Commercial Products

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Analysis of Petrochemicals:		
1.	Constituents, petroleum fractionation,	1
	analysis of petroleum products:	2
2.	specific gravity, viscosity, doctor test, sulphuric acid absorption,	3-4
3.	aniline point, cloud point, pour point;	5-6
4.	determination of water,	7
5.	neutralization value (acid and base numbers),	8
6.	ash content, sulphur and mercapton sulphur,	9-10
7.	determination of lead in petroleum	11
8.	vapour pressure and colour determination,	12
9.	Analysis of Fuels: Proximate and ultimate analysis of fuel,	13
10.	calorific value by Bomb calorimetry,	14
11.	analysis of fuel gases (coal gas, producer gas, water gas)	15
Unit-II: Analysis of Agrochemicals:		
	Analysis of Fertilizers:	
12.	Analysis of nitrogen: urea nitrogen, total Kjeldahl nitrogen method, ammonia nitrogen;	16-18
13.	analysis of phosphorous: total phosphorous, available and non-available, alkalimetric ammonium molybdophosphate method;	19-21
14.	analysis of potassium: potassium by sodium tetraphenyl borate method.	22
15.	Analysis of herbicides: atrazine, alachlor; Analysis of Fungicides: nimbin, carbendazim;	23-24
16.	Analysis of bactericides: chloramine, triclosan, chlorhexidine;	25
17.	Analysis of insecticides: DDT, BHC, aldrin, endosulfan, malathion, monochrotophos;	26-28
18.	Analysis of nematicides: aldicarb; Analysis of rodenticides: warfarin, bromadiolone	29-30
Unit-III: Analysis of Polymers:		
19.	Chemical Methods of Analysis: Introduction, preparation of the sample, determination of purity, physical tests, preliminary examination, burning characteristics, transition points,	31-35
20.	molecular weight, density, refractive index,	36-37
21.	pyrolytic behaviour,	38-40
22.	qualitative and quantitative elementary analysis,	
23.	solubility and acid numbers, acetyl number, iodine number	41
24.	end group analysis, colour tests	42
25.	Analysis of Plastics	
26.	Basics of plastic analysis, fundamental conditions for plastic analysis,	43
27.	water test, copper wire test, acetone test, heat test, isopropyl alcohol test, oil test	44-45
Unit-IV: Analysis of Glass and Ceramics:		
28.	Introduction, composition, method of analysis-sampling and sampling preparation,	46-47
29.	composition analysis-preliminary testing, decomposition, chemical method for the individual constituents-Si, B, Pb, Zn, Al, Cl, Ca, Mg, Ti	48-49
30.	Analysis of Cement:	
31.	Loss on ignition, insoluble residue,	46-50

32.	total silica, sesquioxides, lime,	51-53
33.	magnesia, ferric oxide, sulphuric anhydride, air and dust pollution from cement plants, atmospheric dispersion of pollutants in cement industry	54-60
Unit-V: Analysis of Minerals and Ores:		
34.	Hematite,	61-62
35.	pyrolusite,	63-64
36.	gypsum,	65
37.	dolomite,	66
38.	bauxite,	67
39.	Chromate	68
40.	limestone and	69
41.	uranium ores	70
Analysis of Metal and Alloys:		
42.	Steel, Cu-Ni alloy,	71
43.	solder, bronze, brass,	72
44.	aluminium alloy, ferroalloys of silicon, chromium, titanium and vanadium	73-75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Introduction to Instrumental Analysis, R. D. Braun, McGraw-Hill Book Company, New Delhi*
- *Vogel's Textbook of Quantitative Chemical Analysis, 6th Edn. Pearson Education Asia*
- *Analytical Chemistry, An Introduction, D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch, 7th. Edn., Saunders College publishing, N. Y.*
- *Principles of Instrumental Analysis, D. A. Skoog and J. J. Leary, 4th Edn., N. Y.*
- *The Principles of Electrochemistry, A. Duncan, Mac Innes Dover Publication Inc. N. Y.F. Scholz, Electroanalytical methods, Springer, 2002.*
- *P. Monk, Fundamentals of electroanalytical chemistry, Wiley, 2001.*
- *A.P.F. Turner I. Karube, I. G. Wilson, Biosensors- Fundamentals and applications. Oxford University Press, New York, 1987.*
- *Organic electro chemistry by Henning Lund & Ole Hammerich, , 4th edition, Publisher: Marcel Dekker, Inc, New York.*



