

S.N.D.T. WOMEN'S UNIVERSITY

MUMBAI



**Syllabus
M.Sc.Chemistry**

Programme

Effective From - June 2021

**Eligibility : B.Sc. with 5 units of 4 credits each (Annual System) or
32 credits (Semester System) of chemistry.**

Course Objectives:

1. To provide access to the field of higher education for women.

2. To enable students for research in emerging areas of study.
3. To achieve excellence to the academic disciplines, research and extension activities through emphasis on "Quality in every activity".
4. To train and develop scientist and technologist for industries and academics.
5. To provide job oriented course to meet the socio-economic demands.

FACULTY: Science

TOTAL CREDIT: 96

COURSE : Masters in Chemistry (M.Sc.)

SEMISTER – I

Paper	Title	Hrs/w	Internal	External	Total Marks	Credits
102101	Inorganic Chemistry	4	50	50	100	4
102102	Organic Chemistry	4	50	50	100	4
102103	Physical Chemistry	4	50	50	100	4
102104	Analytical Chemistry	4	50	50	100	4
102201	Practical (Laboratory Course)	8	50	50	100	4
102202	Practical (Laboratory Course)	8	50	50	100	4
Total					600	24

SEMISTER – II

Paper	Title	Hrs/w	Internal	External	Total Marks	Credits
202101	Inorganic Chemistry	4	50	50	100	4
202102	Organic Chemistry	4	50	50	100	4
202103	Physical Chemistry	4	50	50	100	4
202104	Analytical Chemistry	4	50	50	100	4
202201	Practical (Laboratory Course)	8	50	50	100	4
202202	Practical (Laboratory Course)	8	50	50	100	4
Total					600	24

SEMISTER – III

Paper	Title- Inorganic Chemistry	Hrs/w	Internal	External	Total Marks	Credits
302101	Inorganic Chemistry-I	4	50	50	100	4
302102	Inorganic Chemistry-II	4	50	50	100	4
302103	Inorganic Chemistry-III	4	50	50	100	4
302104	Inorganic Chemistry-IV	4	50	50	100	4
302201	Practical- I & II (Laboratory Course)	8	50	50	100	4
302202	Practical- III & IV (Laboratory Course)	8	50	50	100	4
Total					600	24

SEMISTER – IV

Paper	Title- Inorganic Chemistry	Hrs/w	Internal	External	Total Marks	Credits
402101	Inorganic Chemistry-V	4	50	50	100	4
402201	Practical-V (Laboratory Course)	8	50	50	100	4
402301	Internship (six week*)	40	100	100	200	8
402302	Research Project (Experimental, Dissertation, Presentation and Seminar)	40	100	100	200	8
Total					600	24

***Six week internship after 2 semester**

SEMISTER – III

Paper	Title- Organic Chemistry	Hrs/w	Internal	External	Total Marks	Credits
302101	Organic Chemistry-I	4	50	50	100	4
302102	Organic Chemistry-II	4	50	50	100	4
302103	Organic Chemistry-III	4	50	50	100	4
302104	Organic Chemistry-IV	4	50	50	100	4
302201	Practical- I & II (Laboratory Course)	8	50	50	100	4
302202	Practical- III & IV (Laboratory Course)	8	50	50	100	4
Total					600	24

SEMISTER – IV

Paper	Title- Organic Chemistry	Hrs/w	Internal	External	Total Marks	Credits
402101	Organic Chemistry-V	4	50	50	100	4
402201	Practical-V (Laboratory Course)	8	50	50	100	4
402301	Internship (six week*)	40	100	100	200	8
402302	Research Project (Experimental, Dissertation, Presentation and Seminar)	40	100	100	200	8
Total					600	24

***Six week internship after 2 semester**

SEMISTER – III

Paper	Title- Physical Chemistry	Hrs/w	Internal	External	Total Marks	Credits
302101	Physical Chemistry-I	4	50	50	100	4
302102	Physical Chemistry-II	4	50	50	100	4
302103	Physical Chemistry-III	4	50	50	100	4
302104	Physical Chemistry-IV	4	50	50	100	4
302201	Practical- I & II (Laboratory Course)	8	50	50	100	4
302202	Practical- III & IV (Laboratory Course)	8	50	50	100	4
Total					600	24

SEMISTER – IV

Paper	Title- Physical Chemistry	Hrs/w	Internal	External	Total Marks	Credits
402101	Physical Chemistry-V	4	50	50	100	4
402201	Practical-V (Laboratory Course)	8	50	50	100	4
402301	Internship (six week*)	40	100	100	200	8
402302	Research Project (Experimental, Dissertation, Presentation and Seminar)	40	100	100	200	8
Total					600	24

***Six week internship after 2 semester**

25 Marks, 1 credit, 15Hrs (1 lecture=1 hour)

Methodology

1. Lectures, Tutorials
2. Self study/ Internet/ Websites
3. Home assignments

Internal Assessment

Presentation on one of the topic from the text

SEMISTER –I

Code: 102101		Title : Inorganic Chemistry	Credits : 4
Objectives : - I) To understand the basic concepts of inorganic chemistry. II) To develop expertise in collection, preparation & preservation of samples. III) To prepare any standard solution. IV) To acquire knowledge of theoretical concepts of volumetric techniques.			
Paper -I			60 Hours
Unit I	Inorganic chemistry in biological systems : - Essential and trace elements in biological systems and their functions , structure and function of metalloporphyrins, Hemoglobin, cytochrome and hemocyanine. Electron transfer, Respiration and photosynthesis reaction, Metal deficient diseases of Fe, Zn, Cu and Mn and their therapy.		15 Lectures
Unit II	Chemical Bonding:- Recapitulation of hybridization Derivation of wave functions for sp , sp^2 , sp^3 orbital hybridization types considering only sigma bonding , Discussion of involvement of d orbitals in various types of hybridizations. Concept of resonance, resonance energy derivation expected, Formal charge with examples, Critical analysis of VBT, Molecular Orbital Theory for diatomic species of First transition Series, Molecular Orbital Theory for Polyatomic species considering σ bonding for SF_6 , CO_2 , B_2H_6 , I_3^- - molecular species, Weak forces of attraction: Hydrogen bonding – concept, types, properties, methods of detection and importance. Van der Waal's forces, ion-dipole, dipole-dipole, London forces		15 Lectures
Unit III	Molecular symmetry and symmetry groups: – symmetry elements and operations. Symmetry planes, reflections, inversion centre, proper/improper axes of rotation, products of symmetry operations, equivalent symmetry elements and atoms, symmetry elements and optical isomerism, symmetry point groups, classes of symmetry operations, classification of molecular point groups.		15 Lectures
Unit IV	Metal ligand equilibria in solution :- Definition of stability constant, step wise and overall formation constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, Determination of formation constant for binary complexes using pH-metric technique.		15 Lectures

Reference Books :

1. Symmetry and Group theory in Chemistry , R Ameta
2. Symmetry and Spectroscopy of Molecules, K.Veera Reddy.
3. Concise Inorganic Chemistry, J.D.Lee.
4. A Textbook of bioinorganic chemistry, A. K. Das.
5. Selected Topic in Inorganic Chemistry, Wahid U. Malik, G.D.Tuli and R.D.Madan.
6. Advanced Inorganic Chemistry, Volume I and II Gurdeep Raj.
7. Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson.
8. Symmetry in Chemistry: H. Jaffe' and M. Orchin (2002).

SEMISTER –I		
Code: 102102	Title : Organic Chemistry	Credits : 4
Objectives : - I) To describe the chemical and molecular processes that take place in organic chemical reactions. II) To perform aliphatic nucleophilic substitution reactions. III) To differentiate the various types of aliphatic nucleophilic substitution. IV) To identify the stereochemical notations. V) To explain concepts of organic acids & bases.		
Paper -I		60 Hours
Unit I	Nature of Bonding in Organic Molecules :- Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyperconjugation, -molecular orbitals, annulenes, π tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and nonalternant compounds, Huckel rule, energy level of aromaticity, Bonds weaker than covalent - addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	15 Lectures
Unit II	Reaction Mechanism :- Structure and Reactivity Types of Mechanisms, Types of reactions, Thermodynamic and Kinetic requirements, Kinetic and Thermodynamic control, Hammond's postulate, methods of determining mechanisms, isotope effects.	15 Lectures
Unit III	Stereo-chemistry :- Elements of symmetry, chirality, Enantiomeric and diastereomeric relationships, R and S, E and Z nomenclature. Molecules with more than one chiral center, Threo and Erythro isomers, Prochiral relationships, groups and faces, stereospecific and stereoselective reactions. Optical activity in the absence of Chiral Carbon (Biphenyls, allenes and Spiranes), Chirality due to helical shape. Methods of resolution, optical purity, stereochemistry of the compounds containing Nitrogen, Sulphur and phosphorous. Conformational analysis of cycloalkanes, Mono and disubstituted cyclohexanes, decalins, effect of conformation on reactivity	15 Lectures
Unit IV	Acids and Bases: - Factors affecting acidity and basicity, Electronegativity and inductive effect, resonance, bond strength, electrostatic effects, hybridization, aromaticity and solvation. Comparative study of acidity and basicity of organic compounds on the basis of pKa values, Levelling effect and non-aqueous solvents. Acid and base catalysis , general and specific catalysis with examples.	15 Lectures

Reference Books :

1. Advanced Organic Chemistry, IV Edition: Jerry March
2. Stereochemistry of Carbon Compounds: E. L. Eliel
3. Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg.

