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 2022-23)

Approved by BOS on 06.06.2022

Board of Studies- Chemistry

Maharaja Suhel Dev State University,

Azamgarh-276128, Uttar Pradesh (INDIA)

MAHARAJA SUHEL DEV STATE UNIVERSITY, AZAMGARH

SYLLABUS OF M.Sc. CHEMISTRY

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

Year	Semester	Course Code	Paper Title	Theory/ Practical	Credits
I	I	B020701T	Inorganic Chemistry	Theory Compulsory	4
		B020702T	Organic Chemistry	Theory Compulsory	4
		B020703T	Physical Chemistry	Theory Compulsory	4
		B020704T	Principles of Spectroscopy	Theory Compulsory	4
		B020705P	Chemistry Practical	Practical Compulsory	4
		B020706R	Research Project	Compulsory	4
				Total Credit Load for Semester-I	24
I	II	B020801T	Organometallic Chemistry	Theory Compulsory	4
		B020802T	Application of Spectroscopy	Theory Compulsory	4
		*Any two papers from the following optional papers -			
		B020803T	Rearrangements and Photochemistry	Theory Optional/Elective	4
		B020804T	Heterocycles and Vitamins	Theory Optional/Elective	4
		B020805T	Quantum Mechanics and Surface Chemistry	Theory Optional/Elective	4
		B020806T	Biomolecules	Theory Optional/Elective	4
		B020807P	Chemistry Practical	Practical Compulsory	4
		B020808R	Research Project	Compulsory	4
				Total Credit Load for Semester-II	24
				Cumulative Credit Load Semester-I and Semester-II	48
II	III	B020901T	Stereochemistry and Pericyclic Reactions	Theory Compulsory	4
		B020902T	Non-Equilibrium Thermodynamics and Electrochemistry	Theory Compulsory	4
		*Any two papers from the following optional papers -			
		B020903T	Bio-inorganic Chemistry	Theory Optional/Elective	4
		B020904T	Coordination Polymers, Clusters and Nano Structures	Theory Optional/Elective	4

		B020905T	Environmental Chemistry	Theory Optional/Elective	4
		B020906T	Analytical Techniques	Theory Optional/Elective	4
		B020907P	Chemistry Practical	Practical Compulsory	4
		B020908R	Research Project	Compulsory	4
				Total Credit Load for Semester-III	24
II	IV	*Any four papers from the following optional papers-			
		B021001T	Structural Methods in Inorganic Chemistry	Theory Optional/Elective	4
		B021002T	Organic Synthesis	Theory Optional/Elective	4
		B021003T	Medicinal Chemistry	Theory Optional/Elective	4
		B021004T	Solid State Chemistry	Theory Optional/Elective	4
		B021005T	Reagents and Reactions	Theory Optional/Elective	4
		B021006T	Polymer Chemistry	Theory Optional/Elective	4
		B021007P	Chemistry Practical	Practical Compulsory	4
		B021008R	Research Project	Compulsory	4
				Total Credit Load for Semester-IV	24
				Cumulative Credit Load Semester-III and Semester-IV	48
				Cumulative Credit Load of All Semester(I-IV)	96

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

M.Sc.- CHEMISTRY	Year-FIRST	Semester-FIRST
B020701T	Paper-I (Theory) INORGANIC CHEMISTRY	
CREDITS=4	COMPULSORY	
MAX MARKS:100	MIN PASSING MARKS:33	
TOTAL NUMBER OF LECTURES=60		

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.	12
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	12

	thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	
III	**Metal-Ligand Bonding** Limitation of crystal field theory, John-Teller distortions, molecular orbital theory, octahedral, tetrahedral and square planar complexes.	12
IV	**Molecular Symmetry** Symmetry elements and symmetry operations, symmetry groups and subgroups, point symmetry group in inorganic and coordination compounds.	12
V	**Electronics Spectra and magnetic Properties of Transition Metal Complexes** Spectroscopic ground states, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq. B and β parameters, charge transfer spectra.	12

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
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=60

