VEER BAHADUR SINGH PURVANCHAL UNIVERSITY, JAUNPUR

Syllabus for

Master's Degree in Chemistry

Designed As Per Syllabus Development Guidelines

Under

National Educational Policy – 2020

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Consolidated Semester wise list of papers

Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credits
B.Sc. IV/ M.Sc. I	VII	**B020701T**	Inorganic Chemistry	Theory	04
		B020702T	Organic Chemistry	Theory	04
		B020703T	Physical Chemistry	Theory	04
		B020704T	Spectroscopy	Theory	04
		B020705P	Chemistry Practical	Practical	04
B.Sc. IV/ M.Sc. I	VIII	**B020806T**	Inorganic Chemistry	Theory	04
		B020807T	Organic Chemistry	Theory	04
		B020808T	Physical Chemistry	Theory	04
		B020809P	Chemistry Practical	Practical	04
		B020810R	Research Methodology	Theory	08
M.Sc. II	IX	**B020901T**	Inorganic Chemistry	Theory	04
		B020902T	Organic Chemistry	Theory	04
		B020903T	Physical Chemistry	Theory	04
		B020904T	Environmental Chemistry	Theory	04
		B020905P	Chemistry Practical	Practical	04
	X	**B021006P**	Chemistry Practical	Practical	04
		B021007R	Dissertation & Thesis Writing	Theory	08
		B021008T	8 (A) Analytical Chemistry OR 8 (B) Chemistry of Natural Product OR 8 (C) Chemistry of Materials	Theory	04
		B021009T			
		B021010T			
		B021011T	9 (A) Photo Inorganic Chemistry OR 9 (B) Organic Synthesis OR 9 (C) Electrochemistry	Theory	04
		B021012T			
		B021013T			
		B021014T	10 (A) Organo Transition Metal Chemistry OR 10 (B) Medicinal Chemistry OR	Theory	04
		B021015T			
		B021016T			

			10 (C) Polymer Chemistry		

Syllabus Developed by:

S.No.	Name	Designation	Department	College/University
1.	Prof. Dharmendra Kumar Singh	Professor	Chemistry	T.D. College, Jaunpur
2.	Prof. Bharat Singh	Ex- Professor & Head	Chemistry	Allahabad University, Prayagraj
3.	Prof. Bachcha Singh	Ex- Professor & Head	Chemistry	Banaras Hindu University, Varanasi
4.	Prof. Ajay Kumar Shukla	Professor	Chemistry	T.D. College, Jaunpur
5.	Dr. Santosh Kumar Singh	Associate Professor	Chemistry	T.D. College, Jaunpur
6.	Dr. Rajani Singh	Associate Professor	Chemistry	T.D. College, Jaunpur
7.	Dr. Chitrasen Gupta	Associate Professor	Chemistry	Kutir PG College Chakke, Jaunpur
8.	Dr. Arun Kumar	Associate Professor	Chemistry	Hindu P.G. College, Zamania, Ghazipur
9.	Dr.Ram Dulare	Associate Professor	Chemistry	P.G. College, Ghazipur

Note: This syllabus is based on the syllabus (with modifications to the extent of 30%) developed by the committee of experts.

Programme Outcomes (POs)

The programme aims to:

- Understanding of major concepts in all disciplines of Chemistry independently and in group as well as draw logical conclusions through Project and Seminar Presentation.
- Know about the critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Chemistry experiments
- Equip students to face the employment challenges and inculcate confidence to turn into entrepreneur and also step into research career.
- Generation of new scientific insights or to the innovation of new applications of chemical research.
- Know about scientific and technical information resulting from laboratory experimentation in both written and oral formats.
- Learn about modern methods of analysis to chemical systems in a laboratory setting.
- The students will able to know the mechanisms of all types of high level and complicated chemical reactions.
- The students will improve their efficiency on par with their counterparts in premier institutions across the nation.

Programme Specific Outcomes (PSOs):

The Students will able to:

- Know the importance of various elements present in the periodic table, coordination chemistry and structure of molecules, properties of compounds, structural determination of complexes using theories and instruments.
- Gathers attention about the physical aspects of atomic structure, dual behaviour, reaction pathways with respect to time, various energy transformations, significance of electrochemistry, molecular isolation using their symmetry.
- Learns about the potential uses of analytical, industrial chemistry and medicinal chemistry.
- Understand and apply principles of Organic Chemistry for understanding the scientific phenomenon in Reaction mechanisms, Stereochemistry, Organic Synthesis, complex chemical structures, instrumental method of chemical analysis, molecular rearrangements and separation techniques.
- Learn the classical status of thermodynamics.
- Carry out laboratory experiments and to understand good laboratory practices with safety.
- Increase students' ability to develop mathematical models for physical systems.
- Learn about Global level research opportunities to pursue Ph.D. programme targeted approach of CSIR/UGC – NET examination.

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Seventh**
Subject: **CHEMISTRY**		
Course Code: -B020701T	Course Title: **Paper 1: Inorganic Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Gain newer insight regarding the structure, bonding, electronic and magnetic properties of inorganic compounds and coordination complexes.
- Forms the basis of the development of newer molecule based materials which can offer attractive electronic properties at the molecular level.
- Learn also, the content dealing with the magnetic properties may create enthusiasm amongst the students to design and develop new single molecule magnets which now a day are getting attraction as the contrast agents in magnetic resonance imaging (MRI).