4. A Guide Book to Mechanism in Organic Chemistry: Peter Sykes.
5. Principles of Organic Synthesis: R. O. C. Norman
6. Stereochemistry of Organic Compounds: D. Nasipuri
7. Organic Chemistry: Clayden and Greeves
8. Mechanism and Structure in Organic Chemistry: E. S. Gould

SEMISTER –I		
Code: 102103	Title : Physical Chemistry	Credits : 4
Objectives:- 1. Explain the basic concept of thermodynamics and its effects on the ionic strengths. 2. Determine thermodynamic efficiency of various energy related processes. 3. Estimate thermodynamic properties of substances in solid, gas and liquid states. 4. To explain concept of quantum chemistry, operators, oscillators and numerical. 5. Explain the phenomenon of surface chemistry, various theories of surface chemistry		
Paper -I		60 Hours
Unit I	Chemical Thermodynamics :- Nernst heat theorem, the third law of thermodynamics, determination of absolute entropies of solids, liquids and gases. Partial molar properties : Partial molar free energy, chemical potential, partial molar volume and partial molar heat content and their significance, determination of these quantities, concept of fugacity and determination of fugacity .	15 Lectures
Unit II	Quantum Chemistry:- Rigid rotor, spherical coordinates Schrödinger wave equation in spherical coordinates, separation of the variables, the phi equation, wavefunction, quantum number, the theta equation, wave function, quantization of rotational energy, spherical harmonics. 2.2. Hydrogen atom, the two particle problem, separation of the energy as translational and potential, separation of variables, the R the θ^* and the ϕ equations, solution of the reequation, introduction of the four quantum numbers and their interdependence on the basis of the solutions of the three equations, total wave function, expression for the energy, probability density function, distances and energies in atomic units, radial and angular plots., points of maximum probability, expressions for the total wave function for 1s,2s, 2p and 3d orbitals of hydrogen. 2.3. Application of the Schrödinger equation to two electron system, limitations of the equation, need for the approximate solutions, methods of obtaining the approximate solution of the Schrödinger wave equation. 2.4. Hückel Molecular Orbitals theory for ethylene , 1,3-butadiene and benzene. (Derivation expected)	15 Lectures
Unit III	Classical Thermodynamics :- Collision theory, modified collision theory, weakness of the collision theory, Theory of absolute reaction rates, equilibrium hypothesis, Derivation of the rate equation, statistical mechanical derivation and thermodynamic formulation. Isotope effect on reaction rate. Primary salt effect, secondary salt effect. Dynamics of uni-molecular reactions,	15 Lectures

	Lindmann and Hinshelwood theory Kinetics of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and NMR method. Reactions in solution: Reaction between ions, influence of solvent-double sphere model, single sphere model, influence of ionic strength, numericals.	
Unit IV	Surface Chemistry: - Surface tension, capillary action, pressure difference across curved surface (Laplace equation) vapour pressure of droplets (Kelvin equation) Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro kinetic phenomenon), catalytic activity at surfaces, numericals. Colloidal electrolytes, Types of micelles in colloidal electrolytes, Micellization, Thermodynamics of micellization, Mechanism of Micellization, critical micellar concentration, Determinations of critical micellar concentration, Surface active agents, Classifications of surface active agents, Reverse micelles, Solubilization	15 Lectures

Reference Books :

1. Chemical Kinetics - Laidler (McGraw-Hill)
2. Kinetic and Mechanism of Chemical Transformations - J. Rajaram and J.C. CURIACOSE (Macmillan India Ltd.)
3. Physical Chemistry - Atkins (Oxford)
4. Thermodynamics for Chemists - S. Glasstone (EWP, New Delhi)
5. Physical Chemistry - G. M. Barrow
6. Advanced Physical Chemistry - Gurdeep-Raj (Pelenum)
7. Micelles : Theoretical and Applied Aspects - V. Moroi (Plenum)
8. Text Book of Physical Chemistry - S.Glasstone (McMillan)
9. An Introduction to Electrochemistry - S. Glasstone (EWP, New Delhi)
10. Physical chemistry – Robert A .Alberty ., Robert J .Silbey 11. Statistical Thermodynamic – M. C. Gupta.

SEMISTER –I		
Code: 102104	Title : Analytical Chemistry	Credits : 4
Objectives:- 1. To describe the basic concept of analytical chemistry. Qualitative and quantitative analysis. 2. To use/apply the basic statistical treatment of the analytical data for getting a correct result. 3. Describe the different separation techniques such as distillation, Solvent and Solid Phase extraction. 4. Explain the basic of chromatography. 5. To ensure safety in laboratories. 6. To identify different types of environmental pollutants and their global impact. 7. To correlate various methods for control of environmental pollution.		
Paper -I		60 Hours
Unit I	Basic concepts of analytical chemistry: - The role of analytical chemistry, qualitative and quantitative analysis, The analytical process, Validation of a method. Statistical treatment of analytical data: Introduction, types of errors, significant figures, precision and accuracy, methods of expressing accuracy, methods of expressing precision, the confidence limit, tests of significance- the F test, the student T test, rejection of results - the Q test. Statistics for small data sets, linear least squares, correlation coefficient, using spreadsheets for plotting calibration curves, slope, intercept and coefficient of determination, numericals.	15 Lectures
Unit II	Chromatography Introduction:- Basic principles and theory of chromatographic techniques, plate theory of chromatography, rate theory of chromatography, other factors in zone broadening, Development of the chromatogram - Frontal analysis, elution analysis displacement analysis, selection of chromatograph system, qualitative and quantitative analysis by chromatography.	15 Lectures
Unit III	Safety in Laboratories:- Basic concepts of Safety in Laboratories, Personal Protection Equipment (PPE), OSHA, Toxic Hazard (TH) classifications, Hazardous Chemical Processes (including process calorimetry / thermal build up concepts).	15 Lectures
Unit IV	Environmental Chemistry :- Air pollution, water pollution, Impact of pollution in India, Pollution, pollution in India, Greenhouse effect, Acid rain, Ozone depletion and their consequences on environment, Major air pollution disasters, Pollution control methods and techniques, Sampling and analysis of air and water pollution	15 Lectures

Reference Books :

1. Fundamental of Analytical Chemistry 8th Edn. Skoog , West Hollar, Couch.
2. Analytical Chemistry 6th Edition., Gary D. Christian

3. Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftie
4. Instrumental Method of Chemical Analysis, G.R. Chatwal & S.K.Anand.
5. A.K. De, Environmental Chemistry, New Age International Publication, 5th Edition.
6. Wark K. & Werner C., Edited by David and Liptak,Air Pollution, CRC press LLC,3rd Edition.
7. S.P. Mahajan, Environmental Pollution Control in Process Industries, Tata McGraw Hill Publishing Co. Ltd.
8. B.K.Sharma & H. Kaur,Environmental Pollution, Krishna Prakashan Media Pvt Ltd.
9. R.K. Trivedi, P.K.Goyal, Introduction to Air pollution, ABD publisher.
10. P.K.Goyal, Water Pollution: Causes Effect and control, New Age International Publication.

PRACTICALS (102201)

OBJECTIVES :-

1. To conduct separation and estimation of amount of metal ions in binary metal ion mixture.
2. To use/apply the basic statistical treatment of the analytical data for getting a correct result of Volhard's Method.
3. To conduct the experiment on various instrumental techniques.
4. To describe the principles behind the experiment performed in the laboratory.
5. To conduct chemical analyses by qualitative and quantitative analysis of metal complexes.

Code : 102201	PRACTICAL	4 CREDITS
Inorganic Chemistry	Preparation and estimation of percentage metal ion present in a metal complexes :- 1. $\text{Ti}(\text{C}_9\text{H}_8\text{NO})$ 2. $2\text{H}_2\text{O}_2$. $\text{VO}(\text{acac})_2$ 3. $\text{Cis-K}[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_2]$ 4. $[\text{Mn}(\text{acac})_3]$ 5. $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ 6. $\text{Hg}[(\text{Co}(\text{SCN})_4)]$ 7. $[\text{Co}(\text{III})(\text{NH}_3)_6]\text{Cl}_3$ 8. $[\text{Co}(\text{III})(\text{NO}_2)(\text{NH}_3)_5]\text{Cl}_2$ 9. $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$	8 Hours/ Week
Organic Chemistry	Qualitative Organic Analysis:- Separation, purification and identification of binary (Solid-Solid) mixtures. The separation should be carried out using Chemical method. The two components are solid-solid mixtures. Student should submit the purified samples of the separated compounds and prepare a suitable derivative of the two compounds separated out.	
Physical Chemistry	Instrumentation:- 1. Determination of strengths of halides in a mixture potentiometrically. 2. Determination of the strength of strong and weak acid in a given mixture conductometrically. 3. Determination of solubility and solubility product of sparingly soluble salt BaSO_4. 4. Determine the molecular refraction of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the refraction of CH_2, C, H and O atoms. 5. To study the effect of surfactants (sodium chloride) on surface tension of given liquid. 6. To determine the radius of molecule by viscosity measurements.	
Analytical Chemistry	1. To carry out assay of the sodium chloride injection by Volhard's method. Statistical method.	