UNIT	TOPICS	No of Lectures
I	**Free Radical Reactions** Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation,coupling of alkynes, Free radical rearrangement, Hunsdiecker reaction. **Addition to carbon-carbon Multiple Bonds** Mechanistic and stereochemical aspect 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.	12
II	**Addition to Carbon-Hetero atom Multiple Bonds** Generation of enolate ions and their Synthetic applications. Stereochemistry of Witting reaction and Aldol condensation. Stobbe condensation reactions. Hydrolysis of esters. **Elimination Reactions** The E2, E1 and $E1_{cB}$ mechanisms and their stereochemistry and orientation. Reactivity- effects of substrates, attacking base, the leaving	12

	group and the medium. Mechanism and orientation in pyrolytic elimination and Paterson elimination.	
III	**Aliphatic Nucleophilic Substitution** The SN2, SNI, 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 effects of substrate structure, attacking nucleophile, leaving group and reaction medium.	12
IV	**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.	12
V	**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	
CREDITS=4		OPTIONAL
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**Classical Thermodynamics** Brief resume of concepts of laws of thermodynamics, free energy and chemical potential. Partial molar properties, partial molar free energy, partial molar volume and its determination, Gibbs-Duhem equation.	15
II	**Statistical thermodynamics** Concept of distribution, thermodynamic probability and most probable distribution, The Boltzman distribution law, Fermi-Dirac and Bose-Einstein statistics. Partition functions-transnational, rotational, vibrational and electronic partition functions. Calculation of thermodynamic properties and equilibrium constant in terms of partition functions.	15
III	**Chemical Dynamics I**	15

	Methods of determining rate laws, 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.	
IV	**Chemical Dynamics II** Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde) photochemical (hydrogen-bromine and hydrogen chlorine reactions and oscillatory, reactions (Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics and enzyme reactions, Kinetics of fast reactions, dynamics of unimolecular reactions (Lindemann, Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions).	15

Recommended Books:

1. Physical Chemistry P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Grew Hill.
3. Quantum Chemistry, Ira N. Levine. Prentice Hall.
4. Coulson's Valence, R.M. Weeny, ELBS.
5. Chemical Kinetics, K.J. Laidler, Mcgraw-Hill.
6. Kinetics and Mechanism of Chemical Transformations J. Rajaraman and J. Kuriacose Mc Millan.

B020704T	Paper-I (Theory) PRINCIPLES OF SPECTROSCOPY	
CREDITS=4	COMPULSORY	
MAX MARKS:100	MIN PASSING MARKS:33	
TOTAL NUMBER OF LECTURES=60		
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.	12
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.	12
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.	12
IV	**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	12

	studies of nuclei other than proton-^{13}C and ^{19}F	
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 Hamitonian, spin densities and Mc Connell relationship, measurement techniques and applications.	12

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, JohnWileyand 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. Wardsworth 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. RL Madan, CHEMISTRY FOR DEGREE STUDENTS ELECTIVE SEM V/VI AS PER CBS QUANTUM AND SPECTROSCOPY, S Chand Publishing Co.
15. Y.R.Sharma, ELEMENTARY ORGANIC SPECTROSCOPY VOL 4, S Chand
16. GURDEEP RAJ, ADVANCED PHYSICAL CHEMSITRY, KRISHNA PUBLISHING
17. K.L.Kapoor, A Textbook of Physical Chemistry - Quantum Chemistry and Molecular Spectroscopy| Volume 4, Macmillan

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

TOTAL NUMBER OF LECTURES/LABS=120

UNIT	TOPICS	No of Lectures
I	**INORGANIC CHEMISTRY-I** **Qualitative Analysis** Qualitative mixture analysis for seven radicals including two rare elements. (Mo, W, Ti, Zr,Th, Ce, V) in cationic and anionic forms. 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)	40
II	**ORGANIC CHEMISTRY-I** a. Separation and identification of organic compounds using chemical methods from binarymixtures. b. Estimation of glucose, aldehydes and ketones by chemical and spectroscopic methods. c. Synthesis of Dibenzalacetone from benzaldehyde.	40
III	**PHYSICAL CHEMISTRY**	40

	(i) Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media. (ii) Determination of the order of the saponification of ethyl acetate with NaOH. (iii) To determine the temperature coefficient and activation energy of Methyl acetate with NaOH. (iv) To find out the rate constant and order of the reaction between H_2O_2 and HCl (v) To find out the heat of solution of a substance (Oxalic acid) by solubility method. (vi) To determine the solubility of an organic acid at 40 °C and at a temperature lower than the room temperature.	