Department of Pure and Applied Chemistry

University of Kota, Kota

M.Sc. IV Semester Chemistry

Lecture Plans for Academic Session 2018-19

Common Papers for All Specializations

Paper-4.1: CHEM-641: Environmental Chemistry

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Air Pollution:		
1.	Concept of environment chemistry,	1
2.	composition of atmosphere,	
3.	major sources of air pollution, chemical reactions, smog formation, acid rain,	2-3
4.	classification and effect of air pollutants, NO _x , SO _x , CO _x particulates and ozone;	4-5
5.	Greenhouse effect and global warming,	6
6.	ozone depletion,	7
7.	automobile emissions,	8
8.	prevention and control of vehicular pollution,	
9.	alternative fuels: Biodiesel, ethanol, CNG, ultra low sulphur diesel (ULSD)	9
Monitoring of Air Pollution:		
10.	Principles of environment monitoring,	10
11.	methods for monitoring of air pollutants including NO _x , SO _x , CO _x , SPM	11
Prevention and Control of Air Pollution:		
12.	Control of pollution by fuel selection and utilization,	12
13.	process or equipment modification,	13
14.	devices, site selection, stacks, planting trees and growing vegetation,	14
15.	general methods of air pollution control	15
Unit-II: Water Pollution:		
16.	Types of water pollution,	16
17.	sources of water pollution,	17
18.	water pollutants, their classification and effects,	18-19
19.	water pollution laws and standards	20
Analysis of Water		
20.	Chemical and physical examination of water,	21
21.	preservation and pre-concentration,	22
22.	hydrogen ion concentration, acidity, alkalinity, hardness, pH, free CO ₂ , Cl ₂ , metals, ions, dissolved chlorine and oxygen, BOD, COD, chlorine dosage, <i>E. coli</i> index,	23-29
23.	general methods of water pollution control	30
Unit-III: Soil Pollution :		
24.	Composition and types of soil,	31
25.	mineral and organic matter in soil,	

