National Education Policy 2020 Inserted PG Programme on the basis of "Choice Based Credit System-CBCS"

Master of Science in Chemistry

(w.e.f. Session 2024-25)

Approved by BOS on 16.08.2023

Board of Studies- Chemistry

Maharaja Suhel Dev State University,

Azamgarh-276128, Uttar Pradesh (INDIA)

SYLLABUS OF M.Sc. CHEMISTRY

MAHARAJA SUHEL DEV STATE UNIVERSITY, AZAMGARH

Semester wise Titles of the Papers for M.Sc. Chemistry

Academic Year 4th [Semester VII] BACHELOR RESEARCH in CHEMISTRY

- Four Papers (4 credits) each are compulsory.
- Practical (4 credits) is compulsory
- Research project (4 credits) is compulsory.
- Exam of Minor paper (4 credits) can be given either during semester VII or semester VIII.

Course Code	Course Title	Category of Course	Nature of Course	Credits
B020701T	Inorganic Chemistry-I	Compulsory	Theory	4
B020702T	Organic Chemistry-I	Compulsory	Theory	4
B020703T	Physical Chemistry-I	Compulsory	Theory	4
B020704T	Principles of Spectroscopy	Compulsory	Theory	4
B020705P	Chemistry Practical	Compulsory	Practical	4
B020706R	Research Project	Compulsory	Dissertation	4
-	Minor subject from other faculty	Compulsory	Theory	4
			Total Credit Load for Semester-VII	28

Academic Year 4th [Semester VIII] BACHELOR RESEARCH in CHEMISTRY

- Three Papers of (4 credits) each are compulsory.
- Students have to choose any one paper (4 credits) out of the two papers from subject elective courses.
- Practical (4 credits) is compulsory
- Research project (4 credits) is compulsory.
- Exam of Minor paper (4 credits) can be given either during semester VII or semester VIII.

Course Code	Course Title	Category of Course	Nature of Course	Credits
B020801T	Inorganic Chemistry-II	Compulsory	Theory	4
B020802T	Organic Chemistry-II	Compulsory	Theory	4
B020803T	Physical Chemistry-II	Compulsory	Theory	4
B020804T	Applications of Spectroscopy	Elective	Theory	4
B020805T	Bio-physical Chemistry	Elective	Theory	4
B020806P	Chemistry Practical	Compulsory	Practical	4
B020807R	Research Project	Compulsory	Dissertation	4
			Total Credit Load for Semester-VIII	24
			Cumulative Credit Load Semester-VII and Semester-VIII	52

Academic Year 5th [Semester IX] MASTER of SCIENCE in CHEMISTRY

- Two Papers of (4 credits) each are compulsory.
- Students have to choose any two papers, both of which should be from two different group (A and B) (4 credits each).
- Practical (4 credits) is compulsory
- Research project (4 credits) is compulsory.

Course Code	Section	Course Title	Category of Course	Nature of Course	Credits
B020901T		Analytical Techniques	Compulsory	Theory	4
B020902T		Stereochemistry and Pericyclic Reactions	Compulsory	Theory	4

B020903T	A	Inorganic Reaction Mechanism	Elective	Theory	4
B020904T		Biochemistry	Elective	Theory	4
B020905T		Chemical Dynamics	Elective	Theory	4
B020906T	B	Coordination polymer, Cluster and Nanostructure	Elective	Theory	4
B020907T		Heterocyclic Chemistry	Elective	Theory	4
B020908T		Surface Chemistry and Catalysis	Elective	Theory	4
B020909P		Practical	Compulsory	Practical	4
B020910R		Research Project	Compulsory	Dissertation	4
				Total Credit Load for Semester-IX	24

Academic Year 5th [Semester X] MASTER of SCIENCE in CHEMISTRY

- Students have to choose any four papers, one from each group (A, B, C and D) (4 credits each).
- Practical (4 credits) is compulsory
- Research project (4 credits) is compulsory.

Course Code	Section	Course Title	Category of Course	Nature of Course	Credits
B021001T	A	Structural methods in Inorganic Chemistry	Elective	Theory	4
B021002T		Reagents and Reaction	Elective	Theory	4
B021003T		Solid State Chemistry	Elective	Theory	4
B021004T	B	Inorganic Rings, Chains and Clusters	Elective	Theory	4
B021005T		Organic Synthesis	Elective	Theory	4
B021006T		Electrochemistry	Elective	Theory	4
B021007T	C	Bio-inorganic Chemistry	Elective	Theory	4
B021008T		Medicinal Chemistry	Elective	Theory	4
B021009T		Photo Physical Chemistry	Elective	Theory	4
B021010T	D	Environmental Chemistry	Elective	Theory	4
B021011T		Polymer Chemistry	Elective	Theory	4
B021012T		Photo Inorganic Chemistry	Elective	Theory	4
B021013T		Chemistry of Natural Products	Elective	Theory	4
B021014P		Practical	Compulsory	Practical	4
B021015R		Research Project	Compulsory	Dissertation	4
				Total Credit Load for Semester-X	24
				Cumulative Credit Load Semester-IX and Semester-X	48
				Cumulative Credit Load of All Semester(VII-X)	100

NOTE-*1. The examination shall comprise of four theory papers each of three hours duration and practical examination of 18 hours duration (spread over three days) in each semester.*

2. The title/topic of research project is on the discretion of supervisor, therefore no syllabus required. The maximum marks to be awarded is 50/Semester.

Detailed Syllabus

BACHELOR RESEARCH in CHEMISTRY	Year-FOURTH	Semester-SEVENTH(VII)
B020701T	Paper-I (Theory) INORGANIC CHEMISTRY-I	
CREDITS=4	COMPULSORY	
MAX MARKS:100	MIN PASSING MARKS:33	
TOTAL NUMBER OF LECTURES=50		

UNIT	TOPICS	No of Lectures
I	**Stereochemistry and Bonding in Main Group Compounds-** VSEPR, Walsh diagrams (tri- and penta-atomic molecules), dπ-pπ bonds, Bent rule.	10
II	**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 thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	10
III	**Metal-Ligand Bonding-** Limitation of crystal field theory, John-Teller distortions, molecular orbital theory, octahedral, tetrahedral and square planar complexes.	10
IV	**Molecular Symmetry-** Symmetry elements and symmetry operations, symmetry groups and subgroups, point symmetry group in inorganic and co-ordination compounds.	10
V	**Electronics Spectra and magnetic Properties of Transition Metal Complexes-** Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq. B and β parameters, charge transfer spectra, anomalous magnetic moments, magnetic exchange coupling and spin crossover.	10

Recommended Books:

1. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, John Wiley
2. Inorganic Chemistry, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
3. Chemistry of the Elements, N. N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A. B. P. Lever, Elsevier
5. Magnetochemistry, R. L. Carlin, Springer Verlag
6. Modern Spectroscopy, J. M. Hollas, John Wiley.
7. Chemical Applications of Group Theory, F. A. Cotton.
8. Symmetry and Group theory: Some chemical applications, Ramashankar and Suresh Ameta, Himanshu Publications, Udaipur, Delhi.
9. K. Veera Reddy, Symmetry and Spectroscopy of Molecules, New Age
10. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C. H. L. Langford, Oxford

B020702T	Paper-II (Theory) ORGANIC CHEMISTRY-I
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=50	

UNIT	TOPICS	No of Lectures
I	**Aromaticity and Reaction Mechanism** Aromaticity, Huckel's rule, aromaticity in benzenoid, non-benzenoid compounds, anti-aromaticity and homo-aromaticity. Hammond's postulate, Curtin-Hammett principle, Taft Equation, Potential energy diagrams,	08
II	**Free Radical Reactions-**	10

	Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation,coupling of alkynes, Free radical rearrangement, Hunsdiecker reaction. **Elimination Reactions-** The E_2, E_1 and E_{1CB} mechanisms and their stereochemistry and orientation. Reactivity- effects of substrates, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination and Paterson elimination.	
III	**Addition to carbon-carbon Multiple Bonds-** Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals. Regio and chemo selectivity, orientation and reactivity. Addition to cyclopropane ring. Hydroboration, Michael reaction, Sharpless asymmetric epoxidation, Stereochemistry of epoxidation and halolactonisation. **Addition to Carbon-Hetero atom Multiple Bonds-** Generation of enolate ions and their Synthetic applications and Aldol condensation. Stobbe condensation reactions. Hydrolysis of esters.	10
IV	**Aliphatic Nucleophilic Substitution-** The SN2, SN1, mixed SN1', SN2', SNi and SET mechanisms, The neighbouring group mechanism, neighbouring group participation (anchimeric assistance) by oxygen, halogen and sulphur as a neighbouring group. Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon, reactivity effectsof substrate structure, attacking nucleophile, leaving group and reaction medium.	10
V	**Aromatic Electrophilic Substitution-** The arenium ion mechanism, orientation and reactivity, energy-profile diagrams. The ortho/para ratio, ipso attack. Diazonium coupling, Vilsmeier-Haack reaction, Gatterman-Koch reaction. **Aromatic Nucleophilic Substitution-** The ArSN1, ArSN2 and benzyne mechanisms, Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangements.	12

Recommended Books:

1. Stereochemistry of Organic Compounds, Nasipuri, New Age International (P) Limited.
2. Stereochemistry of Carbon Compounds, E. L. Eliel and S. H. Wilen
3. Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press.)
4. Advanced Organic Chemistry, A. F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
5. Advanced Organic Chemistry, J. March, 6th Ed.
6. Mechanism and structure in Organic Chemistry – E. S. Gould (Holt, Rinehart and Winston)
7. Guidebook to Mechanism in Organic Chemistry, Orient Longman, Sykes, P. A New Delhi.