	2. To determine amount of Cr(III) and Fe(II) individually in a mixture of the two by titration with EDTA. 3. To determine the breakthrough capacity of a cation exchange resin.	
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Reference Books :

1. A Text book of Quantitative Inorganic Analysis; A. I. Vogel
2. A Text book of Quantitative Organic Analysis; A. I. Vogel
3. Practical Inorganic Chemistry; Pass Geoffrey and Haydn Sutcliffe.
4. Advanced Practical Inorganic Chemistry; Gurudeep Raj;.
5. Vogel's Qualitative Inorganic Analysis, D. Svehla, VII Edn. Orient Longman Ltd.
6. Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
7. Experiments in chemistry – D.V. Jahagirdar

PRACTICALS (102202)

OBJECTIVES :-

1. To conduct separation and estimation of amount of metal ions in binary metal ion mixture.
2. To Perform/demonstrate the techniques involved in organic binary mixture separation specially solid- liquid mixture.
3. To perform distillation techniques for purification of organic compounds.
4. To use/ apply the technique of separation , crystallization derivatization and function group detection.
5. To use the methods for the preparation of useful compounds using named reaction.
6. To interpret the experimental results obtained by refractometer, spectrophotometer, Ph meter, potentiometer.
7. To conduct the experiment on various instrumental techniques.
8. To describe the principles behind the experiment performed in the laboratory.

Code : 102202	PRACTICAL	4 CREDITS
Inorganic Chemistry	II. Separation and estimation of amount of metal ions from the following mixture solutions 1.Copper- Nickel 2. Nickel- Zinc 3. Iron- Magnesium	8 Hours/ Week
Organic Chemistry	Single Stage Preparations: - i) p-nitro acetanilide from acetanilide. ii) Dibenzylidene acetone from Benzaldehyde The preparations should be carried out using (0.02 to 0.05 mole) of the starting material. ii) The yield, melting point and TLC of the recrystallised product should be recorded.	
Physical Chemistry	Non-Instrumentation. 1. Determine the molecular refraction of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the refraction of CH ₂ , C, H and O atoms. 2. To study the effect of surfactants (sodium chloride) on surface tension of given liquid. 3. To determine the radius of molecule by viscosity measurements.	
Analytical Chemistry	1. To determine the lead and tin content of a solder alloy by titration with EDTA. 2. To determine amount of Cu(II) present in the given solution containing a mixture of Cu(II) and Fe(II). 3. To determine number of nitro groups in the given compound using TiCl ₃ .	

Reference Books :

1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rd Ed. ELBS (1964)
2. Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes, Thomas, Pearson education
3. Standard methods of chemical analysis, F. J. Welcher
4. Standard Instrumental methods of Chemical Analysis, F. J. Welcher
5. W.W.Scott."Standard methods of Chemical Analysis",Vol.I, Van Nostrand Company,Inc.,1939. 6. E.B.Sandell and H.Onishi,"Spectrophotometric Determination of Traces of Metals",PartII,4th Ed.,A Wiley Interscience Publication,New York,1978.

SEMISTER -II

SEMISTER –II		
Code: 202101	Title : Inorganic Chemistry	Credits : 4
Objectives :- 1. Describe the fundamental requirement for interpretation of electronic spectra of metal compound for prediction of their properties. 2. Describe the studies of metal nitrosyls and its preparation, structures and properties. 3. Explain the classification of metal clusters and compound and Chemistry of dioxygen, dinitrogen complexes and non-carbonyl metal clusters. 4. Explain the properties of halogen compounds and noble gases.		
Paper -I		60 Hours
Unit I	Spectroscopic term symbols : - Inter-electronic repulsion, spin orbit coupling, ground terms, determination of terms symbol of d1 to d5 Configuration / complexes, Energy ordering of terms, microstates. Racah parameter. Weak and stronger field approach. Correlation diagram of d ¹ , d ² , d ⁸ and d ⁹ configuration in octahedral and tetrahedral environments, Non-crossing rule. Orgel diagram of d ¹ to d ⁹ configuration in an octahedral and tetrahedral environments, Tanabe Sugano diagram of d ² and d ³ configurations.	15 Lectures
Unit II	Organometallic Chemistry of Transition metals:- 1. Eighteen and sixteen electron rule and electron counting with examples. 2. Preparation and properties of the following compounds (a) Alkyl and aryl derivatives of Pd and Pt complexes (b) Carbenes and carbynes of Cr, Mo and W (c) Alkene derivatives of Pd and Pt (d) Alkyne derivatives of Pd and Pt (e) Allyl derivatives of nickel (f) Sandwich compounds of Fe, Cr and Half Sandwich compounds of Cr, Mo. 3. Structure and bonding on the basis of VBT and MOT in the following organometallic compounds: Zeise's salt, bis(triphenylphosphine)diphenylacetylene platinum(0) [Pt(PPh ₃) ₂ (HC≡CPh) ₂], diallylnickel(II), ferrocene and bis(arene)chromium(0), tricarbonyl (η ² -butadiene) iron(0)	15 Lectures
Unit III	Halogen group & Noble gases:- Halogen group :- Interhalogens, Pseudohalogen, synthesis, properties & applications, structure, oxyacids & oxoanions of Halogens Bonding. Noble gases:- Synthesis, properties, uses, structure & bonding with respect to VSEPR.	15 Lectures
Unit IV	Metal nitrosyl compounds :- Preparations and properties of Nitrosyl halides (NOX), Metal nitrosyl halides, compounds containing NO- group, Compounds containing NO+ groups, Preparation, structure and application of sodium Nitroprusside. EAN and Eighteen electron rules applied to nitrosyl compounds, Nitrosyl compounds of Cobalt, iron and Manganese. Significance of NO for the life of living animal.	15 Lectures

Reference Books :

1. Inorganic Chemistry , J.E. Hubeey, E.A. Keitler, R.L. Keitler.
2. Concise Inorganic Chemistry - J.D. Lee.
3. Symmetry and Spectroscopy of Molecules - K. Veera Reddy
4. Advanced Inorganic Chemistry - Vol. I - Satyaprakash, Tuli, Basu and Madan.
5. Selected Topics in Inorganic Chemistry - W.U. Malik, G.D. Tuli & R.D. Madan.
6. Advanced Inorganic Chemistry Vol. I & Vol. II - Gurdeep and Raj.
7. Some aspect of Crystal Field theory- T. M. Dunn, D.S.Mcclure & R. G. Person

SEMISTER –II		
Code: 202102	Title : Organic Chemistry	Credits : 4
Objectives : 1. To describe various reactions involved in addition to C-C and C-O double bond 2. To Explain aromatic nucleophilic substitution reactions 3. To demonstrate/apply the concepts involved in oxidation & reduction reactions. 4. To describe the basic concepts in aromaticity.		
Paper -I		60 Hours
Unit I	Aromatic Electrophilic and Nucleophilic Substitutions Electrophilic Substitutions:- The arenium ion mechanism, orientation and reactivity, energy profile diagram. The ortho/para ratio, IPSO substitution, orientation in other ring system, Recapitulation of halogenation, nitration, sulphonation and Fridel Craft's reaction, diazonium coupling. Nucleophilic Substitution: The S _N Ar, S _N 1, benzyne mechanism, Effect of substrate structure, leaving group and attacking nucleophile on reactivity.	15 Lectures
Unit II	Addition to Carbon –Carbon multiple bond:- Mechanism and stereochemical aspect of addition reaction involving electrophile, nucleophile and free radicals. Regioselectivity and chemoselectivity, orientation and reactivity, Michael addition, Sharpless asymmetric epoxidation.	15 Lectures
Unit III	Oxidation and Reduction:- CrO ₃ (Jones reagent) PDC, PCC, KMnO ₄ , MnO ₂ , Swern, SeO ₂ , Pb (OAc) ₄ , Pd/C, OsO ₄ , mCPBA, O ₃ , NaIO ₄ , HIO ₄ , R ₃ SiH, Bu ₃ SnH, Boranes & Hydroboration reactions, MVP, H ₂ / catalyst, Wilkinson's catalyst, NaCNBH ₃ , NH ₂ NH ₂ , DIBAL, etc	15 Lectures
Unit IV	Aromaticity: - 2.2.1. Structural, thermochemical, and magnetic criteria for aromaticity, including NMR characteristics of aromatic systems. Delocalization and aromaticity. 2.2.2. Application of HMO theory to monocyclic conjugated systems. Frost-Musulin diagrams. Huckel's (4n+2) and 4n rules. 2.2.3. Aromatic and antiaromatic compounds up-to 18 carbon atoms. Homoaromatic compounds. Aromaticity of all benzenoid systems, heterocycles, metallocenes, azulenes, annulenes, aromatic ions and Fullerene.	15 Lectures

Reference Books :

1. Advanced Organic Chemistry, IV Edition: J. March
2. Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg.
3. A Guide Book to Mechanism in Organic Chemistry: Peter Sykes.
4. Organic Chemistry: Clayden and Greeves
5. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Michael B. Smith, Jerry March, Wiley
6. Advanced Organic Chemistry: Reactions and mechanism, L.G. Wade, Jr., Maya Shankar Singh, Pearson Education.
7. Organic Synthesis, Jagdamba Singh, L.D.S. Yadav, Pragati Prakashan.

