Sacred Heart College (Autonomous)

Department of Chemistry

MSc Chemistry

Course Plan

Academic Year 2014 – 15

Semester 4

COURSE PLAN					
ACADEMIC YEAR 2014-15					
PROGRAMME	**:**	MSc Chemistry	**LECTURE HOURS**	**:**	90
SEMESTER	**:**	IV	**CREDITS**	**:**	4
SUBJECT TITLE	**:**	**Advanced Inorganic Chemistry**	**SUBJECT CODE**	**:**	**CH4E01**
COURSE TEACHERS	**:**	Dr. Joseph John, Mr. Midhun Dominic C D, Mr. Senju Devassykutty, Dr.Ramakrishnan			
Instructional Hours	**:**	5			

Sessions	Topic/Module	Method of teaching *
1-2	**Unit 1: Applications of Group Theory (27Hrs)(JJ)** Transformation properties of atomic orbitals	Conventional Teaching
3-4	hybridization schemes for sigma and pi bonding with examples	Conventional Teaching ICT
5-7	Symmetry Adapted Linear Combination of Atomic orbitals in tetrahedral, octahedral and sandwich complexes.	Conventional Teaching
8-10	Ligand field theory-splitting of *d* orbitals in different environments using group theoretical considerations	Conventional Teaching
11-13	construction of energy level diagrams	Conventional Teaching
14-16	correlation diagrams	Conventional Teaching Assignment
17-18	method of descending symmetry	Conventional Teaching
19-20	formation of symmetry adapted group of ligands	Conventional Teaching
21-22	M.O. diagrams, splitting terms for orbitals, energy levels	Conventional Teaching
23	*d-d* transition-selection rules, vanishing integrals.	Conventional Teaching
24	Raman spectra of complexes with oxo anions as ligands,	Conventional Teaching ASSIGNMENT
25-27	IR and Raman spectra using character tables in tetrahedral, octahedral and square planar complexes	Conventional Teaching
1-2	**Unit 2: Inorganic Spectroscopic Methods. (9 Hrs)(SD)** Infrared and Raman Spectroscopy:	Conventional Teaching ICT

3-4	structural elucidation of coordination compounds containing the following molecules/ions as ligands-NH_3, H_2O, CO,NO, OH^-, SO_4^{2-}, CN^-, SCN^-, NO_2^- and X^- (X=halogen).	Conventional Teaching
5-6	Electron Paramagnetic Resonance Spectroscopy: EPR of d_1 and d_9 transition metal ions in cubic and tetragonal ligand fields,	Conventional Teaching
7	evaluation of *g* values and metal hyperfine coupling constants.	Conventional Teaching
8-9	Mössbauer Spectroscopy: applications of Mössbauer spectroscopy in the study of Fe(III) complexes.	Conventional Teaching
1	**Unit 3: Inorganic Photochemistry (9 Hrs)(SD)** Excited states, ligand field states,	Conventional Teaching
2	charge-transfer states and Thexi states,	Conventional Teaching
3	phosphorescence and fluorescence.	Conventional Teaching
4	Photochemical reactions-substitution and redox reactions of Cr(III), Ru(II) and Ru(III) complexes.	Conventional Teaching
5-6	Applications-synthesis and catalysis, chemical actinometry and photochromism. Metal-metal multiple bonds.	Conventional Teaching ICT
7-8	Metal complex sensitizers-electron relay, semiconductor supported metal oxide systems,	Conventional Teaching
9	water photolysis, nitrogen fixation and CO_2 reduction.	Conventional Teaching
1	**Unit 4: Nanomaterials (18 Hrs)(MD)** General introduction to nanomaterials and emergence of nanotechnology,	Conventional Teaching ASSIGNMENT II
2	Moore's law	Conventional Teaching