26.	soil pollution by industrial wastes, urban wastes, radioactive pollution and agriculture practices	32-34
	Soil Analysis:	
27.	Analysis of nitrates, nitrites, ammonical nitrogen, total nitrogen, phosphates, organic carbon, potassium, calcium, sodium, magnesium, iron, zinc, etc.	35-40
	Control of Soil Pollution:	
28.	Control of domestic and industrial wastes,	41-43
29.	soil remediation,	44
30.	environmental friendly technologies for agriculture	45
Unit-IV: Industrial Pollution:		
31.	Environmental pollution from various industries and control of industrial pollution	46-47
	Industrial Wastes and their Treatment:	
32.	Characteristics and types of industrial wastes,	48
33.	principles of industrial waste treatment,	49-50
34.	protection of biosphere and surface water from pollution with industrial sewages,	51-53
35.	sampling and chemical analysis of industrial waste water,	54-56
36.	waste water treatment,	57
37.	solid waste management,	58
38.	hazardous waste management	59-60
Unit-V: Radioactive Pollution:		
39.	Radioactive substances,	61
40.	state of radioactive isotopes in solution, gases and solids;	62-64
41.	units of radiation,	65
42.	analysis of radionuclides,	66
43.	sources of radioactive pollution,	67
44.	radioactive fallout,	68
45.	nuclear reactors,	69
46.	nuclear installations,	70
47.	radioactive ore processing,	71
48.	nuclear accidents,	72
49.	effects of radioactive pollution on power plants and polymers,	73-74
50.	control of radioactive pollution	75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Environmental Chemistry*. B. K. Sharma. 12th Edition, 2011, Goel Publishing House, Meerut.
- *Environmental Chemistry*, Colin Baird, W.H. Freeman Co. New York, 1998.
- *Environmental Pollution: Principles, Analysis and Control*. P. Narayanan. 1st Edition, 2007, CBS Publishers.
- *Environmental Pollution Control Engineering*. C. S. Rao. 2nd Edition, 2006, New Age International Publishers.
- *Environmental Pollution analysis*, S.M. Khopkar, Wiley Eastern, New Delhi, 1994.
- *Pollution Control in Process Industries*. S. P. Mahajan. 20th Ed, 2006, TataMcGraw-Hill, New Delhi.
- *Industrial Pollution*. V. P. Kudesia. 5th Edition, 2007, Pragati Prakashan, Meerut.
- *Water Supply and Sanitary Engineering*. G. S. Birdie & J. S. Birdie. 8th Edition, 2008, Dhanpat Rai Publication.
- *Environmental Toxicology*, J. Rose Gordon and Breach (Ed.), Science Publication, New York, 1993.
- *Introduction to Atmospheric Chemistry*, P.V. Hobbs, Cambridge.

Paper-4.2: CHEM-642: Recent Methods of Organic Synthesis

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Modern Approaches of Organic Synthesis:		
1.	Principles and concepts of green chemistry,	1
2.	atom economy,	2
3.	waste minimization techniques,	3
4.	different approaches to green synthesis	4
	Reagents:	
5.	Dimethyl carbonate;	5
6.	polymer supported reagents: chromic acid and per-acids	6
	Catalysts:	
7.	Introduction to catalysts,	7
8.	homogeneous and heterogeneous catalysts,	8
9.	solid acid-base catalysts,	9
10.	basic catalysts,	10
11.	metal oxide supported catalysts,	11
12.	oxidation catalysts,	12
13.	polymer supported catalysts,	13
14.	phase transfer catalysts,	14
15.	bio-catalysts	15
Unit-II: Solvents for Organic Synthesis:		
16.	Introduction, characteristics properties, types and examples of green solvents	16-17
	Water:	
17.	Reasons for using water as green solvent,	18
18.	biphasic systems,	
19.	synthesis in water (asymmetric aldol reaction, synthesis of quinoxalines, carbon dioxide fixation, preparation of nanoparticles),	19-21
20.	near critical water	22
	Supercritical Liquids:	
21.	The phase diagram of CO ₂ ,	23
22.	supercritical CO ₂ ,	
23.	properties and applications of CO ₂ in dry cleaning, decaffeination of coffee and synthesis	24
	Ionic Liquids:	
24.	Basic concept, types, physicochemical properties,	25
25.	preparation of ionic liquids: dialkylimidazolium and alkylpyridinium cation based ionic liquids, ionic liquids with fluorine containing anions and chiral ionic liquids;	26-27
26.	synthetic applications of ionic liquids (alkylation, allylation, oxidation and hydrogenation),	28-29
27.	concept of supported ionic liquids and their applications	30
Unit-III: Microwave Assisted Organic Synthesis:		
28.	Introduction of microwave assisted organic syntheses,	31
29.	fundamentals of microwave technology,	32-33
30.	microwave activation,	34-35
31.	equipment,	36
32.	time and energy benefits,	37-38
33.	limitations;	

