

:

SACRED HEART COLLEGE (AUTONOMOUS)

Department of Chemistry

MSc Chemistry

Course Plan

Academic Year 2018-19

Semester Four

PROGRAMME	MSc Chemistry	SEMESTER	4
COURSE CODE AND TITLE	16P4CHET13EL: ADVANCED INORGANIC CHEMISTRY	CREDIT	4
HOURS/WEEK	5	HOURS/SEM	90
FACULTY NAME	Dr. Midhun Dominic C D, Dr. Ramakrishnan S, Mr. Senju Devassykutty, Dr. Abi T.G		

<i>Course Objectives</i>
To apply the principles of group theory in co-ordination complexes.
To analyze the structures of inorganic complexes using IR, Raman, Mossbauer and EPR spectroscopic techniques.
To compare the chemistry of different photochemical reactions.
To interpret the structure and properties of nanomaterials.
To examine the structure and properties of different supramolecular architectures.
To describe the principle and applications of different analytical techniques.
To discuss the theories of acids and bases.
To draw the structures of inorganic molecules

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I Applications of Group Theory (22 h)				
1	Transformation properties of atomic orbitals	PPT	e-resource	
2	hybridization schemes for sigma and pi bonding with examples	PPT/Lecture		
3	Symmetry Adapted Linear Combination of Atomic orbitals in tetrahedral, octahedral and sandwich complexes.	PPT/Lecture		
4	Symmetry Adapted Linear Combination of Atomic orbitals in sandwich complexes.	PPT/Lecture	e-resource	
5	Ligand field theory	PPT/Lecture		
6	splitting of <i>d</i> orbitals in different environments using group theoretical considerations	PPT/Lecture		
7	construction of energy level diagrams	Lecture		
8	Correlation diagrams	Lecture		
9	Correlation diagrams	Lecture		
10	method of descending symmetry	Lecture		
11	method of descending symmetry	PPT/Lecture		
12	method of descending symmetry	PPT/Lecture		
13	formation of symmetry adapted group of ligands	PPT/Lecture		
14	formation of symmetry adapted group of ligands	PPT/Lecture		
15	M.O. diagrams, splitting terms for orbitals, energy levels	PPT/Lecture		
16	M.O. diagrams, splitting terms for orbitals, energy levels	Lecture		
17	<i>d-d</i> transition-selection rules	Lecture		
18	vanishing integrals	Lecture		

19	Raman spectra of complexes with oxo anions as ligands	Lecture		
20	Raman spectra of complexes with oxo anions as ligands	PPT/Lecture		
21	IR and Raman spectra using character tables in tetrahedral, octahedral and square planar complexes	PPT/Lecture		
22	IR and Raman spectra using character tables in tetrahedral, octahedral and square planar complexes	PPT/Lecture		
MODULE II : Inorganic Spectroscopic Methods (9 h)				
23	Infrared and Raman Spectroscopy	PPT/Lecture		
24	structural elucidation of coordination compounds containing the following molecules/ions as ligands-NH ₃ , H ₂ O, CO,NO, OH ⁻	Lecture		
25	SO ₄ ²⁻ , CN ⁻ , SCN ⁻ , NO ₂ ⁻ and X ⁻ (X=halogen).	Lecture		
26	Electron Paramagnetic Resonance Spectroscopy	Lecture		
27	EPR of d^1 and d^9 transition metal ions in cubic and tetragonal ligand fields,	PPT/Lecture		
28	evaluation of g values	PPT/Lecture		
29	Metal hyperfine coupling constants.	PPT/Lecture		
30	Mössbauer Spectroscopy	PPT/Lecture		
31	applications of Mössbauer spectroscopy in the study of Fe(III) and Fe (II) complexes.	PPT/Lecture		
MODULE III : Inorganic Photochemistry (9 h)				
32	Photochemical reactions	PPT/Lecture		
33	Photochemical reactions-substitution and redox reactions of Cr(III), Ru(II) and Ru(III) complexes.	PPT/Lecture		
34	Photo substitution, Photo racemization reactions	PPT/Lecture		