SEMISTER –II		
Code: 202103	Title : Physical Chemistry	Credits : 4
Objectives: - 1. Explain the concept of activation energy and its effects on the rates of chemical reactions. 2. Apply the tools to derive the rate law and its mechanism 3. To explain the influence of different parameters on rate of reactions 4. To explain concept of quantum chemistry , operators , oscillators and numerical. 5. Apply the basic principles of the major spectroscopes, including Raman, ESR, Mossbauer, NMR.		
Paper -I		60 Hours
Unit I	Quantum Chemistry:- The Schrodinger equation, particle in a one dimensional box, Eigen values and Eigen functions, operators, properties of quantum mechanical operators, Hermitian, Linear, Ladder, Hamiltonian and angular momentum operators. Particle in three dimensional box, harmonic oscillator, rigid rotator and numericals.	15 Lectures
Unit II	Chemical Kinetics and Molecular Reaction Dynamics :- 1. Elementary Reactions in Solution:- Solvent Effects on reaction rates, Reactions between ions- influence of solvent Dielectric constant, influence of ionic strength, Linear free energy relationships Enzyme action 2. Kinetics of reactions catalyzed by enzymes -Michaelis-Menten analysis, Lineweaver-Burk and Eadie Analyses. 3. Inhibition of Enzyme action: Competitive, Noncompetitive and Uncompetitive Inhibition. Effect of pH, Enzyme activation by metal ions, Regulatory enzymes. 4. Kinetics of reactions in the Solid State:- Factors affecting reactions in solids Rate laws for reactions in solid: The parabolic rate law, The first order rate Law, the contracting sphere rate law, Contracting area rate law, some examples of kinetic studies.	15 Lectures
Unit III	Quantum Chemistry:- Term symbols and selection rules, spin-orbital coupling, the variation theorem, nondegenerate perturbation theory and applications. Huckel molecular orbital theory of conjugated systems, application to ethylene, butadiene, cyclopropenyl radical , cyclobutadiene and benzene, numericals.	15 Lectures
Unit IV	Molecular Spectroscopy:- 1. Raman Spectroscopy:- Introduction, Rotational Raman spectra, Vibrational Raman Spectra, polarization of light and Raman effect, structure elucidation from combined Raman and IR spectroscopy, applications in structure elucidation. 2. Electronic spectroscopy of molecules:- Born – Oppenheimer approximation, electronic spectra of diatomic molecules, vibrational coarse structure, rotational fine structure dissociation energy and dissociation products, electronic structure of diatomic molecules, molecular photoelectron spectroscopy, application. 3. ESR and Mossbaur spectroscopy applications.	15 Lectures

	4. Principles of NMR : - Chemical applications of PMR in structure elucidation.	
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Reference Books :

1. Quantum Chemistry : Ira N. Levine
2. Quantum Chemistry : R.K. Prasad
3. Quantum Chemistry : B.K. Sen
4. Introduction to Molecular Photo-chemistry : C.H.J. Wells
5. Atkin's Physical Chemistry : Peter Atkins
6. Physical Chemistry : G.K. Vemulapalli.
7. Fundamentals of molecular spectroscopy : C.N. Banewell and E.Mc. Cash (Fourth edition).
8. K.J. Laidler and J.H. Meiser, Physical Chemistry, 2nd Ed., CBS Publishers and Distributors, New Delhi, 1999.
9. Principles of Chemical Kinetics, 2nd Ed., James E. House, ELSEVIER, 2007.

SEMISTER –II

Code: 202104	Title : Analytical Chemistry	Credits : 4
Objectives: - 1. Describe and understand the basic profile of electromagnetic radiations, scientific notations for absorption, emission, transmission, reflection, dispersion, polarization and Classify electromagnetic spectrum ion of spectra. 2. Describe basic concept of microwave spectroscopy and classify molecules on the basis of structural parameters like moment of inertia and intermolecular distances 3. To use/apply the basic statistical treatment of the analytical data for getting a correct result 4. Participants will be able to work more efficiently with knowledge of basic principles. 5. Able to collect data, literature survey for research project.		
Paper -I		60 Hours
Unit I	General introduction of spectral methods of analysis:- Characterization of electromagnetic radiations, Regions of the spectrum, Interaction of radiations with matter - absorption, emission, transmission, reflection, dispersion, polarization and representation of spectra, basic elements of practical spectroscopy, resolving power, signal to noise ratio. Uncertainty relation and natural line width, natural line broadening, intensity of spectral lines, energy levels, selection rules, components of spectrometer and their functions. Microwave spectroscopy: Rotation of molecules, rotational spectra, diatomic molecules - rigid diatomic molecules, intensities of spectral lines, effect of isotopic substitution, non-rigid rotator, the spectrum of non-rigid rotator, polyatomic molecules, technique and instrumentation in outline, applications, numerical problems.	
Unit II	Laboratory work:- 1. Fundamental Laboratory Techniques:- Basic principles, Health and safety, Working with liquids, Basic laboratory procedures I & II, Principles of solution chemistry, pH and buffer solutions. 2. The investigative approach:- Making and recording measurements, SI units (International System of Units) and their use, Scientific method and design of experiments, Project work. Collection of data (primary, secondary), literature survey & review. 3. Analysis and presentation of data: Using graphs, Presenting data in tables, Hints for solving numerical problems, Descriptive statistics, Choosing and using statistical tests, drawing chemical structures, Chemo metrics, Computational chemistry. 4. Statistical Packages for Social Science (SPSS) Workshop.	15 Lectures
Unit III	Data Analysis:- 1. Analysis and presentation of data: Using graphs, Presenting data in tables, Hints for solving numerical problems, Descriptive statistics, Choosing and using statistical tests, drawing chemical structures, Chemo metrics, Computational chemistry. 2. Statistical Packages for Social Science (SPSS) Workshop.	15 Lectures

Unit IV	Spectroscopy:- Vibrational spectroscopy Review of linear harmonic oscillator, the vibrating diatomic molecule, the simple harmonic oscillator, the anharmonic oscillator, the diatomic vibrating rotator, the vibration-rotation spectrum of carbon monoxide, breakdown of the Born-Oppenheimer approximation, the vibration of polyatomic molecules, overtones and combination frequencies, the influence of rotation on the spectra of polyatomic molecules, the influence of nuclear spin, symmetric top molecules, analysis by Infra-red technique - Group frequencies, outline of technique and instrumentation. Raman spectroscopy: Classical and quantum of theory of Raman effect, pure rotational, vibrational and vibrational-rotational Raman spectra, rule of mutual exclusion, overtone and combination vibrations, Rotational fine structure, outline of technique and instrumentation, applications.	15 Lectures
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Reference Books :

1. Instrumental Methods of Chem. Analy. Chatwal and Anand.
2. Instrumental Methods of Chemical Analysis - Willard, Merritt, Dean & Seale
3. Instrumental Methods of Chemical Analysis - Chatwal, Anand
4. Instrumental Methods of Chemical Analysis - R.D. Braun
5. Fundamentals of Molecular Spectroscopy: Banwell.
6. Atomic and Molecular Structure : Manas Chandra
7. Spectroscopic Methods in Organic Chemistry : D.H. Williams and I. Fleming.
8. Organic Spectroscopy: William Kemp (3rd Edition).
9. Inorganic Chemistry - Atkins and Shriver.
10. Principles of Instrumental Analysis - Skoog, Holler and Nieman, 5th Edition.
11. Undergraduate Instrumental Analysis, 6th Edition, J W Robinson, Marcel Dekker.
12. Quality Control and Total Quality Management - P.L. Jain-Tata McGraw-Hill (2006) Total Quality Management - Besterfield - Pearson Education.
13. Industrial Hygiene and Chemical Safety, M H Fulekar.
14. 3000 solved problems in chemistry, Schaums Solved problem series, David E. Goldberger, McGraw Hill International Editions.

PRACTICALS (202201)

OBJECTIVES :-

1. To conduct chemical analyses by qualitative and quantitative analysis of metal complexes.
2. To Perform/demonstrate the techniques involved in organic binary mixture separation specially solid- liquid mixture.
3. To interpret the experimental results obtained by potentiometer, pH meter, conductometer.
4. To conduct the experiment on various instrumental techniques.
5. To describe the principles behind the experiment performed in the laboratory.
6. To develop skills in chromatographic techniques for analysis.

Code : 202201	PRACTICAL	4 CREDITS
Inorganic Chemistry	Semi micro qualitative inorganic analysis:- Identification of three acidic and three basic radicals including one rare earth from the given mixture.	8 Hours/ Week
Organic Chemistry	Qualitative Organic Analysis:- Separation, purification and identification of binary (Solid-Liquid) mixtures. The separation should be carried out using Chemical method. The two components are solid-liquid mixtures. Student should submit the purified samples of the separated compounds and prepare a suitable derivative of the two compounds separated out.	
Physical Chemistry	Instrumentation:- 1. Determination of strengths of halides in a mixture potentiometrically. 2. Determination of the strength of strong and weak acid in a given mixture conductometrically. 3. Determination of solubility and solubility product of sparingly soluble salt BaSO ₄ .	
Analytical Chemistry	Chromatography:- Ion- exchange chromatography, Thin layer chromatography.	

Reference Books :

1. A Text book of Micro and Semi micro Qualitative Inorganic Analysis, IV edn, A. I. Vogel
2. A Text book of Quantitative Inorganic Analysis; A. I. Vogel
3. Practical Inorganic Chemistry- Pass Geoffrey and Haydn Sutcliffe.
4. Advanced Practical Inorganic Chemistry- Gurudeep Raj.
5. Vogel's Qualitative Inorganic Analysis, VII Edn. Orient Longman Ltd. D. Svehla.
6. Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
7. Experiments in chemistry – D.V. Jahagirdar

PRACTICALS (202202)

OBJECTIVES :-

1. To conduct separation and estimation of amount of metal ions in binary metal ion mixture.
2. To use the methods for the preparation of useful compounds using named reaction.
3. To conduct the experiment on various instrumental techniques.
4. To describe the principles behind the experiment performed in the laboratory.
5. Able to handle colorimetric instrument for analysis.

