



# C. ABDUL HAKEEM COLLEGE

Melvisharam, Vellore Dist- 632509, TN, India

Telephone : +91 4172 266487, 266987 | Fax : +91 4172 266587

Web : [www.hakeemcollege.com](http://www.hakeemcollege.com)

## SUBJECT LIST

**Course** M.Sc - Chemistry

**Batch** 2015-2016

**Total Credits** 90

S.No	E/D	Cate.	Type	S. Code	S. Name	I.Ma	I.Mi	E.Ma	E.Mi	P	M	Cr	Pt
<b>Semester - 1</b>					<b>Subject Count - 4</b>	<b>Total Credits - 15</b>							
1	E	Theory	Main	P15MCH101	Stereochemistry & Substitution Reactions	25	0	75	38	50	4	III	
2	E	Theory	Main	P15MCH102	Structural & Coordination Chemistry	25	0	75	38	50	4	III	
3	E	Theory	Main	P15MCH103	Physical Chemistry - I	25	0	75	38	50	4	III	
4	E	Theory	Elective	P15ECH101	Polymer Chemistry (Elective)	25	0	75	38	50	3	III	
<b>Semester - 2</b>					<b>Subject Count - 8</b>	<b>Total Credits - 30</b>							
1	E	Theory	Main	P15MCH201	Organic Reaction Mechanisms	25	0	75	38	50	3	III	
2	E	Theory	Main	P15MCH202	Solid State & Nuclear Chemistry	25	0	75	38	50	3	III	
3	E	Theory	Main	P15MCH203	Physical Chemistry - II	25	0	75	38	50	4	III	
4	E	Theory	Elective	P15ECH201	Green Chemistry (Elective)	25	0	75	38	50	3	III	
5	E	Practical	Main	P15MCHP21	Practical - I Organic Chemistry - I	40	0	60	30	40	5	III	
6	E	Practical	Main	P15MCHP22	Practical - II Inorganic Chemistry - I	40	0	60	30	40	5	III	
7	E	Practical	Main	P15MCHP23	Practical - III Physical Chemistry - I	40	0	60	30	40	5	III	
8	E	Theory	Main	P15CHR201	Human Rights	25	0	75	38	50	2	VII	



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## SUBJECT LIST

Course **M.Sc - Chemistry**

Batch **2015-2016**

Total Credits **90**

S.No	E/D	Cate.	Type	S. Code	S. Name	I.Ma	I.Mi	E.Ma	E.Mi	P	M	Cr	Pt
<b>Semester - 3</b>					<b>Subject Count - 4</b>	<b>Total Credits - 15</b>							
1	E	Theory	Main	P15MCH301	Organic Spectroscopy & Natural Products	25	0	75	38	50	4	III	
2	E	Theory	Main	P15MCH302	Organometallics & Coordination Chemistry	25	0	75	38	50	4	III	
3	E	Theory	Main	P15MCH303	Physical Chemistry - III	25	0	75	38	50	4	III	
4	E	Theory	Elective	P15ECH301	Scientific Research Methodology (Elective)	25	0	75	38	50	3	III	
<b>Semester - 4</b>					<b>Subject Count - 7</b>	<b>Total Credits - 30</b>							
1	E	Theory	Main	P15MCH401	Photochemistry & Bioorganic Chemistry	25	0	75	38	50	4	III	
2	E	Theory	Main	P15MCH402	Inorganic Spectroscopy & Analytical Techniques	25	0	75	38	50	4	III	
3	E	Theory	Main	P15MCH403	Physical Chemistry - IV	25	0	75	38	50	4	III	
4	E	Theory	Elective	P15ECH401	Environmental Chemistry (Elective)	25	0	75	38	50	3	III	
5	E	Practical	Main	P15MCHP41	Practical - IV Organic Chemistry - II	40	0	60	38	50	5	III	
6	E	Practical	Main	P15MCHP42	Practical - V Inorganic Chemistry - II	40	0	60	38	50	5	III	
7	E	Practical	Main	P15MCHP43	Practical - VI Physical Chemistry - II	40	0	60	38	50	5	III	

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Syllabus for M.Sc., Chemistry effective from the year 2015-2016

Year: I Year                      Subject Code : P15MCH101                      Semester : I

Major - 1 Title: **Stereochemistry and Substitution Reactions**

Credits: 4 Max. Marks: 75

## OBJECTIVES:

To learn the concepts of stereochemistry, conformational analysis and their application in the determination of reaction mechanism. To understand the mechanism of nucleophilic and electrophilic substitution reactions.

## UNIT-I: STEREOCHEMISTRY

Optical activity and chirality, Classification of chiral molecules as asymmetric and dissymmetric. Dissymmetry of allenes, biphenyls, spiro compounds, trans cyclooctane and cyclononene and molecules with helical structures. Absolute configuration - R, S notation of biphenyls and allenes. Fischer projection. Inter conversion of Sawhorse, Newmann and Fischer projections. Molecules with more than one asymmetric center (restricted to five carbons), erythro and threo compounds. Asymmetric synthesis, Cram's rule.

Geometrical isomerism. E, Z nomenclature of olefins, Geometrical and optical isomerism (if shown) of disubstituted cyclopropane, cyclobutane and cyclopentanes. Stereo specific and stereo selective reactions.

## UNIT-II: CONFORMATIONAL ANALYSIS

Conformational analysis of disubstituted cyclohexane and Conformation and reactivity of substituted cyclohexanol (oxidation and acylation), cyclohexanone (reduction) and cyclohexane carboxylic acid derivatives (esterification and hydrolysis). Conformation and stereochemistry of cis and trans decalin and 9 - methyldecalin.

## UNIT-III: ALIPHATIC NUCLEOPHILIC AND ELECTROPHILIC SUBSTITUTION REACTIONS

S<sub>N</sub>1, S<sub>N</sub>2 and S<sub>N</sub>i mechanisms - Neighbouring group participation - reactivity, structural and solvent effects - substitution in norbornyl and bridgehead systems - substitution at allylic and vinylic carbons - substitution by ambident nucleophiles - substitution at carbon doubly bonded to oxygen and nitrogen - alkylation and acylation of amines, halogen

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exchange, Von-Braun reaction, alkylation and acylation of active methylene carbon compounds, hydrolysis of esters.

$S_E1$ ,  $S_E2$  and  $S_Ei$  mechanism, double bond shift - Reactivity. Migration of double bond, keto-enol interconversion, HVZ reaction, Stark-Enamine reaction, halogenation of aldehydes and ketones and decarboxylation of aliphatic acids.

#### **UNIT-IV: AROMATIC ELECTROPHILIC SUBSTITUTION REACTIONS**

The arenium ion mechanism. Orientation and reactivity. Typical reactions - nitration, halogenation, alkylation, acylation and diazonium coupling, Formylation, Reimer - Tieman reaction, Vilsmeier - Haack, Gattermann, Gattermann - Koch, Kolbe reaction. Synthesis of di and tri substituted benzene (symmetrical tribromo benzene, 2-amino-5-methylphenol, 3-nitro-4-bromobenzoic acid, 3,4-dibromonitrobenzene, 1,2,3 - trimethylbenzene) starting from benzene or any monosubstituted benzene.

#### **UNIT-V: AROMATIC NUCLEOPHILIC SUBSTITUTION REACTIONS & DETERMINATION OF REACTION MECHANISM**

Methods for the generation of benzyne intermediate and reactions of arynes intermediate. Nucleophilic substitution involving diazonium ions. Aromatic Nucleophilic substitution of activated halides. Ziegler alkylation. Chichibabin reaction.

Kinetic and non-kinetic methods of determining organic reaction mechanism.

Hammett and Taft equations - Simple Problems.