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Metal π- Complexes** Metal Carbonyls, Structure and Bonding, Vibrational Spectra of metal carbonyls for bonding and structure elucidation, important reactions of metal carbonyls, preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes: tertiary phosphine as ligand.	**12**
II	**Stereochemistry and Bonding:** VSEPR, Walsh diagrams (tri-and penta-atomic molecules), dπ- pπ bonds, Bent rule and energetics of Hybridization, some simple reaction of covalently bonded molecules	**12**
III	**Transition Metal complexes:** Limitation of crystal field theory, Molecular orbital theory, Octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.	**12**
IV	**Electronic Spectra of transition metal complexes:** Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d1 –d9), calculation of Dq, and β parameter, charge transfer spectra, spectroscopic method for assignment of absolute configuration in optically active metal chelates and their stereochemical information.	**12**
V	**Magnetic properties of transition metal complexes and Isopoly and Heteropoly acid**: Anomalous magnetic moments, magnetic exchange coupling and spin crossover.Isopoly and Heteropoly acid and salts of V, Mo, W.	**12**

Recommended Books:

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

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Seventh**
Subject: **CHEMISTRY**		
Course Code: -B020702T	Course Title: **Paper 2: Organic Chemistry**	

Course Outcomes:

After completing this course, the students will be able to know about:

- Aromaticity, nonaromaticity and antiaromaticity in carbocyclic and heterocyclic compounds.
- Mechanism and outcome of aliphatic electrophilic substitution reactions.
- Properties and reactivity of stereoisomers and stability of an organic molecule based on structure, including conformation and stereochemistry, Conformational analysis and its effect on organic reactivity, stereoselective and stereospecific synthesis.
- The various types of aliphatic nucleophilic substitution reactions and will give them a better understanding of the processes involved.
- Mechanisms for various organic reactions and how to use their understanding of organic mechanisms to predict the outcome of reactions.

Credits: **04**	Paper: **Core Compulsory**	
Max. Marks: **25+75**	Min. Pass Marks: **……**	
Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.		
Unit	**Topic**	**No. of Lectures**
I	**Nature of bonding in organic molecules** Aromaticity in benzenoid and non-benzenoid compound, alternant and nonalternant hydrocarbons, energy of π-molecular orbitals, annulenes, antiaromaticity, homoaromaticity. Hückel's rule **Aliphatic electrophilic substitution** Biomolecular mechanism – SE2 and SE1. The SE1 mechanism, electrophilic substitution accompanied by doubled bond shifts. Effect of substrates, leaving group and solvent polarity	**15**
II	**Stereochemistry** Conformational analysis of mono and di substituted cycloalkanes, decalines, effect of conformation on reactivity, steric strain due to unavoidable crowding. Enantiotopic and diastereotopic atoms, group of faces, stereospesific and stereoselective synthesis, asymmetric synthesis, optical activity in absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of compound containing nitrogen, sulphur and phosphorous.	**15**
III	**Aliphatic nucleophilic substitution** **The SN2, SN1and SET mechanism.** The neighboring group mechanism, neighbouring group participation by π and sigma bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system. **The SNi mechanism** Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon. Reactivity effect of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis, regioselectivity.	**15**
IV	**Reaction Mechanism: structure and reactivity** Transition state and intermediates, methods of determining mechanism, isotope effect. Generation, structure, stability and reactivity of benzynes, carbenes and nitrenes. Effect of structure on reactivity – resonance and field effect, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.	**15**

Recommended Books:

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

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class:	Year:	Semester:
Bachelor's Degree (with Research)/M.Sc. I	**Four**	**Seventh**

Subject: **CHEMISTRY**

Course Code: -B020703T	Course Title: **Paper 3: Physical Chemistry**

Course Outcomes:

After completing this course, the students will be able to learn:

- The application of classical thermodynamics and non equilibrium thermodynamics.
- The theories of statistical thermodynamics.
- The knowledge of basics of surface chemistry, electro chemistry giving firm foundation in the fundamentals and applications.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Thermodynamics:** **Classical Thermodynamics:** Partial molar quantities and their physical significance. Concepts of fugacity and determination of fugacity. Activity and activity coefficient. **Non Equilibrium Thermodynamics:** Thermodynamic criteria for non – equilibrium state, entropy production and entropy flow, entropy balance equation for different irreversible processes (e.g. heat flow, chemical reaction etc.) transformation of generalized fluxes and forces, non equilibrium stationary states, phenomenological equation, microscopic reversibility and Onsager's reciprocity relation, electrokinetic phenomena.	**15**
II	**Statistical Thermodynamics:** System, assembly, ensemble averaging. Canonical, grand canonical and microcanonical ensembles. Thermodynamic probability and most probable distribution (Boltzman distribution law) and its mathematical derivation. Partition functions- translational, rotational, vibrational and electronic partition function, calculation of thermodynamic properties in the term of partition function. Fermi-Dirac and Bose-Einstein Statistics.	**15**
III	**Surface chemistry** **A. Adsorption** Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapor pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation surface area (BET equation), and surface film of liquids (electro –kinetic phenomenon) catalytic activity at surface.	**10**
IV	**Electrochemistry** Electrolytic conductance of strong electrolytes, Activity, activity coefficient, Debye-Huckel theory for electrolytic solution, determination of activity and activity coefficient, ionic strength. Electrochemistry of solution, Debye-Huckel – Onsager treatment and its extension, ion solvent interaction, Debye Huckel, Bjerrum model. Mechanism of electrode reaction, overpotential current, current potential relation, Tafel equation, over-voltage and decomposition potential, Butler Volmer equation Introduction to corrosion, homogenous theory, form of corrosion, corrosion monitoring and prevention methodism.	**20**

Recommended Books:

- P.W. Atkins, Physical Chemistry, Oxford University Press, New York.