34.	applications,	
35.	reactions in organic solvents: Esterification, Diels-Alder reaction, decarboxylation; solvent free reactions (solid state reactions): Deacetylation, deprotection, saponification, alkylation of reactive methylene compounds	39-45
Unit-IV: Ultrasound Assisted Organic Synthesis:		
36.	Basics of sono-chemistry,	46
37.	ultrasound cavitation,	47-48
38.	sonochemical effect,	49-50
39.	experimental parameters,	51-52
40.	transducers,	53
41.	reactors,	54-55
42.	homogeneous and heterogeneous sono-chemistry,	56-57
43.	oxidation, reduction, substitution reactions, Kornblum-Russell reaction, Hetero Michael reaction, preparation of Grignard's reagent	58-60
Unit-V: Organic Synthesis Using Reactors:		
44.	General introduction and types of reactors,	61
45.	chemical reactor design,	62
46.	simulation and optimization;	63
47.	mass and energy balance,	64-65
48.	mass and energy transfer.	66-67
49.	Batch reactors: Basic concepts, types and reactions;	68
50.	concepts of laboratory and pilot scale organic syntheses.	69
51.	Vapour phase reactors: Types and design. Raw materials, process flow diagrams,	70-72
52.	product syntheses, separations, purifications and waste compositions at industrial scale productions of pharmaceuticals, agrochemicals, organic fertilizers and dyes	73-75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Green Chemistry: Theory and Practice*, Paul T. Anastas and John C. Warner
- *Green Chemistry: An Introductory Text* by Mike Lancaster, Royal Society of Chemistry
- *Green Chemistry and Catalysis* by Sheldon, Arends and Hanefeld, WILEY-VCH, Germany
- *Green Solvents, Vol. 5: Reactions in Water*. edited by Paul T. Anastas, WILEY-VCH
- *Green Solvents, Vol. 6: Ionic Liquids*. edited by Paul T. Anastas, WILEY-VCH
- *Ionic Liquids in Synthesis* by Wasserscheid and Welton. WILEY-VCH
- *Microwaves in Organic Synthesis*, Antonio de la Hoz (Ed), André Loupy (Ed), Wiley-VCH
- *Organic Synthesis in Water*, Paul A Grieco Blackie.
- *Organic Synthesis: Special Techniques*, V. K. Ahluwalia and Renu Aggrawal
- *Chemical Reviews 2007, 107, 2167-2820 (Special issue on Green Chemistry)*
- *Fundamentals and Applications of Organic Electrochemistry: Synthesis, Materials, Devices* by Toshio Fuchigami, Mahito Atohe, Shinsuke Inagi.

Only for Organic Chemistry Specialization (Paper 4.3 & 4.4)

Paper-4.3: CHEM-643: Chemistry of Natural Products

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Terpenoids and Carotenoids:		
1.	Classification, nomenclature, occurrence, isolation,	1
2.	general methods of structure determination,	2
3.	isoprene rule,	
	stereochemistry and synthesis of the following representative molecules:	

4.	citral,	3-4
5.	geraniol,	5
6.	α -terpineol,	6-7
7.	menthol,	8
8.	farnesol,	9
9.	zingiberene,	10-11
10.	abietic acid,	12-13
11.	β -carotene	14-15
Unit-II: Alkaloids:		
12.	Definition, nomenclature and physiological action, occurrence, isolation,	16
13.	identification (qualitative idea only),	17
14.	general methods of structure elucidation,	18-19
15.	degradation,	20
16.	classification based on nitrogen heterocyclic ring,	21
17.	role of alkaloids in plants;	22
	structure, stereochemistry and synthesis of the following:	
18.	ephedrine,	23-24
19.	coniine,	25
20.	nicotine,	26
21.	atropine,	27
22.	quinine,	28
23.	morphine	29-30
Unit-III: Steroids and Hormones :		
24.	Occurrence, nomenclature, basic skeleton,	31
25.	Diel's hydrocarbon and stereochemistry,	32
26.	isolation, identification (qualitative idea only),	33
	structure determination and synthesis of following:	
27.	cholesterol,	34-35
28.	bile acids,	36
29.	androsterone,	37-38
30.	testosterone,	39-40
31.	oestrone,	41-42
32.	progesterone,	43-44
33.	aldosterone	45
Unit-IV: Prophyryns and Plant Pigments:		
34.	Structure and synthesis of haemoglobin and chlorophyll	46-48
	Plant Pigments:	
	Occurrence, nomenclature, isolation, general methods of structure determination, and synthesis of following	49-50
35.	apigenin,	51
36.	luteolin,	52
37.	quercetin,	53
38.	myrcetin,	54
39.	diadzein,	55
40.	cyanidin,	56
41.	cyanidin-7-arabinoside,	57
42.	Hirsutidin.	58
	Biosynthesis of Flavanoids:	
43.	Acetate pathway and shikimic acid pathway.	59-60