#### **Recommended Books**

1. **Organic Synthesis** by R.O.C. Norman, Chapman and Hall, NY, (1980).
2. **Physical Organic Chemistry** by Niel Isaacs, ELBS Publications (1987).
3. **Organic Reaction Mechanism** by S.M. Mukherji and S.P. Singh, MacMillan India Ltd., Chennai (1990).
4. **Organic Chemistry** IV Edition by Stanley Pines.
5. Structures and Mechanism by E.S. Gould
6. Advanced Organic Chemistry, Part A and B, by Francis A. Carey and Richard J. Sundberg, 3<sup>rd</sup> Edition (1990), Plenum Press.
7. Aromatic Nucleophilic Substitution by J. Miller
8. Advanced Organic Chemistry III Edition by J. Miller

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9. Reactive Molecules, C. Wentrup, John Wiley and Sons, New York (1984)
10. Advanced organic reaction mechanism and structure by J. March, Tata McGraw Hill.
11. Organic Chemistry, Marc London
12. Organic Chemistry, Mc Murray
13. Organic Chemistry, Graham Solomons
14. Carbenes, Nitrenes and Arynes by T.L. Gilchrist and C.W. Rees, Thomas Nelson and Sons Ltd., London.
15. Stereochemistry, Conformation analysis and Mechanism by P.S. Kalsi, 2<sup>nd</sup> Edition (1993), Wiley Eastern Limited, Chennai.
16. Stereochemistry of carbon compounds by Ernest Eliel
17. Stereochemistry and Mechanism through solved problems by P.S. Kalsi. Wiley Eastern Ltd., (1994)
18. Basic principles of Organic Stereochemistry by P. Ramesh - Madurai Kamaraj University.
19. Organic Reaction Mechanism by R.K. Bansal.
20. A Guide book to mechanism in organic chemistry by Longman.
21. Structure and mechanism in organic chemistry by C.K. Ingold, Cornell University press.

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2015-2016

Year:	I Year	Subject Code :	P15MCH102	Semester :	I
Major - 2	Title:	<b>Structural and Coordination Chemistry</b>			
Credits:	4	Max. Marks. 75			

### **OBJECTIVES:**

To learn about the inorganic polymers. To study the concept of Coordination Chemistry, stability and stereochemistry of complexes. To study about structure and bonding of some inorganic compounds.

### **UNIT-I: STRUCTURE & BONDING - I**

Polyacids: Isopolyacids and heteropolyacids of vanadium, molybdenum and Tungsten. Applications of silicates as - Molecular sieves, Feldspar, Zeolites and ultramarines. polysulphur - nitrogen compounds and poly - organophosphazenes.

### **UNIT-II: STRUCTURE & BONDING - II**

Boron hydrides: Polyhedral boranes, Structure prediction of boranes by PSEPT (Wade- Mingos Rule) hydroboration, carboranes and metallo – carboranes.

Metal clusters: Chemistry of di and tri nuclear metal Clusters.

### **UNIT-III: COORDINATION CHEMISTRY I**

Stability of complexes; thermodynamic aspects of complex formation; factors affecting stability, HSAB approach.

Determination of stability constants by spectrophotometric, polarographic and potentiometric methods.

### **UNIT-IV: COORDINATION CHEMISTRY II**

Stereochemical aspects; Stereoisomerism in inorganic complexes; isomerism arising out of ligand distribution and ligand conformation; chirality and nomenclature of chiral complexes; optical rotatory dispersion and circular dichroism.

Macrocyclic ligands; types; porphyrins; corrins, Schiff bases; crown ethers.

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### **UNIT-V: COORDINATION CHEMISTRY III**

Evidence for metal-ligand orbital overlap, molecular orbital theory and energy level diagrams, concept of weak and strong field ligands, Jahn-Teller distortion, charge - transfer spectra.

Term states for  $d^2$ , ground state term symbols for  $d^n$  ions - energy diagrams, d-d transitions, Orgel and Sugano - Tanabe diagrams, spin orbit coupling, nephelauxetic effect, spectral and magnetic characteristics of transition metal complexes.

#### **Text Books**

1. FA Cotton and G.W. Wilkinson, **Advanced Inorganic Chemistry**– Acomprehensive Text, John Wiley and Sons, (1988).
2. J.E. Huheey, **Inorganic Chemistry**, Harper and Collins, NY, IV Edition, (1993).
3. K.F. Purcell and J.C. Kotz, **Inorganic Chemistry** WB Saunders Co., USA, (1977).
4. M.C. Shrivvers, P.W Atkins, CH. Langford, **Inorganic Chemistry**, OUP, (1990).
5. N.N. Greenwood and Earnshaw, **Chemistry of the Elements**, Pergamon Press, New York (1984).
6. NH Ray, **Inorganic Polymers**, Academic Press, (1978)
7. S.F.A. Kettle, **Coordination Chemistry**, ELBS, (1973).

#### **Suggested References**

1. A.B.P. Lever, **Inorganic Electronic Spectroscopy**, II Edn., Elsevier, New York, (1984).
2. B.E. Dogulas DH McDaniel's and Alexander, **Concepts and Models of Inorganic Chemistry**, Oxford IBH, (1983).
3. B.N. Figgis, **Introduction to Ligand Fields**, Interscience, (1966).
4. EL. Mutterties, **Polyhedral Boranes**, Academic Press, New York (1975).
5. M.C. Day and J. Selbin, **Theoretical Inorganic Chemistry**, Van Nostrand Co., NY, (1974).
6. WU. Mallik, G.D. Tuli, R.D. Madan, **Selected topics in Inorganic Chemistry**, S. Chand and Co., New Delhi, (1992).

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2015-2016

Year:	I Year	Subject Code :	P15MCH103	Semester :	I
Major - 3	Title:	<b>Physical Chemistry - I</b>			
Credits:	4	Max. Marks. 75			

### **OBJECTIVES:**

To study the partial molar property, fugacity, and its significance. Theories and basic concepts of chemical kinetics, mechanism of acid – base and enzyme catalysis. Basic concepts of rotational spectroscopy and Elements of group theory.

### **UNIT – I: THERMODYNAMICS**

Partial molar quantities – Chemical potential, partial molar volume and partial molar heat content – their significance and determination – variation of chemical potential with temperature and pressure.

Concept of Fugacity – determination of fugacity – Variation of fugacity with temperature and pressure. Duhem – Margules equation.

Concept of activity and activity coefficient – choice of standard state – determination of activity coefficient for non-electrolyte.

### **UNIT – II: CHEMICAL KINETICS**

ARRT – Thermodynamic approach – Eyring equation – Estimation of free energy, enthalpy and entropy of activation and their significance – Statistical treatment of ARRT – Partition function – Transmission coefficient.

Application of ARRT to reaction in solutions – Effect of pressure, dielectric constant and ionic strength on reaction rate in solutions – Jerrum – Bronsted equation - Kinetic isotopic effect – Linear free energy relationships – Hammett and Taft equation.

### **UNIT – III: CATALYSIS**

Acid – Base catalysis – mechanism of acid – base catalysis – bronsted catalysis law.

Catalysis by enzymes – rate of enzyme catalysed reaction – Effect of substrate concentration, pH and temperature on enzyme catalysed reaction – Inhibition of enzyme catalysed reaction.

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### **UNIT – IV: SPECTROSCOPY – I**

Interaction of radiation with matter – Einstein's transition probabilities – Rotational spectroscopy - Rigid rotor model – Non-rigid rotor – rotational energies of diatomic molecules, determination of moment of inertia and bond lengths - relative intensities of spectral lines, rotational spectra of polyatomic molecules.

### **UNIT – V: GROUP THEORY – I (Basic Concepts)**

Symmetry elements and symmetry operations, Group postulates, Types of groups – sub groups, Abelian and non – abelian groups, order of a group – point groups – Group multiplication table for  $C_{2v}$  and  $C_{3v}$  point groups, similarity transformation and classes, Representations – reducible and irreducible representation, Direct product representation.

#### **Text Books**

1. S. Glasstone, Thermodynamics for Chemists, Affiliated East West Press, New Delhi (1950).
2. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, Lal Nagin Chand, New Delhi (1986).
3. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanism of Chemical Transformations. Mac Millan India Ltd (1993).
4. R.J. Laidler, Chemical Kinetics, Harper and Row, New York (1987).
5. K.V. Ramakrishnan and M.S. Gopinath, Group Theory in Chemistry, Vishal Publications (1998).

#### **Suggested References:**

1. Raymond charg, Basic Principles of spectroscopy, McGraw Hill ltd, New York (1971)
2. G.M. Barrow, Introduction to molecular spectroscopy, McGraw Hill, New York (1962)
3. C.N. Banwell, Fundamentals of Molecular spectroscopy, McGraw Hill (1966)
4. W.J. Moore, Physical chemistry, orient Lengman, London (1972)
5. L.K. Nash, Elements of Chemical thermodynamics, Addison Wesley (1962)
6. R.G. Frost and Pearson, Kinetics and mechanism, Wisely, New York (1961)
7. P.K. Bhattacharya, Group theory and its Applications, Himalaya Publishers.

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Syllabus for M.Sc., Chemistry effective from the year 2015-2016

Year: I Year                      Subject Code : P15ECH101                      Semester : I

Elective - 1 Title: **Polymer Chemistry (Elective)**

Credits: 3 Max. Marks: 75

### OBJECTIVES:

To gain the knowledge in the preparation, properties, characterization and uses of polymers.