B020703T	Paper-III(Theory) PHYSICAL CHEMISTRY-I
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=50	

UNIT	TOPICS	No of Lectures
I	**Classical Thermodynamics-** Brief description of the laws of thermodynamics, Concept of entropy and residual entropy, Entropy changes accompanying changes of phase, calculation of entropy changes of an ideal gas with change in P, V, and T, Criteria for reversible and irreversible processes, Gibb's	15

	Free energy and its change with temperature and pressure, Thermodynamic Maxwell relations, Concept of Fugacity, determination of fugacity of a gas, calculation of fugacity at low pressure. Thermodynamic Functions of Mixing, Non-ideal systems	
II	**Chemical Thermodynamics-** Chemical potential and Entropies, Partial molar quantities: Partial molar free energy, Partial molar volume and Partial molar heat content and their significances. Determinations of the partial molar quantities., Gibb's Duhem Equation.	10
III	**Statistical thermodynamics-** Concept of distribution, thermodynamic probability and most probable Distribution. The Boltzmann distribution law, Fermi-Dirac and Bose-Einstein statistics. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using LaGrange's method of undetermined multiplier). Partition functions – translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Application of partition function.	15
IV	**Non-Equilibrium Thermodynamics-** 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.) transformations of the generalized fluxes and forces, non-equilibrium stationary states. phenomenological equations, Onsager reciprocal relations.	10

Recommended Books:

1. Physical Chemistry P.W. Atkins, ELBS.
2. Advanced Physical Chemistry, Puri, Sharma & Pathania, Vishal Publication , Jalandhar
3. Statistical Thermodynamics, S. Glasstton, Willey Publication.
4. Advanced Physical Chemistry, Vol.I,II & III K.L.Kapoor , Mac Millan Publication.
5. Molecular Thermodynamics, J Rajaram and Kuriacose, Mac Millan Publication.
6. Physical Chemistry, Ira & N. Levine, Pearson Publication

B020704T	Paper-IV (Theory) PRINCIPLES OF SPECTROSCOPY
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Unifying Principles-** Electromagnetic radiation, interaction of electromagnetic radiation with matter-absorption, emission, transmission, reflection, refraction, dispersion, polarisation and scattering. Uncertainty relation and natural line width and natural line broadening, selection rules, intensity of spectral lines, Born Oppenheimer approximation, rotational, vibrational and electronic energy leaves.	10
II	**Microwave Spectroscopy-** Classification of molecules, rigid rotor model, Effect of isotopic substitution on the transition frequencies intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.	10
III	**(a) Infrared Spectroscopy-** Review of linear harmonic oscillator, vibrational energies of diatomic molecule, zero point energy, force constant and bond strength; anharmonicity, vibration-rotation spectroscopy. P.Q.R. branches, vibrations of polyatomic molecules, Selection rules, normal modes of vibration, factors affecting the band positions and intensities. **(b) Raman Spectroscopy-** Classical and quantum theories of Raman Effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion, principle. Applications of Raman spectroscopy.	10

IV	**Electronic/Molecular spectroscopy-** Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states; Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; Radioactive and non-radioactive decay, internal conversion	10
V	**Nuclear magnetic Resonance Spectroscopy-** Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing nuclei, chemical shift and its measurements, factors influencing chemical shift de shielding, spin-spin interactions factors influencing coupling constant 'J' Effect of chemical exchange, spin decoupling, basic ideas about instrument, NMR studies of nuclei other than proton-^{13}C and ^{19}F	10
V	**Electron Spin Resonance-Spectroscopy-** Basic principles, Zero field splitting and Kramer's degeneracy, Factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques and applications.	12

Recommended Books:

1. Modern Spectroscopy. J M Hollas, John Willey
2. Introduction to molecular Spectroscopy, M Barrow, Mc Graw Hill.
3. Molecular Spectroscopy, C M Banewell, Mc Graw Hill
4. Basic Principles of Spectroscopy, R Chang, Mc Graw Hill
5. Theory and Applications of UV Spectroscopy, H H Zaffar & Orchin, IBS Oxford.

B020705P	Paper-V (Practical) CHEMISTRY PRACTICAL
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES/LABS=90

UNIT	TOPICS	No of Lectures
I	**INORGANIC CHEMISTRY** Qualitative Analysis 1. Qualitative mixture analysis for seven radicals including two rare elements. (Mo, W, Ti, Zr, Th, Ce, V) in cationic and anionic forms. 2. Separation of a mixture of cations/anions by paper chromatographic technique using aqueous/non-aqueous media. (i) Pb^{2+} and Ag^{+} (aqueous and non-aqueous media) (ii) Co^{2+} and Cu^{2+} (non-aqueous medium) (iii) Cl^{-} and I^{-} (aqueous-acetone medium) (iv) Br^{-} and I^{-} (aqueous-acetone medium)	30
II	**ORGANIC CHEMISTRY** 1. Separation and identification of organic compounds using chemical methods from binary mixtures. 2. Estimation of glucose, aldehydes and ketones by chemical and spectroscopic methods. 3. Synthesis of Dibenzalacetone from benzaldehyde.	30
III	**PHYSICAL CHEMISTRY** 1. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media. 2. Determination of the order of the saponification of ethyl acetate with NaOH. 3. Determine the temperature coefficient and activation energy of Methyl acetate with NaOH. 4. Find out the rate constant and order of the reaction between H_2O_2 and HCl 5. Find out the heat of solution of a substance (Oxalic acid) by solubility method. 6. Determine the solubility of an organic acid at 40 °C and at a temperature lower than the room temperature.	30

Recommended Books:

1. Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS

2. Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) 1999.
3. Inorganic Experiments, J. Derexwoolings VCH
4. Microscale Inorganic Chemistry, Z. Scafran, R.M. Pike and M.M. Singh Wiley.
5. Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand.
6. The systematic identification of Organic Compounds, R.L. Shringer and D.Y. Curlin.
7. Qualitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
8. Basic concept of Analysis chemistry, S.M. Chopkar, Wiley Bastern.
9. Synthesis and characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.
10. Systematic Qualitative Organic Analysis, H. Middeton, Adward Arnoid.
11. Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar.
12. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
13. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman.
14. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman.
15. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill.
16. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi)
17. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003.
18. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House.
19. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books.
20. General Chemistry Experiments, Anil J Elias, University Press (2002)

BACHELOR RESEARCH in CHEMISTRY	Year-FOURTH	Semester-EIGHTH(VIII)

B020801T	Paper-I (Theory) INORGANIC CHEMISTRY-II
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	Types, routes of synthesis, stability, decomposition pathways and polarity of M-C bond, organocopper in organic synthesis.	08
II	**Transitions Metal π-Complexes-** Transition metal π-complexes with unsaturated organic molecules, alkenes, alkynes, dienyl and arene complexes preparations, properties, nature of bonding and structural features.	12
III	**Compounds of Transition metal-Carbon Multiple Bonds-** Alkylidenes, Alkylidynes, low valent carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands	10
IV	**Homogeneous Catalysis-** Homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins. Waker Process, hydrocarbanylation of olefins, oxopalladation reactions, activation of C-H bond.	10
V	**Fluxional Organometallic Compounds-** Fluxionality and dynamic equilibria in compounds such as n^2–olefins and n^3–allyl and dienyl complexes.	10

Recommended Books:

1. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, John Wiley
2. Inorganic Chemistry, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
3. Chemistry of the Elements, N. N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A. B. P. Lever, Elsevier
5. Magnetochemistry, R. L. Carlin, Springer Verlag
6. Modern Spectroscopy, J. M. Hollas, John Wiley.
7. Chemical Applications of Group Theory, F. A. Cotton.
8. Symmetry and Group theory: Some chemical applications, Ramashankar and Suresh Ameta, Himanshu Publications, Udaipur, Delhi.
9. K. Veera Reddy, Symmetry and Spectroscopy of Molecules, New Age