- S. Glasston, Physical Chemistry, Nostrand.
- K.L. Kapoor, Advance Physical Chemistry (Vol-1,2,3,4), MacMillan, India
- Puri Sharma Pathania, Advance Physical Chemistry.
- J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry, Vol.2, Plenum Press, New York.
- M.C. Gupta.Statistical Thermodynamics, Second Edition, New Age International Limited Publisher, India.
- Ira N. Levine. Physical Chemistry,

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Seventh**
Subject: **CHEMISTRY**		
Course Code: -B020704T	Course Title: **Paper 4: Spectroscopy**	

Course Outcomes:

After completing this course, the students will be able to:

- Learn the vibrational properties of inorganic coordination complexes have importance in homogeneous catalysis, Electron transfer agents and in sensors.
- Discuss the applications of IR spectroscopy and Raman Spectroscopy to know about the bonding properties of compounds.
- Know the interaction of electromagnetic radiation with matter.
- Supposed to have gain some knowledge about NMR & ESR.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	**Topic**	**No. of Lectures**

I	**Unifying Principal:** Electromagnetic radiation, interaction of electromagnetic radiation with matter-absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, results of the time dependent perturbation theory, transition moment, selection rules, intensity of spectral line, Born-Oppenheimer approximation, rotational, vibrational and electronic energy level.	**12**
II	**Infrared spectroscopy:** Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strength, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factor affecting the band position and intensities, Far IR region metal ligand vibrations, normal coordinate analysis.	**12**
III	**Raman spectroscopy:** Classical theories of Raman effect. Pure vibrational, vibrational-rotational Raman spectra, selection rule, mutual exclusion principle. Resonance Raman spectroscopy, Coherent Anti Stockes Raman spectroscopy (CARS). **Microwave spectroscopy:** Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequency, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field applications.	**12**
IV	**Nuclear Magnetic Resonance spectroscopy:** Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors affecting chemical shift deshielding, 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 – 13C, 19F and 31P FTNMR, advantages of FTNMR use of NMR in medical diagnostics.	**12**
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:

- Introduction to molecular spectroscopy G.M. Barrow, Mc Graw Hill.
- Modern spectroscopy, J.M. Hollas, John Wiley.
- Basic principles & spectroscopy, R. Chang, Mc Graw Hill.
- Physical methods in chemistry, R.S. Drago, Saunders College.
- Introduction to Magnetic Resource, A carrington and A.D. maclachalan, Harper & Row.

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:	
Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Seventh**
Subject: **CHEMISTRY**		
Course Code: -B020705T	Course Title: **Paper 5: Chemistry Practical**	

Course Outcomes:

After completing this course, the students will be able to:

- Understand the theories taught to them in M.Sc. Sem I in different branches of chemistry e.g. Inorganic, Organic and Physical Chemistry Practicals.
- Know about qualitative analysis of inorganic mixtures and insolubles.Separation techniques of cations and anions by chromatography.
- Learn about qualitative analysis of two component organic mixture.
- The basic knowledge of partial molar volume, phase equilibrium and electrochemistry.
- Focus their aim for future prospects of Ph.D programme and Pharmaceutical industry.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**INORGANIC CHEMISTRY** **Qualitative analysis** • Qualitative analysis of inorganic mixture of 7 radicals containing not more than two of the following less common metals: Tl, Mo, W, Zr, Th, V, U. • Insoluble – oxides, sulfates and halides. **Chromatography** Separation of cations and anions by • Paper chromatography • Column chromatography- Ion exchange.	**20**
II	**ORGANIC CHEMISTRY** **Qualitative analysis**	**20**

	Separation, purification, characterization and identification by making suitable derivatives of the two component Organic mixture (two solids or One solids and one liquid or two liquids and one solid) involving all the functional groups. Use TLC for checking the purity of the\separated compounds and their derivatives and report their Rf values.	
III	**PHYSICAL CHEMISTRY** **Thermodynamics:** • Determination of partial molar volume of solute (e.g. KCl, NaCl etc.) and solvent in a binary mixture. **Phase equilibria:** • Determination of congruent composition and temperature of a binary mixture e.g. diphenylamine-benzophenone system. • To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water). **Electrochemistry:** • Determination of the strength of strong and weak acids in a given mixture conductometrically. • Determination of activity coefficient of zinc ions in the solution of 0.002 M Zinc sulphate using Debye-Hückel's limiting law.	**20**

Recommended Books:

- Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS
- Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) .
- Synthesis and characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.
- Systematic Qualitative Organic Analysis, H. Middeton, AdwardArnoid.
- Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
- Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman.
- Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

1. A complete records of practical exercises in Inorganic, organic and physical chemistry done during the session must be produced by the candidates in three separate record books at the time of practical examination.

2. Total duration of practical examination will be 12 hours spread over two days.

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Eighth**
Subject: **CHEMISTRY**		
Course Code: -B020806T	Course Title: **Paper 6: Inorganic Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Learn the symmetry and reaction mechanism of transition metal complexes of inorganic coordination compounds which now-a-days are gaining importance.
- Know about electron diffraction is used to investigate the nature of solid surfaces and surface films to know about the electron distribution of given sample.
- Learn the bond formation is an important phenomenon in chemistry. In this semester students learn about the design of different highly reactive but potent organometallic compounds.
- Gain the information can be a stepping stone to such students who are willing to excel themselves in industries in particular dealing with pharma sector.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Metal ligand equilibria in solution:** Stepwise and overall formation constant, trends in stepwise constant, factors affecting the stability of metal complex with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin. **Metal Clusters:** Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyls and halide clusters. Compounds with metal-metal multiple bonds	**15**
II	**Reaction mechanism of transition metal complexes:** Energy profile of reaction, reactivity of metal complexes, inert and labile complexes, kinetics of octahedral substitution, substitution of square planar complexes, the trans effect, mechanism of the substitution reaction, redox reaction, electron transfer reaction, outer sphere type reactions, cross reaction and Marcus-Hush theory, inner sphere type reaction	**15**

III	**Symmetry and group Theory in chemistry:** Symmetry element and operation, definition of mathematical group, sub group, cyclic group, conjugacy relation and classes, point symmetry group (Schonflies symbols), use of point group symmetry: optical activity, dipole moment, representation of group by matrices, character of representation, the great orthogonality theorem (without proof) and its importance, irreducible representation, character table and their use.	**15**
IV	**X-ray and electron diffraction** Bragg condition, miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflection, identification of unit cell from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules, Ramachandran diagram. Scattering intensity vs. scattering angle, Wierl equation, measurement technique. Low energy electron diffraction.	**15**