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)
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.

M.Sc.- CHEMISTRY	Year-FIRST	Semester-SECOND
B020801T	Paper-I (Theory) ORGANOMETALLIC CHEMISTRY	
CREDITS=4	COMPULSORY	
MAX MARKS:100	MIN PASSING MARKS:33	
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	Types, routes of synthesis, stability, decomposition pathways and polarity of M-C bond.	12

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	12
IV	**Homogeneous Catalysis** Homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins. Waker Process, hydrocarbanylation of olefins, oxopalladation reactions, activation of C-H bond.	12
V	**Fluxional Organometallic Compounds** Fluxionality and dynamic equilibria in compounds such as n^2–olefins and n^3–allyl anddienyl complexes.	12

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

B020802T	Paper-II (Theory) APPLICATION OF SPECTROSCOPY	
CREDITS=4		COMPULSORY
MAX MARKS:100		MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=60

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.	12
II	**IR Spectroscopy** IR-Spectroscopy: Basic Principles characteristic frequencies of common functional groups, application to organic and inorganic compounds.	12
III	**NMR spectroscopy** Basic principles, introduction to FT NMR techniques, Spectral parameters-Intensity, chemical shift, multiplicity, coupling constant, structure determination of organic compoundsby ^{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.	12
IV	**Mass spectrometry** Basic principles, techniques of ion production and ion and daughter ions, molecular ion andisotope abundance, nitrogen rule energetics of fragmentation. Metastable ions, common fragmentation pathways-fragmentation of common chemical classes. Mc Lafferty rearrangement. Structural elucidation.	12

	Applications of IR, NMR and Mass spectroscopy for structure elucidation of organiccompounds.	
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.	12

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, JohnWileyand 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. Wardsworth 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. RL Madan, CHEMISTRY FOR DEGREE STUDENTS ELECTIVE SEM V/VI AS PER CBS QUANTUM AND SPECTROSCOPY, S Chand Publishing Co.
15. Y.R.Sharma, ELEMENTARY ORGANIC SPECTROSCOPY VOL 4, S Chand
16. GURDEEP RAJ, ADVANCED PHYSICAL CHEMSITRY, KRISHNA PUBLISHING
17. K.L.Kapoor, A Textbook of Physical Chemistry - Quantum Chemistry and Molecular Spectroscopy| Volume 4, Macmillan

B020803T	Paper-III (Theory) REARRANGEMENTS AND PHOTOCHEMISTRY	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**Molecular Rearrangements Migration to electron deficient carbon atom** Pinacole-Pinacolone rearrangement, Wagner-Meerwein rearrangement, Benzil Benzilic acid rearrangement,Favorski rearrangement.	12
II	**Migration to electron deficient nitrogen atom** Wolf, Hofmann, Curtius, Losen, Schmidt, Beckmann rearrangement. Migration to electron deficient oxygen atom, Baeyer-Villiger rearrangement.	12
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.	12
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.	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 Co.

B020804T	Paper-IV (Theory) HETEROCYCLES AND VITAMINS	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=60

UNIT	TOPICS	No of Lectures
I	**Three membered rings**-Aziridines **Four membered rings** - Azetidines and their 2-oxo derivatives **Condensed** pyrroles-Indoles	12
II	**Five-membered rings containing two heteroatoms:** Oxazoles-Reaction as dienes, Cornforth rearrangement, Reaction with singlet oxygen. Isoxzoles- Boulton-Katritzky rearrangement, photoisomerizations. Pyrazoles-Rearrangement to imidazoles Imidazoles - Acidity of C-2 hydrogen, Catalyst for ester hydrolysis Thiazoles-Thiazolium ylide as catalyst	12
III	**Six-membered** – Pyrimidines – ANRORC mechanism in nucleophilic Substitution	12
IV	**Vitamins I** : Structure determination including synthesis of i.Thiamine (Vitamin B1) ii.Pyridoxine (Vitamin B6	12
V	**Vitamins II** : Structure determination including synthesis of i. Biotin (Vitamin H) ii. Vitamin E	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 Co.