35	Energy and electron transfer process in ruthenium complexes	PPT/Lecture		
36	Metal complex sensitizers-electron relay, semiconductor supported metal oxide systems	Lecture	Quiz	
37	water photolysis	PPT/Lecture		
38	Dye sensitized photochemical solar cells	PPT/Lecture		
39	Ruthenium and supramolecular sensitizers	PPT/Lecture		
40	Photo induced electron collection	PPT/Lecture		
CIA-1				
MODULE IV : Nanomaterials (18 Hrs)				
41	General introduction to nanomaterials and emergence of nanotechnology	PPT/Lecture		
42	Moore's law	Lecture		
43	characterization of nano materials using XRD, SEM, TEM (Basic idea only)	PPT/Lecture		
44	Synthesis of Nanomaterials – Precipitation methods, Sol-gel method, chemical vapour deposition, reduction techniques	PPT/Lecture		
45	synthesis and properties of fullerenes	PPT/Lecture		
46	carbon nanotubes	PPT/Lecture		
47	lithography.	PPT/Lecture		
48	Green synthesis of nanoparticles of gold, silver	PPT/Lecture		
49	Thin films-chemical vapor deposition and atomic layer deposition techniques	PPT/Lecture		
50	Diversity in nanosystems	PPT/Lecture		
51	self assembled monolayers on gold-growth process and phase transitions.	PPT/Lecture		
52	Synthesis, structure and bonding of	PPT/Lecture	Video	

	phosphazenes			
53	Quantum dots- preparation	PPT/Lecture		
54	Quantum dots- characterization and applications	PPT/Lecture		
55	Nanoshells-types of systems	PPT/Lecture		
56	Nanoshells- characterization and application.	Lecture		
57	Evolving interfaces of nanotechnology- nanobiology	PPT/Lecture		
58	nanosensors, nanomedicines.	PPT/Lecture		
MODULE V : Advanced topics in Coordination Chemistry (9Hrs)				
59	Coordination Chemistry of Fullerenes. Fullerene metal complexes-Fullerides of alkali metals, Fullerenes as π -ligands,	PPT/Lecture		
60	Metal fullerides, exohedral fullerenes, endohedral fullerenes	PPT/Lecture		
61	Metallo supra molecular chemistry and Molecular Architecture.Molecular recognition	PPT/Lecture		
62	Molecular Receptors- Cation binding Hosts- Crown ethers, Heterocrowns, Spherands, Cryptands, Calixarenes.	PPT/Lecture		
63	Selectivity of Cation Complexation. Anionic Recognition. From anionic to cationic recognition. Neutral Molecules Recognition- Cyclodextrins, Carcerands, Cyclophane	Lecture	Demo video	
64	Metallosupramolecular chemistry	Lecture		
65	Different Strategies and Types. Helicates, Grid type Metal ion Architecture, Ladder and Racks.	Lecture		
66	Supramolecular Assistance in the Synthesis of Molecular and Supramolecular Structures	Lecture		
67	Catenanes, Rotaxanes, Knots and Necklaces	PPT/Lecture		

MODULE VI : Analytical Methods (9 h)				
68	Atomic Spectroscopy: Emission Spectra – Absorption Spectra – Fluorescence Spectra.	PPT/Lecture		
69	Plasma Emission Spectroscopy – Direct current plasma	PPT/Lecture		
70	Inductively coupled plasma (ICP). Principle and Applications	Lecture		
71	Size Exclusion Chromatography: Column Packings – Applications – Chromatographic Separation of Fullerenes (Bucky Balls).	PPT/Lecture		
72	Affinity Chromatography. Chiral Chromatography	PPT/Lecture		
73	Supercritical Fluid Chromatography	PPT/Lecture		
74	important properties of supercritical fluids- Principle and Applications	PPT/Lecture		
75	Analytical procedures involved in the environmental monitoring of water quality	PPT/Lecture		
76	BOD, COD, DO, nitrite and nitrate, iron, fluoride	PPT/Lecture		
CIA-2				
MODULE VII : Acids and Bases (9h)				
77	Acid –Base Strength. Acid-Base interaction	PPT/Lecture		
78	Ionic and Covalent Interaction(Drago and Wayland Concept).	PPT/Lecture		
79	Steric Effect, Solvation Effect, Acid base strength and Proton affinity, Acidity and basicity of Binary Hydrogen compounds	PPT/Lecture		
80	Inductive effect, Non Aqueous solvent and Acid- Base strength	PPT/Lecture		
81	leveling effect, Superacid	PPT/Lecture		
82	Hard and Soft Acids and Bases.- Classification,	PPT/Lecture		