B020802T	Paper-II (Theory) ORGANIC CHEMISTRY-II
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Molecular Rearrangements-** Pinacole-Pinacolone rearrangement, Wagner-Meerwein rearrangement, Wolff rearrangement, Demjanov rearrangement , Dienone-Phenol rearrangement, Beckmann rearrangement, Hofmann rearrangement, Curtius rearrangement, Lossen rearrangement, Schmidt reaction and Baeyer-Villiger rearrangement.	10
II	**Photochemical Reactions-** Interaction of electromagnetic radiation with matter, types of excitations, Jablonski diagram, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. Classification of rate constants and life times of reactive energy states, determination of rate constants of reactions.	10
III	**Photochemistry of Carbonyl Compounds-** Intramolecular reactions of carbonyl compounds- saturated, cyclic and acyclic β,γ-unsaturated and α, β- unsaturated compounds. Intramolecular cyclo- addition reaction-dimerization and oxetane formation.	10
IV	**Photochemistry of Alkenes-** Intramolecular reaction of the olefinic bonds, geometrical isomerism, cyclisation reaction. Rearrangement of 1,4 and 1,5 -dienes.	12
V	**Photochemistry of Aromatic Compounds-** Isomerisation, additions and substitution reaction.	08

Recommended Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, 2 nd edition, Oxford University Press,2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
7. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
8. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
9. Bariyar and Goyal, Organic Chemistry-II, Krishna Prakashan Media, Meerut, Third Edition, 2019
10. Mukherji, Singh, Kapoor, Organic Chemistry, volume 1,2 and 3, 2014, New Age International.
11. Geeta Rani, General Organic Chemistry, Manakin press
12. Arun Bahl & B S Bahl, Advanced Organic Chemistry, S. Chand Publishing Co.

B020803T	Paper-III (Theory) PHYSICAL CHEMISTRY-II
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No. of LECTURES
I	**Introduction to Exact Quantum Mechanical Results** The Schrodinger equation and the postulates of quantum mechanics. Hermitian operators, normalization, orthogonality, Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor.	10
II	**Angular Momentum** Ordinary angular momentum, generalized angular momentum, eigenfunctions, for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.	10
III	**Electronic Structure of Atoms**	10

	Russell-Saunders terms and coupling schemes, Slater-Condon parameters, term separation energies of the p^n configuration, term separation energies for the d^n configuration, magnetic effects spin-orbit coupling and Zeeman splitting, introduction to the methods of self-consistent field, the virial theorem.	
IV	**Approximate Methods** The variation theorem, linear variation principle. Perturbation theory (first order and nondegenerate). Applications of variation method and perturbation theory of the Hydrogen atom.	10
V	**Molecular Orbital Theory** Huckel theory of conjugated systems, Bond order and charge density calculations, Applications to ethylene, butadiene, cyclopropenyl cation/anion, cyclobutadiene, benzene, etc.	10

Recommended Books:

1. Puri Sharma Pathania, Advance Physical Chemistry.
2. Molecular quantum Mechanics by P.W. Atkins Oxford University Press, Oxford New York
3. Quantum Chemistry, Ira N. Levine Pearson
4. Advanced Quantum Chemistry, R K Prasad, New Age Publication
5. Quantum Chemistry, Donald A Mcquarrie, Viva Publication

B020804T	Paper-IV (Theory) APPLICATION OF SPECTROSCOPY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**UV-Visible spectroscopy-** UV-Visible spectroscopy: Basic principles, application of UV-Visible spectroscopy to organic structure elucidation, Woodward- Fisher rules.	10
II	**IR Spectroscopy-** IR-Spectroscopy: Basic Principles characteristic frequencies of common functional groups, application to organic and inorganic compounds.	10
III	**NMR spectroscopy-** Basic principles, introduction to FT NMR techniques, Spectral parameters-Intensity, chemical shift, multiplicity, coupling constant, structure determination of organic compounds by ^{1}HNMR spectra and ^{13}C NMR Assignment of chemical shifts of common organic compounds and functional groups: Introduction to multinuclear NMR of common hetero atoms present in organic compounds.	10
IV	**Mass spectrometry-** Basic principles, techniques of ion production and ion and daughter ions, molecular ion and isotope abundance, nitrogen rule energetics of fragmentation. Metastable ions, common fragmentation pathways-fragmentation of common chemical classes. Mc Lafferty rearrangement. Structural elucidation. **Applications** of IR, NMR and Mass spectroscopy for structure elucidation of organic compounds.	10
V	**ESR Spectroscopy-** **Electron spin resonance**: g value, hyperfine structure, ESR of hydrogen atom, free radicals,ESR of solids, ESR of simple free radicals in solutions, Spin densities, spin polarisation, anisotropy of Zeeman and Hyperfine interactions.	10

Recommended Books:

1. Silversteine and Basser, Spectrometric Identification of Organic Compounds, Willey.
2. Organic Spectroscopy, P.S. Kalsi, New Age International (P) Limited.
3. Spectroscopy of Organic Compounds, Pavia, Mery Finch Publication.
4. Cotton, F.A, Wilkinson,G and Gaus,P. L ,Basic Inorganic Chemistry,3 rd Edition ,Wiley 1995
5. Lee, J. D, Concise Inorganic Chemistry 4 th Edition ELBS,1977

6. Clayden, J., Greeves, N., Warren, S., Organic Chemistry, Second edition, Oxford University Press 2012.
7. Silverstein, R. M., Bassler, G. C., Morrill, T. C. Spectrometric Identification of Organic Compounds, John Wiley and Sons, INC, Fifth edition.
8. Pavia, D. L. et al. Introduction to Spectroscopy, 5th Ed. Cengage Learning India Ed.
9. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wordsworth Publishing Company, Belmont, California, USA, 1988.
10. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
11. Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.
12. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
13. Mukherji, Singh, Kapoor, Organic Chemistry, Vol 1 and 2. New Age International 2014
14. R L Madan, Chemistry for Degree Students, S Chand Publishing Co.
15. Y. R. Sharma, ELEMENTARY ORGANIC SPECTROSCOPY VOL 4, S Chand
16. Gurdeep Raj, Advanced Physical Chemistry, Krishna Publishing House
17. K. L. Kapoor, A Textbook of Physical Chemistry - Quantum Chemistry and Molecular Spectroscopy, Volume 4, Macmillan

B020805T	Paper-V (Theory) BIO PHYSICAL CHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Biological cell and its Constituents-** Biological cell, Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve Conduction. Structure and functions of proteins, enzymes. DNA and RNA in living systems. Helix coil transition.	10
II	**Bioenergetics-** Standard free energy change in biochemical reactions, exergonic, endergonic, Hydrolysis of ATP, synthesis of ATP from ADP.	10
III	**Biopolymer Interactions-** Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic force, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.	10
IV	**Thermodynamics of Biopolymer Solutions-** Thermodynamics of biopolymer solutions, osmotic pressure membrane equilibrium, muscular contraction ion energy generation in mechanochemical system.	10
V	**Biopolymers and their Molecular Weights-** Evaluation of size shape molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity viscosity electrophoresis and rotational motions.	10

Recommended Books:

1. Principles of Biochemistry, A.L. Lehininger, Worth Publishers.
2. Biochemistry, L. Strayer, W.H. Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry: E.E. Conn and P.K. Stumpf. John Wiley.
6. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag.
7. Macromolecules: Structure and Functions, F. World, Prentice Hall.
8. Mukherji, Singh, Kapoor, Organic Chemistry, volume 1,2 and 3, 2014, New Age International.
9. Geeta Rani, General Organic Chemistry, Manakin press
10. Arun Bahl & B S Bahl, Advanced Organic Chemistry, S. Chand Publishing Co.

B020806P	Paper-VI (Practical) CHEMISTRY PRACTICAL
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=90		
UNIT	**TOPICS**	**No of Lectures**
I	**INORGANIC CHEMISTRY** 1. Preparation of Coordination Complexes and their studies by IR and magnetic susceptibility measurements. i. $VO(acac)_2$ ii. $K_3[Fe(C_2O_4)_3]$ iii. Prussian Blue iv. $[Cu(NH_3)_4]SO_4.H_2O$ v. $Na[Cr(NH_3)_2(SCN)_4]$ vi. $[Co(Py)_2Cl_2]$ vii. $[Ni(dmg)_2]$ viii. $[Ni(NH_3)_6]Cl_2$ 2. Quantitative separation and determination of the following pairs of metal ions using gravimetric and volumetric methods i. Ni^{2+} (gravimetrically) and Cu^{2+} (Volumetrically) ii. Ba^{2+} (gravimetrically) and Cu^{2+} (Volumetrically) iii. Fe^{3+} (gravimetrically) and Ca^{2+} (Volumetrically) iv. Mg^{2+} (gravimetrically) and Ca^{2+} (Volumetrically)	30
II	**ORGANIC CHEMISTRY** 1 Separation and identification of organic compounds using chemical methods from binary mixtures namely solid-solid and solid -liquid. 2. Preparation of various organic compounds involving two or three steps employing different reactions viz. Aldol Condensation, reactions of enolate ions, oxidation reactions, Cannizzaro reaction, Molecular rearrangement reactions etc. with a view to give the student sufficient synthetic training in synthetic organic chemistry 3. Isolation of: i. Casein from milk ii. Caffeine from tea leaves iii. Eugenol from cloves	30
III	**PHYSICAL CHEMISTRY** 1. Find out the strength of the given ferrous ammonium sulphate (0.1N) by titrating it against potassium dichromate solution potentiometrically. 2. Find out the strength of the mixture of halides by titrating it against $AgNO_3$ solution potentiometrically. 3. Find out the composition of Ferric ion-Thiocyanate complex by Job's method using spectrophotometer. 4. Titrate a solution of 0.1 N NaOH against 0.1 N HCl conductometrically.	30

