UNIVERSITY OF JAMMU

NOTIFICATION
(18/June/18/35)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the revised Syllabi and Courses of Study in the subject of **Chemistry** of **Master Degree Programme** for I to IV semesters **under** the **(Non-CBCS Scheme) (as given in the Annexure)** for the candidates of **Govt. Degree College, Rajouri, Bhaderwah** and **Govt. Degree College (Boys) Udhampur** for the examinations to be held in the years indicated against each semester as under:-

Subject	Semester	For the examinations to be held in the year
Chemistry	Semester-I	December 2018, 2019 and 2020
	Semester-II	May 2019, 2020 and 2021
	Semester-III	December 2019, 2020 and 2021
	Semester-IV	May 2020, 2021 and 2022

The Syllabi of the courses is available on the University website: www.jammuuniversity.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F.Acd/II/18/5183-5202
Dated: 22-06-2018

Copy for information and necessary action to:

1. Special Secretary to the Vice Chancellor, University of Jammu for the kind information of the Worthy Vice-Chancellor please
2. Sr. P.A. to the Dean Academic Affairs/ Dean Research Studies
3. Sr. P.A. to the Registrar/Controller of Examinations
4. Dean, Faculty of Sciences
5. HOD/Convener, Board of Studies in Chemistry
6. All members of the Board of Studies
7. Principal, Govt. Degree College, Rajouri, Bhaderwah and GDC for Boys, Udhampur,
8. C.A to the Controller of Examinations
9. I/c Director, Computer Centre, University of Jammu
10. Asst. Registrar (Conf. /Exams. PG/ Inf./Pub.)
11. Incharge, University Website for necessary action please.

Assistant Registrar (Academic)

19/6 19/6/18

POST GRADUATE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF JAMMU, JAMMU

M.SC. CHEMISTRY **(Non-Choice Based Credit System)**			
S.No.	**Course No.**	**Title**	**Credits**
Semester-I			
1.	C-410	Inorganic Chemistry-I	04
2.	C-411	Physical Chemistry-I	04
3.	C-412	Organic Chemistry-I	04
4.	C-413	Spectroscopy-I	04
5.	C-416	Laboratory Course	08
Semester-II			
1.	C-460	Inorganic Chemistry-II	04
2.	C-461	Physical Chemistry-II	04
3.	C-462	Organic Chemistry-II	04
4.	C-463	Spectroscopy-II	04
5.	C-464	Computers for Chemists	02
6.	C-465	Laboratory Course	08
Semester-III			
1.	C-510	Environmental Chemistry	04
2.	C-511	Physical Chemistry-III	04
3.	C-512	Bio-organic and Medicinal Chemistry	04
4.	C-513	Spectroscopy-III	04
5.	C-514	Laboratory Course	08
Semester-IV			
Compulsory Courses			
1.	C-570	Analytical Chemistry	04
2.	C-571	Solid State & Structural Chemistry	04
3.	C-572	Heterocyclic Chemistry and Asymmetric Synthesis	04
Inorganic Chemistry			
1.	C-573	Organotransition Metal Chemistry	04
2.	C-575	Laboratory (Inorganic)	08
Organic Chemistry			
1.	C-582	Organic Synthesis and Chemistry of Natural Products	04
2.	C-578	Laboratory Course (Organic)	08
Physical Chemistry			
1.	C-583	Chemistry of Materials	04
2.	C-581	Laboratory Course (Physical)	08
NOTE: Course numbers 570, 571 & 572 are compulsory for all candidates. In addition to the above, the candidate may opt for any one group of specialized courses.			

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

DETAILED SYLLABUS

Course No.: **C-410** Title: **Inorganic Chemistry-I**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Unit-I **12 hrs**

Stereochemistry and Bonding in Main Group Compounds

VSEPR model, Bent rule, energetic of hybridization, structure and hybridization, d´ï p´ bonds, structure and bonding in condensed phosphates, silicates, cyclophosphazenes and Sï N cyclic compounds.

UNIT-II **8 hrs**

Metal Ligand Equilibria in Solution

Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermosynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

Unit-III **15 hrs**

Theories of Bonding

Crystal field theory and its limitations, evidence of metal-ligand orbital overlap, molecular orbital theory, MO energy level diagrams for octahedral, tetrahedral and square planar complexes.

UNIT-IV **12 hrs**

Reaction Mechanism of Transition Metal Complexes-I

Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, Kinetic applications of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage.

UNIT-V **12 hrs**

Reaction Mechanism of Transition Metal Complexes-II

Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction, Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere reactions, cross reactions and Marcus and Hush theory, inner sphere reactions.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Magneto Chemistry, R.L. Carlin, Springer Verlag.

5. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McClaverty, Pergamon.

DETAILED SYLLABUS

Course No.: **411** Title: **Physical Chemistry – I**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

UNIT-I **15 hrs**

Exact quantum mechanical results

Schrodinger equation and the postulates of quantum mechanics. Operator concept, some properties of quantum mechanical operators. Linear and Hermitian operators. Schrodinger wave equation for Hydrogen atom, separation into three equations, quantum numbers and their importance. Radial and angular wave functions (Spherical harmonics).

Complete solution of Schrodinger equation for the following model systems: Particle in a box (1 and 3 dimensional).Concept of degeneracy. The solution of problems of harmonic oscillator & the rigid rotator.Calculation of various average values for the above systems.

UNIT-II **15 hrs**

Angular momentum and electronic structure of atom

General theory of angular momentum. Eigen functions and Eigen values of angular momentum operators. Ladder operators. Spin angular momentum, antisymmetry and Pauli's principle.

Electronic configuration, Russell-Saunders terms and coupling schemes, Slater determinant. Atomic term symbols, term separation of p^n configurations, spin-orbit coupling, Zeeman splitting, virial theorem.

UNIT-III **10 hrs**

Approximation methods

The Variation theorem, linear variation principle. Perturbation theory -first order (non-degenerate). Application of variation method and perturbation method to helium atom.

UNIT-IV **12 hrs**

Chemical Bonding

Molecular orbital theory, LCAO-MO approximation, H_2^+molecular ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave function, brief introduction to H_2. Valence bond treatment of H_2, comparison of MO and VB methods.

UNIT-V **8 hrs**

HMO method and its applications

Huckel's MO theory of conjugated systems; Application to ethylene, butadiene, cyclobutadiene. Calculation of properties- Delocalization energy, electron density and bond order.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Physical Chemistry, P. W. Atkins, ELBS Oxford, 1997.
2. Introduction to Quantum Chemistry, A. K. Chandra, TataMcGraw Hill, 1997.
3. Quantum Chemistry, Ira. N. Levine, Prentice Hall, 2000.
4. Molecular Quantum Mechanics, P. W. Atkins and R. S. Friedmann, Oxford, 1997.
5. Quantum Chemistry, Prasad, New Age Publishers, 2000.
6. Quantum Chemistry and Spectroscopy (Problems and solution), Madan S. Pathania.

DETAILED SYLLABUS

Course No.: **412** Title: **Organic Chemistry – I**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Unit – I **10 hrs**

Nature of bonding in organic molecules

Delocalized chemical bonding-conjugation, cross-conjugation, resonance, hyperconjugation, tautomerism.

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckelôs rule, energy level of molecular orbitals, annulenes, antiaromaticity, homo-aromaticity, crown ether complexes and cryptands, inclusion compounds, cyclodextrins.

Unit – II **15 hrs**

Stereochemistry

Conformational analysis of cyclohexanes; declains, effect of conformation on reactivity, steric strain due to unavoidable crowding.

Elements of symmetry, chirality, R&S configuration, molecules with more than one chiral center, threo- and erythro- isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes). Stereochemistry of the compounds containing nitrogen and sulfur.

Unit – III **12 hrs**

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, thermodynamics and kinetic requirements, kinetic and thermodynamic control, Hammondôs postulate, Curtin-Hammett principle, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

Structure, stability and reactivity of carbenes and nitrenes. Effect of structure on reactivity ï resonance and field effects, steric effect, qualitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants.

Unit – IV **10 hrs**

Aliphatic Nucleophilic Substitutions - I

The S_N2, S_N1, mixed S_N1 and S_N2 and set mechanisms. The neighbouring group mechanism, neighbouring group participation by ů and ´ bonds. Classical and non-classical carbocation, phenonium ions, norbornyl system, common carbocation rearrangements (Pinacol-Pinacolone, Wagner-Meerwin).