	Acid Base strength and Hardness and Softness			
83	Symbiosis, HSAB Theory, HOMO – LUMO concept.	PPT/Lecture		
84	Applications of HSAB –Solubility of halides and chalcogenides, in qualitative Analysis	PPT/Lecture		
85	In biological function and Toxicology of elements and in Medicinal Chemistry (Chelation)	PPT/Lecture		
MODULE VIII : Structure of Some Inorganic Molecules (5 h)				
86	Hybridization and Structure of molecules- Structure of the following molecules- Trimethylborane, Phosphorus pentafluoride, Ammonium tetrafluoroborate, Aluminiumbromide	PPT/Lecture		
87	Structure of molecules containing lone pairs- Spatial requirements between lone pairs and bond pairs, Sulphur tetrafluoride, Bromine trifluoride, Dichloriodate(I) anion,	PPT/Lecture		
88	Pentafluorate(IV) anion, Tetrachloriodate(III)anion, Nitrogen Dioxide,Nitrite ion, nitryl ion, Phosphorus trihalides, Carbonylfluoride and Xenonhexafluoride. Bent's rule and energy of Hybrid orbitals.	PPT/Lecture		
89	Revision	PPT/Lecture		
90	Revision	PPT/Lecture		

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	17/01/2019	Group theory : Problems
2	07/02/2019	Nanomaterials: Opportunities and Challenges

GROUP ASSIGNMENTS/ACTIVITIES – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	23/02/2019	Previous CSIR questions (Group activity)

References

01. F.A. Cotton, Chemical Applications of Group Theory, Wiley-Interscience, 1990.
02. V. Ramakrishnan, M.S. Gopinathan, Group Theory in Chemistry, Vishal Pub., 1985.
03. A.S. Kunju, G. Krishnan, Group Theory and its Applications in Chemistry, PHI Learning, 2010
04. K. Nakamoto, IR and Raman Spectra of Inorganic and Coordination Complexes, Part A-Theory and Applications in Inorganic Chemistry, 6th Edn., John Wiley & sons, 1997.
05. R.S. Drago, Physical Methods in Chemistry, Saunders College, 1992.
06. R.L. Dutta, A. Syamal, Elements of Magnetochemistry, Affiliated East-West Press, New Delhi, 1993.
07. C.N. Banwell, E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edn., Tata McGraw Hill, 1994.
08. A. K. Bridson, Inorganic Spectroscopic Methods, Oxford University Press, 1998.
09. D.M. Roundhill, Photochemistry and Photophysics of Metal Complexes, Plenum Press, 1994.
10. A.W. Adamson, P.D. Fleischauer, Concepts of Inorganic Photochemistry, Wiley, 1975.
11. V. Balzani, V. Carassiti, Photochemistry of Coordination Compounds, Academic Press, 1970.
12. T. Pradeep, Nano: the Essentials, Tata Mc Graw Hill, 2007.
13. C.N.R. Rao, A. Govindaraj, Nanotubes and Nanowires, Royal Society of Chemistry, 2011.
14. D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, 8th Edn., Saunders College Pub., 2007.
15. J.G. Dick, Analytical chemistry, Mc Graw-Hill, 1973.
16. S.E. Manahan, Environmental Chemistry, 9th Edn., CRC Press, 2010.
17. J.E. Huheey, E.A. Keiter, R.A. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4th Edn., Harper Collins College Pub., 1993.
18. H.J. Emeleus, A.G. Sharpe, Modern Aspects of Inorganic Chemistry, 4th Edn., ELBS, 1973.
19. K.F. Purcell, J.C. Kotz, Inorganic Chemistry, Holt-Saunders, 1977.