Unit-V: Prostaglandins, Pyrethroids and Rotenones:		
44.	Occurrence, nomenclature, classification, biogenesis and physiological effects,	61-62
45.	synthesis of PGE ₂ and PGF _{2α}	63-68
	Pyrethroids and Rotenones:	
46.	Synthesis and reactions of pyrethroids and rotenones (for structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible)	69-75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Natural Products : Chemistry and Biological Significance*, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
- *Organic Chemistry: Vol. 2, I.L. Finar, ELBS.*
- *Stereoselective Synthesis: A Practical Approach*, M. Norgradi, VCH.
- *Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas*, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. Harwood Academic Publishers.
- *Introduction to Flavonoids*, B.A. Bohm. Harwood Academic Publishers.
- *New Trends in Natural Product Chemistry*, Ata-ur-Rahman & M.L. Choudhary, Harwood Academic Publishers

Paper-4.4: CHEM-644: Medicinal Chemistry

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Drug Design:		
1.	Procedures followed in drug design & development,	1
2.	concepts of lead compound and lead modification, pro drugs and soft drugs, isosterism, non-isosterism,	2
3.	factors affecting bioactivity,	3
4.	theories of drug activity: occupancy theory, rate theory, induced fit theory;	4
5.	computer-aided drug design,	5
6.	quantitative structure activity relationship,	6
7.	concepts of drug receptors, elementary treatment of drug receptor interactions;	7
8.	physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric,	8
9.	Shelton and surface activity parameters and redox potentials;	
10.	Free-Wilson analysis,	9
11.	Hansch analysis,	
12.	relationships between Free-Wilson and Hansch analysis,	
13.	LD-50 and ED-50 (Mathematical derivations of equations excluded)	10
	Pharmacokinetics & Pharmacodynamics:	
	Pharmacokinetics:	
14.	Introduction to drug absorption, disposition, elimination using pharmacokinetics;	11-12
	Pharmacodynamics:	
15.	Enzyme stimulation, enzyme inhibition,	13
16.	membrane active drugs,	
17.	drug metabolism, factors affecting drug metabolism,	14
18.	biotransformation,	15
19.	significance of drug metabolism in medicinal chemistry	
Unit-II: Anti-cancer Drugs:		
20.	Introduction, cellular apoptosis,	16-17
21.	oncogenes, tumor suppressor genes,	18
22.	disease states, cancer chemotherapy.	19