The S_Ni mechanism.

Unit – V **10 hrs**

a) Aliphatic Nucleophilic Substitutions-II

Nucleophilic substitutions at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium; phase transfer catalysis and ultrasound, ambident nucleophile and regioselectivity.

b) Aliphatic Electrophilic Substitution

Bimolecular mechanism: S_E2 and S_E1. Electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Advanced Organic Chemistry, Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advance Organic Chemistry, F.A. Carey & R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemkstry, C.K. Ingold, Corell University Press.
5. Organic Chemistry, R.T. Morrison & R.N. Boyd, Prentice Hall.
6. Stereochemistry of Organic Compounds, D. Nasipuri.
7. Organic Synthesis, Michael B. Smith, McGraw Hill.

DETAILED SYLLABUS

Course No.: **413** Title: **Spectroscopy-I**
Credits: **4** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

UNIT-I

Unifying Principles **12 hrs**

Electromagnetic Radiation, characterization, quantization of energy, Regions of emr, interaction of emr with matter, Phenomenon related to radiation-Transmission, reflection, refraction, dispersion, polarization.

Width and intensity of spectral lines, Factors contributing to this effect: Collision broadening, Doppler broadening, Heisenbergôs uncertainty principle, Transition probability, Population of states and Path length of sample, Results of time dependent Perturbation theory: Stimulated (Induced) absorption, Stimulated and spontaneous emission, Einstein coefficients, Lasers.

UNIT-II

Microwave Spectroscopy **12 hrs**

Rotational spectroscopy of diatomic molecules based on rigid approximation. Determination of bond length and/or atomic masses from microwave data. Effect of isotopic substitution. Non-rigid totator. Classification of polyatomic molecules. Energy levels and spectra of symmetric top molecules and asymmetric top molecules.

UNIT-III

Vibrational Spectroscopy **12 hrs**

Normal coordinate analysis of homonuclear and heteronuclear diatomic molecules. Extension to polyatomic linear molecules. Derivation of selective rules for diatomic molecules based on Harmonic oscillator approximation. Force constants and amplitudes. Anharmonic oscillator. Overtones and combination bands.

Dissociation energies from vibrational data. Vibration-rotation spectra, P, Q and R branches. Breakdown of the Born-Oppenheimer approximation. Nuclear spin effect.

Raman Spectroscopy

Stokes and anti-stokes lines. Polarizability ellipsoids. Rotational and Vibrational Raman spectroscopy. Selection rules. Polarization of Raman lines.

UNIT-IV

X-ray Diffraction **12 hrs**

Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identifications of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis.

Unit-V

a) Electron diffraction **6 hrs**

Scattering intensity and scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, electron diffraction studies of some compounds, low energy electron diffraction (LEED) and structure of surfaces, applications of LEED.

b) Neutron Diffraction **6 hrs**

Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Physical Methods in Chemistry, R.S. Drago, Saunders College.
3. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
4. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
5. Chemical Applications of Group Theory, F.A. Cotton.
6. Solid State Chemistry and its applications, A.R. West, John Wiley & Sons.
7. Solid State Chemistry: An introduction, L. Smart and E. Moore, Nelson Thrones Ltd., UK.

DETAILED SYLLABUS

Course No.: **416** Title: **Laboratory Course**
Credits: **08** Maximum Marks: **200**
Duration of Examination: **3 hrs** a) Semester Examination: **100**
(including 20 in viva-voce)
b) Sessional Assessment: **100**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Inorganic Chemistry **90 hrs (27 marks)**

Qualitative and Quantitative Analysis

a. Less common metal ions : Tl, W, Mo, Se, Te, Zr, Ti, Ce, Th, V, U (three metal ions in cationic/anionic forms)
b. Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

Preparations

Preparation of selected inorganic compounds and their studies by I.R., electronic spectra and magnetic susceptibility measurements.

1. $Hg[Co(NCS)_4]$
2. cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
3. trans- $K[Cr(C_2O_4)_2(H_2O)_2]$
4. $[Cu(NH_3)_4]\ SO_4\ H_2O$

Physical Chemistry **90 hrs (26 marks)**

Number of hours for each experiment: 3-4 hours

A list of experiments under different headings is given below. Typical experiments are to be selected from each type. Students are required to perform at least 30 experiments.

Error Analysis and Statistical Data Analysis

Errors, types of errors, minimization of errors, error distribution curves, precision, accuracy and combination; statistical treatment for error analysis, student ćô test, null hypothesis, rejection criteria, F&Q test; linear regression analysis, curve fitting, calibration of volumetric apparatus, burette, pipette and standard flask.

Phase Equilibria

To construct the phase diagram for three component system (e.g. Chloroform-acetic acid-water, ethanol-benzene-water, ethanol-ethylacetate-water, acetic acid-benzene-water).

Chemical Kinetics

i) Determination of the effect of (a) change of temperature (b) change of concentration of reactants and catalyst and (c) ionic strength of media on the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
ii) Determination of velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
iii) Determination of the rate constant for the oxidation of iodine ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.
iv) Flowing clock reactions.

v) Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsonted relationship (iodide ion is oxidized by persulaphate ion).

Solutions

i) Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
ii) Determination of the degree of disassociation of weak electrolyte and to study the deviation from ideal behavior that occurs with a strong electrolyte.

Viscosity

i) Determination of molecular weight of high polymer(polystyrene) from viscosity measurements.

Surface-Tension

Study of variation of surface tension of solution with concentration and determination of surface excess. Study of interfacial tension between two immiscible liquids CMC from surface-tension measurements.

Organic Chemistry **90 hrs (27 marks)**

Quantitative Analysis

Separation, purification and identification of compounds of binary mixture (one liquid and one solid) using tlc and column chromatography, chemical tests, IR spectra to be used for functional group identification.

Organic Synthesis

Acetylation: Acetylation of Cholesterol and separation of cholesteryl acetate by column chromatography.
Oxidation: Adipic acid by chromic and oxidation of cyclohexanol.
Grignard reaction: synthesis of triphenylmethanol from benzoic acid.
Aldol condensation: Dibenzal acetone from benzaldehyde.

BOOKS RECOMMENDED

1. Vogelôs Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jaffery and J. Mendham, ELBS.
2. Synthesis and characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.
3. Experiments and techniques in Organic Chemistry, D. Pasto, C. Johnson and M.Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
5. Systematic Qualitative Organic Analysis, H. Middlenton, Adward Arnold.
6. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogelôs Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
9. Findleyôs Practical Physical Chemistry, B.P. Levitt, Longman.
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
11. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
12. Practical Physical Chemistry, Viswanathan and Raghavan.
13. Advanced Physical Chemistry, J.B. Yadav, Goel Publishing House.

DETAILED SYLLABUS

Course No.: **460** Title: **Inorganic Chemistry-II**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

UNIT-I **12 hrs**

Symmetry and Group theory in Chemistry

Symmetry elements and symmetry operations, definition of group, subgroup. Point symmetry group, Schonfilies symbols, Conjugacy relation and classes, representations of symmetry operations by matrices. Character of a representation. The great orthogonality theorem (without proof). Derivation of character tables for C_{2v}, C_{3v} and C_{2h}. Use of character tables in spectroscopy, symmetry aspects of molecular vibrations of H_2O molecule.

UNIT-II **12 hrs**

Electronic spectra of transition metal complexes

Spectroscopic ground states, correlation diagrams, selection rules and their breakdown, Orgel diagrams, Tanbe-Sugano diagrams and spectra of transition metal complexes (d^1 to d^9 states), significances of Dq, B and ϐ parameters, Jahn-Teller effects, Nephelauxetic effect, charge transfer spectra.

UNIT-III **12 hrs**

Magnetic properties of transition metal complexes

Magnetic susceptibility, magnetic moments, Quenching of magnetic moments, spin-orbit coupling, anomalous magnetic behaviour of metal complexes, magnetic exchange and spin-state crossovers.

UNIT-IV **12 hrs**

Metal π-complexes – I

Metal carbonyls, preparation n and important reactions of metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation.

UNIT-V **12 hrs**

(a) **Metal π-complexes – II**
Prepartation, bonding, structure and important reactions of transition metal, nitrosyls, dinitrogen and dioxygen complexes, ligating behavior of tertiary phosphines.