B020805T	Paper-V (Theory) QUANTUM MECHANICS AND SURFACE CHEMISTRY	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**Introduction to Exact Quantum Mechanical Results** The Schrodinger equation, discussion of solutions of the Schrodinger equation to some model system viz. particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.	12
II	**Approximate Methods** The variation theorem, linear variation principle, Perturbation theory (First order and non-degenerate). Applications of variation method and perturbation theory to the Helium atom.	12
III	**Molecular Orbital Theory** Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene cyclobutadiene and Benzene molecules.	12
IV	**Surface Chemistry (a)** **Adsorption:** Gibbs adsorption isotherm, Freudlich Adsoption isotherm, Langmuir Adsorption Isotherm. BET theory of multilayer adsorption and derivation of BET equation.	12
V	**Surface Chemistry (b)** **Micells:** Surface active agents, classification of surface-active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), surface affecting the CMC of surfactants, reverse micelles.	12

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.

B020806T	Paper-VI (Theory) BIOMOLECULES	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**Enzymes** Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Fisher's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis. Enzyme kinetic, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition, regulatory enzymes, Enzyme immobilization.	12
II	**Nucleic Acids**	12

	Secondary and Tertiary structure of DNA/RNA and stabilizing forces, polymorphic nature of DNA, Sequencing, solid phase synthesis; trimester, phosphoramidite and phosphonate methods, Purification : HPLC and gel electrophoresis. Peptide nucleic acid (PNA).	
III	**Lipids** Chemistry and synthesis of phospholipids and glycolipids of lipid aggregates, micelles, bi- layers and biological membrane.	12
IV	**Antibiotics** Synthesis of penicillin G, chloramphenicol, cephalosporin, tetracycline and streptomycin.	12
V	**Pyrethroids and Rotenone's, Pheromones** Synthesis and reactions of Pyrethroids and Rotenones. (For structure elucidation, emphasis is to be placed on the use of parameters wherever possible)	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 Co.

B020807P	Paper-VII (Practical) CHEMISTRY PRACTICAL
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=120

UNIT	TOPICS	No of Lectures
I	**INORGANIC CHEMISTRY** 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. $[Ni(NH_3)_6]Cl_2$ Paper chromatographic separation of a mixture of the following and measurements of Rf values. (a) Pb^{+2}, Ag^{+}, Hg^{+2} (b) Co^{+2}, Ni^{+2}, Cu^{+2} (c) Ba^{+2}, Ca^{+2}, Sr^{+2}	40
II	**ORGANIC CHEMISTRY** (a) 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	40

	(b) Isolation of : i. Caffeine from tea leaves ii. Eugenol from cloves	
III	**PHYSICAL CHEMISTRY** 1. To find out the strength of the given ferrous ammonium sulphate (0.1N) by titrating it against potassium dichromate solution potentiometrically. 2. To find out the strength of the mixture of halides by titrating it against $AgNO_3$ solution potentiometrically. 3. To find out the composition of Ferric ion-Thiocyanate complex by Job's method using spectrophotometer. 4. To titrate a solution of 0.1 N NaOH against 0.1 N HCl spectrophotometrically.	**40**

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.