Code : 202202	PRACTICAL	4 CREDITS
Inorganic Chemistry	Separation and estimation of amount of metal ions from the following mixture solutions:- 1. Copper- Barium 2. Iron –Aluminum 3. Copper- Iron	8 Hours/ Week
Organic Chemistry	Single Stage Preparations:- 1. p-Bromo acetanilide from acetanilide. 2. 1,4-dichlorobenzene from p-chloroaniline 3. Benzophenone from benzene (Friedal Craft) 4. Cyclohexanone to adipic acid. 5. Benzaldehyde to cinnamic acid 6. P – aminobenzoic acid to p-chlorobenzoic acid	
Physical Chemistry	Instrumentation: - 1. Determine the pK₁ and pK₂ value of phosphoric acid by pH metry 2. Determine the indicator constant of given indicator by colorimetric measurements. 3. Study of kinetics of inversion of cane sugar. 4. Determine the solubility of benzoic acid in water at different temperature and hence its heat of solution. 5. Determine the formula of the complex formed between Cu(II) and ammonia by distribution method. 6. Determine the velocity constant of hydrolysis of ester.	
Analytical Chemistry	Colormetric Analysis of elements:- Estimation of metal ions, pk value of metal ions, Estimation of mixture of metal ions	

Reference Books :

1. Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
2. Experiments in chemistry – D.V. Jahagirdar
1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rd Ed. ELBS (1964)
2. Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes, Thomas, Pearson education
3. Standard methods of chemical analysis, F. J. Welcher
4. Standard Instrumental methods of Chemical Analysis, F. J. Welcher
5. W.W.Scott."Standard methods of Chemical Analysis",Vol.I, Van Nostrand Company,Inc.,1939. 6. E.B.Sandell and H.Onishi,"Spectrophotometric Determination of Traces of Metals",PartII,4th Ed.,A Wiley Interscience Publication,New York,1978.

SEMISTER –III		
Code: 302101	Title : Inorganic Chemistry	Credits : 4
Objectives: - 1. To describe basic concepts of co-ordination chemistry. 2. To analyse impact of metal toxicity on environment. 3. To explain magnetic properties of co-ordination compounds. 4. To understand the concept of ^1HMR spectroscopy.		
Paper -I		60 Hours
Unit I	Coordination Chemistry:- 1. Concept & Scope of Ligand Fields. 2. Energy levels of transition metal ions, free ion terms, term wave functions, spin-orbits coupling. 3. Effect of ligand field on energy levels of transition metal ions, weak cubic ligand field effect on Russell- Saunders terms, strong field effect, correlation diagrams, Tanabe- Sugano Diagrams, Spin-Pairing energies.	
Unit II	Environmental Chemistry:- 1. Conception of Heavy Metals: Critical discussion on heavy metals 2. Toxicity of metallic species: Mercury, lead, cadmium, arsenic, copper and chromium, with respect to their sources, distribution, speciation, biochemical effects and toxicology, control and treatment. 3. Case Studies: (a) Itai-itai disease for Cadmium toxicity, (b) Arsenic Poisoning in the Indo-Bangladesh region. 4. Interaction of radiation in context with the environment: Sources and biological implication of radioactive materials. Effect of low level radiation on cells- Its applications in diagnosis and treatment, Effect of radiation on cell proliferation and cancer.	15 Lectures
Unit III	Nuclear Magnetic Resonance Spectroscopy (^1H NMR) :- Elementary ideas (Recapitulation); Spin-spin couplings, Different types of couplings, factors affecting on coupling constants, Karplus equation, Spin systems (AB, AX, ABX, AMX), Rate processes, spin decoupling, shift reagents, Nuclear Overhauser effect (NOE), INEPT and INADEQUATE.	15 Lectures
Unit IV	Coordination Chemistry:- Electronic spectra of complexes- band intensities, band energies, band width & shapes, spectra of 1st, 2nd & 3rd row ions and rare earth ion complexes, spectrochemical & nephelauxetic series, charge transfer & luminescence, spectra, calculations of Dq , B , β parameters. Magnetic properties of complexes-paramagnetism 1st & 2nd Ordered Zeeman effect, quenching of orbital angular momentum by Ligand fields, Magnetic properties of A, E & T ground terms in complexes, spin free spin paired equilibria	15 Lectures

Reference Books :

1. Inorganic Chemistry: Shriver & Atkins (1990) Oxford.
2. Inorganic Electronic spectroscopy: A.B.P. Level, 2nd edn. (1984) Elsevier Science Publishers New York.

SEMISTER –III		
Code: 302102	Title : Organic Chemistry	Credits : 4
Objectives : 1. To understand the application of FMO concept. 2. To demonstrate the oxidation synthesis. 3. To describe pericyclic reactions and their applications. 4. To introduce concept of bioorganic chemistry.		
Paper -I		60 Hours
Unit I	Introduction to FMOs: HOMO and LUMO and significance of HOMO-LUMO gap in absorption spectra as well as chemical reactions. MOs of formaldehyde: The effect of electronegativity perturbation and orbital polarization in formaldehyde. HOMO and LUMO (π and π^* orbitals) of formaldehyde. A brief description of MOs of nucleophiles and electrophiles. Concept of 'donor-acceptor' interactions in nucleophilic addition reactions on formaldehyde. Connection of this HOMO-LUMO interaction with 'curved arrows' used in reaction mechanisms. The concept of hardness and softness and its application to electrophiles and nucleophiles. Examples of hard and soft nucleophiles/ electrophiles. Identification of hard and soft reactive sites on the basis of MOs.	15 Lectures
Unit II	Oxidation Synthesis:- (a) Oxidation of alcohol to aldehyde, ketone or acid: Jones reagent, Swern oxidation, Collins reagent, Fetizon's reagent, PCC, PDC, PFC, IBX, Activated MnO_2, Chromyl chloride (Etard reaction), TEMPO, CAN, NMO, Moffatt oxidation (b) Oxidative cleavage of Carbon-Carbon double bonds: KMnO_4, Ozonolysis. (c) Oxidations using SeO_2, PhSeBr. (d) Selective cleavages at functional groups: Cleavage of glycols, IO_4, $\text{Pb}(\text{OAc})_4$. (b) Reductions (a) Catalytic Hydrogenation; (b) Reduction of nitriles, oximes and nitro compounds; (c) Reduction of acids and Esters; (d) Reduction with metal hydride- Sodium cyanoborohydride, Diborane, L- & K-Selectrides, LiBH_4, DIBAL-H; (e) Birch reduction and related reactions, (h) Luche reagent, Wolf-Kishner reduction, Clemmenson reduction, Wilkinson catalyst, TBTH.	15 Lectures
Unit III	Pericyclic Reactions:- Features and classification of pericyclic reactions, Phases, nodes and symmetry properties of molecular orbital in ethylene, 1,3-butadiene, 1,3,5-hexatriene. Allyl cation, allyl radical, pentadienyl cation and pentadienyl radical. Thermal and photochemical reactions. Electrocyclic reactions: Woodward-Hoffmann selection rules for electrocyclic reactions. Explanation for the mechanism of electrocyclic reactions by: (i) Symmetry properties of HOMO of open chain partner; (ii) Conservation of orbital symmetry and orbital symmetry correlation diagram and (iii) Huckel-Mobius aromatic and antiaromatic transition state method.	15 Lectures
Unit IV	Bioorganic chemistry introduction:-	15 Lectures

	Basic concepts, Proximity effects in organic chemistry, Molecular adaptation, Molecular recognition. Enzyme Chemistry :-Introduction, Nomenclature, Classification and Extraction of enzymes, Introduction to catalysis and enzymes; Multifunctional catalysis, Intramolecular Catalysis, Mechanism of enzyme action, Factors responsible for enzyme specificity, Enzyme activity and kinetics (Michaelis Menten and Lineweaver–Burk plots), Enzyme Inhibitions (Reversible and irreversible), Structure, Mechanism of action and applications of α-Chymotrypsin, Ribonuclease, lysozyme and Carbopeptidase-A. Enzymes in synthetic organic chemistry. [Additions, eliminations, substitutions, condensations, cyclocondensations, oxidations, reductions and rearrangement reactions are to be covered]	
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Reference Books :

1. Bioorganic chemistry (A chemical approach to enzyme action): Hermann Dugas.
2. Biotransformation in Organic chemistry: K. Faber
3. Enzyme structure and Mechanism: Alan Fersht.
4. Enzyme catalysis in organic synthesis vol.1: Karlheinz Drauz and Herbert Waldmann.
5. Bioorganic, Bioinorganic and supramolecular chemistry: P. S. Kalsi and J. P. Kalsi .
6. Organic Chemistry, J. Claydens, N. Greeves, S. Warren and P. Wothers, Oxford University Press.
7. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Part A, page no. 713-769, and B, Plenum Press.
8. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Michael B. Smith, Jerry March, Wiley.
9. Organic Chemistry, R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, Pearson Publication (7th Edition)