(b) Isopoly and heteropoly acids and salts of molybdenum and tungsten.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Symmetry and Spectroscopy of molecules, K.V. Reddy, New Age International Publishers.
2. Group Theory and Symmetry in Chemistry, Kamlesh Bansal, Campus Book International.
3. Symmetry and Structure, S.F.A. Kettle, Wiley.

4. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
5. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
6. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
7. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
8. Magnetochemistry, R.L. Carlin, Springer Verlag.
9. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McClaverty, Pergamon.

DETAILED SYLLABUS

Course No.: **461** Title: **Physical Chemistry-II**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

UNIT-I **14 hrs**

Chemical Dynamics – I

Collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions.

Pyrolysis of acetaldehyde, decomposition of ethane, photochemical and thermal reaction between hydrogen and bromine, Photochemical reaction between hydrogen and chlorine, oscillatory reactions (Belousov-Zhabotinsky reaction). Homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method and flash photolysis.

UNIT-II

a) Chemical Dynamics – II **6 hrs**

Dynamics of molecular motions, dynamics of unimolecular reactions (Lindemann, Hinshelwood and Rice-Ramsperger-Kassel (RRK) theories of unimolecular reactions). Kinetics of decomposition of N_2O_5.

b) Macromolecules **7 hrs**

Polymer-definition, types of polymers, electrically conducting, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization.
Molecular mass, number and mass, average molecular mass, molecular mass determination (osmometry, viscometry, sedimentation and light scattering methods), chain configuration of macromolecules, calculation of average dimensions of various chain structures.

UNIT-III Surface Chemistry **13 hrs**

a) Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area, surface films on liquids, BET equation, Catalytic activity at surfaces.

b) Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding of micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

UNIT-IV **10 hrs**

Electrochemistry-I

Debye-Huckel limiting law, Debye-Huckel-Onsagar treatment and its extension. Debye-Huckel-Jerum mode, Thermodynamics of electrified interfaces. Lippman equation, Method

of determination of surface excess, Structure of electrified interfaces: Helmholtz-Perrin, Guoy-Chapman, Stern models.
Over potential, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Unit-V **10 hrs**

Electrochemistry-II

Analogies between semiconductor and electrolyte, Structure of semiconductor-electrolyte interface, The diffuse charge region inside an intrinsic semiconductor (The Garrett-Brattain Space), Differential capacity due to space charge.
Bioelectro Chemistry: Cells, membranes and mitochondria, membrane potentials, older and modern theories of membrane potentials, Electrochemical mechanism of nervous system: General and facts.
Nernst-planck equation, electrocardiography. Polarography theory, Ilkovic equation; half wave potential and its significance.

Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Chemical Kinetics, K.J.Laidler, Mcgraw-Hill.
3. Kinetics and mechanism of Chemical Transformations, J.Rajaraman and J. Kuiacose, McMillan.
4. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.
5. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N.Reddy, Plenum.
6. Introduction to Ploymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

DETAILED SYLLABUS

Course No.: **462** Title: **Organic Chemistry – II**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

Unit – I

a) Aromatic Electrophilic & Nucleophilic Substitutions 8 hrs

The arenium ion mechanism, orientation and reactivity, erengy profile diagrams. The ortho/para ratio, ipso attack, orientation of other ring systems. Ffiedel-Crafts reactikon from alkenes and alcohol substrates, Vilsmier reaction. Gattermann-Koch reaction.

b) Aromatic Nucleophilic Substitutions 6 hrs

The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser, and Smiles rearrangements.

Unit – II

a) Addition of Carbon-Carbon Multiple Bonds & Elimination Reactions 8 hrs

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity, addition to cyclopropane ring, hydroboration, Michael reaction, Sharpless asymmetric epoxidation.

b) Elimination Reactions 5 hrs

The E2, E1 and E1cB mechanisms. Orientation of the double bond. Reactivity: effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

Unit – III 13 hrs

Addition to Carbon-Hetero Multiple Bonds

Mechanisms of metal hydride reduction of saturated and unsaturated carbonyl compounds. Acids, esters and nitriles. Addition of Grignard, Organizinc and Organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.

Mechanism of condensation reactions involving enolates ï Aldol, Knoevenagel and Claisen. Hydrolysis of esters and amides.

Unit – IV 14 hrs

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, and 1,3,5-hexatriene system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n and 4n+2 systems. Cycloadditions antrafacial and suprafacial additions, 4n and 4n+2 systems, 1,3-dipolar cycloadditions.

Sigmatropic rearrangements-suprafacial and antrafacial shifts of H, Sigmatropic shifts involving carbon moieties, Claisen, Cope and Ene reaction.

Unit – V **11 hrs**

Free Radical Reactions

Types of free radical mechanisms (substitution at an aromatic substitute), neighbouring group assistance reactivity (at an aliphatic, aromatic substitute and at bridge head). The effect of solvent and attacking radicals on reactivity. Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction and Hunsdiecker reaction.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerrry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentic-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Acadmeic and Professional.
8. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.

DETAILED SYLLABUS

Course No.: **463** Title: **Spectroscopy-II**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

UNIT-I **12 hrs**

Ultraviolet and Visible Spectroscopy

Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls.

Optical Rotatory Dispersion (ORD) and Circular Dichorism (CD)

Definition, deduction of absolute configuration, octant rule for ketones.

UNIT-II **12 hrs**

Infrared Spectroscopy

Basic principles, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance.

UNIT-III **12 hrs**

Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, larmour frequency, chemical shift, spin-spin interaction, shielding mechanism, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry: hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra: nuclear magnetic double resonance, contact shift reagents, solvent effects, Fourier transform techniques, nuclear Overhauser effect (NOE). Resonance of other nuclei ï F, P.

UNIT-IV **12 hrs**

Carbon-13 NMR Spectroscopy

General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon). Two dimension NMR spectroscopy ï COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.

UNIT-V **12 hrs**

Mass Spectrometry

Introduction, ion production ï El, Cl, FD and FAB, factors affecting fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral

fragmentation of organic compounds with respect to their determination. Introduction to modern MS techniques (MALDI, ESI).

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Physical Methods for Chemistry, R.S. Drago, Saunders Company.
2. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
3. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
4. Progress in Inorganic Chemistry, Vol. 8 ed., F.A. Cotton, Vol. 15 ed., S.J. Lippard, Wiley.
5. Transition Metal Chemistry, ed. R.L. Carlin, Vol. 3, Dekker.
6. Inorganic electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Horwood.
8. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
9. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.
10. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
11. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw Hill.
13. Organic Spectroscopy, William Kamp.

DETAILED SYLLABUS

Course No.: **465** Title: **Laboratory Course**
Credits: **08** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

Inorganic Chemistry **90 hrs (27 marks)**

Preparations

Preparation of selected inorganic compounds and their studies by I.R., electronic spectra and magnetic susceptibility measurements. Quantitative analysis of metals in complexes by Gravimetric/Volumetric techniques.

1. $VO(acac)_2$
2. $K_3[Fe(C_2O_4)_3]$
3. $Mn(acac)_3$
4. $TiO(C_9H_8NO)_2H_2O$
5. $Na[Cr(NH_3)(NCS)_4]$
6. $Ni(acac)_2$
7. $[Co(Py)_2Cl_2]$
8. $[Ni(NH_3)_6]Cl_2$
9. $Ni(dmg)_2$
10. $[Co(NH_3)_6]$ $[Co(NO_2)_6]$
11. cis- $[Co(trien)(NO_2)_2]Cl.H_2O$
12. Pressian Blue, Turnbullôs Blue

Physical Chemistry **90 hrs (27 marks)**

Heat of solution:

To study the heat of solution of benzoic acid/oxalic acid by solubility method at different temperatures and the effect of electrolyte on it.

Adsorption:

Study the adsorption of oxalic acid on charcoal and hence check the validity of Langmuir adsorption isotherm and classical adsorption isotherm.

Critical solution temperature:

Determine the mutual solubility curve of phenol and water and hence find its consolute temperature and the effect of electrolyte on the system.

Abbe's refractometer:

Determine the refractive indices of given organic liquid at room temperature

pH meter and Conductivity meter:

Determine the pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence determine the dissociation constant of acid.
Determine the strength of strong and weak acid and their mixture using pH metry.
Determine the strength of strong and weak acid and their mixture using conductivity meter.
Study of kinetics of second order reaction using conductivity ï meter .

Phase-Equilibria

Phase diagram of two component eutectic systems (Naphthalene-benzoic acid; acetamide-benzoic acid; naphthalene-diphenyl).