## UNIT- I: BASIC CONCEPTS

Classification – Nomenclature and isomerism – functionality – Molecular forces and chemical bonding in polymers – Linear, branched and cross linked polymers. Thermoplastic and thermosetting polymers – Elastomers, Fibers and resins.

## Techniques of polymerization—emulsion, bulk, solution and suspension.

## UNIT- II: KINETICS AND MECHANISM

Kinetics and Mechanism of polymerization – free radical, cationic, anionic and coordination polymerization (Ziegler - Natta Catalyst) – Copolymerisation – Kinetics–Kinetic chain length–degree of polymerization, chain transfer reagents - initiators – inhibitors – retarders. Living polymers – group transfer polymerisation.

## UNIT – III

### A) Structure and Properties

Structure - property relationship – Mechanical properties, Thermal properties – Glass transition temperature – Factors affecting Glass transition temperature- Glass transition temperature of copolymers-Glass transition temperature and melting point- Importance.

## B) Molecular Weight Determination

Average molecular weight- Number average and Weight average molecular weight-  
Determination of molecular weight – Ultracentrifuge, Osmometry, Viscosity and light  
scattering method.

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### **UNIT – IV: INDUSTRIAL NATURAL POLYMERS**

Important industrial polymers – preparation and application of polyethylene, poly vinyl chloride, poly urethanes, polytetrafluoro ethylene, poly acrylonitrile, Nafion and ion-exchange resins.

Importance of Natural polymers – application and structure of Starch, Cellulose and Chitosan derivatives.

### **UNIT – V: SPECIALITY POLYMERS**

Bio polymers – biodegradable polymers – biomedical polymers – poly electrolytes - conducting polymers – high temperature and fire retardant polymers - polymer blend – polymer composites – polymer nanocomposites – inter penetrating network polymers – Electroluminescent polymers.

#### **Text Books:**

1. F. W. Bill Meyer. Text book of polymer science, III Edition, John Wiley and sons, New York.
2. P. J. Flory. Principles of Polymer Chemistry, Cornell Press (recent edition).
3. V. R. Gowarikar, B. Viswanathan, J. Sridhar, Polymer Science – Wiley Eastern, 1986.
4. G. S. Misra – Introduction to Polymer Chemistry, Wiley Eastern Ltd.,
5. P. Bahadur, N. V. Sastry, Principles of Polymer Science, Narosa Publishing House.
6. G. Odian, Principles of Polymerization, McGraw Hill Book Company, New York, 1973.

#### **Suggested References**

1. Rudin, The Elements of Polymer Science and Engineering. Academic Press, New York, 1973.
2. E. A. Coolins, J. Bares and E. W. Billmeyer, Experiments in Polymer Science, Wiley Interscience, New York, 1973.

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Syllabus for M.Sc., Chemistry effective from the year 2015-2016

Year:	I Year	Subject Code :	P15MCH201	Semester :	II
Major - 4	Title:	<b>Organic Reaction Mechanisms</b>			
Credits:	3	Max. Marks. 75			

### OBJECTIVES:

To learn the various types of reactions, rearrangements and their synthetic utility, Aromaticity, Nitrenes and Carbenes.

### UNIT-I: ADDITION TO CARBON - CARBON AND CARBON – HETERO MULTIPLE BONDS

Electrophilic, nucleophilic and neighbouring group participation mechanisms - addition of halogen and nitrosyl chloride to olefins. Hydration of olefins and acetylenes. Hydroboration, hydroxylation, Michael addition, 1, 3 - dipolar additions, Carbenes and their additions to double bonds -Simon - Smith reaction. Mannich, Stobbe, Darzen, Wittig, Wittig - Horner and Benzoin reactions.

### UNIT-II: ELIMINATION REACTIONS

E<sub>1</sub>, E<sub>2</sub> and E<sub>1c</sub>B mechanism - E<sub>1</sub>, E<sub>2</sub> and E<sub>1c</sub>B spectrum - Orientation of the double bond - Hoffmann and Saytzeff rules - Competition between elimination and substitution. Typical eliminations reactions - dehydration, dehydrohalogenation and dehalogenation. Stereochemistry of E<sub>2</sub> eliminations in cyclohexane systems. Mechanism of pyrolytic eliminations. Chugaev and Cope eliminations.

### UNIT-III: OXIDATIONS AND REDUCTIONS

Mechanism - oxidation of alcohols - use of DMSO in combination with DCC and acetic anhydride in oxidising alcohols - oxidation of methylene to carbonyl, oxidation of aryl methenes - allylic oxidation of olefins. Ozonolysis - oxidation of Olefinic double bonds and unsaturated carbonyl compounds-oxidative cleavage of C-C bond. Reduction: Selectivity in reduction of 4-t-butylcyclohexanone using selecterides. Hydride reductions - reduction with LiAlH<sub>4</sub>, NaBH<sub>4</sub>, tritertiarybutyloxyaluminium hydride, sodium cyanoborohydride, trialkyltin hydride, hydrazines.

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### **UNIT-IV: MOLECULAR REARRANGEMENTS**

A detailed study with suitable examples of the mechanism of the following rearrangements: Pinacol - Pinacolone - Wagner - Meerwein, Demjanov, Dienone - phenol, Favorski, Baeyer - Villiger, Wolf, Stevens (in cyclic systems) and Von Richter rearrangements.

### **UNIT -V: AROMATICITY, CARBENES & NITRENES**

Aromaticity of benzenoid, heterocyclic, and non-benzenoid compounds, Huckel's rule - Aromatic systems - non-aromatic (cyclo octatetraene etc.) and anti aromatic system (cyclobutadiene etc.) - system with more than 10 $\pi$  electrons - Annulenes upto C<sub>18</sub> (synthesis of all these compounds is not expected).

Carbenes and nitrenes: Methods of generation, structure, addition reactions with alkenes - insertion reactions.

#### **Recommended Books**

1. Principles of organic synthesis R.O.C. Norman, Chapman and Hall, London. 1980.
2. Structure and Mechanism by E.S. Gould
3. Advanced Organic Chemistry - Part B by Francis A. Carey and Richard J, Sundberg, 3<sup>rd</sup> Edition 1990.
4. Organic Reaction Mechanism by S.M. Mukherji and S.P. Singh, MacMillan India Ltd., Chennai - 1990.
5. Organic synthesis by Michael Smith.
6. Carbenes, Nitrenes and Arynes by T.L. Gilchrist and C.W. Rees, Thomas Nelson and Sons Ltd., London.
7. Molecular Rearrangements Vol-I and Vol-II by Paul de Mayo.
8. Advanced Organic Chemistry III Edition by J. March.
9. Stereochemistry and Mechanism through solved problems by P.S. Kalsi, Wiley Eastern Ltd., 1994.
10. Some Modern Methods of Organic Synthesis by W Carruthers, III Edition, Cambridge University Press, 1993.
11. Modern Synthetic Reactions by H.O. House, The Benjamin Cummings Publishing Company, London, 1972
12. Advanced organic chemistry, Mc Murray, Thomas Pvt. Ltd.,
13. Organic reaction mechanisms: Parmer and Chawla, S. Chand and Co.,

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Syllabus for M.Sc., Chemistry effective from the year 2015-2016

Year:	I Year	Subject Code :	P15MCH202	Semester :	II
Major - 5	Title:	<b>Solid State &amp; Nuclear Chemistry</b>			
Credits:	3	Max. Marks. 75			

### **OBJECTIVES:**

To study about the theories of coordination complexes, Chemistry of lanthanides, to learn about Nanotechnology and use of Inorganic Compounds in Biological Chemistry.

### **UNIT-I: THE CHEMISTRY OF SOLID STATE**

Structure of Solids; Comparison of X-ray and Neutron Diffraction; structure of Pervoskite, cadmium iodide and nickel arsenide; spinels and reverse spinels; defects in solids, stoichiometric and non-stoichiometric compounds.

Electrical, Magnetic and optical properties of solids. Band theory, semiconductors, superconductors, solid state electrolytes. Types of magnetic behaviour, dia, para, ferro, antiferro and ferrimagnetism: Hysteresis. Solid state lasers, inorganic phosphors, ferrites.

### **UNIT- II: NUCLEAR CHEMISTRY I**

Nuclear properties: Nuclear spin and moments, origin of nuclear forces, salient features of the liquid drop and the shell models of the nucleus.

Modes of Radioactive Decay: orbital electron capture: nuclear isomerism, internal conversion, detection and determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M, Scintillation and Cherenkov counters.