23.	Mechanism of action and structure activity relationship. Synthetic procedures of	20-21
24.	mechlorethamine, cyclophosphamide,	22
25.	capacetabine, 6-mercaptopurine, trimetrexate,	23
26.	dactinomycin, daunomycin,	24
27.	etoposide, irinotecan,	25
28.	paclitaxel , imatinib	26
	Anti-viral Drugs:	
29.	Classification of viruses,	27
30.	infectious process, mechanism of action,	
31.	structure activity relationship Synthetic procedures of	28
32.	idoxuridine, zidovudine,	29
33.	nevirapine, efavirenz, squinavir	30
	Unit-III: Cardiovascular Drugs :	
34.	Cardiovascular diseases,	31
35.	drug inhibitors of peripheral sympathetic function,	32
36.	central intervention of cardiovascular output,	33
37.	intermediatory myocardial metabolism,	34
38.	cardiac electrophysiology	35
39.	Mechanism of action and structure activity relationship Synthetic procedures of	36
40.	nitroglycerin, aspirin,	37
41.	verapamil, diltiazem,	
42.	procainamide, lidocaine, sotalol	38
	Anti-hypertensive Drugs	
43.	Mechanism of action, classes of anti-hypertensive drugs, Synthetic procedures of	39
44.	digitalis, methyldopa,	40
45.	tolazoline, phenoxybenzamine,	41
46.	doxazosin, propranolol, acebutamol, labetalol,	42-43
47.	captopril,	44
48.	losartan	45
	Unit-IV: Drugs Affecting Central Nervous System :	
	Anxiolytics, Sedatives and Hypnotics:	
49.	GABA receptor modulators,	46
50.	mechanism of action and structure activity relationship of benzodiazepines and barbiturates Synthetic procedures of	47-48
51.	diazepam, alprazolam, zolpidem,	49-50
52.	ramelteon, buspirone,	51
53.	phenobarbital, butobarbital, pentobarbital	52-53
	Anti-psychotics:	
54.	Neurotransmitters, neurochemistry of mental diseases,	54
55.	mechanism of action,	55
56.	structure activity relationship Synthetic procedures of	56
57.	chlorpromazine,	57
58.	thiothixene, haloperidol,	58

59.	clozapine, olanzapine, quetiapine	59-60
Unit-V: Anti-infective Drugs :		
	Mechanism of action, structure activity relationship and synthetic procedures of drugs of following classes	
60.	<i>Anti-fungal Drugs:</i> Fluconazole, caspofungin and griseofulvin	61-62
61.	<i>Anti-bacterial Drugs:</i> Ciprofloxacin, nitrofurazone and sulfamethazine	63-64
62.	<i>Anti-tubercular Drugs:</i> Isoniazid and rifampin	65
63.	<i>Anti-protozoal Drugs:</i> Metronidazole	66
64.	<i>Anthelmintic Drugs:</i> Albendazole	67
65.	<i>Anti-malarial Drugs:</i> Quinine, chloroquine, primaquine and artemisinin	68-69
Analgesic Drugs:		
66.	Origin and types of pain,	70
67.	mechanism of action and structure activity relationship of steroidal and non-steroidal drugs.	71
	Synthetic procedures of	
68.	pentazocine, paracetamol, aspirin,	72-73
69.	ibuprofen, diclofenac, sumatriptan	74-75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Burger's Medicinal Chemistry and Drug Discovery All Volumes, Wiley.*
- *Wilson Gisvold's Text book of Organic Medicinal and pharmaceutical Chemistry, Ed. Robert F. Dorge.*
- *Foye's Principles of Medicinal Chemistry, David A. Williams, LWW.*
- *Introduction to Medicinal Chemistry, A Gringuage, Wiley- VCH.*
- *An Introduction to Medicinal Chemistry, Graham L. Patrick, Oxford University Press*
- *An Introduction to Drug Design, S. S. Pandeya and J. R. Dimmock, New age International.*
- *Goodman and Gilman's Pharmacological Basis of Therapeutics, Mc Graw-Hill.*
- *The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic press.*
- *Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley.*
- *Handbook of Stability Testing in Pharmaceutical Development: Regulations, Methodologies, and Best Practices by Kim Huynh-Ba, Springer*

Only for Analytical Chemistry Specialization (Paper 4.3 & 4.4)

Paper-4.3: CHEM-643: Instrumental Methods of Analysis

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: X-rays Diffraction :		
1.	Production of X-rays,	1
2.	X-rays spectra,	
3.	monochromatic X-rays sources,	2
4.	X-rays detectors,	
5.	X-rays absorption,	3
6.	X-ray fluorescence,	
7.	X-rays diffraction methods,	4
8.	Bragg's law,	
9.	determination of crystal structure by Bragg's law,	5-6
10.	XRD apparatus,	7-8
11.	applications of XRD in crystalite size determination by using Sherrer formula,	9-10
12.	determination of cis-trans isomerism, polymer crystallization	11