Phase diagram of two component compound forming systems (salicylic acid ï benzamide, acetamide-ɓ-naphthol).

Organic Chemistry **90 hrs (26 marks)**

a. **Organic Synthesis:** Sandmeyer reaction: p-Chlototoluene from p-toluidine. Acetoacetic ester condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation. Cannizzaro reaction: Benzaldehyde and 4-Chlorobenzaldehyde as substrates. Knoevenagel Condensation: Synthesis of cinnamic acid. Friedel Crafts Reaction: ɓ-Benzoyl propionic acid from succinic anhydride and benzene. Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline. Beckmann Rearrangement of Acetophenone and Benzophenone oximes.
The products may be characterized by Spectral Techniques.

b. Separation and identification of organic compounds from two component mixture.

c. **Quantitative Analysis:** Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method. Estimation of amines/phenols and glucose using bromated bromide solution/acetylation method. Determination of Iodine and Saponification values of an oil sample. Determination of DO, COD and BOD of water sample.

BOOKS RECOMMENDED

1. Vogelôs Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jaffery and J. Mendham, ELBS.
2. Synthesis and characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.
3. Experiments and techniques in Organic Chemistry, D. Pasto, C. Johnson and M.Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
5. Systematic Qualitative Organic Analysis, H. Middlenton, Adward Arnold.
6. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogelôs Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
9. Findleyôs Practical Physical Chemistry, B.P. Levitt, Longman.
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
11. Experiments in Physical Chemistry by Shoemaker.
12. Practical Physical Chemistry by Viswanathan and Raghavan.
13. Advanced Practical Physical Chemistry by J.B. Yadav, Goel Publishing House.

DETAILED SYLLABUS

Course No.: **510** Title: **Environmental Chemistry**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in Dec 2019, Dec 2020 & Dec 2021.

Unit – I

a) Environment: 8 hrs

Introduction, Composition of atmosphere, vertical temperature and stability of atmosphere, heat budget of the earth atmospheric system. Biogeochemical cycle of C, N, O and S, Bio-distribution of elements.

b) Soils: 6 hrs

Composition of soil, micro and macro nutrients, NPK in soil, Acid-base and ion exchange reactions in soils, Soil pollution due to fertilizers, pesticides, plastics and metals.

Unit – II

Hydrosphere 12 hrs

Chemical composition of water bodies ï lakes, streams and rivers; Hydrological cycle; Aquatic pollution due to inorganic, organic, pesticide, industrial sewage, detergent, oil pollutants; Water quality parameter and their analytical methods: Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demands, Solids, contents of chloride and chlorine demand; Purification and treatment of water and criteria of water quality.

Unit – III

Industrial Pollution 12 hrs

a) Environmental implications and abetment of Cement industry, sugar mill, distillery industry, paper and pulp mill, thermal power plant and polymer/plastic industry.
b) Disposal of wastes and their management.

Unit – IV 8 hrs

Atmosphere

Chemical composition of atmosphere ï particles, ions and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effects and analytical methods, Chlorofluoro hydrocarbons, Green house effect, acid rains.

Unit - V 10 hrs

Environmental Toxicology

a) Hazardous waste: Introduction, origin, transport, effects and fates; Biodegradation and principles of decomposition; Chemical treatment of hazardous wastes.
b) Bhopal gas tragedy, Chernobyl, Three Mile Island and Minamata disasters.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Environmental Chemistry, S. E. Manahan, Lewis Publishers
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers
3. Environmental Chemistry, A. K. De, Wiley Eastern.
4. Environmental Pollution Analysis, S. M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F. J. Welcher, Vol. III, Van Nostrand Reinhold Co.
6. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.
7. Elemental Analysis of Airborne Particles, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication.
8. Environmental Chemistry, C. Baird and W. H. Freeman.

DETAILED SYLLABUS

Course No.: **511** Title: **Physical Chemistry – III**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in Dec 2019, Dec 2020 & Dec 2021.

Unit – I

Non Equilibrium Thermodynamics **10 hrs**

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g. heat flow, chemical reaction etc.) transformation of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsagerôs reciprocity relations, electrokinetics phenomena, diffusion, electric conduction, irreversible thermodynamics for biological systems, coupled reactions.

Unit – II

Transport Phenomenon **10 hrs**

Diffusion coeffieicnt, Fickôs first and second laws, relation between flux and viscosity, relation between flux and viscosity, relationship between diffusion coefficient and mean free path, relation between thermal conductivity/viscosity and mean free path of a perfect gas, Einstein relation, Nernst-Einstein equation, Stokes-Einstein equation, Einstein-Smoluchowski equation.

Unit – III

Thermodynamics of Mixtures **10 hrs**

Brief resume if classical concepts of thermodynamics cinluding free energy, chemical potential and entropies, partial molar properties: partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concepts of fugacity and determination of fugacity.

Non ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions: determination of activity and activity coefficients: ionic strength.

Unit – IV

Statistical Mechanics **10 hrs**

Role of statistical mechanics, Ensemble: Micro canonical, canonical and grand canonical, postulates of ensemble averaging, phase space, Stirlingôs approximation, occupation number, micro and macro states, statistical weight factor, probability, concept of distribution, thermodynamic probability, types of statistics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, most probable distribution of three types of statistics, Lagrangeôs undetermined multipliers, evaluation of ß, comparison of three statistics, molecular partition function and its significance, thermodynamic properties in terms of partition function, numericals

Unit – V

Applications of statistical mechanics **12 hrs**

Factorisation of molecular partition function, canonical ensemble partition function (Independent and distinguishable molecules or particles; independent and indistinguishable molecules or particles), evaluation of translational, rotational, vibrational, electronic and nuclear partition functions, contribution of translational, rotational and vibrational partition functions to thermodynamic functions, effect of nuclear spin in diatomic molecules, equilibrium constant of ideal gas in terms of partition function. Heat capacities of solids: the Einstein theory and the Debye theory, numerical.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Theoretical Chemistry: S. Glasstone.
2. Statistical Thermodynamics: M.C. Gupta.
3. Physical Chemistry: P.W. Atkins.
4. Chemical Thermodynamics: R.P. Rastogi and R.R. Misra.
5. Statistical Mechanics and Properties of Matter: E.S.R. Gopal.
6. Statistical Mechanics, D.A. McQuarrie.
7. Thermodynamics of Irreversible Processes, Rolf Haase.
8. Fundamental of Chemical Thermodynamics, E.N. Yeremin.
9. Introduction to Irreversible Thermodynamics, Prgogine.
10. Modern Thermodynamics, D. KondePudi and I. Prigogine.

DETAILED SYLLABUS

Course No.: **512** Title: **Bio-Organic & Medicinal Chemistry**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in Dec 2019, Dec 2020 & Dec 2021.

UNIT-I **12 hrs**

Enzymes, kinds and mechanism of enzymatic reactions

Introduction and historical perspectives, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specialization and regulation. Nomenclature and classification. Fischerôs lock and key: and Koshlandôs induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis.

Orientation and steric effect in enzyme catalysis (acid, base and covalent catalysis).

UNIT-II **13 hrs**

Chemistry of Vitamins B-Complex and Coenzymes

Introduction, classification and nomenclature of vitamins. Occurance, functions and mechanism of action of thiamine, Riboflavin and Pantothenic acids. Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate. NAD^+, $NADP^+$, FMN, FAD, lipoic acid, vitamin B_{12}.

UNIT-III **10 hrs**

Drug-design

Introduction, concept of Lead compounds, Factors governing drug design and rational approach. Drug design through method of variations, disjunction and conjunction. Bioisosteric replacement, rigid analogs, homologation of alkyl chains, changes in ring size and ring position isomers, alteration of stereochemistry, fragments of lead molecules.

UNIT-IV **12 hrs**

Synthesis and mode of action

1. Cardiovascular drugs: Antihypertensive and hypotensive drugs:
   Hydralazine (Apresoline hydrochloride), Methyldopa (Aldomet), Procainamide (Pronestyl); Antisympathetic drugs- Propanolol (Indral), Verapamil (Isoptin) and Prenylaminelactate (Synadrin).
2. Antiparkinsonian Agents: Biperiden hydrochloride (Akineton hydrochloride), Ethopropazine hydrochloride (Profenamine) and Levodopa (Bendopa).
3. Anticancer drugs: Adriamyon, Texol, Tomoxifen [only Mode of Action].
4. Antihistaminic drugs: Citrizine, (Promethazine hydrochloride) and Chloropheniramine meleate (Alermine).
5. Antimalarials: Chloroquine phosphate (Resochin) and Mepacrine hydrochloride (Quinacrine).