M.Sc.- CHEMISTRY	Year-SECOND	Semester-THIRD
B020901T	Paper-I (Theory) STEREOCHEMISTRY AND PERICYCLIC REACTIONS	
CREDITS=4	COMPULSORY	
MAX MARKS:100	MIN PASSING MARKS:33	
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**Aromaticity and π-Molecular Orbitals of Conjugated Systems** Aromaticity in benzenoid, non-benzenoid compounds and metallocenes, Huckel's rule, energy of pi-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. **Reaction Mechanism: Structure and Reactivity** Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects, kinetic and stereo chemical studies.	12
II	**Stereochemistry** Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, optical purity, enantiotopic and diasterotopic atoms, group and faces, stereospecific and stereoslective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape, R/S Nomenclature. Conformational analysis of cycloalkanes, disubstituted cyclohexanes, decalin.	12
III	**Pericyclic Reactions** Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1,3,5-hexatriene and allyl system, Classification of pericyclic reactions, Woodward-Hoffmann correlation diagrams, FMO and PMO approach, Electrocyclic reactions-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems.	12
IV	**Cycloadditions-**antrafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition ofketenes, 1,3-dipolor cycloadditions and cheleoptropic reactions.	12
V	**Sigmatropic rearrangement** Suprafacial and antarafacial shift of H, sigmatropic shifts involving carbon moieties, retention and inversion of configuration, (3,3) and (5,5) sigmatropic rearrangements, detailedtreatment of Claisen and Cope-rearrangements. Introduction to Ene 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, 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

B020902T	Paper-II (Theory) NON EQUILIBRIUM THERMODYNAMICS AND ELECTROCHEMISTRY	
CREDITS=4		COMPULSORY
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**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.	15
II	**Electrolytes I** Arrhenius theory and 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, charge density and electrical potential. Fugacity, concept of fugacity, determination of fugacity of gas (graphical method and generalised method), variation of fugacity with pressure and temperature. Duhem-Margules equation, Application of Duhem-Margules equation to total pressure (KONOVALOV'S First and second law).	15
III	**Electrolytes II** 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.	15
IV	**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.	15

BOOKS SUGGESTED

1. Foye, W.O., Lemke, T.L. & William, D.A.: Principles of Medicinal Chemistry, 4th ed., B..I. Waverly Pvt. Ltd. NewDelhi.
2. Peter Atkins & Julio De Paula, Physical Chemistry 9th Ed., Oxford University Press (2010).
3. Metz, C. R. Physical Chemistry 2nd Ed., Tata McGraw-Hill (2009).
4. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
5. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
6. Castellan, G. W. Physical Chemistry 4th Edn. Narosa (2004).
7. Allen Bard ,J Larry . Faulkner R ,Fundamentals of Electrochemical methods –fundamentals and applications ,New York, John Wiley & sons , 2001
8. H. J. Arnikar, Essentials of Nuclear Chemistry, 4th ed., New Age International, New Delhi, 1995.
9. Bariyar and Goyal, Physical Chemistry-II, Krishna Prakashan Media, Meerut , Third Edition, 2019
10. TN SRIVASTVA AND PC KAMPOJ, SYSTEMATIC NALYTICAL CHEMISTRY,

SHOBANLALNAGINCHAND
11. KL KAPOOR, THERMODYNAMICS AND CHEMICAL EQUILIBRIUM VOL-2, Macmillan
12.Bahl and Bahl, Essential of Physical Chemistry, S Chand & Company
13. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
14. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
15. Introduction to Polymer Science V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Easter.

B020903T	Paper-III (Theory) BIO-INORGANIC CHEMISTRY	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	Role of Metal Ions in Biological Systems Photosystems; nitrogen fixation, Na^+ / K^+ pump.	12
II	**Complexes of Biological Significance** Metal complexes of porphyrins and phthalocyanine, Vitamin B12 and B6; chlorophylls.	12
III	**Metallo Proteins** Function, Electronic structure, bonding and stereochemistry of the active site Natural oxygen carrying proteins – Haemoglobin, Myoglobin, Hemerythrins andHemocyanin Electron Transport Protein – (a) Iron – sulphur Proteins – Rubredoxin and Ferrodoxins (b)Cytochromes (types a, b and c)	12
IV	**Metallo enzymes** Mo-containing Enzymes – Nitrogenase; Xanthine Oxidase, sulphite, Oxidase and Nitrate reductase (b) Iron-containing enzymes, cytochrome - c- oxidase, catalases, Peroxidases, cytochrome-p-450	12
V	**Copper – containing Enzymes** – Superoxide dismutase (SOD), Bovine Superoxide dismutase (BOD), ascorbic acid oxidase and (b) Zinc – containing Enzymes carboxy – peptidase A and B; carbonic anhydrase and Urease.	12