3-4	synthesis and properties of fullerenes and carbon nanotubes,	Conventional Teaching
5-6	techniques of synthesis-electroplating and electrophoretic deposition, conversion through chemical reactions and lithography.	Conventional Teaching
7	Thin films-chemical vapor deposition and atomic layer deposition techniques	Conventional Teaching ICT
8-9	Diversity in nanosystems: self assembled monolayers on gold-growth process and phase transitions.	Conventional Teaching
10-11	Gas phase clusters- formation, detection and analysis.	Conventional Teaching
12-13	Quantum dots- preparation, characterization and applications.	Conventional Teaching
14-15	Nanoshells-types of systems, characterization and application.	Conventional Teaching
16-18	Evolving interfaces of nanotechnology-nanobiology, nanosensors, nanomedicines.	Conventional Teaching
1-3	**Unit 5: Analytical Methods (18 Hrs)(RKS)** The basis and procedure of sampling-crushing and grinding, gross sampling. Sampling of solids, liquids, gas, particulate solids, metals and alloys. Preparation of a laboratory sample.	Conventional Teaching
4-5	Moisture in samples-essential and non essential water, occluded water. Determination of water in samples-direct and indirect methods.	Conventional Teaching
6-7	Decompositions and dissolution-reagents for decomposition and dissolution like HCl, H_2SO_4, HNO_3, $HClO_4$ and HF	Conventional Teaching
8	Microwave decompositions, combustion methods	Conventional Teaching
9-10	Uses of fluxes like Na_2CO_3, Na_2O_2, KNO_3, $K_2S_2O_7$, NaOH, B_2O_3 and lithium meta borate.	Conventional Teaching

11-12	Elimination of interferences from samples by precipitation, electrolytic precipitation, separation by extraction and ion exchange separation.	Conventional Teaching
13-15	Analytical procedures involved in the environmental monitoring of water quality- BOD, COD, DO, nitrite and nitrate, iron, fluoride, soil moisture, salinity, soil colloids, cation and anion exchange capacity.	Conventional Teaching Assignment
16-18	Air pollution monitoring: sampling and collection of air pollutants-SO_2, NO_2, NH_3, O_3, and SPM.	Conventional Teaching
1-2	**Unit 6: Acids and Bases and Non-aqueous Solvents (9 Hrs)(RKS)(JJ)** Acid base concept in non aqueous media-HSAB concept,	Conventional Teaching
3-4	solvent effects, linear free energy relationship-mechanism and methods of determination	Conventional Teaching
5	Reactions in non-aqueous solvents. Ammonia - solutions of metals in liquid ammonia.	Conventional Teaching
6	Protonic solvents: anhydrous sulfuric acid, hydrogen halides.	Conventional Teaching
7	Aprotic solvents: non-polar solvents, non-ionizable polar solvents, polar solvents undergoing autoionization	Conventional Teaching
8	liquid halogens, interhalogen compounds,	oxy halides, dinitrogen tetroxide, sulphur dioxide
9	oxy halides, dinitrogen tetroxide, sulphur dioxide	

References

01. F.A. Cotton, Chemical Applications of Group Theory, Wiley-Interscince, 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.

Programme **MSc Branch –III Chemistry- 2014-15**

Semester: SEMESTER IV-**ADVANCED ORGANIC CHEMISTRY**

	Term – I (Before I Internal tests) – 30 % of the syllabus				
Sl No	Topic/Module	Hour / session	Teacher/invited persons etc.	Method of teaching *	Remarks: Books, reference etc
1	**Unit 1: Molecular Recognition and Supramolecular Chemistry** Concept of molecular recognition, host-guest complex formation, forces involved in molecular recognition.Molecular receptors: cyclodextrins, crown ethers, cryptands, spherands,	8 Hrs	Dr V.S Sebastian	Lecture Assignments and seminar	01. J.M. Lehn, Supramolecular Chemistry: Concepts and Perspectives, VCH, 1995. 02. F. Vogtle, Supramolecular Chemistry: An Introduction, Wiley, 1993.
2	**Unit 8: Research Methodology of Chemistry** 1 The search of knowledge, purpose of research, scientific methods, role of theory, characteristics of research. 2 Types of research: fundamental, applied, historical and experimental research. 3 Chemical literature: primary, secondary and tertiary sources of literature. Classical and comprehensive reference. Literature databases: ScienceDirect, SciFinder. Chemical Abstract. 4 Scientific writing: research reports, thesis, journal articles, books. Types of publications: articles, communications, reviews. Important scientific and Chemistry Journals. Impact factor.	**9 Hrs**	Dr Joseph T. Moolayil	Lecture Assignments and seminar	1.R.L. Dominoswki, Research Methods, Prentice Hall, 1981. 2.J.W. Best, J.V. Kahn, Research in Education, 10th Edn., Pearson/Allyn&Bacon ,2006. 3.. H.F. Ebel, C. Bliefert, W.E. Russey, The Art of Scientific Writing, Wiley-VCH, 2004.
3.	**Unit 2: Green Alternatives to Organic Synthesis** 1 Principles of Green Chemistry: basic concepts, atom economy, twelve principles	**3 Hrs**			V.K. Ahluwalia, Green Chemistry, Ane Books, 2009.