13.	X-ray photoelectron spectroscopy (XPS),	12
14.	X-ray fluorescence spectroscopy (XRF),	13
15.	Auger electron spectroscopy (AES),	14
16.	Energy-dispersive X-ray spectroscopy (EDS or EDX)	15
Unit-II: Electron Diffraction:		
17.	Scattering intensity v/s scattering angle,	16
18.	Wierl equation,	17
19.	measurement technique,	18-19
20.	elucidation of structure of simple gas phase molecules,	20-21
21.	low energy electron diffraction and structure of surfaces	22-23
Neutron Diffraction:		
22.	Scattering of neutrons by solids and liquids,	24
23.	magnetic scattering,	25
24.	measurement techniques,	26-27
25.	elucidation of structure of magnetically ordered unit cell	28-29
26.	Microscopic Methods: General introduction to SEM and TEM	30
Unit-III: Thermo-analytical Methods:		
27.	Introduction and classification of thermoanalytical methods;	31
28.	thermogravimetric analysis (TGA): definition, types, instrumentation, TGA curve, factors affecting TGA curves, calculation of percent decomposition and composition of compounds,	32-35
29.	limitation and advantages of TGA, application of TGA to the thermal behavior including crystalline copper sulphate, calcium oxalate monohydrate, zinc hexafluorosilicate;	36-39
	differential thermal analysis (DTA): definition, theoretical basis, instrumentation, factors affecting the DTA curve,	40-42
30.	application of DTA, advantages and disadvantages of DTA;	43
31.	differential scanning calorimetry (DSC): Definition, comparison of DTA and DSC techniques, instrumentation, factors affecting DSC curves	44-45
Unit-IV: Radio-analytical Methods:		
32.	Determination of nuclear radiation and counting devices,	46
33.	radioactivity tracers- principal and applications,	47-48
34.	isotopic analysis-direct and inverse,	49
35.	special analytical application-radiometric titrations,	50-51
36.	neutron activation analysis principle, instrumentation, applications and limitations,	52-53
37.	radio-chromatography and radio-immunoassay	54-55
Nephelometry and Turbidometry:		
38.	Introduction, theory, comparison of spectrophotometry, turbidimetry and nepelometry,	56-58
39.	instrumentation and applications.	59-60
Unit-V: Polarimetry:		
40.	Polarisation of light, optical activity, theories of optical activity,	61-62
41.	factors affecting angle of rotation,	63
42.	specific rotation,	
43.	optical rotator dispersion and circular dichroism-Cotton effect, ORD and CD curves,	64
44.	instrumentation, measurement of rotatory power, applications of polarimetry,	65-66
45.	optical activity and chemical constitution,	67
46.	representation of optical isomerism,	68

47.	deciding between two structures for a molecule,	
48.	distinguish between a pair of enantiomorphs,	69
49.	saccharimetry, difference between saccharimetry and polarimetry, saccharimeters,	70-71
50.	kinetic polarimetry, spectropolarimetry	72
	Refractometry:	
51.	Principle, parameters influencing refraction,	73
52.	significance of critical angle during measurements,	
53.	refractometers,	74
54.	qualitative and quantitative analysis and analytical applications	75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- D. A. Skoog and D. M. West, *Fundamentals of Analytical Chemistry*, Holt Rinehart and Winston Publications, IV Edn, 1982.
- D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, *Fundamentals of Analytical Chemistry*, Thomson Asia Pte Ltd., Singapore, Viiiith Edn., 2004.
- D.A. Skoog, *Principles of Instrumental Analysis*, Saunders College Pub.Co, III Edn., 1985.
- J.G. Dick, *Analytical Chemistry*, McGraw Hill Publishers, 1974.
- Willard, Merit, Dean and Settle, *Instrumental Methods of Analysis*, CBS Publishers and Distributors, IV Edn., 1989
- G. D. Christian and J.E.O Reilly, *Instrumental Analysis*, Allyn and Bacon Inc, II Edn., 1986.
- G.W. Ewing, *Instrumental Methods of Chemical Analysis*, McGraw Hill Pub, 1975