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

B020904T	Paper-IV (Theory) COORDINATION POLYMERS, CLUSTERS AND NANOSTRUCTURES	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**Coordination Polymers** Classification, types of metal-organic frameworks (MOFs), Synthetic strategies,characterization, properties and applications.	12
II	**Metal π-Complexes** 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.	12
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.	12
V	Isopoly and Heteropoly Acids and Salts	12

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

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

TOTAL NUMBER OF LECTURES=60

UNIT	TOPICS	No of Lectures
I	**Introduction to Environmental Chemistry** Concept and scope of environmental chemistry, Environmental terminology and nomenclatures, Environmental segments.	12
II	The natural cycles of environment (Hydrological, Oxygen, Nitrogen, Carbon, Sulphur).	12
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, sulphuroxides.	12
IV	**Air Pollution** Particulates, Aerosols, SO_x, NO_x, CO_x and hydrocarbon, Photochemical smog, Air Quality Standards.	12
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	12

	separation (Pb, As, Hg).	

Recommended Books: 1. Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press.)
2. Advanced Organic Chemistry, A. F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
3. Advanced Organic Chemistry, J. March, 6th Ed.
4. Mechanism and structure in Organic Chemistry – E. S. Gould (Holt, Rinehart and Winston)
5. Textbook of Pericyclic Reaction, Concept and Application, K.C. Majumdar and P. Biswas, Scientific International Pvt. Ltd.
6. Photochemistry and Pericyclic Reactions, Jagdamba Singh and Jaya Singh, New Age International (P) Limited.
7. Guidebook to Mechanism in Organic Chemistry, Orient Longman, Sykes, P. A New Delhi.

B020906T	Paper-VI (Theory) ANALYTICAL TECHNIQUES
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=60

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.	12
II	**Analytical Spectroscopy** Principle, applications and limitations of spectrophotometry,Beer-Lambert law, analysis of mixtures, atomic absorption spectrometry (AAS).	12
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.	12
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).	12
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).	12

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

B020907P	Paper-VII (Practical) CHEMISTRY PRACTICAL
CREDITS=4	COMPULSORY
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES/LABS=120

UNIT	TOPICS	No of Lectures
A.	**INORGANIC CHEMISTRY**	
I	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 $PhBCl_2$ (c) Ammonium hexachorostannate $(NH_4)_2\ SnCl_6$ (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	20
II	**Spectrophotometric Determinations** (i) Manganese/chromium/vanadium in steel sample. (ii) Nickel/molybdenum/tungsten/vanadium/uranium by extractive spectrophotometric method. (iii) Fluoride/nitrate/phosphate (iv) Iron-phenanthrolin complex: Job Method.	20
B.	**ORGANIC CHEMISTRY**	
I	Separation and identification of organic compounds using chemical methods fromorganic mixtures containing up to three components.	10
II	Preparation of organic compounds involving several stages.	10
III	Separation and identification of the sugars in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of their Rf values.	10
IV	Estimation of carbohydrates, protein, amino acids, ascorbic acid, blood cholesterol andaspirin in APC tablets by UV-visible Spectrophotometric method.	10
C.	**PHYSICAL CHEMISTRY**	40
I	(i) Determination of solubility and solubility product of sparingly soluble salts (e.g. $PbSO_4$, $BaSO_4$) conductometrically. (ii) Determination of the strength of strong and weak acids in a given mixture conductometrically. (iii) Determination of the strength of strong and weak acids in a given mixture using potentiometer. (iv) To determine the strength of NaOH and NH_4OH in a given solution by titrating it against strong acid (HCl) conductometrically. (v) To calculate the molecular weight of a polymer by viscosity method. (vi) To find the temperature coefficient for a given liquid by viscometry.	