	of Green Chemistry, principles of green organic synthesis. 2 Green alternatives to Organic Synthesis: coenzyme catalysed reactions, thiamine catalyzed benzoin condensation.		Dr Joseph T. Moolayil	Lecture Assignments and seminar	
4	**Unit 5: Chemistry of Natural Products and Biomolecules** .1 Basic aspects of structure and classification of carbohydrates, terpenoids,alkaloids, steroids, plant pigments, lipids, vitamins, amino acids, proteins and nucleic acids. Nomenclature of prostaglandins. 2 Synthesis of camphor, atropine, papaverine, quinine, cyanin, quercetin,, β-carotene, testosterone, PGE_2 and $PGF_{2\alpha}$. 3 Methods for primary structure determination of peptides, proteins and nucleic acids.	**12 Hrs**	Dr M. George	Lecture Assignments and seminar	1.J.M. Berg, J.L. Tymoczko, L. Stryer, Biochemistry, 6th Edn., W.H. Freeman, 2010. 2.A.L. Lehninger, D.L. Nelson, M.M. Cox, Lehninger Principles of Biochemistry, 5th Edn., W.H. Freeman, 2008. . J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press, 2004.
5	**Unit7: Advances in Polymer Chemistry** 1 Conducting polymers, polymers for NLO applications, temperature resistant and flame retardant polymers, polymers for medical applications. .2 Dendrimers and dendritic polymers: terminology, classification of dendrimers. Methods of synthesis: convergent and divergent approaches. Dendrimers as nanocapsules.	7 Hrs	June Cyriac	Lecture Assignments and seminar	

*ICT enabled, Lecture method (conventional)

	Term – II – 40 % of the syllabus (before the second Internal tests)				
Sl No	Topic/Module	Hour/ session	Teacher/invited persons etc.	Method of teaching *	Remarks: Books, reference etc

1	**Unit 1: Molecular Recognition and Supramolecular Chemistry** Tweezers,carcerands, cyclophanes, calixarenes, carbon nanocapsules. Importance of molecular recognition in biological systems like DNA and protein. Controlled release phenomena.	8 Hrs	Dr V.S Sebastian	Lecture Assignments and seminar	01. J.M. Lehn, Supramolecular Chemistry: Concepts and Perspectives, VCH, 1995. 02. F. Vogtle, Supramolecular Chemistry: An Introduction, Wiley, 1993.
2	**Unit 2: Green Alternatives to Organic Synthesis** **1.**Electrophilic aromatic substitution reactions. Oxidation-reduction reactions. Clay catalysed synthesis. Condensation reactions. Green photochemical reactions. 2 Green Solvents: ionic liquids, supercritical CO_2, fluorous chemistry. 3 General principles of microwave and ultrasound assisted organic synthesis**..** **4.** Green alternatives of molecular rearrangements: pinacol-pinacolone and benzidine rearrangements.	7 Hrs	Dr Joseph T. Moolayil	Lecture Assignments and seminar	V.K. Ahluwalia, Green Chemistry, Ane Books, 2009.
3.	**Unit 4: Stereoselective Transformations** 4.1 Assymmetric induction-chiral auxiliaries and chiral pool. 4.2 Enantioselective catalytic hydrogenation developed by Noyori and Knowels.	**5 Hrs**	Dr Joseph T. Moolayil	Lecture Assignments and seminar	1.W. Carruthers, I.Coldham, Modern Methods of Organic Synthesis, Cambridge University Press, 2004. 02. J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press, 2004. 03. R.O.C. Norman, J.M. Coxon, Principles of Organic Synthesis, Blackie Academic and Professional, 1993.