Recommended Books:

1. Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS
2. Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) 1999.
3. Inorganic Experiments, J. Derexwoolings VCH
4. Microscale Inorganic Chemistry, Z. Scafran, R.M. Pike and M.M. Singh Wiley.
5. Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand.
6. The systematic Indentification of Organic Compounds, R.L. Shringer and D.Y. Curlin.
7. Qualitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
8. Basic concept of Analysis chemistry, S.M. Chopkar, Wiley Bastern.
9. Synthesis and characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.
10. Systematic Qualitative Organic Analysis, H. Middeton, Adward Arnoid.
11. Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar.
12. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
13. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman.
14. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman.
15. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill.
16. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi)

17. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003.
18. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House.
19. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books.
20. General Chemistry Experiments, Anil J Elias, University Press (2002)
21. Experimental Physical Chemistry, V.D. Athawale, Parul Mathur, New Age International (P) Limited.
22. Systematic Experiment in chemistry, Arun Sethi, New Age International (P) Limited.
23. Experiments in Physical chemistry, J.C. Ghosh, Bharati Bhavan.
24. Advanced Practical Physical Chemistry, JB Yadav.
25. Practical Organic Chemistry, Mann and Saunders.

MASTER of SCIENCE in CHEMISTRY	Year-FIFTH	Semester-NINTH(IX)
B020901T	Paper-I (Theory) ANALYTICAL TECHNIQUES	
CREDITS=4	COMPULSORY	
MAX MARKS:100	MIN PASSING MARKS:33	
TOTAL NUMBER OF LECTURES=50		

UNIT	TOPICS	No of Lectures
I	**Errors in Quantitative Analysis-** Accuracy, precision, sensitivity, specificity, standarddeviation, classification of errors and their minimization, significant figures, Normal error curve.	10
II	**Analytical Spectroscopy-** Principle, applications and limitations of spectrophotometry, Beer-Lambert law, analysis of mixtures, atomic absorption spectrometry (AAS).	10
III	**Voltammetry and Potentiometry-** Principles, voltammograms, equation of voltammogram, different waveforms–linear scan, square scan and triangular scan, cyclic voltammetry. General principles, calomel electrodes, Ag/AgCl electrodes, membrane electrodes – ion selective electrodes, glass electrodes, liquid membrane electrodes.	10
IV	**Chromatography-** Partition and distribution, principles of chromatography, plate and rate theory. retention time and retention factor, resolution and separation factor; general idea about adsorption, partition and column chromatography, paper and thin layer chromatography, gas chromatography (GC) and high performance liquid chromatography (HPLC).	10
V	**Thermo-analytical Methods-** Thermal methods of analysis: Principles and instrumentations of TG and DTA. Complementary nature of TG and DTA. Differential scanning calorimeter (DSC).	10

Recommended Books:

1. P.W. Atkins, Physical Chemistry, Oxford University Press, New York.
2. S. Glasston, Physical Chemistry, Nostrand.
3. Advance Physical Chemistry (Vol-1,2,3,4), K.L. Kapoor, MacMillan, India
4. Puri Sharma Pathania, Advance Physical Chemistry.
5. J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry, Vol.2, Plenum Press, New York.
6. Molecular Quantum Mechanics By P.W. Atkins Oxford University Press, Oxford New York
7. Physical Chemistry, Ira N. Levine

B020902P	Paper-II (Theory) STEREOCHEMISTRY AND PERICYCLIC REACTIONS
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=50	

UNIT	TOPICS	No of Lectures
I	**Stereoisomerism with chiral centre-** Elements of symmetry, chirality, molecules with more than one chiral center, threo and	10

	erythro isomers, Interconversion of Fischer, Newman and saw-horse projections and configurational projections R/S and E/Z. Principle of axial and planar chirality, optical isomerism of biphenyl, allenes and spiranes, optical activity due to intramolecular crowding and absolute configuration.	
II	**Topicity and pro stereoisomerism-** Introduction, homotropic, enantiotropic and diastereotropic atoms, group and faces. Nomenclature and symbols. **Cyclostereoisomerism-** Configuration and conformations, stability of mono and disubstituted cyclohexanes and decalines .	10
III	**Assymmetric Synthesis-** Chemoselective, regioselective and stereospecific reactions (with example), Method of asymmetric synthesis- i. **Enantioselective synthesis with chiral non racemic reagents and catalysts-** Hydroboration with chiral boranes ($IPCBH_2$), $(IPC)_2BH$, carbonyl group reduction with chiral complex hydride (BINAL-H, Chiral oxazaborolidines), chiral organometal complex (-) DAIB, 3-exodimethylamino isoborneol. ii. **Enantioselective epoxidation/Hydrogenation of alkene-** Sharpless epoxidation, enantioselective hydrogenation with [Rh(DIPAMP)]+ iii. **Diastereoselective synthesis-** Aldol reactions (Chiral enolate & achiral aldehyde and achiral enolate and chiral aldehyde) Cram's rule (Felkin- Anh, polar and chelate models)	10
IV	**Pericyclic Reactions-** Characteristics and classification of pericyclic reactions, Conversion of M.O's symmetry, Correlation, FMO and PMO methods for the study of following reactions- i. **Electrocyclic reactions-** Study of linear conjugated dienes and trienes having 4nπ and [4n+2] π conrotatory and disrotatory motions. ii. **Cycloadditions-** iii. Supra and antara facial overlapping; study of [2+2] and [4+2] systems, detailed study of Diels- Alder reaction, 1,3-dipolor cycloadditions reactions.	10
V	**Sigmatropic shift-** Study of [1,3],[1,5] and [3,3] sigmatropic shifts. Claisen and Cope rearrangements. Chelotropic Reactions, Group transfer reaction.	12

Recommended Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, 2 nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
7. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
8. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
9. Bariyar and Goyal , Organic Chemistry-II, Krishna Prakashan Media, Meerut , Third Edition, 2019
10. Mukherji, Singh, Kapoor, Organic Chemistry, volume 1,2 and 3, 2014, New Age International. 11. Geeta Rani, General Organic Chemistry , Manakin press
12. Arun Bahl & B S Bahl, Advanced Organic Chemistry, S. Chand Publishing Company

B020903T	Paper-III (Theory) INORGANIC REACTION MECHANISM
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN MARKS:33
TOTAL NUMBER OF LECTURES=50	

UNIT	TOPICS	No of Lectures

I	**Introduction to Inorganic Reaction Mechanism-** Energy profile of a reaction, reaction reactivity of metal complexes, inert and labile complexes, kinetics application of valence bond and crystal field theories, factors affecting the lability of complexes.	15
II	**Mechanism of Substitution Reactions in Octahedral Complexes-** kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage.	10
III	**Mechanism of Substitution Reactions in Square Planar-** Complexes Mechanism of substitution reactions in Pt(II) complexes, factors effecting the reactivity of square planar complexes, Trans-effect, theories of trans-effect and application of trans-effect to synthesis of complexes.	10
IV	**Electron Transfer (or Oxidation -Reduction) Reaction-** Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross-reactions and Marcus-Hush theory, inner sphere type reactions.	15

Recommended Books:

1. Inorganic Reaction Mechanism - F. Basolo & G. Pearson.
2. Inorganic Reaction Mechanism - J. O. Edwards.
3. Selected Topics in Inorganic Chemistry- Malik, Madan & Tuli.
4. Katakis, D. and Gordon, G. Mechanism of Inorganic Reactions John Wiley & Sons: N.Y. (1987).
5. Langford, H. and Gray, H.B. Ligand Substitution Processes W.A. Benjamin

B020904T	Paper-IV (Theory) BIOCHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Cell Structure and Functions-** Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP the biological energy currency.	10
II	**Carbohydrates-** Classification, Nomenclature and Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. Structural polysaccharides-cellulose and chitin. Storage polysaccharides-starch and glycogen.	10
III	**Lipids-** Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins composition and function.	10
IV	**Amino-acids, Peptides and Proteins-** Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structure α-helix, β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein. Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids.	12
V	**Nucleic Acids** Purine and pyrimidine bases of nucleic, base pairing via H-bonding structure of ribonucleic acid (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces responsible for holding it.	08