Web resource references:

- <https://www.understandingnano.com/resources.html>

PROGRAMME	MSc CHEMISTRY	SEMESTER	4
COURSE CODE AND TITLE	16P4CHET14 : ADVANCED ORGANIC CHEMISTRY	CREDIT	4
HOURS/WEEK	5	HOURS/SEM	90
FACULTY NAME	Dr. Joseph T Moolayil, Dr. V. S Sebastian, Dr. Franklin J, Dr. Grace Thomas, Dr. June Cyriac		

COURSE OBJECTIVES
To illustrate the principles of biosynthesis, biomimetic synthesis, green synthesis and stereoselective transformations.
To explain the chemistry of advanced polymeric materials.
To describe the structure and applications of natural products and biomolecules
To explain the mechanism of drug action and drug designing
To explain different scientific methods, scientific writing and scientific journal

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I : BIOSYNTHESIS AND BIOMIMETIC SYNTHESIS (15H)				
1	Basic principles of the biosynthesis of terpenes	PPT	video	
2	Basic principles of the biosynthesis of steroids and alkaloids	PPT/Lecture		
3	Basic principles of the biosynthesis of carbohydrates, and nucleic acids.	PPT/Lecture		
4	Biosynthesis of cholesterol and morphine,	PPT/Lecture	e-resource	
5	Biosynthesis of, glucose and phenyl alanine.	PPT/Lecture		
6	Biogenesis of isoprenoids and alkaloids.	PPT/Lecture		
7	Biomimetic synthesis of progesterone.	Lecture		

8	Biomimetic synthesis of spatreine.	Lecture		
9	Structure of DNA and RNA	Lecture	Q & A Session	
10	Replication of DNA	PPT/Lecture		
11	Flow of genetic information	PPT/Lecture		
12	Protein biosynthesis	PPT/Lecture		
13	Transcription and translation			
14	Genetic code	PPT/Lecture		
15	Regulation of gene expression	Lecture		
MODULE II : GREEN ALTERNATIVES TO ORGANIC SYNTHESIS (12H)				
16	Principles of Green Chemistry	PPT/Lecture	Q & A Session	
17	Basic concepts, atom economy - twelve principles of Green Chemistry	PPT/Lecture		
18	Principles of green organic synthesis.			
19	Green alternatives to Organic Synthesis: Coenzyme catalysed reactions -thiamine catalyzed benzoin condensation.	PPT/Lecture		
20	Green alternatives of molecular rearrangements: Pinacol-pinacolone and Benzidine rearrangement.	PPT/Lecture		
21	Electrophilic aromatic substitution reactions.	PPT/Lecture		
22	Oxidation-reduction reactions.	PPT/Lecture		
23	Clay catalysed synthesis.	PPT/Lecture		
24	Condensation reactions. Green photochemical reactions.	PPT/Lecture		
25	Green Solvents: Ionic liquids, supercritical CO ₂ , fluororous chemistry.	PPT/Lecture		

26	General principles of microwave assisted organic synthesis.	PPT/Lecture		
27	General principles of ultrasound assisted organic synthesis.	PPT/Lecture		
MODULE III : ADVANCES IN POLYMER CHEMISTRY (13H)				
28	Degree of polymerization, classification and stereochemistry of polymers.	PPT/Lecture		
29	Ziegler-Natta catalyst.	PPT/Lecture		
30	Glass transition temperature of polymers, factors affecting glass transition temperature.	PPT/Lecture		
31	Natural and synthetic rubber (SBR, Butyl, neoprene	PPT/Lecture		
32	Natural and synthetic rubber neoprene and nitrile rubber	PPT/Lecture		
33	Vulcanization.	PPT/Lecture		
34	Conducting polymers	PPT/Lecture		
35	Temperature resistant and flame retardant polymers	Lecture	Quiz	
36	Polymers for medical applications.	Lecture	Q & A Session	
37	Dendrimers and dendritic polymers, Terminology- classification of dendrimers	PPT/Lecture		
38	Methods of synthesis: convergent and divergent approaches	PPT/Lecture		
39	.Dendrimers as nanocapsules. Applications of dendrimers	PPT/Lecture		
40	Hyper branched polymers: definition, synthesis, applications.	PPT/Lecture		
MODULE IV : STEREOSELECTIVE TRANSFORMATIONS (10H)				
41	Assymmetric induction	PPT/Lecture	Q & A Session	