Unit-V **13 hrs**

(a) Antibiotics: Introduction, classification, isolation and chemistry of Pencillins, Chloramphenicol and tetracycline (oxy tetracycline).

(b) Vitamins: Occurrence, chemistry, functions and mechanism of action of Ascorbic acid, Ŭ-Tocopherol and Vitamin K_1 & K_2.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Bio-organic Chemistry: A Chemical Approach to enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.
2. Enzyme Chemistry: Impact and Aplications, Ed. Collin J. Suckling, Chapman and Hall.
3. Enzymatic Reaction Mechanism, C. Walsh and W.H. Greeman.
4. Immobilised Enzymes: An Introduction and Application in Biotechnology, M.D. Travan, John Wiley.
5. Enzyme Structure and Mechanism, A. Fersht and W.H. Freeman.
6. Textbook of Organic Medicinal and Pharmaceuticals Chemistry, 8th Ed., Edited by R.F. Doerge, J.B. Lippincott Co., Philadelphia 1982.
7. Pharmaceutical Chemistry in Perspective, B.G. Reuben and H.A. Wittcoff, John Wiley and Sons., N.Y.
8. Principles of Medicinal Chemistry, Lea and Febiger, Philadelphia, USA.
9. Strategies of Organic Drug Synthesis and design, D. Lendnicer, John Wiley and Sons, N.Y.
10. Burgerôs Medicinal Chemistry, Drug Discovery and Development, John Wiley and Sons.

DETAILED SYLLABUS

Course No.: **513** Title: **Spectroscopy - III**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in Dec 2019, Dec 2020 & Dec 2021.

Unit-I

Vibrational Spectroscopy **12 hrs**

Symmetry and shape of AB_2, AB_3, AB_4, AB_5 and AB_6 molecules. Mode of bonding of ambidentate ligands, nitro, thiocyanato, ethylenediamine and diketonato complexes,
Raman Spectroscopy: Stokes and anti-stokes lines, polarisability of ellipsoids, Rotational and vibrational Raman spectroscopy, Selection rules, Resonance Raman spectroscopy, Basic understanding and its applications particularly for study of active sites of metalloproteins.

Unit-II

Electron Spin Resonance Spectroscopy **12 hrs**

Basic Principle, spin Hamiltonian, Hyperfine coupling, spin polarization and McConnell relationship, Isotropic and anisotropic hyperfine coupling constants, spin-orbit coupling and significance of g- tensor, Applicaion to transition metal complexes(having one unpaired electron) including biological systems and inorganic free radical viz. BF_2, F_2, PH_4 etc.

Unit-III

Mossbauer Spectroscopy **12 hrs**

Basic Principles, spectral parameters and spectrum display, Application of the technique to the studies of :

(a) bonding and structure of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin,
(b) Sn^{2+} and Sn^{4+} compounds, nature of M-L bond, coordination number, and structure and
(c) Detection of oxidation state and inequivalent MB atoms.

Unit-IV

Nuclear Magnetic Resonance of Paramagnetic Substances in Solution **12 hrs**

The chemical shift in Diamagnetic and Paramagnetic molecules, factors affecting nuclear relaxation, The contact and Pseudo-contact shifts,
Application to characterization of metal sites in metalloproteins, Application to analysis of intermolecular interactions : ligands binding to metalloproteins and protein-protein interaction. An overview of NMR of metal nuclide with emphasis on ^{195}Pt and ^{119}Sn NMR.

Unit-V **12 hrs**

Photoelectron Spectroscopy

Basic Principles, ɔ- photo-electric effect, ionization process, Koopmanôs theorem, photoelectron spectra of simple molecules, Application of photoelectron spectroscopy, ESCA and Auger Electron spectroscopy.

Nuclear Quadrupole Resonance Spectroscopy

Introduction, energies of the quadrupole transitions, effect of a magnetic field on the spectra, applications

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Physical Methods for Chemistry, R. S. Drago, Saunders Company.
2. Infrared and Raman Spectra : Inorganic and coordination compounds, K. Nakamoto, Wiley.
3. Structural Methods in Inorganic Chemistry, E.A. V. Ebsworth, D. W. H. Rankin and S. Cradock, ELBS.
4. Progress in Inorganic Chemistry, Vol. 8, ed., F. A. Cotton, Vol. 15, ed. S.J. Lippard, Wiley.
5. Applications of physical methods to Inorganic and Bioinorganic Chemistry, Robert A. Scott, Charles M. Lukehart, Wiley.

DETAILED SYLLABUS

Course No.: **514** Title: **Practical Course**
Credits: **08** Maximum Marks: **200**
Duration of Examination: **14 hrs** a) Semester Examination: **100** (including 20 in viva-voce)
b) Sessional Assessment: **100**

Syllabus for the examinations to be held in Dec 2019, Dec 2020 & Dec 2021.

INORGANIC CHEMISTRY — 90 hrs (26 marks)

Preparation

Preparation of selective inorganic compounds and their study by IR, electronic spectra, Mossbauer, ESR and magnetic susceptibility measurement. Handling of air and moisture sensitive compounds involving vacuum lines.

Selection can be made from the following:

1. Sodium amide, Inorganic Synthesis, 1946, 2, 128.
2. Synthesis and thermal analysis of group II metal oxalate hydrate. J. Chem. Ed., 1988, 65, 1024.
3. Atomic absorption analysis of Mg and Ca.
4. Trialkoxyboranes-Preparation, IR and NMR spectra.
5. $PhBCl_2$ Dichlorophenylborane-synthesis in vacuum line.
6. Preparation of Tin(IV) iodine, Tin(IV) chloride and Tin(II) iodide. Inorg. Synth., 1953, 4, 119.
7. Relative stability of Tin(IV) and Pb(IV). Preparation of ammonium hexachlorostannate $(NH_4)_2SnCl_6$, ammonium hexachloroplumbate $(NH_4)_2PbCl_6$.
8. Hexa-bis(4-nitrophenoxy) cyclotriphosphazene.
9. Synthesis of trichlorodiphenylatimony (V) hydrate. Inorg. Synth., 1985, 23, 194.
10. Sodium tetrathionate $Na_2S_4O_6$.
11. Metal complexes of dimethyl culfoxide (IR): $CuCl_2$.2DMSO, $PdCl_2$, 2DMSO, $RuCl_2$.4DMSO. J. Chem. Educ., 1982, 59, 57.
12. Synthesis of metal acetylacetonate: Magnetic moment, IR, NMR. Inorg. Synth., 1957, 5, 130; 1963, 1, 183.
13. Bromination of $Cr(acac)_3$. J. Chem. Edu., 1986, 63, 90.

Flame Photometric Determinations

a) Sodium and potassium when present together.
b) Lithium/calcium/barium/strontium.
c) Cadmium and magnesium in tap water.
d) Zinc and magnesium.
e) Thin-layer chromatography-separation of nickel.
f) Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

ORGANIC CHEMISTRY — 90 hrs (27 marks)

Qualitative Analysis

Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

Paper Chromatography
Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

Spectroscopy
Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR and MS).

PHYSICAL CHEMISTRY **90 hrs (27 marks)**
Number of hours of each experiment 3-4 hours. A list of experiments under different heading are given below .Typical experiments are to be selected from each type.

Chemical Kinetics
i) Study the kinetics of bromination of phenol by bromide-bromate mixture in an acid medium as a clock reaction.
ii) To find out the order of reaction between potassium bromate and potassium iodide.

Thermodynamics
i) Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
ii) Determination of temperature dependence of solubility of compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

Conductivity
i) Determine the hydrolysis constant of aniline hydrochloride at different temperatures conductometrically.
ii) Estimate the concentration of HCl, CH_3COOH and $CuSO_4.5H_2O$ in a given solution by carring out conductometric titration with NaOH solution.
iii) Determine the equivalent conductance of a strong electrolyte i.e. NaCl, KCl at several concentrations and hence verify Debye Huckel Onsager equation.
iv) Determine the equivalent conductance of a weak electrolyte i.e. CH_3COOH at infinite dilutionby Kohlrasch law.
v) Determine the degree of hydrolysis and hydrolysis constant of CH_3COONa, NH_4Cl.

pH metry
i) Determine the strength of unknown solution of HCl by titrating it with NaOH solution using pH meter.
ii) To find the strength of unknown solution of NH_3 solution by titrating it with CH_3COOH solution.
iii) To find the strength of unknown solution of Na_2CO_3 solution by titrating it with HCl solution.
iv) To find out the dissociation constant of polybasic acid e.g. phosphoric acid by titrating it with NaOH solution.