Recommended Books:

1. Principles of Biochemistry, A.L. Lehninger Worth Publishers.

2. Biochemistry, L. Strayer, W.H. Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry Voet and Voet, John Wiley.
5. Outlines of Biochemistry, E.E. Conn and P.K. Stumpt, John Wiley

B020905T	Paper-V(Theory) CHEMICAL DYNAMICS
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Chemical Dynamics I-** Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions. Steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions	10
II	**Chemical Dynamics II-** Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethene), general features of fast reactions, study of fast reactions by flow method, relaxation method. photochemical (hydrogen-bromine and hydrogen chlorine reactions and oscillatory, reactions (Belousov-Zhabolinsky reaction), dynamics of unimolecular reactions (Lindemann, Hinshelwood and Rice-Ramsperger- Kassel-Marcus (RRKM) theories of unimolecular reactions), Relaxation method.	10
III	**Molecular collisions-** Collision theory of reaction rates, Intermolecular potential and centrifugal barrier, impact parameter, collision cross section and rate, energy threshold, opacity function and reaction cross-section. Experimental probes of reactive collisions: IR chemiluminescence, laser-induced, fluorescence.	10
IV	**Kinetics of Complex reactions-** Opposing or reversible reactions, kinetics of consecutive reactions, Kinetics of Chain reactions, Kinetics of chain and branched chain reaction, Kinetics of fast reactions	10
V	**Kinetics of reaction in solution-** Diffusion-controlled reaction in solution, Debye-Smoluchowski equation, Influence of solvent on rates of reaction, Influence of ionic strength on rates of reaction. Molecular reaction dynamics	10

Recommended Books:

1. P.W. Atkins, Physical Chemistry, Oxford University Press, New York.
2. S. Glasston, Physical Chemistry, Nostrand.
3. Advance Physical Chemistry (Vol-1,2,3,4), K.L. Kapoor, MacMillan, India
4. Puri Sharma Pathania, Advance Physical Chemistry.
5. Chemical Kinetics, K J Ladler, Mc Graw Hill
6. Kinetics and Mechanism of Chemical Transformation, J Rajaraman & J Kuriacose, Mc Millan
7. Physical Chemistry, Ira N. Levine.

B020906T	Paper-VI(Theory) COORDINATION POLYMERS, CLUSTERS AND NANOSTRUCTURES
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Coordination Polymers-** Classification, types of metal-organic frameworks (MOFs), Synthetic strategies, characterization, properties and applications.	07
II	**Metal π-Complexes-**	14

	Metal carbonyl, structure and bonding vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls. Preparation, bonding, structure and important reactions of transition metal nitrosyls, dioxygen and dinitrogen complexes and tertiary phosphine as ligand.	
III	**Metal Clusters-** Higher boranes, carboranes, Metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.	12
IV	**Synthesis and applications of nanoparticles-** Introduction of Nano Particles; its different methods for preparation; its applications.	10
V	Isopoly and Heteropoly Acids and Salts	07

Recommended Books:

1. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, John Wiley
2. Inorganic Chemistry, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
3. Chemistry of the Elements, N. N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A. B. P. Lever, Elsevier
5. Magnetochemistry, R. L. Carlin, Springer Verlag
6. Modern Spectroscopy, J. M. Hollas, John Wiley.
7. Chemical Applications of Group Theory, F. A. Cotton.
8. K. Veera Reddy, Symmetry and Spectroscopy of Molecules, New Age
9. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C. H. L. Langford, Oxford

B020905T	Paper-VII(Theory) HETEROCYCLIC CHEMISTRY & VITAMINS	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=50		

UNIT	TOPICS	No of Lectures
I	**Introduction and nomenclature of heterocyclic compounds.** **Small ring Heterocycles-** Three membered and four membered heterocycles-synthesis and reaction of aziridines oxiranes, thiranes, azetidines, oxetanes and thietanes.	10
II	**Benzo-Fused Five-Membered Heterocycles-** Synthesis and reactions including medicinal application of benzo pyrroles, benzofurans and benzo-thiophenes.	10
III	**Six-membered Heterocycles with one Heteroatoms-** Synthesis and reaction of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones. Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones. **Six-membered Heterocycles with two or more heteroatoms-** Synthesis and reactions of diazines, triazines and thiazines.	10
IV	**Vitamins I** : Structure determination including synthesis of i.Thiamine (Vitamin B1) ii.Pyridoxine (Vitamin B6	10
V	**Vitamins II** : Structure determination including synthesis of i. Biotin (Vitamin H) ii. Vitamin E	10

Recommended Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
5. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, 2 nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.

7. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
8. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
9. Bariyar and Goyal , Organic Chemistry-II, Krishna Prakashan Media, Meerut , Third Edition, 2019
10. Mukherji, Singh, Kapoor, Organic Chemistry, volume 1,2 and 3, 2014, New Age International. 11. Geeta Rani, General Organic Chemistry , Manakin press
12. Arun Bahl & B S Bahl, Advanced Organic Chemistry, S. Chand Publishing Co.

B020908T	Paper-VII(Theory) SURFACE REACTIONS AND CATALYSIS
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Adsorption-** Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, Freundlich Adsorption isotherm, Langmuir Adsorption Isotherm. BET theory of multilayer adsorption and derivation of BET equation.	10
II	**Micelles-** Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), surface affecting the CMC of surfactants, reverse micelles.	10
III	**Chemistry of Macromolecules-** Introduction of type of polymers, Poly dispersion-average molecular weight concept, number, weight and viscosity average molecular weights, Method of determining the molecular weight by osmotic pressure, Light scattering, Sedimentation and Viscosity methods.	10
IV	**Homogeneous Catalysis-** Characteristics of catalytic reactions, Classification of catalysis, Activation of catalyzed reaction, homogeneous catalysis, Enzyme catalysis, Mechanism of enzyme catalysis reactions, kinetics of enzyme catalysis reactions Effect of temperature on enzyme catalysis	10
V	**Heterogeneous Catalysis –** Heterogeneous catalysis, Surface reactions, Unimolecular surface reactions, Biomolecular surface reactions, pH dependence of rate constant of catalysed reaction, Autocatalysis and oscillatory reactions	10

Recommended Books:

1. P.W. Atkins, Physical Chemistry, Oxford University Press, New York.
2. S. Glasston, Physical Chemistry, Nostrand.
3. Advance Physical Chemistry (Vol-1,2,3,4), K.L. Kapoor, MacMillan, India
4. Puri Sharma Pathania, Advance Physical Chemistry.
5. J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry, Vol.2, Plenum Press, New York.
6. Molecular quantum Mechanics By P.W. Atkins Oxford University Press, Oxford New York
7. Physical Chemistry, Ira N. Levine.

B020909P	Paper-IX(PRACTICAL) CHEMISTRY PRACTICAL
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES/LABS=90

A	**INORGANIC CHEMISTRY** 1. Preparation of selected inorganic compounds and structural elucidation on the basis of given spectra (IR, ESR and MS) Selection can be made from the following- a. Sodium amide b. Dichlorophenyl borane $PhBCl_2$	30

	c. Ammonium hexachorostannate $(NH_4)_2SnCl_6$ d. Trichlorodiphenyl antimony (V) hydrate e. Sodium Tetrathionate, $Na_2S_4O_6$ f. Metal acetylacetonate. g. Preparation of Fe (II) Chloride. h. Phosphine Ph_3P and its transition metal complexes. i. Ferrocene j. Copper Glycine Complex 2. Spectrophotometric Determinations a. Mn/Cr/V in steel sample b. Ni/Mo/W/V/U/ by extractive spectrophotometric method c. F^- /NO_2^- /PO_4^{3-} in water in colorimetric method d. Iron-phenanthroline complex: Jobs method of continuous variations. e. Zr-Alizarin Red-S complex: Mole ratio method. f. Cu-Ethylenediamine complex: Slope-Ratio Method.	
B	**ORGANIC CHEMISTRY** 1. Separation and identification of organic compounds using chemical methods fromorganic mixtures containing up to three components. 2. Preparation of organic compounds involving several stages. 3. Verification of Lambert Beer's Law using bromocresol green reagent. 4. Estimation of carbohydrates, protein, amino acids, ascorbic acid, blood cholesterol andaspirin in APC tablets by UV-visible Spectrophotometric method.	30
C	**PHYSICAL CHEMISTRY** 1. Determination of solubility and solubility product of sparingly soluble salts (e.g. $PbSO_4$, $BaSO_4$) conductometrically. 2. Determination of the strength of strong and weak acids in a given mixture conductometrically. 3. Determination of the strength of strong and weak acids in a given mixture using potentiometer. 4. Find the temperature coefficient for a given liquid by viscometry. 5. Test the validity of Beer's law for a solution of $CuSO_4$ and also determine λ max. 6. Scan a spectral absorption curve of a given substance using spectrophotometer and also determine the wavelength of maximum absorption.	30