SEMISTER –III		
Code: 302103	Title : Physical Chemistry	Credits : 4
Objectives: - 1. To describe the nuclear particles & its physical properties. 2. To explain semiconductor materials and their application in devices. 3. To analyse the concept of storage cell. 4. To understand phase equilibria rule concept.		
Paper -I		60 Hours
Unit I	Nuclear particles and its properties :- The fundamental particles, roll call of elementary particles, composition of the nucleus, theories of nuclear composition, nuclear properties, mass defect and binding energy, nuclear stability explained by different factors. Nuclear size and density, mechanical effects due to orbiting and spinning of nucleons, orbital angular momentum of the nucleons, Total angular momentum of the nucleons, magnetic quantum numbers, principal and radial quantum numbers, total angular momentum of nucleus, total magnetic nuclear angular momentum quantum number, magnetic properties of the nucleous, the neutron magnetic moment, the structure of nucleon the net magnetic moments, The spin of odd Z odd N nuclei, The Nordhein rule.	15 Lectures
Unit II	Imperfections in solids & Semiconductors and their devices:- Perfect and imperfect crystal, Point defects, Stiochiometric defects, Schottky and Frenkel defects. Thermodynamics of their formation, colour centers. Nonstoichiometric defects. Metal excess and metal deficiency defects. Line imperfections, edge dislocation and screw dislocation, Burger's circuits. Surface imperfection, `grain boundries and stacking faults. Semiconductors and their devices :- Intrinsic and extrinsic semiconductors, semiconductors materials and their fabrication, semiconductors devices p-n junctions, properties of p-n junctions, semiconductors diode as rectifier, Filters circuits, Zener diode as a voltage stabilizer, transistors transistor as an amplifier Super conductivity: conventional super conductors, organic super conductors (organic metals), fullerence, high temperature super conductors, organic charge transfer complexes Applications	15 Lectures
Unit III	Electrodeposition& Storage Cells :- Introduction, the electrogrowth of metals on electrodes , the reaction pathway for electro deposition, surface diffusion of ions, cathodic deposition of metals from solutions, factors affecting cathodic deposition of metals, electrochemical dissolution and passivity of metals, anodic dissolution of metals, film and adsorption theories of passivity. Electroplating of metals, mechanism, throwing power of an electroplating bath, factors affecting throwing power, typical electrodeposition processes, and applications of electroplating of	15 Lectures

	metals. Numericals Storage Cells:- Introduction of storage cells, fuel cells, solar cells Types of storage cells (batteries), measure of cell performance , charging and discharging , introduction of classical batteries , modern batteries –zinc-air , nickel-metal oxide and lithium batteries.	
Unit IV	Phase equilibria:-. 1. Recapitulation: Introduction and definition of terms involved in phase rule. Thermodynamic derivation of Gibbs Phase rule. 2. Two component system: a) Solid –Gas System : Hydrate formation, Amino compound formation b) Solid – Liquid System: Formation of a compound with congruent melting point, Formation of a compound with incongruent melting point . (with suitable examples)	15 Lectures

Reference Books :-

1. K.J. Laidler and J.H. Meiser, Physical Chemistry, 2nd Ed., CBS Publishers and Distributors, New Delhi, 1999.
2. Principles of Chemical Kinetics, 2nd Ed., James E. House, ELSEVIER, 2007.
3. A Text book of physical Chemistry ; Applications of thermodynamics vol III, Mac Millan Publishers India Ltd ,2011
4. Theoretical Electrochemistry, L.Antropov.
5. Modern Electrochemistry, Vol 1,2A and 2B, John O" M Bokris
6. Solid State chemistry and its Applications-A. R. West (John Wiley and sons)
7. Principles of Solid State –H.V. Keer (Wiley Eastern Limited)
8. Selected topics in solid state physics vol.12 The growth of crystals from liquids
9. Essentials of nuclear chemistry by H.J. Arnikar 4th Edn, New Age International(p) Ltd.
10. Nuclear chemistry by M. G. Arora & M. Singh Anmol publication, New Delhi
11. A text book of Nuclear chemistry by C.V. Shekar Dominant publication & distribution, New Delhi.

SEMESTER-III

PRACTICALS (302201)-Inorganic Chemistry

OBJECTIVES : -

To conduct separation of amount of metal ions in binary metal ion mixture.

Code : 302201	PRACTICAL	4 CREDITS
Inorganic Chemistry	1. Separation and estimation of Zn(II) and Mg(II) from given mixture using Amberlite IRA 400 anion exchange resin 2. Determine the Total hardness of water by using EDTA 3. Determine the percentage of chlorine from bleaching powder using Volhard method 4. Determination of iron content from given sample by using 8- hydroxyquinoline as extractant	8 Hours/Week

Reference Books :

1. A Text book of Quantitative Inorganic Analysis; A. I. Vogel
2. Advanced Practical inorganic chemistry; Gurudeep Raj.
3. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House

PRACTICALS (302202) -Inorganic Chemistry

OBJECTIVES : - To estimate of amount of metal ions in binary metal ion mixture.

Code : 302202	PRACTICAL	4 CREDITS
Inorganic Chemistry	Prepare and estimate the percentage of metal ion in the metal complex and their spectral studies 1. Tris (thiourea) Copper(II) Sulphate 2. [Copper (II) (Acetyl acetone) ₂] 3. Manganese (II) Phthalocyanine 4. K ₃ [Cr(CNS) ₆] 4H ₂ O	8 Hours/ Week

Reference Books :-

1. A Text book of Quantitative Inorganic Analysis; A. I. Vogel.
2. Practical inorganic chemistry; Pass Geoffrey and haydn Sutcliffe.
3. Advance Inorganic Analysis – S K Agarwala, Keemti Lal , Pragati Prakashan.

SEMESTER-III

PRACTICALS (302201) - Organic Chemistry

OBJECTIVES :-

1. To Perform/demonstrate the techniques involved in organic ternary mixture separation specially solid-liquid mixture.
2. To perform distillation techniques for purification of organic compounds.
3. To use/ apply the technique of separation , crystallization derivatization and function group detection.
4. To use the methods for the preparation of useful compounds using named reaction.

Code : 302201	PRACTICAL	4 CREDITS
Organic Chemistry	Qualitative analysis of ternary mixtures. In a mixture at least one liquid one water soluble compound be given.	8 Hours/Week

Reference Books :

Vogel Practical Organic Chemistry.

PRACTICALS (302202) -Organic Chemistry

OBJECTIVES :-

- 1.To perform distillation techniques for purification of organic compounds.
2. To use/ apply the technique of separation , crystallization derivatization and function group detection.
3. To use the methods for the preparation of useful compounds using named reaction.

Code : 302202	PRACTICAL	4 CREDITS
Organic Chemistry	Preparations involving at least two stage based on name reactions, condensations, cyclocondensations, reagents and rearrangements (as covered under the theory). Separation purification of the product by column is desired. 1. Phthalic anhydride – Phthalimide – Anthranilic acid. 2. acetophenone – Oxime – Acetanilide. 3. Phthalic anhydride – o – benzoyl benzoic acid anthraquinone. 4. Chlorobenzene – 2, 4 – dinitrochlorobenzene – 2,4-dinitrophenol.	8 Hours/ Week

Reference Books :

Vogel Practical Organic Chemistry.

SEMESTER-III

PRACTICALS (302201)-Physical Chemistry

OBJECTIVES :-

1. To interpret the experimental results obtained by refractometer, spectrophotometer, pH meter, potentiometer.
2. To conduct the experiment on various instrumental techniques.
3. To describe the principles behind the experiment performed in the laboratory.

Code : 302201	PRACTICAL	4 CREDITS
Physical Chemistry	1.To determine the indicator constant pK_{in} of an indicator by using half height method (Bromo cresol purple) (DVJ-200) 2.Determine the variation of viscosity with composition of I) ethanol-water, II) methanolethylidene chloride, III) nitric acid- chloroform and confirm the formation of compound.(TKC-250) 3. Determine the molecular weight of macromolecules.(TKC-251)	8 Hours/Week

Reference Books :

1. Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
2. Experiments in chemistry – D.V. Jahagirdar

PRACTICALS (302202)- Physical Chemistry

OBJECTIVES :-

1. To interpret the experimental results obtained by refractometer, spectrophotometer, Ph meter, potentiometer.
2. To conduct the experiment on various instrumental techniques.
3. To describe the principles behind the experiment performed in the laboratory.

Code : 302202	PRACTICAL	4 CREDITS
Physical Chemistry	1.Titrate ferrous ammonium sulphate with ceric sulphate and find out formal redox potential of Fe^{+2}/Fe^{+3} and Ce^{+3}/Ce^{+4} system 2.To determine the proton-ligand stability constant of an organic acid and the metal-ligand stability constant of its complex by pH measurements.(TKC-176) 3. Conductometric titration of a mixture of strong acid, weak acid and a salt.(DVJ)	8 Hours/ Week

Reference Books :

1. Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
2. Experiments in chemistry – D.V. Jahagirdar

SEMISTER -IV

SEMISTER –IV		
Code: 402101	Title : Inorganic Chemistry	Credits : 4
Objectives :- 1. Describe the structural and functional relationships, mechanisms and importance of metalloenzymes. 2. Use rules for description of the structure and stereochemistry of bioorganic compounds 3. Describe the Metal Nucleic Acid Interactions in biological systems. 4. Describe the objectives of inorganic nanocomposite materials , preparation by using physical and chemical methods. 5. Explain the mechanism of formation of nanomaterials , role of surfactants in the synthesis of nonmaterial by sol- Gel and coprecipitation method. 6. To analyze the formation of nanomaterials by microscopic, diffraction and spectroscopic techniques.		
Paper -I		60 Hours
Unit I	Bioionrganic chemistry :- 1. Overviews of Bioniorganic Chemistry 2. Principles of Coordination Chemistry related to Bioionorganic Protein, Nucleic acids and other metal binding biomolecules 3. Choice, uptake and assembly of metal containing units in Biology	15 Lectures
Unit II	1. Control and utilization of metal ion concentration in cells. 2. Binging of metal ions and complexes to bimolecular active centers.	15 Lectures
Unit III	Chemistry of Nanomaterials:- General introduction & synthesis of nanomaterials by physical methods :-Objective of study, synthesis of nanoparticles by physical method, mechanical methods- high energy ball milling, melt mixing, method based on evaporation, physical vapour deposition with consolidation. Ionized cluster beam deposition. Laser vaporization, Laser pyrolysis, sputter deposition, electric arc deposition, Chemical Vapour Deposition (CVD).	15 Lectures
Unit IV	Synthesis of Nanomaterials by Chemical Methods :- Introduction, colloids and colloids in solution, interaction of colloids and medium, colloids in vacuum, colloids in medium, effect of charge on colloids, stearic repulsion, synthesis of colloids, growth of nanoparticles, synthesis of metal and semiconductor nanoparticles by colloidal route, Langmuir-Blodgett (L-B) method, sol gel method, electrochemical method.	15 Lectures