BOOKS RECOMMENDED

1. Advannnced Practical Organic Chemistry, 3rd ed., N.K. Vishnoi, Vikas Publishing House Pvt. Ltd.
2. Vugelôs Textbook of Practical Organic Chemistry, A.I. Vogel et.al., Published by Prentice Hall (5th Edn.).

3. Advanced Practical Organic Chemistry, John Leonard, Barry Lygo and Garry Procter, CRC Press (Taylor & Francis Group).
4. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
5. Findleyôs Practical Physical Chemistry, B.P. Levitt, Longman.
6. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
7. Experiments in Physical Chemistry by Shoemaker.
8. Practical Physical Chemistry by Viswanathan and Raghavan.

DETAILED SYLLABUS

Course No.: **570** Title: **Analytical Chemistry**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Unit-I

Separation Methods **12 hrs**

(a) Solvent Extraction
Liquid-liquid extraction, Principles and process of solvent extraction, Techniques of solvent extraction, Extraction by chelation, Extraction by salvation, Extraction equilibria for chelation and salvation, Extraction by ion pair formation.

(b) Classification of chromatographic methods, Column chromatography, Adsorption phenomenon, nature of adsorbents, solvent systems, differential migration, Thin-layer chromatography (TLC), coating materials and preparation of TLC plates, solvents for development, detection of compounds in TLC, R_f value in TLC, applications of TLC in chemistry.

Unit-II **12 hrs**

(a) Ion-exchange chromatography, Principle and theory of cation-exchange and anion-exchange chromatography, Applications of ion-exchange chromatography, ion chromatography as separation technique, structure and characteristics of resins, eluants used in separation, detectors used in ion chromatography, analytical application of ion chromatography

(b) Paper chromatography, Nature of paper-support, stationary phase, solvent system, technique of paper chromatography, various modes of development: ascending, descending and horizontal, applications.

Unit-III

Thermoanalytical and Electroanalytical Methods **12 hrs**

(a) Introduction, Thermogravimetry (TG), instrumentation, Differential thermal analysis (DTA) and differential scanning calorimetry (DSC), applications of thermal methods.

(b) Potentiometric method: Reference electrodes and indicator electrodes. The hydrogen, calomel and Ag-AgCl electrodes, The glass electrode, performance and limitations, measurement of pH, potentiometric titrations, redox and precipitation titrations.

Unit-IV **12 hrs**

(a) Application of Electrochemistry: Electrode reaction fundamentals, potentials of electrochemical reactions, Electrochemical cells and practical considerations, solvent/electrolyte for electrochemistry, working, reference and auxiliary electrodes, Applications: Potential sweep methods, linear sweep voltametry (LSV), cyclic voltametry (CV), Practical considerations for potential sweep methods, Example of application of CV to study Rh complexes, surface- attached analytes in CV

(b) Fuel analysis : Classification of fuels, grading of coal, proximate and ultimate analysis of coal, producer, water and natural gas, calorific value of fuel, Flash and fire point of liquid fuels, aniline point of liquid fuels, carbon residue of liquid fuels, octane and cetane numbers

Unit-V

Clinical Chemistry and Drug Analysis **12 hrs**

(a) Clinical Chemistry : Composition of blood-collection and preservation of samples, clinical analysis, serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphates. Immunoassay : principles of radio immunoassay (RIA) and applications, blood gas analysis.

(b) Drug analysis : Narcotics and dangerous drug, Classification of drugs, screening by gas chromatography and thin-layer chromatography and spectrophotometric measurements.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. A Textbook of Quantitative Inorganic Analysis, A. I. Vogal, Longman
2. Analytical Chemistry, G. D. Christian, J. Wicy.
3. Fundamentals of analytical Chemistry, D. A. Skoog. D. M. West and F. J. Hooler, W. B. Saunders.
4. Analytical Chemistry-Principles. J. H. Kennedy and W. B. Saunders
5. Analytical Chemistry-Principles.and Techniques. L. G. Hargis, Prentice Hall.
6. Analytical Chemistry, 2nd Edn., Kellner, Mermet, Otto, Valcarcel, Widmer. Wiley-VCH
7. Applications of physical methods to Inorganic and Bioinorganic Chemistry, Robert A. Scott, Charles M. Lukehart, Wiley.
8. Principles and practice of Analytical Chemistry, 5th Edn., Fifield & Kealey, Bleckwell Science.
9. Basic concepts of Analytical Chemistry, 2nd Edn., S. M. Khopkar, New Age Intl. Ltd. Publishers.
10. Analytical Chemistry, H. Kaur, Pragati Prakashan.
11. Analytical Chemistry, Dr. Alka Gupta, Pragati Prakashan.
12. Analytical Chemistry, Krupadanam et al, Universities Press.
13. Analytical Chemistry, Kealey and Haines, Instant Notes, Viva.

DETAILED SYLLABUS

Course No.: **571** Title: **Solid State and Structural Chemistry**

Credits: **04** Maximum Marks: **100**

Duration of Examination: **3 hrs** a) Semester Examination: **80**

b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

UNIT – I **12 hrs**

Preparative Methods and Crystal Symmetry

General Principles of Solid State Reactions, Preparation of materials in solid state: Precursor, ceramic, sol-gel, hydrothermal, electrochemical reduction methods, vapour phase transport and high pressure methods, preparation of thin films, growth of single crystals, Closed packed structures: cubic close packing and hexagonal close packing, Some important structure types : NaCl, ZnS, CsCl and perovskite ($SrTiO_3$).

UNIT – II **12 hrs**

Crystal Defects and Solid Solutions

Crystal defects - Perfect and imperfect crystals, Intrinsic and extrinsic defects, Point defects (Schottky and Frenkel defects), Thermodynamics of Schottky and Frenkel defect formation, Colour centres, Line defects: Edge dislocation and Screw dislocation, Plane defects: Grain boundary and Staking faults, Topochemical control of solid state organic reactions, New superconductors

Solid solutions: Substitutional solid solutions, interstitial solid solutions, more complex solid solutions mechanisms, requirements for solid solutions and formation.

UNIT – III **12 hrs**

Structure of Solids

Crystal systems, Bravais lattice, lattice planes, Miller indices and directions, symmetry: point symmetry, space symmetry and point groups. Representation of point groups and selected examples, space groups.

UNIT – IV **12 hrs**

Electronic and Ionic Conduction

Metals, insulators and semiconductors, electronic structure of solids ; chemical and physical approaches- band theory, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping of semiconductors, Applications of semiconductors, Controlled valency semiconductors, Band structure of inorganic solids, Ionic conductivity in solids, Solid electrolytes- Fast ion conductors: Ŭ-AgI, ɓ-Alumina, Halide ion conductors, Oxide ion conductors.

UNIT – V **12 hrs**

Magnetic and Dielectric Properties

Magnetic properties ï classification of materials. Behaviour of substances in a magnetic field, effect of temperature : Curie and Curie-Weiss laws, calculation of magnetic moments, Mechanisms of ferro and anti-ferromagnetic ordering, super exchange and double exchange, Ferromagnetic domains and hysteresis, soft and hard magnetic materials, Dielectric materials, Ferroelectricity, Pyroelectricity, Piezoelectricity, Applications of Ferro-, Piezo- and Pyroelectrics.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. New Directions in Solid State Chemistry: C.N.R. Rao and J. Gopalakrishan, Cambridge University press, Cambridge.
2. Solid State Chemistry, A.R. West, John Wiley, New York.
3. Solid State Physics, N.J. Dekker, Macmillan, London.
4. Solid State reactions, H. Schmalaried, A.P., London.
5. Magnetochemistry, R.L. Catin, Springerverlag, Berlin.
6. Solid State Chemistry, N.B. Hannay, Prentice Hall (India) Ltd., New Delhi.
7. Solid State Chemistry, H.V. Keer.
8. Solid State Chemistry, An Introduction, L. Smart and E. Moore, Nelson Thrones Ltd, U.K.