Nuclear Reactions: Types, reactions, cross section, Q-value, threshold energy, compound nucleus theory: high energy nuclear reactions, nuclear fission and fusion reactions as energy sources; direct reactions; photonuclear and thermo nuclear reactions.

### **UNIT-III: NUCLEAR CHEMISTRY II**

Stellar energy: synthesis of elements, hydrogen burning, carbon burning. Nuclear Reactors: fast breeder reactors, particle accelerators, linear accelerators, cyclotron and synchrotron.

Radio Analytical Methods: Isotope dilution analysis, Radiometric Titrations, Radio Immuno Assay and Neutron Activation Analysis.

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### **UNIT-IV: THE CHEMISTRY OF LANTHANIDES, ACTINIDES AND NANOTECHNOLOGY**

Chemistry of lanthanides and actinides, oxidation state spectral, magnetic characteristics, coordination numbers, stereochemistry, nuclear and non-nuclear applications.

Nanotechnology - introduction - preparatory methods, characterization, application as sensors, biomedical applications, application in optics and electronics.

### **UNIT-V: BIOINORGANIC CHEMISTRY**

Transport proteins: oxygen carriers, metalloenzymes, carboxy peptidase, carbonic anhydrase, iron-sulphur proteins, chlorophyll, salient features of the photo synthetic process, vitamin B<sub>12</sub>. Fixation of nitrogen, nitrogen cycle.

Anti-cancer drugs and their mechanism of action, natural and man-made radio isotopes and their applications in medicine.

#### **Text Books:**

1. A.R. West, **Basic solid state chemistry**, John Wiley, (1991).
2. S. Glasstone, **Source Book on Atomic Energy**, Van Nostrand Co., (1969).
3. G. Frieland, J.w. Kennedy and J.M. Miller, **Nuclear and Radiochemistry**, John Wiley and Sons, (1981).
4. Hari Jeevan Arnikaar , **Essentials of nuclear chemistry**, New Age International (P) Ltd., (2005).
5. Hari Jeevan Arnikaar, **Nuclear Chemistry Through Problems**, New Age International (P) Ltd., (2007).
6. G.T. Seaborg, **Trans uranium elements**, Dowden Hutchinson and Ross, (1978).
7. Nishit Mathur, **Nano chemistry**, RBSA publishers (2010).
8. Patrick Salomon, **A hand book on Nano Chemistry**, Dominant publishers and distributors (2008).
9. G.B. Sergeev , **Nano chemistry** ,Elsevier Science and Technology (2007).
10. U. Saityanarayana, **Essentials of Biochemistry**, Books and Allied (P) Ltd.,

#### **Suggested References:**

1. W.E. Addison, **Structural principle in Inorganic chemistry**, Longman (1961).
2. D.M. Adams, **Inorganic solids**, John Wiley Sons (1974).
3. Azaroff, **Solid State Chemistry**, John Wiley.

### **C. Abdul Hakeem College (Autonomous), Melvisharam.**

4. B.E. Douglas DH McDaniel's and Alexander, **Concepts and Models of Inorganic Chemistry**, Oxford IBH, (1983).
5. M.C. Day and J. Selbin, **Theoretical Inorganic Chemistry**, Van Nostrand Co., New York (1974).
6. J.E. Huheey, **Inorganic Chemistry - Principles, Structure and Reactivity**, Harper Collins, New York, IV Edition (1993).
7. N. Greenwood and A. Earnshaw, **Chemistry of Elements**, Pergamon, NY, (1984).
8. F.A. Cotton and G. Wilkinson, **Advanced Inorganic Chemistry - A Comprehensive Text**, John Wiley and Sons, V Edition (1988).
9. K.F. Purcell and J.C. Kotz, **Inorganic Chemistry** - WB Saunders Co., USA (1977)
10. W.U. Malik, G.D. Tuli, R.D. Madan, **Selected topics in Inorganic Chemistry**, S. Chand and Co., New Delhi, (1992).
11. M.N. Hughes, **The Inorganic Chemistry of Biological processes**, Wiley London, II Edition (1982).
12. Jonathan W. Stead, David R. Turner and Karl J. Wallace., **Core concepts in Supramolecular Chemistry and Nano chemistry**, John Wiley sons Ltd (2007).
13. Beoffry A.Ozin, Andre Arsenault, Ludovico & Cademartiri. **Nano chemistry - A chemical approach to nano materials**, Royal Society of chemistry (2009).
14. Kenneth J. Klabunde, **Nano scale materials in Chemistry** A. John Wiley & Sons Publishers (2001).
15. L. Stryer, **Biochemistry** Edition, Freeman & Co., New York (2002) .
16. D. L. Nelson and M.M. Cox, Lehninger, **Principles of Biochemistry**, III edition, McMillan North Publication (2002).
17. W. Kaim and B. Schwederski, **Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, an Introduction and Guide**, Wiley, New York (1995).
18. S. J. Lippard and J. M. Berg, **Principles of Bioinorganic Chemistry**, University Science Books (1994).
19. I. Bertini, H. B. Grey, S. J. Lippard and J. S. Valentine, **Bioinorganic Chemistry**, Viva Books Pvt. Ltd., New Delhi (1998).

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2015-2016

Year:	I Year	Subject Code :	P15MCH203	Semester :	II
Major - 6	Title:	<b>Physical Chemistry - II</b>			
Credits:	4	Max. Marks. 75			

### **OBJECTIVES:**

To study the various types of molecular spectroscopy, basic concepts of electrochemistry, fundamental principles of Quantum Chemistry. Debye-Huckel limiting law – To study kinetics of complex reactions, the applications of Group theory.

### **UNIT – I: ELECTRO CHEMISTRY – I**

Mean ionic activity and mean ionic activity coefficient – concept of ionic strength – Debye –Huckel theory of strong electrolytes – activity coefficient of strong electrolytes – Determination of activity coefficient by electrochemical method.

Debye-Huckel limiting law – qualitative and quantitative verification – Debye – Huckel limiting law at appreciable concentrations of electrolytes – Huckel equation – Debye-Huckel Bronsted equation.

### **UNIT – II: SPECTROSCOPY – II**

Vibrational spectroscopy – harmonic oscillator – unharmonicity – vibrational spectra of polyatomic molecules – vibrational frequencies – vibrational coupling – overtones - Fermi resonance.

Raman spectra – Raman effect – rotational and vibrational Raman spectra.

Electronic spectra – Frank-Condon Principle – Types of electronic transitions – Selection Rules – Solvent effects on electronic transitions.

### **UNIT – III: QUANTUM CHEMISTRY – I**

Photoelectric effect – Compton Effect – wave-particle duality – uncertainty principle

Theory of wave motion – Wave equation for electrons – Wave function  $\Psi$  and its physical meaning – condition for acceptable wave function – condition for normalization and orthogonality.

Operator Algebra – Commutative property – linear operator – Eigen values and eigen functions – Hermitian property of operators – Basic postulates of quantum mechanics.

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### **UNIT – IV: CHEMICAL KINETICS – II**

Kinetics of complex reaction, reversible, consecutive, parallel reactions, chain reactions, general treatment of chain reactions – chain length – Rice Herzfeld mechanism – Thermal decomposition of acetaldehyde - explosion limits.

Study of fast reactions – relaxation methods – temperature and pressure jump method – stopped flow technique – Flash photolysis method.

### **UNIT – V: APPLICATIONS OF GROUP THEORY – II**

Orthogonality theorem and its consequences – Construction of character table for  $C_{2v}$  and  $C_{3v}$  – Standard reduction formula – hybrid orbitals in non-linear molecules ( $CH_4$ ,  $XeF_4$ ,  $BF_3$ ,  $SF_6$ , and  $NH_3$ ) Determination of representations of vibrational modes in non-linear molecules ( $H_2O$ ,  $PCl_5$ ,  $BF_3$  and  $NH_3$ ). Symmetry selection Rules for IR and Raman spectra.