Reference Books :

1. Nanotechnology: Principles and practices- Sulabha K. Kulkarni (capital Pub. Co.)
2. NANO- The next revolution –Mohan Surendra Rajan(National book Trust, India)
3. The British Glass Website- Types of Glass://www.britiglass.org.uk.
4. Fundamental of Nanotechnology – Gabor L. Hornyak, John J. Moore, Harry F. Tibbals, Joydeep Dutta.
5. Recent advances in the liquid phase synthesis of Inorganic Nanoparticles- B. L. Cushing
- .6. Biological Chemistry of the Elements: R.J.P. Williams & F.R. Desalvia, Oxford University Press – (1991)
7. Bioinorganic Chemistry : Inorganic elements in the Chemistry of life : An introduction & guide: W. Kaim, B. Schwederski, VCH, 1991 (1991).

PRACTICAL

SEMISTER -IV		
Code:402202	Title : Inorganic Chemistry	Credits : 4
Objectives : 1. To apply previous knowledge to perform experiment scientifically and safety. 2. To design experimental procedure on ores and alloy analysis. 3. To interpret the results. 4. To demonstrate the skill of chemical analysis different ores & alloys 5. Identify different types of analytical instruments in their respective laboratories. 6. Implement the principles and operating condition of the instruments 7. Differentiate between classical and instrumental methods of chemical analysis. 8. Explain different types of Instrumental methods. 9. Describe molecular absorption, atomic absorption and atomic emission spectrometer.		
Paper -I	PRACTICAL	
Ore Analysis	Ore Analysis:- a. Determination of Silica and Manganese in pyrolusite b. Determination of Copper and iron from chalcopyrite.	8 hours/week
Colorimetry	Simultaneous determination of Cr. & Mn.	

Reference Books :

- 1) Text book of Quantitative Analysis, A.I. Vogel 4th edn (1992)
- 2) Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
- 3) Experiments in chemistry – D.V. Jahagirdar.

IN-PLANT TRAINING

SEMISTER IV - IN-PLANT TRAINING		
Code: 402301	Title : Inorganic Chemistry	Credits : 8 (9wks)
Objectives: i) The intern will develop skills in the Industry/Institutes in practical work situation. ii) Intern will develop and strengthen their professional skills and interpersonal relationship in work environment of the industry. iii) It will provide opportunity to find out their interest in a particular carrier. iv) Experiential learning will have broader perspective for employment.		
In-plant Training & Evaluation: Internship placement will be in research institutes, industries like pharma, food and cosmetic or Government organization (BARC or Haffkine Institute), subject to approval of the internship coordinator. Student will prepare a detailed plan with the approval of external mentor which will be submitted to the internship coordinator within 7 days of the joining. At the end of internship, student will prepare a write up (2000 to 3000 words) based on their daily work activities in the organization and give presentation in the college. Evaluation of the internship assignment and presentation will be done internally and externally.		

Research project (Experimental, Dissertation, presentation and Seminars)

SEMISTER IV : Research project (Experimental, Dissertation, presentation and Seminars)		
Code: 402302	Title : Inorganic Chemistry	Credits : 8 (6wks)
Objectives: 1.To design research oriented project on particular context. 2. To conduct experiment scientifically with safety. 3. To identify the topic with the consideration feasibility. 4. Able to collect data and literature survey. 5. To interpret observed data statistically 6. Acquire knowledge and skills for higher level research work. 7. To prepare a dissertation report with complete follow up of research methodology. 8.To develop the skill of communication in presentation 9. To demonstrate the utility of various software such as ChemDraw, Origin, MS-Office etc. 10. To employ/use the techniques used in typing of dissertation such as Foot Note, End Note etc		
RESEARCH PROJECT (Experimental) : Students will be given guidance on basic research approaches, methodology and tools; and		

expected to collect data (primary, secondary), conduct literature survey.
After completion of research study conduct experiment scientifically with safety.

Research project (Experimental, Dissertation, presentation and Seminars):-

After completion of research study, each student will submit the report of 50-60 pages (12,000 to 15,000 words). The chapter wise indexing and typing rules will be the same as of thesis writing. Each student will develop skill of communication in presentation in college seminars.

Each report will be evaluated by the guide and external referee. Evaluation of research project will be conducted internally and externally.

SEMISTER -IV

SEMISTER –IV		
Code: 402101	Title :Organic Chemistry	Credits : 4
Objectives :- 1. To explain the principles of drug design and drug discovery. 2. To describe the Structure Activity Relationship in drug design and discovery. 3. Describe the structures of classes of heterocyclic aromatic organic compounds. 4.. Classify simple heterocyclic aromatic compounds as electron deficient or electron rich and explain their reactivity based on these properties. 5. Apply organometallic reactions that applied in heterocyclic chemistry. 6. Explain on a mechanistic level, reactions and synthesis of important electron deficient nitrogen containing heterocycles; pyridines, diazines and their benzo-condensed analogs. 7. Explain on a mechanistic level,, reactions and synthesis of important electron rich.heterocycles; furans, pyrroles and thiophenes and 1,3-azoles, and benzo-condensed analogs. 8. Explain Green chemistry and sustainability which relates to problems of societal concern.. 9. Describe Green chemistry and sustainability developments that affect society, the environment and economic development. 10. Analyze a process and identify parameters that make environmentally friendly/sustainable/green.		
Paper -I		60 Hours
Unit I	Principles of Drug design and drug discovery :- Introduction to drug discovery, Folklore drugs, stages involved in drug discovery- disease, drug targets, bioassay. Discovery of a lead, screening of natural products and synthetic compound libraries. Pharmacokinetics (ADME), pharmacodynamics, Nature of drug-receptor interactions and their theories-Occupancy theory, Induced-fit theory, Macromolecular perturbation theory and Two-state model of receptor activation. Natural products as lead structures in drug discovery, Pharmacophore, structure pruning technique e.g. morphine. Discovery of lead structure from natural hormones and neurotransmitters, Principles of design of agonists (e.g. Salbutamol), antagonists (e.g. cimitidine) and enzyme inhibitors	15 Lectures

	(e.g. captopril), Drug discovery without lead, serendipity, Penicillin and Librium as examples, Principles of prodrug design.	
Unit II	Heterocyclic compounds:- Nomenclatures of all types of heterocycles, Classification of heterocycles: as aromatics based upon various membered ring systems.	15 Lectures
Unit III	Organic Synthesis:- General synthetic routes based on name reactions, reactivities, utilities and wherever possible spectral analyses of the following class of heterocycles. Four membered: Azetidines, including β - lactams. Five membered: Thiazoles, Oxazoles, Pyrazoles and Imidazoles Six membered: Pyridines, Pyrimidines. Fused heterocycles: Flavones, Chromones, Coumarines, Indoles, Quinolines, Benzodiazepines, and Phenothiazines.	15 Lectures
Unit IV	Introduction to Green Chemistry:- Green chemistry, relevance and goals, Anastas' twelve principles of green chemistry-Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.	15 Lectures

Reference Books :

1. Burger's medicinal chemistry and drug discovery by Manfred E. Wolf.
2. Introduction to Medicinal chemistry by Patrick.
3. Introduction to drug design by R Silverman
4. Heterocyclic Chemistry: vol. I, II, III: R. R. Gupta, M. Kumar and M. Gupta
5. Heterocyclic Chemistry: Joules and Mills
6. Modern heterocyclic Chemistry: L. A. Paquette (Benjamin) .
7. Green Chemistry-Environmentally benign reactions. V. K. Ahluwalia. Ane Books India (Publisher)
8. Green Chemistry-Designing Chemistry for the Environment. Paul T. Anastas & Tracy C. Williamson.
9. Green Chemistry- Environment friendly alternatives. Rashmi Sanghi & M. M. Srivastava.