4	**Unit 5: Chemistry of Natural Products and Biomolecules** Replication of DNA, flow of genetic information, protein biosynthesis, transcription and translation, Genetic code, regulation of gene expression, DNA sequencing. The Human Genome Project. DNA profiling and the Polymerase Chain Reaction (PCR).	6 Hrs	Dr M. George	Lecture Assignments and seminar	1.J.M. Berg, J.L. Tymoczko, L. Stryer, Biochemistry, 6th Edn., W.H. Freeman, 2010. 2.A.L. Lehninger, D.L. Nelson, M.M. Cox, Lehninger Principles of Biochemistry, 5th Edn., W.H. Freeman, 2008. . J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press, 2004.
5	**Unit 6: Medicinal Chemistry and Drug Designing (9 Hrs)** 1 Introduction to Drug design: modeling techniques, receptor proteins, drugreceptor interaction, drug action, drug selectivity, drug metabolism. 2 Important chemicals used in drug action, anticoagulants and anticoagulant therapy, anti-anginal drugs, antihypertensive agents, antimalarial drugs, aminoquinolines and alkaloids	6 Hrs	Dr M. George	Lecture Assignments and seminar	V.K. Ahluwalia, M. Chopra, Medicinal Chemistry, Ane Books, 2008. J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press, 2004.
6	**Unit7: Advances in Polymer Chemistry** Applications of dendrimers. Hyperbranched polymers: definition, synthesis, applications.	2 Hrs	June Cyriac	Lecture Assignments and seminar	
7	**Unit 3: Principles of Nanochemistry ()** 3.1 Basic principles of Nanochemistry: methods of synthesis of Nanomaterials (basic	**6 Hrs**	June Cyriac	Lecture Assignments and seminar	T. Pradeep, Nano: the Essentials, Tata McGraw Hill, 2007.

	idea only). Characterisation of Nanomaterials: UV-Visible spectroscopy, SEM, TEM, STM, (principles only).				

*ICT enabled, Lecture method (conventional)

	Term – III – 30 % of the syllabus (before the model examination)				
Sl No	Topic/Module	Hour/ session	Teacher/invited persons etc.	Method of teaching *	Remarks: Books, reference etc
1	**Unit 1: Molecular Recognition and Supramolecular Chemistry** Applications of supramolecular complexes in perfumery and medicine. Targeted drug delivery.	2 Hrs	Dr V.S Sebastian	Lecture Assignments and seminar	01. J.M. Lehn, Supramolecular Chemistry: Concepts and Perspectives, VCH, 1995. 02. F. Vogtle, Supramolecular Chemistry: An Introduction, Wiley, 1993.
2	**Unit 4: Stereoselective Transformations** 1.Assymetric aldol condensation pioneered by Evans. 2.Assymmetric Diels-Alder reactions. 3.Assymmetric epoxidation using Jacobsen's catalyst	4 Hrs	Dr Joseph T. Moolayil	Lecture Assignments and seminar	1.W. Carruthers, I.Coldham, Modern Methods of Organic Synthesis, Cambridge University Press, 2004. 02. J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press, 2004. 03. R.O.C. Norman, J.M. Coxon, Principles of Organic Synthesis, Blackie Academic and Professional, 1993.

3	Antibiotics: Important penicillins, chloramphenicol, tetracyclins and cephalosporins. Drugs for cancer, AIDS and diabetes.	3 Hrs	Dr M. George	Lecture Assignments and seminar	V.K. Ahluwalia, M. Chopra, Medicinal Chemistry, Ane Books, 2008. J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press, 2004.
4	**Unit 3: Principles of Nanochemistry** Characterisation of Nanomaterials , XRD (principles only). Applications of nanomaterials in medicine.	3 Hrs	June Cyriac	Lecture Assignments and seminar	T. Pradeep, Nano: the Essentials, Tata McGraw Hill, 2007.

*ICT enabled, Lecture method (conventional)