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.

M.Sc.- CHEMISTRY	Year-SECOND	Semester-FOURTH

B021001T	Paper-I (Theory) STRUCTURAL METHODS IN INORGANIC CHEMISTRY
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=60

UNIT	TOPICS	No of Lectures
I	**Symmetry and Group Theory in Chemistry** Character tables for C_2V and C_3V point groups. Representation reducible and irreducible, analysis of reducible representation. Simple Applications of the character table.	12
II	**Vibrational Spectroscopy** Symmetry and shapes of AB_2, AB_3 and AB_4, mode of bonding of ambidenate ligands such as thiocynanate, nitrate, sulphate and urea, application of Raman spectroscopy particularly for the study of ionic equilibrium in solution.	12
III	**Electron Spin Resonance Spectroscopy** Hyperline coupling spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes having one unpaired electron and inorganic free radicals such as PH_4, F_2^- and (BH_3)	12
IV	**Nuclear Quadrupole Resonance Spectroscopy** Quadrupole nuclei quadrupole moments, electric field gradient, coupling constant, splittings, applications.	12
V	**Mossbauer Spectroscopy**	12

	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.	

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

B021002T	Paper-II (Theory) ORGANIC SYNTHESIS
CREDITS=4	OPTIONAL/ELECTIVE
MAX MARKS:100	MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES=60

UNIT	TOPICS	No of Lectures
I	**Disconnection Approach** General introduction to synthons and Synthetic equivalents, Disconnections, (C-C, C-S, C-O,bonds).	12
II	Functional group interconversion, order of events in organic synthesis, chemo selectivity, cyclisation, amine synthesis.	12
III	**Protecting Groups** Principle of protection of alcoholic, amino, carbonyl and carboxylic groups.	12
IV	**One group C-C disconnections:** Alcohols and carbonyl compounds, regioselectivity. Alkene synthesis, use of acetylene and aliphatic nitro compounds in organic synthesis.	12
V	**Two group C-C disconnections:** Diels -Alder reaction, 1,3-difunctionalised compounds, α, β-unsaturated carbonyl compounds. Michael addition and Robinson annellation.	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 Co.

B021003T	Paper-III (Theory) MEDICINAL CHEMISTRY	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**Antineoplastic Agents** Introduction, cancer chemotherapy, special problems, role of alkylating agents and anti-metabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards and 6 mercaptopurine, Recent development in cancer chemotherapy, Hormone and natural products.	12
II	**Cardiovascular Drug** Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, subnitrate, diltiazem quinidine, veramil, methyldopa, atenolol oxprenolol.	12
III	**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.	12
IV	**Psychoactive Drugs-The Chemotherapy of Mind** Introduction, neurotransmitters, CNS depressant, general anaesthetics, mode of action of hypnotics, sedatives, antianxiety drugs, benzodiazepines, buspirone, neurochemistry of mental diseases. Antipsychotic drug-the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin ethosuximide, trimethadione barbiturates, thiopental sodium glutethimide.	12
V	**Antibiotics** Cell wall biosynthesis, inhibitors, β-lactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, penicillin, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracycline and streptomycin.	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

B021004T	Paper-IV (Theory) SOLID STATE CHEMISTRY	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

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.	15
II	**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.	15
III	**Electronic 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,	15
IV	**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.	15

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.

B021005T	Paper-V (Theory) REAGENTS AND REACTIONS	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		

UNIT	TOPICS	No of Lectures
I	**Regents in Organic Synthesis I** Use of following reagents in organic synthesis and functional group transformation (including stereochemistry where possible) Complex metal hydrides – NaBH4, LiAlH4, DIBAL, diborane, diisoamylborane, thexylborane, 9-BBN, isopinocamphenyl and di isopinocampheylborane, catecholborane; Gilman's reagent; Lithium di isopropyl amide (LDA).	12
II	**Regents in Organic Synthesis II** Use of following reagents in organic synthesis and functional group transformation (including stereochemistry where possible): Dicyclohexylcarbcarbodimide (DCC); 1, 3- Dithiane (Reactivity Umpolung); Trimethylsilyl iodide; Tri n-butyltin hydride; DEAD.	12
III	**Regents in Organic Synthesis III**	12