DETAILED SYLLABUS

Course No.: **572** Title: **Heterocyclic Chemistry and Asymmetric Synthesis**

Credits: **04** Maximum Marks: **100**

Duration of Examination: **3 hrs** a) Semester Examination: **80**

b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Unit – I

Nomenclature of Heterocycles **6 hrs**

Replacement and systematic nomenclature (Hantzsch-Widmann system) for monocyclic, fused and bridged heterocycles and simple spiroheterocycles. Carbocycles, ring assemblies, same repeating units, different repeating units.

Aromatic Heterocycles **6 hrs**

General chemical behavior of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra, empirical resonance energy, delocalization energy and diamagnetic susceptibility), Alprozam, Aphox.

Unit – II

Benzo-Fused Five Membered Heterocycles **6 hrs**

Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes.

Six-Membered Heterocycles with One heteroatom **6 hrs**

Synthesis and reactions of pyridinium salts and pyridines.

Synthesis and reactions of benzopyrylium salts, coumarins and chromones.

Unit – III

Six Membered Heterocycles with two or more Heteroatoms **6 hrs**

Synthesis and reactions of diazines and triazines (Pyrazines, Pyridazines and 1,2,4-triazines).

Seven- and Large-Membered Heterocycles **6 hrs**

Synthesis and reactions of azepines, oxepines and thiepines.

Unit – IV **12 hrs**

Asymmetric synthesis: Non-enzymatic approaches

Models of asymmetric synthesis using naturally occurring chiral compounds. Nucleophile and electrophile bearing chiral auxillary, Dielsï Alder cycloaddition and Claisenï cope rearrangements.

Asymmetric carbon ï carbon bond formation using alkylation, Michael reaction and addition to carbonyl compounds. Cramôs rule and Felkinï Ahn model. Asymmetric oxidation and reduction.

Unit – V **12 hrs**

Asymmetric Synthesis: Enzymatic approach

Use of different types of enzymes lipases (PLAP), oxidases, reductases, Bayer-Villiger monooxygenase, penicillin acylase and Baker yeast in organic synthesis. Enzyme-triggered cyclization of haloalkyl oxiranes catalyzed by epoxide hydrolases. application to biomimetic natural product ((3*R*,9*R*,10*R*)-panaxytriol, (+)-pestalotin and (2*R*,5*S*)-pityol) synthesis

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Heterocyclic Chemistry, Thomas L. Gilchrist, 3rd Edition, Addison Wesley Longman Limited 1997.
2. Heterocyclic Chemistry, Vol. 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag.
3. The Chemistry of Heterocycles, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Pandler, Wiley Interscience.
5. An Introduction to Heterocyclic Compounds, R.M. Acheson, John Wiley and Sons.
6. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, Eds. Pergamon Press.
7. G.Solladie, J.D. Morrison (ed.), Asymmetric Synthesis, Academic Press.
8. Advanced Asymmetric Synthesis, ed. G.R. Stephenson, Blackie, Glasgow, 1996.
9. Organic Synthesis, Michael B. Smith, McGraw Hill, International Edition.

DETAILED SYLLABUS

Course No.: **573** Title: **Organotransition Metal Chemistry**

Credits: **04** Maximum Marks: **100**

Duration of Examination: **3 hrs** a) Semester Examination: **80**

b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Unit-I **12 hrs**

Compounds of Transition Metal-Carbon Multiple Bonds

Alkylidenes, alkylidynes: low valent (Fischer) and high valent (Schrock) carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions of the ligands and applications.

Unit-II **12 hrs**

Transition Metal – π Complexes

Transition Metal ï ´ complexes with unsaturated organic molecules like alkenes, alkynes, allyls, diene and arene complexes, preparation, properties, chemical reactions, nature of bonding and structural properties.

Unit-III **12 hrs**

σ – Bonded Transition Metal Complexes (Hydrocarbyls)

Types, bonding and structure of hydrocarbyls, routes of synthesis, thermal stability and decomposition pathways, chemical reactions and applications of organo-copper compounds in organic synthesis.

Unit-IV **12 hrs**

Homogeneous Catalysis

Stoichiometric reactions for catalysis, activation of C-H bond, homogeneous hydrogenation catalysis (Wilkinsons Catalyst), Asymmatric Hydrogenation using Chiral Catalyst, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), Methanol carbonylation and olefin oxidation: Wacker, Monsanto & Cativa process.

Unit-V **12 hrs**

Fluxional Organometallic Compounds

Fluxionality and dynamic equilibria in compounds such as ɖ^2-olefin, ɖ^3-allyl and dienyl complexes, non-rigid molecules in different coordination geometry.

Transition Metal Compounds with Bonds to Hydrogen

Chemistry of transition metal compounds with bonds to hydrogen: Types, synthesis and chemical reactions; Aluminohydrides and Borohydrides.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Principles and Applications of Organotransitiion Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
3. Metallo-organic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
5. Basic Organometallic Chemistry, Concepts, Syntheses and Applications, B.D. Gupta and A.J. Elias, University Press.

DETAILED SYLLABUS

Course No.: **575**

Title: **Practical Course (Inorganic Chemistry)**

Credits: **08**

Maximum Marks: **200**

Duration of Examination: **14 hrs**

a) Semester Examination: **100** (including 20 in viva-voce)

b) Sessional Assessment: **100**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

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270 hrs

Preparation

Preparation of selected inorganic compounds and their study by IR, electronic spectra, Mossbauer, ESR and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines.

1. Magnetic moment of $Cu(acac)_2H_2O$
2. Cis and Trans $[Co(en)_2Cl_2]^+$
3. Separation of optical isomer cis-$[Co(en)_2Cl_2]Cl$. J. Chem. Soc., 1960, 4369.
4. Ion exchange separation of oxidation state of vanadium. J. Chem. Educ., 1980, 57, 316; 1978, 55, 55.
5. Determination of Cr(III) complexes.
   $[Cr(H_2O)_6]NO_3.3H_2O.[Cr(H_2O)_4Cl_2]Cl.2H_2O$.
   $[Cr(en)_3]Cl_3.Cr(acac)_3$. Inorg. Synth., 1972, 13, 184.
6. Preparation of N.N.bis(salicyldehyde)ethylenediamine salen, $H_2Co(salen)$. J. Chem. Educ., 1977, 54, 443; 1973, 50, 670.
   Determination of O_2 absorption by Co(salem). Acct. Chem. Res., 1975, 8, 384.
   Reaction of Oxygen adduct with $CHCl_3$(deoxygenation).
7. Preparation of Fe(II)chloride (use it as Friedelcraft chlorination source). J. Org. Chem., 1978, 43, 2423, J. Chem. Edu., 1984, 61, 645; 1986, 63, 361.
8. Reaction of Cr(III) with a multidentate ligand: a kinetic experiment (visible spectra Cr-EDTA complex) J.A.C.S., 1953, 75, 5670.
9. Preparation of Co (phenonthroline-5, 6-quinone). J. Chem. Soc. A., 1970, 447; J. Chem. Edu., 1977, 54, 710.
10. Preparation and use of Ferrocene, J. Chem. Edu., 1966, 43, 73; 1976, 53, 730.
11. Preparation of copper glycine complex-cis and trans bis (glycinato copper(II)). J. Chem. Soc. Dalton, 1979, 1901, J. Chem. Edu., 1982, 59, 1052.
12. Preparation of phosphine Ph_3P and its transition metal complexes.
13. Any other experiment such as conversion of p-xylene to terephthalic acid catalyzed by $CoBr_2$ (homogeneous catalysis).

DETAILED SYLLABUS

Course No.: **582** Title: **Organic Synthesis and Chemistry of Natural Products**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

UNIT – I **16 hrs**

Disconnection Approach

An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections (1,2 and 1,3-difunctionalised compounds), chemoselectivity, reversal of polarity.

UNIT – II **10 hrs**

One Group C-C Disconnections

Alcohols and carbonyl compounds, regioselectivity, use of acetylenes and aliphatic nitro compounds in organic cynthesis.

Two Group C-C Disconnections

Biological Cope, Cope and Claisen reaction, Diels-Alder reaction, 1,3-difunctionalised compounds, Ǔ, ɓ-unsaturated carbonyl compounds, 1,5-difunctionalised compounds, Michael addition and Robinson annelation.

UNIT – III **10 hrs**

Rearrangements

General mechanistic considerations ï nature of migration, migratory aptitude, memory effects.

A detailed study of the following rearrangements:

Demyanov, Benzil-Benzilic acid, Favorskii, Stevens, Arndt-Eistert synthesis, Neber, Hofman, Curtius, Schmidt, Baeyer-Villiger and Shapiro, Eschenmosher and Prins reaction.