42	Chiral auxiliaries and chiral pool.	PPT/Lecture		
43	Enantioselective catalytic hydrogenation developed by Noyori and Knowles	PPT/Lecture		
44	Continued	PPT/Lecture		
45	Assymmetric aldol condensation pioneered by Evans	PPT/Lecture		
46	Continued	PPT/Lecture		
47	Assymmetric Diels- Alder reactions	PPT/Lecture		
48	Continued	PPT/Lecture		
49	Assymmetric epoxidation using Jacobsen's catalyst	PPT/Lecture	Video	
50	Continued	PPT/Lecture		
MODULE V : CHEMISTRY OF NATURAL PRODUCTS AND BIOMOLECULES (14H)				
51	Synthesis of camphor	PPT/Lecture		
52	Synthesis of atropine,	PPT/Lecture		
53	Synthesis of, papaverine	Lecture		
54	Synthesis of cyanin,	PPT/Lecture		
55	Synthesis of quercetin,	PPT/Lecture		
56	Synthesis of β -carotene,	PPT/Lecture		
57	Synthesis of testosterone,	PPT/Lecture		
58	Synthesis of, PGE ₂ and PGF _{2α} ,	PPT/Lecture		
59	Synthesis Vitamine C	PPT/Lecture		
60	Synthesis of Riboflavin.	PPT/Lecture		
61	Methods for primary structure determination of peptides, proteins.	PPT/Lecture		
62	Methods for primary structure determination of p, proteins.	PPT/Lecture		
63	Enzymes- classification and structure	PPT/Lecture		

64	Enzymes- mode of action.	PPT/Lecture		
MODULE VI : MEDICINAL CHEMISTRY AND DRUG DESIGNING (16H)				
65	Drug- Structure-activity relationships- a general idea.	PPT/Lecture		
66	Drug action - drug selectivity	PPT/Lecture		
67	Receptor proteins- drug-receptor interaction	PPT/Lecture		
68	Drug metabolism.	PPT/Lecture		
69	Drug-receptor theory: occupancy theory, rate theory, induced fit theory	PPT/Lecture		
70	Activation-aggregation theory.	PPT/Lecture		
71	Mechanism of drug acting on DNA- intercalating agent (proflavin), alkylating agent uracil mustard, cisplatin	PPT/Lecture		
72	Chain cutting agents (bleomycin).	PPT/Lecture		
73	Central nervous system acting drugs	PPT/Lecture		
74	Antidepressants, tranquilizers	PPT/Lecture		
75	Sedatives and hypnotics.	PPT/Lecture		
76	A general idea of cardio-vascular drugs.	PPT/Lecture		
77	Introduction to Drug design	PPT/Lecture		
78	Concept of combinatorial and parallel synthesis.	PPT/Lecture		
79	Computer assisted drug design	PPT/Lecture		
80	Illustration of drug development through a specific example of antibacterials- Penicillins.	PPT/Lecture		
MODULE VII : RESEARCH METHODOLOGY OF CHEMISTRY (10H)				

81	The search of knowledge - purpose of research - scientific methods	PPT/Lecture		
82	Role of theory -Characteristics of research.	PPT/Lecture		
83	Types of research: Fundamental research, applied research, historical and experimental research.	PPT/Lecture		
84	Statistical calculations: Presentation of data, mean, median, mode, errors in chemical analyses, linear regression and correlation. Method of least squares.	PPT/Lecture		
85	Chemical literature: Primary, secondary and tertiary sources of literature. Classical and comprehensive reference.	PPT/Lecture		
86	Literature databases: Science Direct, SciFinder. Chemical Abstract.	PPT/Lecture		
87	Scientific writing: Research reports, thesis, journal articles, books	PPT/Lecture		
88	Types of publications: articles, communications, reviews.	PPT/Lecture		
89	Important scientific journals- important Chemistry journals	PPT/Lecture		
90	Impact factor	PPT/Lecture		

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	22/2/2019	Write a note on important types of publications

GROUP ASSIGNMENTS/ACTIVITES – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	6/2/2019	Make a list of Important scientific journals