#### **Text Book:**

1. C.N. Banwell and E.M. McCash, Fundamentals of Molecular spectroscopy, IV - Edition, Tata McGraw Hill (2005).
2. D.N. Sathyanarayana, Vibrational Spectroscopy, New Age International Publishers (2004).
3. Carrington and Ad. McLachlan, Introduction to Magnetic Resonance, Harper and Row, New York (1967).
4. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanism of Chemical Transformations. Mac Millan India Ltd (1993).
5. R.J. Laidler, Chemical Kinetics, Harper and Row, New York (1987).
6. K.V. Raman, Group Theory and its Applications to Chemistry, Tata Mc Graw Hill Publishing Co., (1990).
7. K.V. Ramakrishnan and M.S. Gopinath, Group Theory in Chemistry, Vishal Publications (1998).
8. S. Glasstone, Introduction to Electrochemistry, Affiliated East west press, New Delhi (1960)
9. D.R. Crow, Principles and Applications to Electrochemistry, chapman and Hall (1991)
10. R.K. Prasad, Quantum chemistry, Wiley Eastern, New Delhi (1992)
11. E. Anantharaman, Fundamentals of Quantum chemistry, Mac Millan India Limited (2001)

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

### **Suggested References:**

1. A.K. Chandra, Introduction to Quantum chemistry, Tata McGraw Hill
2. D.A. Mc Quarrie, Quantum Chemistry, University Science books, Mill valley, California (1983).
3. C.N. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill (1966)
4. R.G. Frost and Pearson, Kinetics and mechanism, Wisely, New York (1961)
5. N. Thinkam, Group theory and Quantum mechanics, McGraw Hill Book company, New York (1964)

**C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2015-2016

Year: 1 Year

Subject Code : P15ECH201

Semester : II

Elective - 2 Title:

## Green Chemistry (Elective)

Credits: 3

Max. Marks. 75

## OBJECTIVES:

To know eco-friendly methods of synthesis. This helps in planning the synthesis of any type of organic compounds with the revolution of Green Chemistry.

## UNIT I: PRINCIPLES & CONCEPT OF GREEN CHEMISTRY

Introduction –Concept and Principles-development of Green Chemistry- Atom economy reactions –rearrangement reactions , addition reactions- atom uneconomic-sublimation-elimination-Wittig reactions-toxicity measures- Need of Green Chemistry in our day to day life.

## UNIT II: MEASURING AND CONTROLLING ENVIRONMENTAL PERFORMANCE

Importance of measurement – lactic acid production-safer Gasoline – introduction to life cycle assessment-four stages of Life Cycle Assessment (LCA) –Carbon foot printing-green process Matrics-eco labels -Integrated Pollution and Prevention and Control(IPPC)-REACH (Registration, Evaluation, Authorization of Chemicals)

## UNIT III: EMERGING GREEN TECHNOLOGY AND ALTERNATIVE ENERGY SOURCES

Design for Energy efficiency-Photochemical reactions- Advantages-Challenge faced by photochemical process. Microwave technology on Chemistry- Microwave heating – Microwave assisted reactions-Sono chemistry and Green Chemistry –Electrochemical Synthesis-Examples of Electrochemical synthesis.

## UNIT IV: RENEWABLE RESOURCES

Biomass –Renewable energy – Fossil fuels-Energy from Biomass-Solar Power- Other forms of renewable energy-Fuel Cells-Alternative economics-Syngas economy- hydrogen economy-Bio refinery chemicals from fatty acids-Polymer from Renewable Resources – Some other natural chemical resources.

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### **UNIT V: INDUSTRIAL CASE STUDIES**

Methyl Methacrylate (MMA)-Greening of Acetic acid manufacture-Vitamin C-Leather manufacture –Types of Leather –Difference between Hide and Skin-Tanning –Reverse tanning –Vegetable tanning –Chrome tanning-Fat liquoring –Dyeing –Application-Polyethylene- Ziegler Natta Catalysis- Metallocene Catalysis-Eco friendly Pesticides-Insecticides.

#### **References:**

Mike Lancaster , Green Chemistry and Introductory text, II Edition

P.T.Anastas and J.C Warner, Green Chemistry theory and Practice, Oxford University press, Oxford (1988).

P.Tundo *et.al.*, Green Chemistry, Wiley –Blackwell, London (2007).

Protti D.Dondi *et.al.*, Green Chemistry

T.E Graedel, Streamlined Life cycle Assessment, Prentice Hall, New Jersey (1998).

V.K. Ahluwalia, Methods and Reagents of Green Chemistry: An Introduction by Green Chemistry.

[www.clri.org](http://www.clri.org)

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2016-2017

Year:	II Year	Subject Code :	P15MCH301	Semester :	III
Major - 7	Title:	<b>Organic Spectroscopy &amp; Natural Products</b>			
Credits:	4	Max. Marks. 75			

### **OBJECTIVES**

To understand the concepts of spectral techniques and to apply these techniques for the quantitative and structural analysis of organic compounds. To understand Terpenes, Alkaloids, Heterocycles, Steroids and their importance.

### **UNIT-I: UV AND IR SPECTROSCOPY AND ITS APPLICATIONS**

Ultraviolet - Visible spectroscopy - types of electronic transitions - chromophores and auxochromes - factors influencing position and intensity of absorption bands - absorption spectra of dienes, polyenes and unsaturated carbonyl compounds - Woodward - Fieser rules.

IR Spectroscopy - vibrational frequencies and factors affecting them - identification of functional groups - intra and inter molecular hydrogen bonding - finger print region - Far IR region - metal ligand stretching vibrations.

### **UNIT-II: NMR SPECTRA AND ITS APPLICATIONS**

Nuclear spin - magnetic moment of a nucleus - nuclear energy levels in the presence of magnetic field relative populations of energy levels - basic principles of NMR experiments - CW and FT NMR -  $^1\text{H}$  NMR - chemical shift and coupling constant - factors influencing proton chemical shift and vicinal proton - proton coupling constant -  $^1\text{H}$  NMR spectra of simple organic molecules such as  $\text{CH}_3\text{CH}_2\text{Cl}$ ,  $\text{CH}_3\text{CHO}$  etc. AX and AB spin system - spin decoupling - nuclear overhauser effect- chemical exchange.  $^{13}\text{C}$  NMR - proton decoupled and off - resonance  $^{13}\text{C}$  NMR spectra - factors affecting  $^{13}\text{C}$  chemical shift -  $^{13}\text{C}$  NMR spectra of simple organic molecules. Problem solving (for molecules with a maximum number of  $\text{C}_{10}$ ).

### **UNIT-III: PHYSICAL METHODS OF STRUCTURAL DETERMINATION**

Mass Spectroscopy - Principles - measurement techniques - (EI, CI, FD, FAB, SIMS) - presentation of spectral data - molecular ions - isotope ions - fragment ions of odd and even electron types - rearrangement ions - factors affecting cleavage patterns - simple and multicentre fragmentation - McLafferty rearrangement. Mass spectra of hydrocarbons,

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alcohols, phenols, aldehydes and ketones. Octant rule, cotton effect, axial halo ketone rule, ORD and its applications.

### **UNIT-IV: TERPENES & ALKALOIDS**

Introduction, classification, isoprene rule, structural determination of terpenoids citral, Geraniol, Farnesol,  $\alpha$ -pinene and camphor.

Introduction-isolation of alkaloids - total synthesis of quinine, morphine and reserpine.

### **UNIT-V: HETEROCYCLES & STEROIDS**

Imidazole, oxazole, thiazole, flavones, isoflavones, anthocyanins, pyrimidines (cytosine and Uracil only) and purines (adenine, guanine only). Syntheses of parent and simple alkyl or aryl substitution - derivatives are expected.

Total synthesis of Cholesterol, Conversion of cholesterol to progesterone, estrone and testosterone.

### **Recommended Books**

1. Application of absorption spectroscopy of organic compounds by J. Dyer, Prentice and Hall of India, Pvt., New Delhi.
2. Spectrometric identification of organic compounds by R.M. Silverstein, G.d. Bassler and Monson. John Wiley and Sons, New York.
3. Introduction to the spectroscopic methods for the identification organic compounds - 2 volumes, Schiemann Pergamman Press.
4. Organic Chemistry, Vol. II, I.L. Finar, 5<sup>th</sup> edition ELBS publication.
5. Spectroscopy of Organic compounds by P.S. Kalsi, Wiley Eastern Ltd., Chennai.
6. Advanced organic chemistry III Edition by J. March.
7. Advanced organic Chemistry by Francis A. Carey and Richard J. Sundberg, 3<sup>rd</sup> Edition (1990).
8. Physical organic chemistry by Neil S. Issac, ELBS publication 1987.
9. Organic reaction mechanism, Macmillan India, 1999.
10. Spectroscopy W. Kemp, Macmillan Ltd.,
11. Structural identification of organic compounds Y.R. Sharma, S. Chand & Co.
12. Chemistry of organic Natural Products by Dr.O.P. Agarwal, Goel Publishing House, Meerut.
13. Terpene Chemistry - James verghese.