Recommended Books:

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

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Eighth**
Subject: **CHEMISTRY**		
Course Code: -B020807T	Course Title: **Paper 7: Organic Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Learn about the free radical reaction and elimination reaction.
- Know about the mechanism and outcome of aromatic electrophilic substitution reactions.
- The various types of aromatic nucleophilic substitution reactions and will give them a better understanding of the processes involved.
- Know about the mechanisms for various organic reactions and how to use their understanding of organic mechanisms to predict the outcome of reactions.
- Know about molecular orbital symmetry and possibility of thermal and photochemical pericyclic reactions.
- Learn about UV-VIS and IR spectroscopy which will be helpfull in the structural elucidation of organic compounds.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Aromatic Electrophilic substitution** The arenium ion mechanism, Orientation and reactivity, energy profile diagram. The ortho / para ratio, ipso attack, orientation in other ring system. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction **Aromatic Nucleophilic substitution** The SNAr, SN1, benzyne and SRN1 mechanisms. Reactivity-effect of substrates structure, leaving group and attacking nucleophile. The Von Richter, Sommelet–Houser and Smiles rearrangements.	**12**
II	**Free Radical Reactions** Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead Alicyclic halogenation (NBS), oxidation of aldehyde to carboxylic acid, auto-oxidation, coupling of alkynes. Sandemeyer reaction. Hunsdiecker reaction. **Addition to Carbon – Carbon multiple bonds** Mechanistic and stereochemical aspects of addition reaction envolving electrophiles. Nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, Michaels reaction.	**12**

III	**Addition to Carbon – Hetero multiple bonds** Witting reaction. Mechanism of condensation reaction involving enolates-aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Sotobbe reaction. Hydrolysis of ester and amides, ammonolysis of esters. **Elimination Reactions** The E2, E1 and E1cB mechanism. Reactivity-effects of substrates structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.	**12**
IV	**Pericyclic Reactions** Molecular orbital Symmetry, Frontier orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward Halfmann correlation diagram, FMO and PMO approach, electrocyclic reaction – conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloaddition – antarafacial and suprafacial addition, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloaddition and chelotropic reactions. Sigmatropic rearrangement – Suprafacial and antarafacial shift of H, sigmatropic shift involving corban moieties, 3,3 and 5,5-sigmatropic rearrangement. Claisen, cope and azacope rearrangements. Fluxional tautomerism. Ene reaction	**12**
V	**Applications of Spectroscopy:** **Ultraviolet and Visible Spectroscopy** Various electronic transitions (185-800 nm), Beer-Lambert Law, effect of solvent on electronic transitions, ultraviolet bands for unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and unsaturated carbonyl compounds. Steric effect in biphenyls. **Infrared Spectroscopy** Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance.	**12**

Recommended Books:

- Spectrometric Identification of Organic Compounds, Silversteine and Basser, Willey.
- Organic Spectroscopy, P.S. Kalsi, New Age International (P) Limited.
- Spectroscopy of Organic Compounds, Pavia, Mery Finch Publication.
- Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press.)
- Organic Spectroscopy, I Fleming, McGraw-Hill Inc., US. 6. H.O. House, Synthetic Organic Chemistry.
- Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press.)
- Advanced Organic Chemistry, A. F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
- Advanced Organic Chemistry, J. March, 6th Ed.
- Mechanism and structure in Organic Chemistry – E. S. Gould (Holt, Rinehart and Winston)
- Textbook of Pericyclic Reaction, Concept and Application, K.C. Majumdar and P. Biswas, Scientific International Pvt. Ltd.
- Photochemistry and Pericyclic Reactions, Jagdamba Singh and Jaya Singh, New Age International (P) Limited.
- Guidebook to Mechanism in Organic Chemistry, Orient Longman, Sykes, P. A New Delhi.

This course can be opted as an elective by the students of following subjects: **Open to all**	
Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:	
Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Eighth**
Subject: **CHEMISTRY**		
Course Code: -B020808T	Course Title: **Paper 8: Physical Chemistry**	

Course Outcomes:

After completing this course, the students will be able to know:

- The limitation of classical thermodynamics, Statistical thermodynamics and Non equilibrium thermodynamics.
- The difference between the classical and quantum mechanics.
- The connections between common approximation methods and standard chemical frame works, e.g., Born-Oppenheimer approximation and molecular orbital theory.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Quantum Chemistry:** **Fundamental Background:** Normalised and orthogonal wave functions, operators, Algebra of operators, Eigen value and Eigen functions. Laplacian operator, Hermitian operator, Hamiltonian operator, postulate of quantum mechanics, Linear Momentum operator, Angular momentum. **Introduction to Quantum mechanical results:** The Schrödinger equation and the postulates of quantum mechanics. Discussion of solution of the Schrödinger equation to the 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 nondegenerate). Simple application of variation method in perturbation theory.	**08**
III	**Electronic structure of atom:** Electronic configuration, Russell-Saunders term and coupling schemes, Slater-Condon parameter, term separation energy of pn configuration, term separation energy for the dn configuration, magnetic effects: spin-orbit coupling and Zeeman splitting. **Molecular Orbital Theory:** Huckel theory of conjugated system, bond order and charge density calculation. Application to ethylene, butadiene cyclobutadiene and Benzene molecule.	**20**
IV	**Chemical Dynamics** **Theory of reaction rate:** Collision, activated complex and unimolecular reaction i.e. Lindeman and preliminary ideas (Hinshelwood, Rice Ramsperger and RKKM theories), thermodynamics of reaction rate. The ideas of reaction kinetics in solution with special reference to kinetic salt effects. The fast reaction kinetics, fundamental aspects of NMR, Relaxation methods and flash photolysis. Preliminary ideas of molecular reaction dynamics. Simple ideas of Oscillatory chemical reaction, Belousov- Zhabotinsky reaction. Photochemical reactions involving pyrolysis of molecules and kinetics of enzyme reaction.	**20**