References

1. D. Voet and J.G. Voet *Biochemistry* Wiley, 2nd ed, 1995
2. J. Mann, *Chemical Aspects of Biosynthesis*, Oxford Chemistry Primer No. 20, 1994.
3. *Biomimetic Organic Synthesis*, First Edition. Edited by Erwan Poupon and Bastien Nay. Wiley-VCH Verlag GmbH & Co., 2011
4. W. Carruthers, *Modern Methods of Organic Synthesis*, Cambridge University Press, 1996.
5. J. Clayden, N. Greeves, S. Warren and P. Wothers, *Organic Chemistry*, Oxford University Press, 2001.
6. R.O.C. Norman and J.M. Coxon, *Principles of Organic Synthesis*, ELBS with Chapman & Hall, 1993.
7. V.K.Ahluwalia, *Green Chemistry: Environmentally Benign Reactions*, Ane Books, New Delhi, 2009.
8. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, *Principles of Biochemistry* 6th edition, 2006 (W.H. Freeman & Co.).
9. Lehninger, Nelson, D. L. and M. M. Cox. *Principles of Biochemistry* 5th edition (W. H. Freeman & Co.), 2008.
10. V.K.Ahluwalia, M.Gupta, *Medicinal Chemistry*, Ane Books, New Delhi, 2012.
11. Patric, G. L., *An Introduction to Medicinal Chemistry*. 5th Edn.; Oxford University, 2013.
12. Silverman, R. B., *The Organic Chemistry of Drug Design and Drug Action*. 2nd ed.; Academic Press: 2004 Press: 2005
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17. H.F.Ebel, C.Bliefert and W.E.Russey, *The Art of Scientific Writing*, VCH, Weinheim, 1988.
18. Durtson, Poole, *Thesis and assignment writing*- Anderson, 1971.
19. John E. Freund. *Modern elementary statistics*, 2003, ISBN-13: 978-0131874398
20. S. P. Gupta. *Statistical Methods*: S. Chand, 2014.

PROGRAMME	M.Sc. CHEMISTRY	SEMESTER	4
COURSE CODE AND TITLE	16P4CHET15EL: ADVANCED PHYSICAL CHEMISTRY	CREDIT	4
HOURS/WEEK	5	HOURS/SEM	90
FACULTY NAME	DR. K B JOSE, DR. THOMMACHAN XAVIER, DR. JORPHIN JOSEPH, DR. JINU GEORGE, Dr. IGNATIUS ABRAHAM		

Course Objective

To describe the physical principles of crystallography and apply it in explaining the properties of solids and liquid crystals.
To apply the principles of electrochemistry in electrochemical cells, fuel cells, storage cells and corrosion.
To explain the principles of dynamic electrochemistry
To describe the principles of diffraction methods and various atomic spectroscopic techniques
To apply various electro-analytical techniques in qualitative and quantitative analysis.

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I : CRYSTALLOGRAPHY				
1	Crystallography- Miller indices, stereographic projection	Lecture		
2	Point groups (derivation not expected), translational symmetry, glide planes and screw axes	PPT/Lecture	e-resource	
3	space groups, simple cases like triclinic and monoclinic systems	PPT/Lecture		
4	Interplanar spacing	PPT/Lecture	e-resource	

5	Method of determining lattice types	PPT/Lecture		
6	Reciprocal Lattices	PPT/Lecture		
7	Crystallography- methods of characterizing crystal structure	Lecture		
8	Rotating crystal method	Lecture		
9	Powder X-ray diffraction method	Lecture		
10	Determination of structure of sodium chloride by powder method	Lecture		
11	Comparison of the structures of NaCl and KCl	PPT/Lecture		
12	Brief outline of single crystal X-ray diffraction	PPT/Lecture		
13	Crystal growth techniques.	Lecture	video	
14	Crystallography- Structure factor	Lecture		
15	Atomic scattering factor	Lecture		
16	Co-ordinate expression for structure factor	PPT/Lecture		
17	Structure by Fourier synthesis.	PPT/Lecture		
18	Revision	Lecture	e-resource	
19	Liquid crystals: mesomorphic state, types, examples and application of liquid crystals.	Lecture		
20	Theories of liquid crystals. Photoconductivity of liquid crystals.	Lecture		
MODULE II : ELECTROCHEMISTRY				
21	Electrochemical cells and	Lecture		
22	concentration cells	PPT/Lecture	e-resource	