UNIT – IV **14 hrs**

Oxidations

Oxidation of alcohols (Chromic acid, $KMnO_4$, $Pb(OAc)_4$, Oppneaur Swern); aldehydes and ketones (chromium trioxide complexes); Amine (H_2O_2, peracids and quinones); sulfides (peracid, HIO_4).

Oxidation with osmium and ruthenium tetraoxide, iodobenzene diacetate and thalium (III) nitrate.

Reduction

Birch reduction; Reduction of aldehydes, ketones, acids and their derivatives (clemenson, Wolff Kishner, lithium aliminium hydride, sodium borohydride, DIBAL-H, diborane, aluminium isopropoxide).

Reduction of nitro, azo, oxime and nitrile groups (Lithium aliminium hydride and DIBAL-H).

UNIT – V **10 hrs**

Alkaloids

Definition, physiological action, occurrence and isolation. Structure elucidation and synthesis of Quinine and Morphine.

Steroids

Occurrence, basic skeleton, Dielôs hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Testosterone, Progestrone.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Designing Organic Synthesis, S. Warren, Wiley.
2. Organic Synthesis ï Concept, Methods and Starting Materials, J. Fuhrhop and G. Penzillin, Verlage VCH.
3. Some Modern Methods of Organic Synthesis, W. Carruther, Cambridge University Press.
4. Principles of Organic Synthesis, R. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Chemistry of Natural Products, S.V. Bhat, B.A. Nagasampagi and M. Sivakumar, Narosa Publ. House, N.D.
6. The Total Synthesis of Natural Products Vol. 4, J. Apsimon (1981), John Wiley Interscience Publ. (N.Y.).
7. The Logic of Chemical Synthesis, E.J. Corey and X.M. Cheng, John Wiley and Sons, New York, N.Y.
8. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
9. Organic Chemistry, Vol.2, I.L. Finar, ELBS.
10. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
11. Polar rearrangements, Laurence M. Harwood, Oxford Science Publications, Oxford University Press.
12. Organic Synthesis, Michael B. Smith, McGraw Hill.

DETAILED SYLLABUS

Course No.: **578** Course Category: **PSEC**
Title: **Lab Course Organic Chemistry**
Credits: **08** Maximum Marks: **200**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

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270 hrs

Multi-Step Synthesis of Organic Compounds

The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques.
Photochemical reaction:-
BenzophenoneŸ BenzpinacolŸ Benzpinacolone
Beckmann rearrangement: Benzanilide from benzene
BenzeneŸ BenzophenoneŸ Benzophenone oximeŸ Benzanilide
Benzilic acid rearrangement: Benzilic acid from benzoin
BenzoinŸ BenzilŸ Benzilic acid
Synthesis of heterocyclic compounds-Three component coupling for the synthesis of dihydropyrimidinones.
Scraup Synthesis: Preparation of quinoline from aniline
Fisher ï Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine
Synthesis using microwaves
Alkylation of diethyl malonate with benzyl chloride
Synthesis using phase transfer catalyst
Alkylation of diethyl malonate or ethyl acetoacetate with an alkyl halide

Extraction of Organic Compounds from Natural Sources

1. Isolation of caffeine from tea leaves
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)
3. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported)
4. Isolation of piperine from black pepper
5. Isolation of lycopene from tomatoes

Spectrophotometric (UV/VIS) Estimations of any four of the following:

1. Amino acids
2. Proteins
3. Carbohydrates
4. Cholesterol
5. Ascorbic acid
6. Aspirin
7. Caffeine

BOOKS RECOMMENDED

1. Elementary Practical Organic Chemistry, Part-1, 2nd ed., Vogel.
2. Monograph on Green Chemistry by Green Chemistry Task Force Committee, DST.
3. Spectrophotometric determination of amino acid by Michail A. Alterman, Peter Hunziker, Vol. 828, Print ISBN: 978-1-61779-444-5.

DETAILED SYLLABUS

Course No.: **583** Title: **Chemistry of Materials**
Credits: **04** Maximum Marks: **100**
Duration of Examination: **3 hrs** a) Semester Examination: **80**
b) Sessional Assessment: **20**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Unit – I **8 hrs**

Basics of Polymers

Importance of polymers, Basic concepts: Monomers, repeat units, degree of polymerization. Linear branched and network polymers, classification of polymers. Polymerization: Condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions.

Unit – II **14 hrs**

Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. Viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

Unit – III **14 hrs**

Structure and Properties

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Crystallization and melting. Polymer structure and physical properties-crystalline melting point, T_m-melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, T_g, effect of molecular weight, diluents, chemical structure, chain topology, branching and cross lonking.

Unit – IV **12 hrs**

Liquid Crystals

Mesomorphic behavior, classification of liquid crystals, nematic and smectic mesophases; homeotropic, planer, schlieren textures, Nematic droplets, Mauguin textures, Texturesin smectic phases, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals.

Unit – V **12 hrs**

Multipurpose Materials

Ferrous alloys; Fe-C phase transformations in ferrous alloys, stainless steels; non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.

Glasses, ceramics and Composites

Glassy state, glass formers and glass modifiers, applications Ceramic structures, mechanical properties.

Microscopic composites; dispersion-strengthened and particle-reinforced fibre-reinforced composites, macroscopic composites.

Thin Films and Langmuir-Blodgett Films

Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

NOTE FOR PAPER SETTING

The question paper will contain ten questions each carrying 16 marks. There will be two questions from each unit and the candidate has to attempt five questions in all, selecting one question from each unit.

BOOKS RECOMMENDED

1. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
2. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.R. Lambe, Prentice Hall.
5. Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie Academic and Professional.
6. Materials Science and engineering, An Introduction, W.D. Callister, Wiley.
7. Principles of the Solid state, H.V. Keer, Wiley Eastern.
8. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.

DETAILED SYLLABUS

Course No.: **581**

Title: **Practical Course (Physical Chemistry)**

Credits: **08**

Maximum Marks: **200**

Duration of Examination: **14 hrs**

a) Semester Examination: **100** (including 20 in viva-voce)

b) Sessional Assessment: **100**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

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270 hrs

1. Determination of Planckôs Constant by means of LEDôs method based on expression of diode current for $V<V_0$. The dependence of current with temperature is to be measured, keeping the V slightly below V_0 and material constant ɖ to be obtained from V-I characteristics of the diode.
2. Four Probe set-up for measuring the resistivity of very low to highly resistive samples at temperature upto 200°C with PID controlled oven, having the following setup:
   (i) Four Probe Arrangement with built-in RTD sensor & PID controlled Oven
   (ii) D.C. Microvoltmeter
   (iii) Constant Current Source
   For low resistivity samples like thin films for metals and alloys
   (iv) Low Current Source
3. Measurement of Magentoresistance of Semiconductors with the apparatus consisting of:
   a) Four Probe Arrangement
   b) Sample: Ge Crystal (n-type)
   c) Magnetoresistance setup
   d) Electromagnet
   e) Constant Current Power Supply
   f) Digital Gaussmeter
4. Study of Dependence of Hall Coefficient on Temperature by the following setup:
   a) Hall Effect Setup
   b) Hall Probe (Ge: p-type) with a small oven
   c) Electromagnet
   d) Constant Current Power Supply
   e) Digital Gaussmeter
5. Study of the energy band-gap and diffusion potential of P-N Junctions.
6. Study of T_C and other related properties in high T_C superconductors.
7. Determine the order, the velocity constant and the activation energy of the hydrolysis of tertiary-amyl iodide.
8. Determine the velocity constant of the decomposition of benzene diazonium chloride.
9. Determine the velocity coefficient of inversion of sucrose by 0.5N hydrochloric acid at 25°C.
10. To determine the basicity of an organic acid by conductometric measurement.
11. To study the kinetics of the reaction between potassium persulphate and potassium iodide.
    a) Determine the rate constant and order of the reaction.
    b) Study the influence of ionic strength on the rate constant.
12. Determine the dissociation constant of picric acid by studying its distribution between benzene and water.

13. Investigate the reaction between acetone and iodine, potassium permanganate and oxalic acid.
14. Precipitation titrations using conductivity meter.
15. Determine acid and base dissociation constant of amino acid and find isoelectric point of acid (glycine).

BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findleyôs Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry by Viswanathan and Raghavan.