MASTER of SCIENCE in CHEMISTRY	Year-FIFTH	Semester-TENTH(X)
B021001T	Paper-I(Theory) STRUCTURAL METHODS IN INORGANIC CHEMISTRY	
CREDITS=4	OPTIONAL/ELECTIVE	
MAX MARKS:100	MIN PASSING MARKS:33	
TOTAL NUMBER OF LECTURES=50		

UNIT	TOPICS	No of Lectures
I	**NMR Spectroscopy-** (i) Use of Chemical shifts and spin-spin couplings for structural determination, (ii) Double resonance, and Dynamic processes in NMR, (iii) Decoupling phenomenon, Nuclear Overhauser Effect, DEPT spectra and structural applications in ^{13}C NMR, (iv) Use of Chemicals as NMR auxiliary reagents (shift reagents and relaxation reagents) (v) ^1H NMR of paramagnetic substances. (vi) NMR of Metal nuclei.	12
II	**Vibrational Spectroscopy-** Applications of vibrational spectroscopy in investigating the stretching and bending modes of molecules (AB_3 and AB_4 types).	08
III	**Electron Spin Resonance Spectroscopy-**	15

	Basic principle, Hyperfine Splitting (isotropic systems); the g-value and the factors affecting thereof; interactions affecting electron energies in paramagnetic complexes (Zero-field splitting and Kramer's degeneracy); Electron-electron interactions, anisotropic effects (the g-value and the hyperfine couplings); Structural applications to transition metal complexes.	
IV	**Mossbauer Spectroscopy-** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin. (2) Sn^{+2} and Sn^{+4} compounds-nature of M-L bond, coordination number, structure and (3) detection of oxidation state and inequivalent MB atoms.	15

Books Recommended:

1. E. A. V. Ebsworth, D. W. H. Rankin and S. Cradock, Structural Methods in Inorganic Chemistry, 1st Edn.(1987), Blackwell Scientific Publications, Oxford, London.
2. R. S. Drago, Physical Methods in Chemistry, International Edition (1992), Affiliated EastWest Press,New Delhi.
3. K. Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, 4th Edn. (1986), John Wiley & Sons, New York.
4. W. Kemp, Organic Spectroscopy, 3rd Edn. (1991), Macmillan, London.
5. G. Aruldhas, Molecular Structure and spectroscopy, Prentice Hall of India Pvt. Ltd., New Delhi (2001)

B021002T	Paper-II(Theory) REAGENTS AND REACTIONS	
CREDITS=4	OPTIONAL/ELECTIVE	
MAX MARKS:100	MIN PASSING MARKS:33	
TOTAL NUMBER OF LECTURES=50		

UNIT	TOPICS	No of Lectures
I	**Regents in Organic Synthesis-** Use of following reagents in organic synthesis and functional group transformation (including stereochemistry where possible) Complex metal hydrides – $NaBH_4$, $LiAlH_4$, DIBAL, Lithium diisopropyl amide (LDA), Dicyclohexyl carb carbodiimide (DCC); Trimethylsilyl iodide; Tri n-butyltin hydride, Hydrazine and phenylhydrazine	10
II	**Preparation and uses of following reagents in organic synthesis-** Gilman's reagent, DEAD, DDQ, Nucleophilic heterocyclic carbenes (NHC), 1, 3- Dithiane (Reactivity Umpolung), Wilkinson Catalyst, Nitrogen, Sulphur and Phosphorus Ylides. Pd(0) complex in organic synthesis (Heck, Suzuki, Stille reactions)	10
III	**Oxidation-** Scopes of the following reagents with application and mechanism; SeO_2, Jones reagent, PCC, PDC, peracids, Swern, TEMPO, Des-Martin oxidation, Corey-Kim oxidation and iodobenzene diacetate	08
IV	**Reduction-** Scope, mechanism and stereochemistry of reduction with following reagents -Complex Metal hydrides, Diborane, diisoamylborane, 9-BBN, Birch reduction, Corey, Bakshi and Shibata (CBS) and Luche reduction.	10
V	**Name reactions with mechanism and application in organic synthesis-** **i. Based on miscellaneous strategies-** Acyloin Condensation, Bergmann cyclisation, Corey-Winter, Julia, Michael addition, Nazaro Peterson, Pauson-Khand reaction, Robinson annulations, Stetter, Reformatsky, Shapiro and Stork enamine, Woodword-Prevost hydroxylation, Wharton transportation and Wharton fragmentation reaction. **ii. Based on multicomponent strategies-** Biginelli, Passerini, Ugi and Mitsonubu reactions	12

Recommended Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.
3. Carey, F. A., Guiliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
4. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.

5. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.
6. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
7. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
8. March, J. Advanced Organic Chemistry, Fourth edition, Wiley.
9. Bariyar and Goyal, Organic Chemistry-II, Krishna Prakashan Media, Meerut, Third Edition, 2019
10. Mukherji, Singh, Kapoor, Organic Chemistry, volume 1,2 and 3, 2014, New Age International.
11. Geeta Rani, General Organic Chemistry, Manakin press
12. Arun Bahl & B S Bahl, Advanced Organic Chemistry, S. Chand Publishing Co.

B021003T	Paper-III(Theory) SOLID STATE CHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Solid State Reactions-** General Principles for reaction between two solids: Reactions conditions, structural considerations, surface area, reactivity, Kinetics of solids state reactions.	08
II	**Basic concept of Symmetry in crystal systems and crystal lattice-** Unit cell and Crystal lattices, brief concept of molecular symmetry, concept of Symmetry in crystal systems, Herman Mauguin notation for symmetry elements in crystal systems, representation of screw axis and glide planes, restriction of symmetry elements in crystals systems, representation of lattice planes and directions, Bravias lattices, concept of Miller indices and Weiss indices,	10
III	**Crystal Defects and Non-Stoichiometry-** Perfect and imperfect crystals, intrinsic and extrinsic defects points defects, vacancies-Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, non- stoichiometry and defects.	12
IV	**Electronic, optical properties and Band Theory-** Metals, insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, optical properties, Optical reflectance, Photoconduction, photoelectric effect.	10
V	**X-Ray diffractions-** Bragg condition, Miller indices, Laue method, Bragg method of X-ray structural analysis of crystals, index reflections. Structure of simple lattices and X-ray intensities.	10

Recommended Books:

1. Solid State Chemistry and its Applications, A.R. West, Plenum.
2. Principles of the Solid State H.V. Keer Wiley Easter.
3. Solid State Chemistry, N.B. Hannay.
4. Solid State Chemistry, D.K. Chakrabarty, New Age International.
5. Macromolecules: Structure and Functions, F. World, Prentice Hall.

B021004T	Paper-IV(Theory) INORGANIC RINGS, CHAINS AND CLUSTERS
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Clusters and element-element bonds-** Polyhedral boranes: Electron deficiency vs sufficiency. Types and IUPAC nomenclature. Wade's polyhedral skeleton electron pair theory (PSEPT). W. N. Lipscomb's styx rules and semi-topological structures of boranes. Equivalent and resonance structures. Wade's vs Lipscomb's methods of studying higher boranes.	15
II	**Heteroboranes-**	15

	Types of heteroboranes with special reference to carboranes, structure, bonding and IUPAC nomenclature. Metallaboranes, Metallacarboranes, metal σ and μ bonded borane/carborane clusters. Resemblance of Metallaboranes/ Metallacarboranes with ferrocene and related compounds.	
III	**Metal Clusters-** Metal-metal bonds. Concept of quadrupolar bond and its comparison with a C-C bond; Types of metal clusters and multiplicity of M-M bonds. Simple and condensed metal carbonyl clusters. Applications of PSEPT and Wade's-Mingo's and Lauhr's rule over metal carbonyl clusters.	10
IV	**Inorganic Polymers:-** Classification, Types of Inorganic Polymerization, Comparison with organic polymers, Boron-oxygen and boron-nitrogen polymers, silicones, coordination polymers, sulphur-nitrogen, sulphur-nitrogen-fluorine compounds, - binary and multicomponent systems, haemolytic inorganic systems.	10

Recommended Books:

1. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 6th Edn. (1999), John Wiley & Sons, New York.
2. James E. Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison Wesley Pub. Co., New York
3. N. N. Greenwood and A. Earnshaw, Chemistry of the Elements, 2nd Edn. (1997), Butterworth Heinemann, London
4. Inorganic Polymers, by James E. Mark, Harry R. Allcock, and Robert West
5. Inorganic Polymeric and Composite Materials; by George Wypych

B021005T	Paper-V(Theory) STRATEGIES IN ORGANIC SYNTHESIS
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Disconnection Approach-** General introduction to synthons and Synthetic equivalents, Disconnections, (C-C, C-S, C-O,bonds).	08
II	**Protection and Deprotection of Groups-** Principle of protection and deprotection of alcohols, 1,3-diols, amines, carbonyl and carboxyl groups in organic synthesis	08
III	**One Group C-C Disconnections-** Alcohols and carbonyl compounds, regioselectivity. Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.	08
IV	**Two Group C-C Disconnections-** Diels-Alder reaction 1,3-difunctionalized compounds, α,β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalized compounds. Micheal addition and Robinson annelation	08
V	**Ring synthesis** Saturated heterocycles, synthesis of 3-4, 5- and 6-membered rings, aromatic heterocycles in organic synthesis	08
VI	**Synthesis of Some complex Molecules-** Application of the above in the synthesis of following compounds; Camphor, Longifoline, Cortisone, Reserpine and Vitamin D.	10

Recommended Books:

1. Modern synthetic Reactions, H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers Cambridge Univ. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B, F.A. Carey and R.L. Sundherg, Plenum Press.
6. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey Elevier.