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2016-2017

Year: II Year Subject Code : P15MCH302 Semester : III

Major - 8 Title: **Organometallics & Coordination Chemistry**

Credits: 4 Max. Marks. 75

### **OBJECTIVES**

To study about the Coordination complexes, Substitution in Coordination complexes and to study Organometallic chemistry and Inorganic photochemistry.

### **UNIT-I: ORGANOMETALLIC CHEMISTRY - I**

Carbon donors: Alkyls and aryls metallation, bonding in carbonyls and nitrosyls, chain and cyclic donors, olefins, acetylene and allyl system, synthesis structure and bonding in ferrocene.

Reactions: Association, substitution, addition and elimination reactions, ligand protonation, electrophilic and nucleophilic attack on ligands. Carbonylation, Decarboxylation, oxidative addition and fluxionality.

### **UNIT-II: ORGANOMETALLIC CHEMISTRY - II**

Catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (Oxo process), oxidation of olefins to aldehydes and ketones (Wacker process) polymerization (Ziegler - Natta Catalyst); cyclo oligomerisation of acetylene using nickel catalyst (Reppé's catalyst); polymer-bound catalysts.

### **UNIT-III: COORDINATION CHEMISTRY - IV**

Electron transfer reactions, outer and inner sphere processes; atom transfer reaction, formation and rearrangement of precursor complexes, the bridging ligand, precursor and successor complexes, Marcus Theory.

Complementary, non-complementary and two electron transfer reactions.

### **UNIT-IV: COORDINATION CHEMISTRY - V**

Substitution Reactions: Substitution in square planar complexes, reactivity of platinum complexes, influences of entering, leaving and other groups, the trans effect and its theories.

### **UNIT-V: COORDINATION CHEMISTRY - VI**

Substitution of octahedral complexes of cobalt and chromium, replacement of coordinated water, solvolytic (acids and bases) reaction,  $SN^1$ ,  $SN^2$  &  $SN^1CB$  mechanism, applications in synthesis (platinum and cobalt complexes only).

## C. Abdul Hakeem College (Autonomous), Melvisharam.

**Inorganic Photochemistry:** Photo-substitution, Photoredox and isomerisation process, application of metal complexes in solar energy conversion.

### TEXT BOOKS

1. R.C. Mehrotra, A. Singh, **Organo Metallic Chemistry**, Wiley Eastern Co., (1992).
2. F. Basolo and R.G. Pearson, **Mechanism of Inorganic Reaction**, Wiley NY (1967).
3. J. Huheey, **Inorganic Chemistry**, Harper and Collins, NY IV Edition, (1993).
4. K.F. Purcell and J.C. Kotz, **Inorganic Chemistry**, W. Saunders Co., (1977).
5. S. FA Kettle, **Coordination Chemistry**, ELBS, (1973).
6. F.A. Cotton and G. Wilkinson, **Advanced Inorganic Chemistry**, John Wiley and Sons, V Edition (1988).
7. D.F. Shriver, Pw. Atkins and C.H. Langford, **Inorganic Chemistry**, OUP (1990).
8. Guillermo J. Ferraudi, **Elements of inorganic photochemistry**, Wiley (1988).
9. Arthur W. Adamson, Paul D. Fleischauer, **Concepts of inorganic photochemistry**, Wiley(1975).

### SUGGESTED REFERENCES

1. G. Coates M.I. Green and K. Wade. **Principles of Organometallic chemistry**, Methven Co., London (1988).
2. P. Powell, **Principles of Organometallic chemistry**, Chappman and Hall. (1998).
3. G.S. Manku, **Theoretical Principles of Inorganic Chemistry**, McGraw-Hill Education, (1984).
4. M.C. Day and J. Selbin, **Theoretical Inorganic Chemistry**, Van Nostrand Co., New York (1974).
5. R.B. Heslop and K. Jones, **Inorganic Chemistry**, Elsevier Scientific Publ., (1976).
6. F. Basolo and R.G. Pearson, **Mechanism of Inorganic Reaction**, Wiley NY (1967).
7. M.C. Day and J. Selbin, **Theoretical Inorganic Chemistry**, Van Nostrand Co., New York (1974).
8. B.E. Dogulas DH McDaniel's and Alexander, **Concepts and Models of Inorganic Chemistry**, Oxford IBH (1983).
9. WU. Mallik, G.D. Tuli, R.D. Madan, **Selected topics in Inorganic Chemistry**, S. Chand and Co., New Delhi (1992).

**C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2016-2017

Year: II Year                      Subject Code : P15MCH303                      Semester : III

Major - 9 Title: **Physical Chemistry - III**

Credits: 4 Max. Marks: 75

## OBJECTIVES

To study the principle and applications of NMR spectroscopy, the fundamental principles and applications of Quantum chemistry, study of electrode-electrolyte interface, various aspects in photochemistry and introductory statistical thermodynamics.

## UNIT – I MAGNETIC RESONANCE SPECTROSCOPY

Resonance spectroscopy – Zeeman effect – Equations of motion of spin in magnetic fields – Chemical shift – Factors affecting chemical shift – Spin – Spin coupling and coupling constant – NMR of simple AX and AMX type molecules – Chemical exchange in NMR – Relaxation process – NMR and Restricted Rotation –  $C^{13}$ ,  $^{19}F$ ,  $^{31}P$  NMR spectra applications – Brief discussion of FT NMR spectroscopy.

## UNIT – II QUANTUM CHEMISTRY – II

Schrodinger wave equation – Elementary applications of schrodinger wave equation – Particle in one and three dimensional box – Quantum mechanical results for harmonic oscillator and rigid rotor – Schrodinger equation for hydrogen (No derivation) and the solution – Approximation methods – Variation and Perturbation methods – Application to hydrogen and helium atoms.

## UNIT – III ELECTROCHEMISTRY - II

Electrode – Electrolyte interface – Adsorption at electrified interface – Electrical double layer – electrocapillary phenomenon – Lippmann equation – Structure of double layers – Helmholtz Perrin; Guoy – Chapmann and stern model of electrical double layers.

Diffusion – Fick's law of diffusion – Effect of ionic association on conductance – Electro kinetic phenomena – Membrane potential.

## UNIT – IV PHOTOCHEMISTRY – I

Absorption and emission of radiation – Franck – Condon principle – Decay of electronically excited states – Jablonski diagram – Radiative and non-radiative transitions – Fluorescence and phosphorescence

Photophysical kinetics of unimolecular processes – Kinetics of biomolecular process – Static and dynamic quenching – Stern-Volmer equation – Concentration dependence of quenching –Excimer formation.

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

### **UNIT – V STATISTICAL THERMODYNAMICS – I**

Objectives of statistical thermodynamics – Micro states and macro states – Concept of mathematical and thermodynamic probability – Distribution of distinguishable and non-distinguishable particles.

Derivation of Maxwell-Boltzmann distribution law – Partition function – Evaluation of translational, vibrational, rotational and electronic partition function.

#### **TEXT BOOKS**

1. S. Glasstone, Introduction to electrochemistry, Affiliated East West Press, New Delhi (1960).
2. P.H. Reiger, Electrochemistry, Chapman and Hall, New York (1994).
3. M.C. Gupta, Statistical thermodynamics, Wiley Easter, New Delhi (1990).
4. K.K. Rohatgi, Mukherjee, Fundamentals of Photo chemistry, Wiley Eastern Ltd. (1978).
5. N.J. Turro, Modern Molecular Photochemistry, Benjamin, Cumming Mento Park, California (1978).
6. S.Glasstone Text book of physical chemistry.
7. R.K. Prasad, Quantum chemistry, Wiley Eastern, New Delhi (1992).
8. M.W. Hanna, Quantum mechanics in Photochemistry, W.A. Benjamin Inc. London (1965).
9. Raymond chang, Basic principles of spectroscopy, McGraw Hill Ltd., New York (1971).
10. W. Kemp, NMR in chemistry, McMillan Ltd., (1986).

#### **SUGGESTED REFERENCES**

1. C.N. Banwell, Fundamentals of Molecular spectroscopy, McGraw Hill (1966).
2. A.K. Chandra Introductory quantum chemistry, Tata McGraw Hill.
3. D.A. McQuarrie, Quantum chemistry, university science books, Mill valley, California (1983).
4. J.O.M. Bokris and A.K.N. Reddy, Electrochemistry, Vol. 1 and 2, Plenum, Now York (1977).
5. B.J. Meclelland, Statistical thermodynamics, chapman and Hall, London (1973).