Recommended Books:

- P.W. Atkins, Physical Chemistry, Oxford University Press, New York. 2. S. Glasston, Physical Chemistry, Nostrand
- S. Glasston, Physical Chemistry, Nostrand
- K.L. Kapoor, Advance Physical Chemistry (Vol-1,2,3,4), Mac Millan, India
- Puri Sharma Pathania, Advance Physical Chemistry.
- M.C. Gupta. Statistical Thermodynamics, Second Edition, New Age International Limited Publisher, India by
- A.K Chandra. Introductory Quantum chemistry Second Edition,Tata Mc Graw-Hill publishing company Limited, India
- R.K Prasad. Quantum chemistry Through problems and solution,New age International Pvt. Ltd, Publishers.
- Ira N. Levineance Physical Chemistry (Vol-1,2,3,4), K.L. Kapoor,Mac Millan, India
- Puri Sharma Pathania, Advance Physical Chemistry.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Eighth**
Subject: **CHEMISTRY**		
Course Code: -B020809T	Course Title: **Paper 9: Chemistry Practical**	

Course Outcomes:

After completing this course, the students will be able to learn:

- The understand of the theories taught to them in M.Sc. semester (II) in different branches of chemistry e.g. Inorganic, Organic and Physical Chemistry Practicals are able to gain them.
- The qualitative analysis and determination of two metal ions volumetrically and gravimetrically.
- The preparation of selected inorganic compounds and their characterization by spectroscopic method.
- About one steps synthesis involving different name reactions.
- The basic knowledge like preparation of solution, standardization of secondary solution, dilution, calibration, and handling of some sophisticated electronic related to the practical syllabus.
- The basic knowledge of chemical kinetics potentiometery, pH- metery, order of reaction, saponification of an ester.
- To focus their aim for future prospects of Ph.D. programme and Pharmaceutical industry.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**INORGANIC CHEMISTRY** **Quantitative analysis** Separation and determination of two metal ion Cu-Ni, Cu-Zn., Cu-Fe etc. involving volumetric and gravimetric methods. **Preparation and their characterisation** Preparation of selected inorganic compound and their studies by I.R., electronic	**20**

	spectra • $VO(acac)_2$ • cis-$K[Cr(C_2O_4)_2 (H_2 O)_2]$ • $Na[Cr(NH_3)_2 (SCN)_4]$ • $[Mn(acac)_3]$ • $K_3 [Fe(C_2O_4)_3]$ • Prussian Blue, • $Co[(NH_3)_6][Co(NO_2)_6]$ • $[Ni(NH_3)_6]Cl_2$ • $Ni(DMG)_2$ • $[Cu(NH_3)_4]SO_4.H_2O$	
II	**Organic Synthesis** One Step synthesis involving- • Adipic acid by chromic acid oxidation of cyclohexanol • Triphenylmethanol from Benzoic acid • Dibenzal acetone from Benzaldehyde • *p*-chlorotoluene from *p*-Toluidine • *p*-nitroaniline from *p*-bromoaniline **Quantitative Estimation** • Determination of iodine and saponification values of an oil. • Determination of DO, COD and BOD of water sample. • Estimation of amine/phenols using bromate/bromite solution or acetylation method. • Determination of the percentage of number of hydroxyl group in an organic compound	**20**
III	**PHYSICAL CHEMISTRY** **Chemical Kinetics:** • To find the velocity constant of the hydrolysis of an ester catalysed by an acid and also find the temperature coefficient and its energy of activation. • To determine the order of saponification of ethyl acetate with sodium hydroxide. • Determination of velocity constant of decomposition of Benzene diazonium chloride. • Determination of rate constant and order of reaction between H_2O_2 and HI. **Potentiometry/pH metry:** • Determine the strength of the given hydrochloric acid solution by titrating it against sodium hydroxide solution using pH meter. • To find out the strength of hydrochloric acid and acetic acid in a mixture of both by titrating it against sodium hydroxide solution by using pH meter. • To find out the strength of acetic acid by titrating it against sodium hydroxide using pH meter.	**20**
Recommended Books:		

- Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS.
- Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester).
- Inorganic Experiments, J. Derexwoolings VCH
- Basic concept of Analysis chemistry, S.M. Chopkar, Wiley Bastern.
- Synthesis and characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.
- Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar.
- Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
- Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman.
- Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill.
- Experiments in Physical chemistry, J.C. Ghosh, Bharati Bhavan.
- Advanced Practical Physical Chemistry, J.B. Yadav.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

1. A complete records of practical exercises in Inorganic, organic and physical chemistry done during the session must be produced by the candidates in three separate record books at the time of practical examination.

2. Total duration of practical examination will be 12 hours spread over two days.

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. I**	Year: **Four**	Semester: **Eighth**
Subject: **CHEMISTRY**		
Course Code: -B020810R	Course Title: **Paper 10: Research Methodology**	

Course Outcomes:

After completing this course, the students will be able to know about:

- The methods of separating a mixture or solution of chemical substances to obtain the pure constituents.
- The traditional methods of purification such as crystallization, extraction and distillation.
- The chromatographic techniques as they give accurate and complete separation and purification of the compounds.
- The techniques of chromatography such as HPLC.
- The Meaning objective & motivation of Research.
- How the Research problem will define and its design.