B021006T	Paper-VI(Theory) ELECTROCHEMISTRY

CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Electrochemistry I-** Basic concept of electrochemistry, Transport phenomenon determination of transport number, Kohlrausch's law and its application, Ostwald's dilution law.	10
II	**Electrochemistry II-** Arrhenius concept of electrolytes, Limitation of Arrhenius theory of electrolytic dissociation, Role of solvent and inter-ionic forces, Activities and activity coefficients, determination of activity coefficients, mean activity, mean molality and molality of electrolyte, mean molar activity coefficient, Debye-Huckel Theory of the structure of dilute ionic solution, charge density and electrical potential,	10
III	**Electrochemistry III-** Properties of ionic cloud, activity coefficients from Debye-Huckel theory of activity of strong electrolytes, Limiting law and its verification, Debye-Huckel Theory to more concentrated solutions, Partial molar quantities of electrolytic solutions, determination of partial molar volume	10
IV	**Corrosion-** Types of corrosion, electrochemical theories of corrosion, kinetics of corrosion (corrosion current and corrosion potential), corrosion measurements (weight loss, OCP measurement, and polarization methods), passivity and its breakdown, corrosion prevention techniques (electrochemical, inhibitor, and coating methods).	10
V	**Electrochemical techniques-** Impedance technique-its application for studying electrode kinetics and corrosion. Cyclic voltammetry: Instrumentation, current-potential relation applicable for Linear Sweep Voltammetry (LSV) and Cyclic Voltammetry (CV), interpretation of cyclic voltammograms and parameters obtainable from voltammograms.	10

Recommended Books:

1. Physical Chemistry P.W. Atkins, ELBS.
2. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
3. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
4. Introduction to Polymer Science V.R. Gowarikar, N. V. Vishwanathan and J. Sridhar, Wiley Eastern.
5. Physical Chemistry, Puri, Sharma & Pathania

B021007T	Paper-VII(Theory) BIO-INORGANIC CHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Metal Ions in Biological System-** Occurrence and availability of Inorganic elements in organisms, transport and storage of Inorganic elements, Dose response of an element, biological function of inorganic elements, beneficial and toxic elements, essential and trace metals.	10
II	**Complexes of Biological Significance-** Metal complexes of porphyrins and phthalocyanine, Vitamin B_{12} and B_6; chlorophylls.	08
III	**Metal Storage, Transport and Biomineralization-** Sidrophore, phytosidrophores, ferretin, transferrin, hemosiderine, biomineralization, assembly of advanced materials e.g. calcium phosphate, calcium carbonate, iron biominerals.	12
IV	**Metalloenzymes-** Mo-containing Enzymes- Nitrogenase; Xanthine Oxidase, sulphite,	10

	Oxidase and Nitrate reductase and Iron-containing enzymes, cytochrome C oxidase, catalases, Peroxidases, cytochrome-p-450	
V	**Transport and Function of Alkali and Alkaline Earth Metals-** Roll of Alkali and alkaline earth metals in neuro sensation. Ion Channels, ion pumps, magnesium catalysis of phosphate, ubiquitous regulatory role of calcium.	10

Recommended Books:

1. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, John Wiley
2. Inorganic Chemistry, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
3. Chemistry of the Elements, N. N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A. B. P. Lever, Elsevier
5. Magnetochemistry, R. L. Carlin, Springer Verlag
6. Modern Spectroscopy, J. M. Hollas, John Wiley.
7. Chemical Applications of Group Theory, F. A. Cotton.
8. Symmetry and Group theory: Some chemical applications, Ramashankar and Suresh Ameta, Himanshu Publications, Udaipur, Delhi.
9. K. Veera Reddy, Symmetry and Spectroscopy of Molecules, New Age
10. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C. H. L. Langford, Oxford

B021008T	Paper-VIII(Theory) MEDICINAL CHEMISTRY	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=50		

UNIT	TOPICS	No of Lectures
I	Introduction of drug absorption, disposition, elimination using pharmacokinetics, SAR, important pharmacokinetic parameters in defining drug disposition in therapeutics.	06
II	**Antineoplastic Agents-** Introduction, cancer chemotherapy, role of alkylating agents and anti-metabolites in treatment of cancer. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards and 6-mercaptopurine. Recent development in cancer chemotherapy, hormones and natural products.	08
III	**Cardiovascular Drug-** Introduction, cardiovascular diseases, classification of cardiovascular drugs and their uses. Synthesis of amyl nitrate, aspirin, diltiazem. quinidine, verapamil, methyldopa, atenolol, oxprenolol, minoxidil, tocanideHCl, dalvastatin, fenofibrate and amlodipine.	08
IV	**Local Anti-Infective Drugs-** Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutol, fluconazole, econazole, griseofulvin, chloroquine and primaquine.	08
V	**Psychoactive Drugs-The Chemotherapy of Mind-** Introduction, neurotransmitters, CNS depressant, general anaesthetics, mode of action of hypnotics, sedatives, antianxiety drugs, Antipsychotic drug-the neuroleptics, antidepressants, study of diazepam, oxazepam, clonazepam, alprazolam, phenytoin, ethosuximide, trimethadione barbiturates, thiopental sodium glutethimide, benzodiazepines and buspirone	12
VI	**Antibiotics** Cell wall biosynthesis, inhibitors, β-lactam rings, antibiotics inhibiting protein synthesis. Study of penicillin V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, chlotetracycline, methacycline, azithromycin and cefuroxime.	08

Recommended Books:

1. Introduction to Medical Chemistry, A. Gringuage, Wiley-VCH.
2. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry. Ed. Robert, F. Dorge.
3. An introduction of Drug Design, S.S. Pandeya and J.R. Dimmock, New Age International.

4. Burger's Medicinal chemistry and Drug Discovery, Vol. I, (Chapter 9 Ed. M.E. Wolff, John Wiley.
5. Goodman and Gilman's Pharmacological Basis of therapeutics, Mc Graw-Hill.
6. The Organic Chemistry of Drug Design and Drug Action. R.B. Silvermann, Academic Press.
7. Strategies for Organic Drug Synthesis and Design. D. Lednicer, John Wiley.

B021009T	Paper-IX(Theory) PHOTO PHYSICAL CHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Mechanism of Absorption and Emission of Radiation of Photochemical Interest-** Electronic energy states of atoms; The selection rule, spectroscopic terms for electronic states. Notation for excited state of organic molecules, Einstein's treatment of absorption & emission phenomena, Time dependent Schrodinger equation, Intensity of electronic transition, Rules governing the transition between two energy states, d-d transition, charge transfer transition.	10
II	**Photo physical Processes in Electronically Excited Molecules-** Types of photo-physical processes, Radiation-less transition, Fluorescence emission, Fluorescence & Structure, Triplet State & phosphorescence emission, Emission property and the electronic configuration. Photo physical kinetics of unimolecular processes.	10
III	**Photo-physical Kinetics of Bimolecular Processes-** Kinetic & optical collisions, Biomolecular collision in gases & mechanism of fluorescence quenching, collision in solution, Stern- Volmer equation. Concentration dependence of quenching, quenching by foreign substances.	10
IV	**Photochemical Primary Processes-** Classification of photochemical reaction, rate constants & lifetimes of reactive transition states, light intensity and rate of photochemical reactions, Types of photochemical reaction, Decomposition of Br_2, Cl_2 etc.	10

Recommended Books:

1. Principles of Physical Chemistry, P.W. Atkins, Oxford Press.
2. Physical Chemistry, Thomas Engel, Philip Reid, Pearson Education (2006)
3. Fundamental of photochemistry, K. K. Rohatgi –Mukherjee, New Age International, 2008.