Paper-4.4: CHEM-644: Analysis of Consumers Products

S. No.	Unit wise Broad Topics of the Syllabus	Tentative Lecture(s) Allotted
Unit-I: Drug Analysis:		
1.	Introduction to drugs, their classification,	1
2.	sources of impurities in pharmaceutical raw materials (chemical, atmospheric and microbial contaminants etc.);	2-5
3.	impurity profile,	6-7
4.	limit test, solubility tests, disintegration test, stability test,	8-10
5.	narcotic and dangerous drugs,	11-12
6.	analysis of some drugs (paracetamol, diclofenac, losartan, inidazole, alprazolam)	13-15
Unit-II: Clinical Analysis:		
7.	Sampling and selective analysis of biological fluids (using routine and automatic instruments): glucose, bilirubins & biluverdins, total cholesterol, haemoglobin, creatinine, total proteins, albumin, urea-nitrogen, carticosteroids and barbiturates;	16-15
8.	vitamins and antibiotics;	26-27
9.	immunological methods of analysis: ELISA and RIA	28-30
Unit-III: Food Analysis:		
10.	Sampling and selective analysis of food flavours, food colour, food preservatives, milk and milk products, floor starches, tea, coffee, sugar content analysis of honey, jam & jelly; alcohol content in beverages;	31-38
11.	analysis of oils and fats: softening point, congent point, titre point, cloud point, iodine value, saponification value, acid value and Polenske value, Elaiden test;	39-44
12.	pesticide residue analysis	45
Unit-IV: Cream & Lotion Analysis:		
13.	Composition of creams and lotions,	46
14.	determination of water, propylene glycol, non-volatile matter and ash content,	47-50

15.	determination of borates, carbonates, sulphates, phosphates, chlorides, titanium and zinc oxides	51-54
	Face Powder, Deodorant & Antiperspirant Analysis	
16.	Composition,	55
17.	analysis of fats and fatty acids, boric acid, Mg, Ca, Zn, Fe, Ti, Al, phenol, hexachlorophenone, methanamine, sulphonates and urea	56-60
Unit-V: Soap Analysis:		
18.	Method of analysis: sampling, separation, identification;	61-62
19.	determination of fatty acids, total anhydrous soap and combined alkali, potassium, water, determination of inorganic fillers and soap builders;	63-68
20.	determination of constituents and other additives	69
	Detergent Analysis	
21.	Types,	70
22.	method of analysis: sampling, separation, identification of components, determination of surfactants and other constituents	71-75

Range of lectures required for completion of broad topics of the Syllabus : 65-75

Books:

- *Standard Methods of Chemical Analysis, F. J. Welcher*
- *Instrumental Methods of Analysis (6th Edition) – H. H. Willard & L. L. Merritt.*
- *A Text Book of Quantitative Inorganic Analysis (3rd Edition) – A. I. Vogel.*
- *Treatise on Analytical Chemistry (Series of Volumes) – I. M. Kolthoff & P. J. Elwing.*
- *Introduction to Instrumental Analysis – R. D. Braun.*
- *Handbook of Industrial Chemistry – Davis Burner*
- *Association of Official Analytical Chemistry (AOAC) – 13th Edition 1980.*
- *Pharmacopoeia of India, British & United States.*
- *Hand Book of Food Analysis – S. N. Mahindru.*
- *Analytical Biochemistry – Holme Peck*
- *Post Graduate Chemistry Practical Part – I – Patel, Gadre & Turkhia.*
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