	Use of following regents in organic synthesis and function group transformation (including stereochemistry where possible) : DDQ; Hydrazine and phenyl hydrazine; Nucleophilic heterocyclic carbenes (NHC); Nitrogen, Sulphur and Phosphorus Ylide: Preparation and their synthetic applications.	
IV	**Name reactions** Selective Organic name reaction and their Synthetic Application Stork Enamine reaction; Ene Reaction; Barton Reaction; Hofmann-Loffler-Freytag Reaction;Shapiro Reaction.	12
V	**Green Chemistry** Introduction of green chemistry basic principles of green chemistry, organic synthesis using visible light, ionic liquid and PEGs. Selective Organic name reaction and their Synthetic Application Baylis-Hillman Reaction, Stetter Reaction.	12

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.

B021006T	Paper-VI (Theory) POLYMER CHEMISTRY	
CREDITS=4		OPTIONAL/ELECTIVE
MAX MARKS:100		MIN PASSING MARKS:33
TOTAL NUMBER OF LECTURES=60		
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	12

	(Condensation) Polymerization, Chain growth (addition) polymerization, radical chain-ionic and co-ordination and copolymerization. Polymerization in homogeneous and heterogeneous systems	
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.	12
III	**Crystalline Polymers** Crystalline polymers, configurations of crystalline polymer chains. Crystal structures and morphology of crystalline polymers, crystallization temperature (T_c) and melting temperature (T_m) of polymers and their relationship with glass transition temperature (T_g), factors effecting T_m and T_g.	12
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.	12
V	**Important Commercial Polymers** Polyethylene, polyvinyl chloride polyamides polyesters, phenolic resins. Epoxy resins and silicone polymers. Functional polymers, fire retarding polymers and electrically conducting polymers.	12

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 Chamistry, H.R. Alcock and F.W. Lambe, Prentice Hall.

B021007P	Paper-VII (Practical) CHEMISTRY PRACTICAL	
CREDITS=4		COMPULSORY
MAX MARKS:100		MIN PASSING MARKS:33

TOTAL NUMBER OF LECTURES/LABS=120

UNIT	TOPICS	No of Lectures
A.	**INORGANIC CHEMISTRY**	
I	**Flame Photometric Determinations** (i) Sodium and Potassium when present together. (ii) Lithium/calcium/Barium/Strontium (iii) Cadmium and Magnesium in tap water	20
II	**Chromatographic Separations** (i) Thin layer chromatographic separation of Nickel, Cobalt and Zinc. Determination of Rf values. (ii) Cadmium and Zinc (iii) Zinc and Magnesium	20
B.	**ORGANIC CHEMISTRY**	
I	Synthesis of organic compounds involving several steps.	15
II	Isolation of casein from milk, piperine from black pepper and nicotine from tobacco.	15
III	Applications of NMR spectroscopy (^1H & ^{13}C), UV, IR and Mass Spectroscopy in structure determination of organic and biologically important compounds	10

C.	PHYSICAL CHEMISTRY		
	(i)	To test the validity of Beer's law for a solution of $CuSO_4$ and also determine $\lambda_{max.}$	40
	(ii)	To scan a spectral absorption curve of a given substance using spectrophotometer and also determine the wavelength of maximum absorbtion.	
	(iii)	To synthesized polystyrene by bulk polymerization.	
	(iv)	To synthesized polystyrene by bulk polymerization.	
	(v)	To calculate the molecular weight of a synthesized polystyrene in exercise (i and ii) by viscosity method.	
	(vi)	Kinetics of Ir(III) catalysed oxidation of reducing sugars by sodium periodate in alkalinemedium.	

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.
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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)
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18. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House.
19. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books.
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24. Advanced Practical Physical Chemistry, JB Yadav.
25. Practical Organic Chemistry, Mann and Saunders.