Credits: **08**	Paper: **Core Compulsory**
Max. Marks: **100**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Introduction** Meaning, Objective, Motivation and Types of research. Research Approaches its significance and methods vs methodology. Scientific methods of research and importance that how research is done.	**08**
II	**Research Problem:** Selection, Necessity and Technique involved in Research	**06**
III	Research Design Meaning and need of Research Design Features and important concept relating to Research Design . Basic Principal of Experimental and different research design	**06**
IV	• Distillation • Crystallization • Filtration • Evaporation • Extraction	**20**
V	• Adsorption • Centrifugation • TLC • HPLC • Paper Chromatography	**20**

Recommended Books:

- R. Lloyd and LC Snyder Resoures, Inc walnut Greek, California
- F. Colin Poole, Department of Chemistry, Wayne State University Detroit MI 48202, USA 2003 Elsevier.
- J. D. Seader, and J. Ernest Henley, Separation Process Principles, Wiley, 2nd edition (2013).
- C.R. Kothari, Research Methodology, methods and techniques, New Age International.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Ninth**
Subject: **CHEMISTRY**		
Course Code: -B020901T	Course Title: **Paper 1: Inorganic Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Learn with the some brief glimpses of bioinorganic and detailed investigation of Electron Spin Resonance (ESR) studies of paramagnetic compounds and about Mössbauer Spectroscopy.
- Gain additionally, the knowledge about the vibrational spectroscopy of inorganic compounds.
- Get know supposed to have some expertise in dealing with ESR and Mössbauer Spectroscopy.
- Get motivated to have inclination towards the bioinorganic chemistry.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Applications of Inorganic Spectroscopy** **Electron Spin Resonance Spectroscopy** Hyperfine 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) including biological systems and to inorganic free radicals such as PH_4^-, F_2^- and BH_3^-.	**13**
II	**Mössbauer Spectroscopy** Basic Principles, spectral parameters and spectrum display. Application of the technique to the studies of (a) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (b) Sn^{+2} and Sn^{+4} compounds – nature of M-L bond, coordination number, structure and (c) detection of oxidation state and in equivalent MB atoms.	**12**
III	**Vibrational Spectroscopy** Symmetry and shapes of AB_2, AB_3 and AB_4, mode of bonding of ambidentate ligands such as thiocyanate, nitrate, sulfate and urea	**08**
IV	**Bioinorganic Chemistry** **Metal Ions in Biological Systems** (a) Essential and trace metals. (b) Na+ /K+Pump. Hemeproteins and oxygen uptake, structure and function of haemoglobin, myoglobin, hemocyanins and hemerythrin model synthetic complexes of iron, cobalt and copper. **Electron Transfer in Biology** Structure and function of metalloproteins in electron transport processes-cytochromes and ion sulphur proteins. **Nitrogenase** Biological nitrogen fixation, molybdenum nitrogenase	**15**
V	**Bioenergetics and ATP cycle** DNA polymerisation, glucose storage, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem-II in cleavage of water.	**12**

Recommended Books:

- Physical Methods for Chemistry, R. S. Drago, Saunders Company.
- Structural Methods in Inorganic Chemistry, E. A. V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS
- NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Norwood.
- Practical NMR Spectroscopy, M.L. Martin, J. J. Delpeuch and G. J. Martin, Heyden.
- Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Berg, University Science Books
- Bioinorganic Chemistry, I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine, University Science Books.
- Inorganic Biochemistry volume I and II. ed. G. L. Eichhorn, Elsevier

This course can be opted as an elective by the students of following subjects: **Open to all**	
Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:	
Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Ninth**
Subject: **CHEMISTRY**		
Course Code: -B020902T	Course Title: **Paper 2: Organic Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Gain the knowledge about nuclear magnetic resonance spectroscopic and mass spectrometry techniques for organic structure elucidation of organic molecules.
- Know the basics of photochemical reactions and photochemical reaction of alkenes and carbonyl compounds.
- Learn the fundamental properties and reactivity of biologically important carbohydrates molecules.
- Know the mechanism of action of enzymes, enzyme catalysed reactions, enzyme models and applications of enzymes.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Applications of Organic spectroscopy** **Nuclear Magnetic Resonance Spectroscopy** General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides &mercapto), chemical exchange, effect of deuteration, factor influencing coupling constant 'J'. Spin decoupling, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra-nuclear magnetic double resonance, chemical shift reagents, solvent effects and use of NMR in medical diagnostics (MRI) application in structural determination.	**15**

II	**Two dimension NMR spectroscopy** Introduction to COSY and DEPT techniques. **Carbon-13 NMR Spectroscopy** General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants.	**07**
III	**Mass Spectrometry** Introduction, ion production – El, Cl, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometery. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.	**08**
IV	**Photochemistry** **Photochemical Reactions** Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy. **Photochemistry of Alkenes** Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1, 4 - and 1, 5 – dienes. **Photochemistry of Carbonyl Compounds** Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, α, β -unsaturated and β, γ unsaturated compounds. Cyclohexadienones. Intermolecular unsaturated and cyloaddition reactions – dimerisations and oxetane formation.	**15**
V	**Bioorganic Chemistry** **Enzymes** Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition. **Mechanism of Enzyme Action** Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A. **Biotechnological Applications of Enzymes** Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.	**15**

Recommended Books:

- Organic Photochemistry: A visual approach, Jan Kopecky, VCH publishers (1992).
- Oganic Photochemistry, O. Kan, McGraw-Hill Inc., US.
- Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press).
- Fundamentals of Photochemistry, KK Rohatagi, New Age International (P) Limited.
- Bioorganic, Bioinorganic and Supramolecular Chemistry, P.S. Kalsi, New Age International (P) Limited.
- Principles of Molecular Photochemistry, Nicholas J. Turro, V. Ramamurthy J. C., Viva Books.
- Spectrometric identification of organic compounds R.M. Silverstein, G.C. Bassler and T.C. morill, John, Wiley.
- Application of spectroscopy of organic compounds J.R. Dyer, Pentice Hall.
- Spectroscopic methods in organic chemistry D.H. williams. I. Fleming, Tata Mc Graw-Hill
- Spectroscopy of organic compounds P.S. Kalsi, New Age International

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Ninth**
Subject: **CHEMISTRY**		
Course Code: -B020903T	Course Title: **Paper 3: Physical Chemistry**	

Course Outcomes:

After completing this course, the students will be able to learn :