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2016-2017

Year: II Year Subject Code : P15ECH301 Semester : III

Elective - 3 Title: **Scientific Research Methodology (Elective)**

Credits: 3 Max. Marks. 75

### **OBJECTIVES**

To study about the importance of research, literature survey, error analysis, statistical treatment. To study about the conventions of writing thesis.

### **UNIT-I: INTRODUCTION**

Nature and importance of research - aims, objective, principles and problems - selection of research problem - survey of scientific literature - primary and secondary sources - citation index for scientific papers and journals - patents. Aids of computer devices in literature survey.

### **UNIT-II: CONDUCT OF RESEARCH WORK**

Physical properties useful in analysis and methods of separation prior to analysis - Isolation techniques - extraction - Soxhlet extraction, crystallization, sublimation - methods for vacuum sublimation and distillation under reduced pressure.

Chemistry of working with hazardous materials - acid / water sensitive, corrosive, toxic, explosive and radioactive materials.

### **UNIT-III: EVALUATION OF ANALYTICAL DATA**

Precision and accuracy - Reliability - determinate and random errors - distribution of random errors - normal distribution curve.

### **UNIT-IV: STATISTICAL TREATMENT OF ANALYTICAL DATA**

Statistical treatment of finite samples - the students test and F test - Criteria for rejection of an observation - the Q test, significant figures and computation rules - data plotting - least square analysis.

### **UNIT-V: THESIS AND ASSIGNMENT WRITING**

Conventions of writing - the general format - page and chapter format - use of quotations and footnotes - preparation of tables and figures - referencing - appendices - Revising editing and evaluating the final product - proof reading - Meanings and examples of commonly used abbreviations.

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### **REFERENCES**

1. Douglas A. Skoog and Donald, M. West, Fundamental of analytical chemistry, Halt Saundersons International Edition.
2. J. Anderson, H.M. Durston and M.Poole, Thesis and assignment writing - Wiley Eastern Ltd., (1970).
3. J. March, Advanced organic chemistry - reactions, Mechanism & Structure. McGraw Hill Student Edition.
4. Vogel's Textbook of quantitative chemical analysis, ELBS edition.

**C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2016-2017

Year: II Year Subject Code : P15MCH401 Semester : IV

Major - 10 Title: **Photochemistry & Bioorganic Chemistry**

Credits: 4 Max. Marks: 75

### OBJECTIVES:

To understand the concepts of Photochemical Pericyclic Reactions. To learn free radicals reactions, Applications and Techniques of Dyeing, Proteins, Nucleic acids, Antibiotics and Vitamins.

## UNIT-I: PHOTOCHEMISTRY & PERICYCLIC REACTIONS

Photochemical excitation - Fate of the excited molecules - Jablonski diagram - study of photochemical reactions of ketone - photoreduction - photocyclo addition - Paterno - Buchi reaction - di pi-methane rearrangement.

Pericyclic reactions – classification – orbital symmetry – Woodward Hoffman rules - Analysis of electrocyclic, cyclo addition and sigmatropic reactions - correlation diagrams for butadiene - cyclobutene system hexatriene to cyclohexadiene system. Structure of bulvalene, a fluxional molecule - Cope and Claisen rearrangement.

## UNIT-II PROTEINS AND NUCLEIC ACIDS

Proteins: Peptides and their synthesis – synthesis of tripeptide. Merrifield synthesis, Determination of tertiary structure of Protein, Bio-Synthesis of Proteins. Nucleic Acids: Types of Nucleic Acids-DNA & RNA polynucleotide chain. Components-biological functions. Structure and role of (genetic Code) DNA and RNA (Nucleotides only) Biosynthesis of Cholesterol.

### **UNIT-III: ANTIBIOTICS & VITAMINS:**

Introduction, structural elucidation and synthesis of pencillin, streptomycin, chloromycetin and tetracyclines.

Synthesis of vitamin A1 (Reformatsky and Wittig reaction methods only).

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### **UNIT-IV: FREE RADICALS & DYES**

Long and short-lived free radicals, methods of generation of free radicals. Addition of free radicals to olefinic double bonds. The following aromatic radical substitutions are to be studied: decomposition of diazocompounds, phenol - coupling - Sandmeyer reaction Gomberg reaction, Pschorr reaction, Ulmann reaction, mechanism of Hunsdiecker reaction Detection of free radicals by ESR.

Introduction, various methods of dyeing, classification of dyes, nitroso dyes, Azodyes, - Fast green, Methyl Orange, Methyl Red, Fast Red, triphenylmethane dyes - Malachite green, Rosaniline, Aniline blue, Crystal violet, Xanthene dyes - Fluorescein, Rhodamine B, Anthraquinone dyes – Alizarin – Preparation and uses.

### **UNIT – V: MODERN SYNTHETIC METHODS, REACTIONS AND REAGENTS**

Synthesis of simple organic molecules using standard reaction like acetylation, alkylation of enamines and active methylene compounds, Grignard reactions, Phosphorus and sulphur ylides Robinson annulation, Diels Alder reactions, protection and deprotection of functional groups (R-OH, R-CHO, RCO-R, R-NH<sub>2</sub> and R-COOH). Uses of the following reagents: DCC, Trimethylsilyliodide, 1, 3-Dithiane (umpolung), diisobutylaluminiumhydride (DIBAL), 9BBN, Trimethylsilylchloride.

### **RECOMMENDED BOOKS**

1. Molecular Reaction and Photochemistry by Charles H. Depuy and Orville, L. Champman, Prentice Hall of India Pvt., Ltd., New Delhi.
2. Organic Chemistry, Vol. II, I.L. Finar, 5<sup>th</sup> edition ELBS publication.
3. Advanced organic chemistry III Edition by J. March.
4. Chemistry of organic Natural Products by Dr. O.P. Agarwal, Goel Publishing House, Meerut.
5. Advanced Organic Chemistry by Francis A. Carey and Richard J. Sundberg, Plenum Press, New York.

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2016-2017

Year:	II Year	Subject Code :	P15MCH402	Semester :	IV
Major - 11	Title: <b>Inorganic Spectroscopy &amp; Analytical Techniques</b>				
Credits:	4	Max. Marks. 75			

### **OBJECTIVES**

To study about the Inorganic Spectroscopy and Analytical techniques.

### **UNIT-I: INORGANIC SPECTROSCOPY - I AND MAGNETIC PROPERTIES**

Applications to inorganic systems of the following: ultra violet, visible, infra-red and Raman spectra of metal complexes, organometallic and simple inorganic compounds with special reference to coordination sites, isomerism.

Magnetic Susceptibility and measurements - Guoy method, Faraday method; applications.

### **UNIT-II: INORGANIC SPECTROSCOPY - II**

#### **Application to Inorganic systems of the followings**

NMR, NQR and Mossbauer spectra - NMR of  $^{31}\text{P}$ ,  $^{19}\text{F}$ , NMR shift reagents. NQR - Nitrosyl compounds. Mossbauer spectra of Fe and Sn systems.

### **UNIT-III: INORGANIC SPECTROSCOPY - III**

ESR Introduction - Zeeman equation, g-value, nuclear hyperfine splitting, interpretations of the spectrum, simple carbon centered free radicals. Anisotropy - g-value and hyperfine splitting constant. McConnell's equation, Kramer's theorem. ESR of transition metal complexes of copper, manganese and vanadyl complexes.

Photoelectron spectroscopy (UV and X-ray) - photo electron spectra - Koopman's theorem, time structure in PES, chemical shift and correlation with electronic charges.

### **UNIT-IV: INSTRUMENTAL ANALYSIS - I**

Atomic Spectroscopic methods: Introduction – classification of spectral methods

AAS, and AES – Principle, instrumentation, spectral and chemical interferences, applications, differences between AAS and AES, advantages of AAS over AES.

ICP: Introduction, instrumentation, interferences and applications.

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### UNIT-V: INSTRUMENTAL ANALYSIS - II

Chromatography: GLC and HPLC – Principle, instrumentation, working, types of detectors and applications.

Electron Microscopy – SEM, TEM and AFM - Principle, instrumentation, applications.

#### TEXT BOOKS

1. A. Earnshaw, **Introduction to Magneto Chemistry**, Academic Press, London, (1968).
2. C.N.R. Rao, I.R. Ferraro, **Spectroscopy in Inorganic Chemistry**, Vol. I and Vol. II, Academic Press, (1970).
3. D. A. Skoog and D.M. West, **Principles of Instrumental Methods of analysis**, Saunderson's College Publ. III Edition, (1985).
4. E. A. V. Ebsworth, D. W. H. Rankin and S. Craddock, **Structural Methods in Inorganic Chemistry**, II Edition, Blackwell Scientific Publications, Oxford, London (1991).
5. G.D. Christian and J.E.G. Reilly, **Instrumental Analysis**, Allyn Bacon, II Edition, (1986).
6. H.A. Strobel, **Chemical Instrumentation**, Addison - Wesley Pub. Co., (1976).
7. R. S. Drago, **Physical Methods for Chemists**, Saunders College Publishing, Philadelphia (1992).
8. Willard Merritt, Dean and Settle, **Instrumental methods of analysis**, CBS Publ. VI edition, (1986).