B021010T	Paper-X(Theory) ENVIRONMENTAL CHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Introduction to Environmental Chemistry-** Concept and scope of environmental chemistry, Environmental terminology and nomenclatures, Environmental segments.	10
II	The natural cycles of environment (Hydrological, Oxygen, Nitrogen, Carbon, Sulphur).	08
III	**Chemical Toxicology-** Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur oxides.	12
IV	**Air Pollution-** Particulates, Aerosols, SO_x, NO_x, CO_x and hydrocarbon, Photochemical smog, Air Quality Standards.	10
V	**Water Pollution-** Water-quality parameters and standards: physical and chemical parameters, Dissolved oxygen, BOD, COD, Total organic carbon, Total nitrogen, Total sulphur, Total phosphorusand chlorine, chemical separation (Pb, As, Hg).	10

Recommended Books:

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

B021011T	Paper-XI(Theory) POLYMER CHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Basic concepts-** Monomers, repeat units, degree of polymerization. Linear, branched and network polymers, Classification of polymers, Polymerization; Step growth (Condensation) Polymerization, Chain growth (addition) polymerization, radical chain-ionic and co-ordination and copolymerization. Polymerization in homogeneous and heterogeneous systems.	10
II	**Polymer Characterization-** Molecular weight of polymers: Polydispersity and average molecular weight concept of polymers (Number, weight and viscosity average molecular weights). Different methods of measurement of molecular weight of polymers. Analysis and testing of polymers. Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis of polymers.	10
III	**Crystalline Polymers-** Crystalline polymers, configurations of crystalline polymer chains. Crystal structures and morphology of crystalline polymers, crystallization temperature (Tc) and melting temperature (Tm) of polymers and their relationship with glass transition temperature (Tg), factors effecting Tm and Tg.	10
IV	**Polymer Processing-** Plastics, elastomers and fibres compounding processing techniques calendaring die-casting, rotational casting film casting injection moulding. Blow moulding, extrusion moulding, foaming, reinforcing and fibre spinning.	10
V	**Properties of Commercial Polymers-** Polyethylene, polyvinyl chloride polyamides polyesters, phenolic resins. Epoxy resins and silicone polymers. Functional polymers, fire retarding polymers and electrically conducting polymers.	10

Recommended Books:

1. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
2. Physics and chemistry of Polymer, J.M.G. Cowie, Blackie Academic and Professional.
3. Polymer Science, V.R. Gowarker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.
4. Functional Monomers and Polymers. K. Takemoto, Y. Inaki and R.M. Rttanbrite.
5. Contemporary polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.

B021012T	Paper-XII(Theory) PHOTO INORGANIC CHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Basics of Photochemistry-** Absorption, excitation, Photochemical laws, quantum yield electronically excited states, life times-measurements of the times Flash photolysis, stopped flow techniques. Energy dissipation by radiative and non-radiative processes, absorption spectra, Franck-Condon principle, photochemical stages-primary and secondary processes.	10
II	**Properties of Excited States-** Structure, dipole moment, acid-base strengths, reactivity Photochemical kinetics calculation of rates of radiative processes. Bimolecular deactivation-quenching.	10
III	**Excited States of Metal Complexes-** Excited states of metal complexes: comparison with organic compounds, electronically excited states of metal complexes, charge-transfer spectra, charge transfer excitations methods for obtaining charge-transfer spectra	10
IV	**Ligand Field Photochemistry-** Photo substitution photooxidation and photoreduction, lability and selectivity, zero vibrational levels of ground state and excited state. Energy content of excited state, zero, zero spectroscopic energy, development of the equations for redox potentials of the excided states.	10
V	**Metal Complex Sensitizers-** Metal complex sensitizer, electron relay, metal colloid systems, semiconductor supported metal or oxide systems, water photolysis nitrogen fixation and carbon dioxide reduction.	10

Recommended Books:

1. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
2. Inorganic Photochemistry. J. Chem. Educ. Vol. 60, no, 10. 1983.
3. Progress in Inorganic Chemistry, vol, 30. ed. S.J. Lippard. Wiley.
4. Coordination chem. Revs,. 1981, vol. 39, 121, 131:1975, 15.321: 1990. 97313.
5. Photochemistry of Coordination compounds. V. Balzan and V. Carassiti, Academic Press.
6. Elements of Inorganic Photochemistry. G.J. Ferraudi, Wiley.

B021013T	Paper-XIII(Theory) CHEMISTRY OF NATURAL PRODUCTS
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=50

UNIT	TOPICS	No of Lectures
I	**Bio-synthesis of Natural Products-** a. The acetate hypothesis, poly β-Ketoacids, Biosynthesis, Biogenesis Primary andSecondary reactions involved in biosynthesis. Biosynthesis of poly-ß-ketoacid b. Isoprene rule, mevalonic acid from acetyl Co-enzyme Biosynthesis of mono,sesqui, di and triterpenes. c. Shikimic acid pathway for biosynthesis of aromatic ring. General biosynthesis of alkaloids	10
II	**Terpenoids and Carotenoids-** Classification, isoprene rule. Structure determination, stereochemistry, synthesis of the following representative molecules: citral, α- terpenol, farnesol, santonin, abietic acid and ß- carotene, menthol. For structure elucidation emphasis is to be placed on the use of spectral data wherever possible	10
III	**Alkaloids-** General methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, Structure, stereochemistry and synthesis of the following: Ephedrine, (+) nicotine, quinine and morphine. For structure elucidation emphasis is to be placed on the use of spectral data wherever possible.	10

IV	**Steroids -** Basic skeleton Diel's hydrocarbon and stereochemistry, structure determination and synthesis of cholesterol, testosterone, estrone and progesterone. For structure elucidationemphasis is to be placed on the use of spectral data wherever possible.	10
V	**Prostaglandins-** Occurrence, nomenclature, classification. Synthesis of PGE2 and PGF2a **Plant Pigments-** General methods of structure determination, synthesis of Apigenin, Quercetin Cyanidin Hirsutin. Quercetin-3 glucoside, Diazein and cyanidine-7 glucoside. For structure elucidation emphasis is to be placed on the use of spectral data wherever possible	10

Recommended Books:

1. Natural Products: Chemistry and Biological Significance, J. Mannm R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
2. Organic Chemistry, Vol-2, I.L. Finar, ELBS.
3. Stereoselective Synthesis: A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston, Harwood Academic Publishers.
6. Introduction of Flavonoids, B.A. Bohm, Harwood Academic Publishers.
7. New Trends in Natural Product Chemistry, A. Rahaman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.

B021016P	Paper-XVI (Practical) CHEMISTRY PRACTICAL	
CREDITS=4		COMPULSORY
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES/LABS=90		

UNIT	TOPICS	No of Lectures
A.	**INORGANIC CHEMISTRY** **1. Flame Photometric Determinations** i. Sodium and Potassium when present together. ii. Lithium/Calcium/Barium/Strontium iii. Cadmium and Magnesium in tap water **2. Chromatographic Separations** i. Nickel, Cobalt and Zinc. ii. Cadmium and Zinc iii. Zinc and Magnesium **3.Determination of copper in copper sulphate solution by spectrophotometer.**	30
B	**ORGANIC CHEMISTRY** 1. Separation and identification of organic compounds using chemical methods from organic mixtures containing up to three components namely three solids, two solid & one liquid and one solid & two liquids. 2. Preparation of organic compounds involving several stages. 3. Isolation of lactose from milk, piperine from black pepper and nicotine from tobacco. 4. Applications of NMR spectroscopy (^{1}H & ^{13}C), UV, IR and Mass Spectroscopy in structure determination of organic and biologically important compounds.	30
C	**PHYSICAL CHEMISTRY** 1. Synthesized polystyrene by bulk polymerization. 2. Synthesized polystyrene by solution/emulsion polymerization. 3. Calculate the molecular weight of a synthesized polystyrene in	30

	exercise (i and ii) by viscosity method. 4. Potentiometric titration of a solution of Fe^{2+} against $Cr_2O_7^{2-}$ and the determination of the redox potential of Fe^{2+}/Fe^{3+} system. 5. Determine the strength of NaOH and NH_4OH in a given solution by titrating it against strong acid (HCl) conductometrically.	

Recommended Books:

1. Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS
2. Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) 1999.
3. Inorganic Experiments, J. Derexwoolings VCH
4. Microscale Inorganic Chemistry, Z. Scafran, R.M. Pike and M.M. Singh Wiley.
5. Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand.
6. The systematic Indentification of Organic Compounds, R.L. Shringer and D.Y. Curlin.
7. Qualitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
8. Basic concept of Analysis chemistry, S.M. Chopkar, Wiley Bastern.
9. Synthesis and characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.
10. Systematic Qualitative Organic Analysis, H. Middeton, Adward Arnoid.
11. Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar.
12. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
13. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman.
14. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman.
15. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill.
16. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi)
17. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003.
18. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House.
19. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books.
20. General Chemistry Experiments, Anil J Elias, University Press (2002)
21. Experimental Physical Chemistry, V.D. Athawale, Parul Mathur, New Age International (P) Limited.
22. Systematic Experiment in chemistry, Arun Sethi, New Age International (P) Limited.