- The basic theories and kinetics of solid state reactions.
- Perfect and imperfect crystals and their defects. They will also gain the knowledge of electronic properties and band theory.
- The quantum theory of paramagnetism, hysteresis.
- The electrically conducting solids and new superconductors
- How to determine reaction mechanism and what is the gas phase photolysis.
- The experimental techniques and photo chemical processes.
- The biopolymers, their interactions, their thermodynamics and their molecular weight determination.
- The bioenergetics and statistical mechanics in biopolymers.
- The structure and function of cell membrane, transport of ions and applications of diffraction methods
- The Chemisorption, sorption, desorption and kinetics of gas-solid interface.
- About nuclear reaction, fission, fusion, radioactive technique and neutron-activation analysis.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Solid State Chemistry** A brief idea about solid state reactions and kinetics of solid state reactions. **Crystal Defects and Non-Stoichiometry** Perfect and imperfect crystals, intrinsic and extrinsic defects – point defects, line and plane defects, vacancies, Schottky and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centers, non-stoichiometry and defects. **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, super conductors. Optical Properties – Optical reflectance, photoconduction	**18**
II	**Energy States of Molecules** Franck – Condon Principle, Physical properties of excited molecules such as refractive index, pKa values and dipole moment. Light emission and chemical reaction from excited states, radiationless deactivation of excited states. **Determination of Reaction Mechanism** Classification, rate constants and life times of reactive energy states – determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions – photo-dissociation, gas-phase photolysis.	**12**
III	**Nuclear chemistry** Nuclear reactions, fission and fusion, mass defect, fission product and yields: Radioactive decay and equilibrium, radioactive techniques, tracer technique, neutron-activation analysis, counting technique such as G.M. ionisation and proportional counter.	**06**
IV	**Heterogeneous Reactions:** Adsorption, sorption, chemisorption and desorption, gas-solid adsorption, adsoption with dissociation, competition adsorption, non-ideal adsorption, rates of adsorption and desorption, kinetics of unimolecular and bimolecular reactions at gas-solid interfaces.	**06**

V	**Biopolymers** Evaluation of size, shape, molecular weight and extent of hydration of biopolymers by various experimental techniques electrophoresis **Biopolymer Interactions** Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. **Thermodynamics of Biopolymer Solutions** Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium muscular contraction and energy generation in mechanochemical system. **Cell Membrane and Transport of Ions** Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction.	**18**

Recommended Books:

- Solid Sate Chemistry and its Application, A. R. West, Plenum
- Principal Of The Solid state, H. V. Keer, Wiley Eastern.
- Solid Sate Chemistry, N.B. Hannay.
- Solid Sate Chemistry, D.K. Chakrabarty, New age Intenational.
- Fundamental of Photochemistry,K. K. Rohtagi-Mukherji, , Wiley Eastern.
- Molecular photochemistry, N. J. Turro, W. A. Benjamin.
- Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill
- Principles of Biochemistry, A. L. Lehninger, Worth publisher.
- Biochemistry, L. Stryer, W.H. Freeman.
- Biochemistry, J David Rawn, Neil Patterson.
- Biochemistry, Voet and Voet, John Wiley.
- Outlines of Biochemistry, E. E. Conn and P.K. Stumpf, John Wiley.
- Essentials of Nuclear Chemistry by H.J. Arnikar, New Age International
- Nuclear Chemistry by U.N. Dash S. Chand & Sons.

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Ninth**
Subject: **CHEMISTRY**		
Course Code: -B020904T	Course Title: **Paper 4: Environmental Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Know about environmental chemistry is an interdisciplinary science that includes atmospheric, aquatic and soil chemistry, as well as heavily relying on analytical chemistry and being related to environmental and other areas of science.
- Gain the knowledge of the fate of chemical species in the air, soil and water environments the effects of human activity and biological activity on these.
- Grasp the knowledge of industrial pollution and environmental toxicology.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Environment** Introduction, Composition of atmosphere, Vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere. Biogeochemical cycles of C,N,P,S and O. Bio distribution of elements	**12**
II	**Hydrosphere** Chemical Composition of Water bodies- lakes, streams river and wet lands etc, hydrological cycle Aquatic Pollution Inorganic, Organic, Pesticide, Agricultural, Industrial and Sewage, detergents, oil spills and oil pollutants, Water quality parameters-dissolved oxygen, biochemical oxygen demands, solids metals, content of chloride, Sulphate, phosphate, nitrate and micro-organisms water quality standards. Analytical methods for measuring BOD, DO, COD, F, Oil, Metals (As, Cd, Cr, Hg, Pb, Se etc) residual chloride and chlorine demand, Purification and treatment of water.	**18**
III	**Soil** Composition, micro and macro nutrients, Pollution- fertilizers, pesticides, plastics and metals, waste treatment.	**06**

IV	**Atmosphere** Chemical Composition of atmosphere, Particles, Ions and radicals and their formation chemical and photochemical reaction in atmosphere smog formation, oxides of N,C,S,O and their effect, pollution by chemicals, petroleum, minerals, ChloroFluoro hydrocarbons. Green house effect, acid rain, air pollution controls and their chemistry. Analytical methods for measuring air pollutants, continuous monitoring instruments,	**12**
V	**Industrial Pollution** Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy, polymers, drugs etc. Radionuclide analysis, Disposal of Wastes and their management. **Environmental Toxicology** Chemical solution to environmental problems, biodegradability, principles of decomposition, better industrial processes.	**12**

Recommended Books:

- Manahan, Stanley E. Fundamentals of Environmental Chemistry Boca Raton: CRC Press.
- Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L. Strong Chemistry of the Environment, Elsevier Science & Technology.
- A.K. De., Environmental Chemistry, Wiley Eastern.
- Clair, N. Sawyer, Perry L. Mc Carty, Gene F. Parking Chemistry for environmental engineering and Science (5thedition) McGraw Hill Professional.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Ninth**
Subject: **CHEMISTRY**		
Course Code: -B020905T	Course Title: **Paper 5: Chemistry Practical**	