PRACTICAL

SEMISTER -IV		
Code:402202	Title :Organic Chemistry	Credits : 4
Objectives : 1. To apply the solubility nature of organic substances of different functional groups. 2. To perform the pilot separation of binary mixtures. 3. To deploy the systematic producers organic substances analysis 4. To deploy the test involving identification of special elements 5. To perform the confirmatory test for various functional groups. 6. To perform the preparations of derivative all functional groups 7. To explain the techniques involving drying and recrystallization by various method		
Code-402202	PRACTICAL	4 Credits
		8 hours/week
Separation of binary mixture	1. Separation of binary mixture using physical and chemical methods.	
Characterization of one of the components	2. Characterization of one of the components with the help of chemical analysis and confirmation of the structure with the help of derivative preparation and its physical constant	
Purification and determination of mass and physical constant of the second component	Purification and determination of mass and physical constant of the second component. The following types are expected: (i) Water soluble/water insoluble solid and water insoluble solid, OR (ii) Non-volatile liquid-Non-volatile liquid (chemical separation) OR (iii) Water-insoluble solid-Non-volatile liquid	

Reference Books :

1. Systematic Qualitative organic analysis, H. Middleton (Orient Longman)
2. A Handbook of Organic Analysis, H.T. Clark (Orient Longman)
3. Systematic Identification of organic compounds, R.L. Shriner (John Wiley, New York)
4. Practical Organic Chemistry by Mann and Saunders

IN-PLANT TRAINING

SEMISTER IV - IN-PLANT TRAINING		
Code: 402301	Title : Inorganic Chemistry	Credits : 8 (9wks)
Objectives: i) The intern will develop skills in the Industry/Institutes in practical work situation. ii) Intern will develop and strengthen their professional skills and interpersonal relationship in work environment of the industry. iii) It will provide opportunity to find out their interest in a particular carrier. iv) Experiential learning will have broader perspective for employment.		
In-plant Training & Evaluation: Internship placement will be in research institutes, industries like pharma, food and cosmetic or Government organization (BARC or Haffkine Institute), subject to approval of the internship coordinator. Student will prepare a detailed plan with the approval of external mentor which will be submitted to the internship coordinator within 7 days of the joining. At the end of internship, student will prepare a write up (2000 to 3000 words) based on their daily work activities in the organization and give presentation in the college. Evaluation of the internship assignment and presentation will be done internally and externally.		

Research project (Experimental, Dissertation, presentation and Seminars)

SEMISTER IV : Research project (Experimental, Dissertation, presentation and Seminars)		
Code: 402302	Title : Inorganic Chemistry	Credits : 8 (6wks)
Objectives: 1.To design research oriented project on particular context. 2. To conduct experiment scientifically with safety.		

3. To identify the topic with the consideration feasibility.
4. Able to collect data and literature survey.
5. To interpret observed data statistically
6. Acquire knowledge and skills for higher level research work.
7. To prepare a dissertation report with complete follow up of research methodology.
8. To develop the skill of communication in presentation
9. To demonstrate the utility of various software such as ChemDraw, Origin, MS-Office etc.
10. To employ/use the techniques used in typing of dissertation such as Foot Note, End Note etc

RESEARCH PROJECT (Experimental) :

Students will be given guidance on basic research approaches, methodology and tools; and expected to collect data (primary, secondary), conduct literature survey.

After completion of research study conduct experiment scientifically with safety.

Research project (Experimental, Dissertation, presentation and Seminars):-

After completion of research study, each student will submit the report of 50-60 pages (12,000 to 15,000 words). The chapter wise indexing and typing rules will be the same as of thesis writing. Each student will develop skill of communication in presentation in college seminars.

Each report will be evaluated by the guide and external referee. Evaluation of research project will be conducted internally and externally.

SEMISTER –IV		
Code: 402101	Title : Physical Chemistry	Credits : 4
Objectives :- 1.State the importance of a multi-technique approach for the elucidation of reaction mechanisms . 2.Derive and develop structure/activity relationships in homorgeneous catalysis. 3. Describe the various process of polymerization reaction. 4. Explain the kinetics of polymerization process. 5. To understand the utility of conducting polymers.		
Paper -I		60 Hours
Unit I	Introduction to Magnetochemistry :- Definition of magetic properties, types of magnetic behaviour, sources of paramagnetism, Pascals constants and it's applications, Determination of magnetic susceptibility. Numericals.	15 Lectures
Unit II	Macromolecules :- Introduction, Formation of synthetic high polymers classification, Polymerization reactions: Chain and Step. Average molecular weight, Number average weight, Methods of determination of molar masses of polymers; Viscosity, Osmometry, Molar mass of charged macromolecules, Donnan membrane equilibrium, Ultracentrifugation, light scattering, Diffusion	15 Lectures
Unit III	Photochemical Reactions:- Introduction, low of photochemical equivalence, photocatalytic reactions, types of photocatalytic reactions, photooxidation, photoreduction, photosensitization, photocatalytic degradation. Chemiluminescence, photosynthesis. Numericals	15 Lectures
Unit IV	Homogeneous Catalysis:- Introduction, mechanism of catalysis, Acid-base catalysis, effect of pH on rate constant. Micellar catalysis, enzyme catalysis, factors governing rate of enzyme reactions, kinetics of enzyme catalysed reactions. Autocatalysis and oscillatory reaction, Lotka-Volterra mechanism, the brusselator, the eregonator, bistability, chemical chaos. Numericals	15 Lectures

Reference Books :

1. A.Earn Shaw, Introduction to Magnetochemistry, Academic Press.
 2. J.Sharma, Magnetochemistry.
 3. R.I.Dutta and Syamal, Elements of magnetochemistry.
- D. Voet, J. G. Voet, Biochemistry 3rd Edition (2004), Wiley International Publication.

4. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry 3rd Edition (2002) McMillan North Publication.
5. Polymer Science. By V. R. Gowariker, N. V. Viswnathan, Jayadev Sreedhar.
6. Polymers and Resins. By Brage Golding
Physical chemistry- Atkin and D.Paula, Oxford University press
7. Physical chemistry- Berry, Rice, Ross Oxford University press
8. Physical chemistry-principles And Applcation in Biological Sciences -Tinoco, Sauer Pearson Education.
9. Physical chemistry-W.J.Moor

PRACTICAL

SEMISTER -IV

Code:402202		Title : Physical Chemistry	Credits : 4
Objectives : 1. To apply previous knowledge for performing experiment scientifically and safety 2. To design experimental procedure on given experiment 3. To perform the chemical analysis by using conductometer, PH meter, Potentionmetry. 4. To interpret the experimental results obtained by conductometer,PH meter. 5. To explain the principle of various instrumental techniques. 6. To understand the principles behind the experiment performed in the laboratory			
Code-402202	PRACTICAL		4 Credits
Potentiometer	(i)	Titrate ferrous ammonium sulphate with cerric sulphate and find out formal redox potential of Fe +2/ Fe+3 and Ce+3/Ce+4 system	8 hours/week
pH metry	(ii)	To determine the proton-ligand stability constant of an organic acid and the metal-ligand stability constant of its complex by pH measurements.(TKC-176)	
Conductometry	(iii)	Conductometric titration of a mixture of strong acid, weak acid and a salt.(DVJ)	

Reference Books :

- 1.Systematic experimental physical chemistry – T. K. Chondhekar & S.W. Rajbhoj
2. Experiments in chemistry – D.V. Jahagirdar

IN-PLANT TRAINING

SEMISTER IV - IN-PLANT TRAINING		
Code: 402301	Title : Inorganic Chemistry	Credits : 8 (9wks)
Objectives: i) The intern will develop skills in the Industry/Institutes in practical work situation. ii) Intern will develop and strengthen their professional skills and interpersonal relationship in work environment of the industry. iii) It will provide opportunity to find out their interest in a particular carrier. iv) Experiential learning will have broader perspective for employment. In-plant Training & Evaluation: Internship placement will be in research institutes, industries like pharma, food and cosmetic or Government organization (BARC or Haffkine Institute), subject to approval of the internship coordinator. Student will prepare a detailed plan with the approval of external mentor which will be submitted to the internship coordinator within 7 days of the joining. At the end of internship, student will prepare a write up (2000 to 3000 words) based on their daily work activities in the organization and give presentation in the college. Evaluation of the internship assignment and presentation will be done internally and externally.		

Research project (Experimental, Dissertation, presentation and Seminars)

SEMISTER IV : Research project (Experimental, Dissertation, presentation and Seminars)		
Code: 402302	Title : Inorganic Chemistry	Credits : 8 (6wks)
Objectives: 1.To design research oriented project on particular context. 2. To conduct experiment scientifically with safety. 3. To identify the topic with the consideration feasibility. 4. Able to collect data and literature survey. 5. To interpret observed data statistically 6. Acquire knowledge and skills for higher level research work. 7. To prepare a dissertation report with complete follow up of research methodology. 8.To develop the skill of communication in presentation 9. To demonstrate the utility of various software such as ChemDraw, Origin, MS-Office etc. 10. To employ/use the techniques used in typing of dissertation such as Foot Note, End Note etc RESEARCH PROJECT (Experimental) : Students will be given guidance on basic research approaches, methodology and tools; and expected to collect data (primary, secondary), conduct literature survey. After completion of research study conduct experiment scientifically with safety.		

Research project (Experimental, Dissertation, presentation and Seminars):-

After completion of research study, each student will submit the report of 50-60 pages (12,000 to 15,000 words). The chapter wise indexing and typing rules will be the same as of thesis writing. Each student will develop skill of communication in presentation in college seminars.

Each report will be evaluated by the guide and external referee. Evaluation of research project will be conducted internally and externally.

First to Fourth Semester

Question Paper Pattern for Theory

Time: 3 Hrs

Marks: 100(Converted to 50 Marks)

Note: All Questions are Compulsory

Q.1 Attempt any TEN of the following Objective Ques. --- 20 Marks

15 questions from Unit I, II, III& IV.

Q.2 Attempt any TWO of the following --- 20 Marks

Four questions from Unit I.

Q.3 Attempt any TWO of the following --- 20 Marks

Four questions from Unit II.

Q.4 Attempt any TWO of the following --- 20 Marks

Four questions from Unit III.

Q.5 Attempt any TWO of the following --- 20 Marks

Four questions from Unit IV.

First to Fourth Semester

Question Paper Pattern for Practical (internal/external)

Lab Course

Time: 4 Hrs.

Marks: 50

Q.1	Synopsis of Experiment	--- 05Marks
Q.2	Experiment	--- 30 Marks
Q.3	Viva	--- 10 Marks
Q.4	Record Book	--- 05 Marks