#### SUGGESTED REFERENCES

1. AI Vogel, **Text book of Qualitative Analysis** - IV Edition (1985).
2. C. N. Banwell and E.M. Mc Cash, **Fundamentals of Molecular Spectroscopy**, IV edition, Tata McGraw Hill, New Delhi (1994).
3. D.A. Skoog D.M. West, Holt Reinhert and Winston, **Fundamental of Analytical Chemistry**, Publication, IV Edition (1982).
4. D.N. Sathyanarayana, **Electronic Absorption Spectroscopy and Related Techniques**, Universities Press (India) Ltd., Hyderabad (2001).
5. FA Cotton and G Wilkinson, **Advanced Inorganic Chemistry**, John Wiley and Sons, V Edition (1988).
6. G. Aruldas, **Molecular Structure and spectroscopy**, Prentice Hall of India Pvt. Ltd., New Delhi (2001).
7. J. Huheey, **Inorganic Chemistry**, Harper and Collins, NY, IV Edition, (1993).
8. J. M. Hollas, **Modern Spectroscopy**, IV edition, John Wiley & Sons, Ltd., Chichester (2004).
9. M.C. Shriver, P.W Atkins, CH. Langford, **Inorganic Chemistry**, OUP (1999).
10. Nakamoto, **Infrared and Raman Spectra of Inorganic and Coordination Compounds**, III Edn., John Wiley and Sons, New York, (1986).
11. O. Khan, **Molecular Magnetism**, New York, VCH (1993).
12. R.L. Carlin, **Magneto chemistry**, Springer-Verlag, New York, (1986).
13. S.F.A. Kettle, **Physical Inorganic Chemistry: A Coordination Chemistry Approach**, Oxford University Press, (1998).

## **C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2016-2017

Year:	II Year	Subject Code :	P15MCH403	Semester :	IV
Major - 12	Title: <b>Physical Chemistry - IV</b>				
Credits:	4	Max. Marks. 75			

### **OBJECTIVES**

To study the applications of quantum chemistry and chemical bonding, study of various aspects, types of reactions in photochemistry, to study the electrochemical kinetics, over potential corrosion, to study statistical thermodynamics, quantum statistics and irreversible thermodynamics.

### **UNIT – I QUANTUM CHEMISTRY – III**

Born-oppenheimer approximation – Valence bond theory for hydrogen molecule – LCAO – MO theory for di and polyatomic molecules.

Huckel theory for conjugated molecules (Ethylene, butadiene and benzene) – Semi-empirical methods – Slater orbitals and HF-SCF method.

### **UNIT – II ELECTRO CHEMISTRY – III**

Mechanism of electrode reaction –Polarisation and over potential – Butler-Volmer equation for one step and multistep electron transfer reaction – Significance of electron exchange current density and symmetry factors – Transfer coefficient and its significance – Mechanism of hydrogen and oxygen evolution reaction.

Corrosion and passivation of metals –Pourbaix diagram – Evan's diagram – Fuel cells.

### **UNIT – III STATISTICAL THERMODYNAMICS - II**

Expressions for thermodynamic functions in terms of partition function – Applications of partition function to heat-capacity of ideal gases – Heat capacity of solids – Einstein and Debye models.

### **UNIT – IV STATISTICAL THERMODYNAMICS – III**

Quantum statistics: Fermi-Dirac and Bose-Einstein statistics and their corresponding distribution functions –Comparison of quantum and classical statistics – Applications of Quantum statistics to electron gas in metals and Planck's radiation law.

Irreversible thermodynamics – Forces and fluxes – linear force-flux relation – Phenomenological equations.

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### **UNIT – V PHOTOCHEMISTRY – II**

Experimental methods – Quantum yield and life time measurements – Steady state principle – Quantum yield and chemical Actinometry.

Kinetics of Photochemical reactions – Hydrogen and halogen reactions

Photo isomerization, Photo rearrangement, Photo reduction – Photo redox, Photosubstitution and Photosensitized reactions – Aspects of solar energy conversion and storage.

#### **Text Books**

1. R.K. Prasad, Quantum chemistry, Wiley Eastern, New Delhi (1992).
2. D.A. McQuarrie, Quantum chemistry, university science books, Mill valley, California (1983).
3. N.J. Turro, Modern Molecular Photochemistry, Benjamin, Cumming Mento Park, California (1978).
4. K.K. Rohatgi, Mukherjee, Fundamentals of Photo chemistry, Wiley Eastern Ltd. (1978).
5. S. Glasstone, Introduction to electrochemistry, Affiliated East West Press, New Delhi (1960).
6. D.R. Crow, Principles and applications of electrochemistry, Chapman and Hall (1991).
7. M.C. Gupta, Statistical thermodynamics, Wiley Easter, New Delhi (1990).
8. R. Hasee, Thermodynamics of irreversible process, Addition Wesley, Reading, Mass (1969).

#### **SUGGESTED REFERENCES**

1. J.O.M. Bokris and A.K.N. Reddy, Electrochemistry, Vol. 1 and 2, Plenum, Now York (1977).
2. B.J. Mecclelland, Statistical thermodynamics, chapman and Hall, London (1973).
3. I. Prigogine, Introduction to Thermodynamics of irreversible process.
4. A.K. Chandra Introductory quantum chemistry, Tata McGraw Hill.
5. P.W. Atkins, Quantum Mechanics, Oxford university press, Oxford (1983)

**C. Abdul Hakeem College (Autonomous), Melvisharam.**

Syllabus for M.Sc., Chemistry effective from the year 2016-2017

Year: II Year Subject Code : P15ECH401 Semester : IV

Elective - 4 Title: **Environmental Chemistry (Elective)**

Credits: 3 Max. Marks: 75

## UNIT - I: ATMOSPHERIC CHEMISTRY

The structure of the earth's atmosphere- chemistry of the lower and upper atmosphere. The chemistry of air pollution- oxides of nitrogen- hydrogen sulphide and oxides of sulphur- Aerosols – ozone depletion and consequences- dioxins burning plastics- other atmospheric chemicals- smog- radio activity and fallout- air pollution abatement. Green house effect- Global warming, oxides of carbon.

## UNIT - II: THE EARTH

The lithosphere - Composition of Lithosphere – Inorganic and Organic components in soil.  
The exploitation of mineral resources and the abuse of earth – earth resources – Wastes and pollutants in soil and conservation steps.

The hydrosphere : The fresh water chemistry – the structure and properties of liquid water – lakes, rivers, ponds and stream – river chemistry, pollution and aeration – mercury pollution. The chemical constituents of sea water- organic matter and suspended material- ocean dumping- oil pollution. The role of water in our total environment.

## UNIT - III: THE BIOSPHERE

The structure of the biosphere, Man's perturbation of the biosphere – Man as a chemical factory – material use and waste – energy use and thermal pollution – ecological disruption – chemical sensation, hormonal imbalance and mutagens.

Hydrosphere - lithosphere interaction: The structure of water at an interface – chemical composition of mineral water – chemical exchange between sediments and the water column.

## UNIT IV: INTERACTIONS

Lithosphere- biosphere interaction: soil chemistry – the prospects of agriculture- agricultural pollution – pesticides and other persistent pollutants – the deposition of coal and petroleum – theories of origin of petroleum. Atmosphere – biosphere interaction and atmosphere – hydrosphere interaction: history of earth's atmosphere – the nitrogen cycle – the carbon cycle – air – sea interactions.

## UNIT - V: POLLUTION CONTROL

Pollution control in the following: Fertiliser, petroleum, pulp and paper, tanning, sugar, alcohol, electroplating and nuclear reactors.

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Analysis of pollutants: Sum, specific and group parameters BOD, COD, Fe, Cr, Cu, Pb, and Ni-SO<sub>2</sub> and NO<sub>x</sub>.

#### **REFERENCES**

1. Chemistry of our environment R.A.Horne
2. Environmental chemistry A.K.De
3. Environmental chemical analysis Iain L, Marr and Malcom S. Cresser
4. Pollution control in process industries S.P.Mahajan