23	activity coefficient determination	PPT/Lecture		
24	liquid junction potential, evaluation of thermodynamic properties	Lecture		
25	the electrode double layer, electrode-electrolyte interface	PPT/Lecture	e-resource	
26	different models of double layer, theory of multilayer capacity,	PPT/Lecture		
27	electro capillary, Lippmann equation, membrane potential.	Lecture		
28	Storage Cells: Lead,	Lecture		
29	Ni-Cd, Lithium	Lecture		
30	Fuel cells, classification based on working temperature	PPT/Lecture		
31	Chemistry of fuel cells,	PPT/Lecture	e-resource	
32	H ₂ -O ₂ fuel cells	Lecture		
33	Fuel cell efficiency	Lecture		
34	Electro catalysis.	Lecture		
35	Dynamic Electrochemistry	Lecture		
36	Kinetics of electron transfer	Lecture		
37	Polarization -electrolytic polarization	PPT/Lecture		
38	Dissolution and decomposition potential,	PPT/Lecture		
39	Concentration polarization	PPT/Lecture		
40	Overvoltage	Lecture	e-resource	
41	Hydrogen and oxygen overvoltage	Lecture		
42	Butler-Volmer equation for simple electron	PPT/Lecture		

	transfer reactions,			
43	Tafel equation and its significance	PPT/Lecture		
44	transfer coefficient, exchange current density, rate constants.	PPT/Lecture		
MODULE III : DIFFRACTION METHODS				
45	Electron diffraction of gases. Wierl's equation	Lecture		
46	Neutron diffraction method-SANS	Lecture		
47	Comparison of X-ray,	Lecture		
48	electron and neutron diffraction methods.	PPT/Lecture		
49	X-ray diffraction techniques	PPT/Lecture	e-resource	
50	XRD	PPT/Lecture		
51	SAXS	PPT/Lecture		
52	WAXS	PPT/Lecture		
MODULE IV : SPECTROSCOPIC TECHNIQUES				
53	Atomic absorption spectroscopy (AAS),	PPT/Lecture		
54	principle of AAS,	PPT/Lecture		
55	absorption of radiant energy by atoms	PPT/Lecture		
56	Classification of atomic spectroscopic methods	PPT/Lecture		
57	measurement of atomic absorption,	PPT/Lecture		
58	Instrumentation.	PPT/Lecture	e-resource	
59	Atomic emission spectroscopy (AES),	PPT/Lecture		

60	advantages and disadvantages of AES	Lecture		
61	Origin of spectra	Lecture		
62	Principle and instrumentation.	Lecture		
63	Flame emission spectroscopy (FES)	Lecture		
64	Flames and flame temperature	Lecture		
65	Spectra of metals in flame, instrumentation	Lecture		
66	Introduction to Fluorescence Spectroscopy	Lecture		
MODULE V : ELECTRO ANALYTICAL TECHNIQUES				
67	Polarography	PPT/Lecture		
68	decomposition potential, residual current	Lecture		
69	migration current, supporting electrolyte	Lecture		
70	diffusion current, Polarogram,	Lecture	Video	
71	half wave potential, limiting current density	Lecture		
72	Polarograph, explanation of polarographic waves	PPT/Lecture		
73	The dropping mercury electrode, advantages and limitations of DME	PPT/Lecture		
74	Applications of polarography	PPT/Lecture		
75	Quantitative analysis- pilot ion procedure, standard addition methods	PPT/Lecture	e-resource	
76	Qualitative analysis-determination of half wave potential of an ion,	Lecture		
77	advantages of polarography.	Lecture		
78	Amperometry: general principles of	Lecture		

	amperometry			
79	application of amperometry in the qualitative analysis of anions and cations in solution, Instrumentation	Lecture	Video	
80	Amperometric titrations - titration procedure, merits and demerits of amperometric titrations	Lecture		
81	Coulometry: coulometer-Hydrogen Oxygen coulometers, silver coulometer	PPT/Lecture		
82	Coulometric analysis with constant current	PPT/Lecture		
83	Coulometric titrations, application of coulometric titrations-neutralization titrations, complex formation titrations, redox titrations	PPT/Lecture	Video	
84	Advantages of coulometry	Lecture		
85	Voltametry: Voltametry-cyclic-voltametry	Lecture		
86	Anodic stripping voltametry	Lecture		
87	Ion selective electrodes:	PPT/Lecture		
88	glass electrodes	PPT/Lecture	Video	
89	sodium, potassium, lithium ion selective electrodes	PPT/Lecture		
90	Revision			

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	15/01/2019	Environmental applications of Atomic Spectroscopy
2	10/02/2019	Use of fuel cells in space shuttles
3	25/02/2019	Applications of Liquid Crystals

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