Course Outcomes:

After completing this course, the students will be able to:

- Know about Preparation of inorganic complex and their structural determination by spectroscopic methods.
- Learn about separation and identification of three component organic mixture.
- Learn about structural elucidation of organic compounds by UV-VIS I.R. NMR & Mass spectroscopic method.
- Know about the isolation of caffeine from tea and casein from milk.
- Learn about the determination of Pka of an indicator and also test the validity of Beer's-Lambert's law.
- Learn about the determination of activity coefficient and ionic product of water by EMF method.
- Focus their aim for future prospects of Ph.D programme and pharmaceutical industry.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Inorganic Chemistry** Preparation of selected inorganic compounds and structural elucidation on the basis of given spectra (IR, ESR and MS) from the following • Copper glycine complex • Sodium amide • Sodium tetrathionate • Ferrocene **Chromatographic separation** • Thin layer chromatographic separation of Nickel, Magnesium, Cobalt and Zinc and determination of Rf values • Cadmium and zinc • zinc and magnesium	**20**
II	**Organic Chemistry** **Qualitative Analysis** • Separation and identification of compounds of a mixture of three organic compounds (three solid or two solid one liquid or one solid two liquid), prepare suitable derivative if possible. Purify the separated components check with TLC. **Isolation of the following**	**20**

	• Caffeine from tea leaves • Casein from milk • Lactose from milk • Lycopene from tomatoes	
III	**Physical Chemistry Practical:** **Spectrophotometer/colorimeter:** • Determination of PKa of an indicator (e.g. methyl red) in (a) aqueous (b) micellar media • To test the validity of Beer-Lambert's law using photo electric absorption meter/colorimeter and to determine the unknown concentration of the solution. **E.M.F. Measurements:** • Determination of activity coefficient of electrolytes. • Determination of ionic product of water (Kw). • To find out the strength of given F.A.S. solution by titrating it against potassium dichromate solution potentiometrically. Also find the redox potential of the ferrous –ferric $\left(Fe^{2+} \Leftrightarrow Fe^{3+}\right)$ system. **Polarimetry:** • Determination of rate constant for hydrolysis/inversion of cane sugar using polarimeter. • Determination of specific rotation and molecular rotation of cane sugar polarimetrically and also find the concentration of the unknown solution. Calculate the intrinsic rotation for cane sugar.	**20**

Recommended Books:

- Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J.Mendhan ELBS
- Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester).
- Microscale Inorganic Chemistry, Z. Scafran, R.M. Pike and M.M. Singh Wiley.
- Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand.
- The systematic Indentification of Organic Compounds, R.L. Shringer and D.Y. Curlin.
- Qualitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
- Synthesis and characterization of Inorganic compounds, W.L. Jolly, Prentice Hall.
- Systematic Qualitative Organic Analysis, H. Middeton, AdwardArnoid.
- Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar.
- Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
- Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman.
- Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman.
- Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill.
- Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi)
- Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition.

This course can be opted as an elective by the students of following subjects: **Open to all**	
Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:	
Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

1. A complete records of practical exercises in Inorganic, organic and physical chemistry done during the session must be produced by the candidates in three separate record books at the time of practical examination.

2. Total duration of practical examination will be 12 hours spread over two days.

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021006T	Course Title: **Paper 6: Chemistry Practical**	
Course Outcomes: After completing this course the students wile able to learn about: • Flame photometric analysis. • Colorimetric and spectrophotometric analysis. • Three steps synthesis and identification of organic compound by their spectral data • Separation and identification of glucose, fructose and sucrose by paper chromotography. • Kinetics of catalysed oxidation of Pd(II) and Ir (III)		
Credits: **04**	Paper: **Core Compulsory**	
Max. Marks: **25+75**	Min. Pass Marks: **……**	
Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.		

Unit	Topic	No. of Lectures
I	**Inorganic Chemistry** **Spectrophotometric determination** • Magnese/Chromium/Vanadium in stell sample • Nickel/molebdenum/tungsten/Vanadium/uranium by extractive spectro-photometric method • Iron-phenanthroline complex: Job method	**20**

	Flame Photometric Determinations • Sodium and Potassium when present together • Lithium/calcium/Barium/Strontium • Cadmium and Magnesium in tap water.	
II	**Organic Chemistry** • Multi step synthesis of organic compounds preparation of organic compounds involving not more than three steps. • Benzanilide from Benzene • Benzilic acid from Benzoic • Quinoline from Aniline • 2-phenylindole from phenyl hydrazine • Alkylation of diethylmalonate with an alkyl halide **Paper Chromatography** • Identification of organic compounds on the basis of given spectral data (UV, IR, PMR, CMR and MS) • Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.	**20**
III	**Physical Chemistry:** • Kinetics of Pd(II) catalysed oxidation of reducing sugars by N-bromoacetamide in acidic medium. • Kinetics of oxidation of ketones by Ce(IV) sulphate in acidic medium catalysed by Ir(III) chloride. • Study of cyclic alcohols by cerium (IV) sulphate in acidic medium in presence of iridium (III) chloride. • Ruthenium (III) chloride catalysed oxidation of aliphatic or cyclic alcohols or glycols by alkaline hexacyanoferrate (III). • Kinetics of iridium (III) chloride catalysed oxidation of aromatic aldehydes/alcohols/hydrocarbons by Ce(IV) sulphate in aqueous acidic medium.	**20**

Recommended Books:

- Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J.Mendhan ELBS
- Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) 1999.
- Inorganic Experiments, J. Derexwoolings VCH
- Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand.
- Qualitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
- Basic concept of Analysis chemistry, S.M. Chopkar, Wiley Bastern.
- Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar.
- Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
- Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman.
- Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman.

- Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill.
- Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House.
- Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books.
- General Chemistry Experiments, Anil J Elias, University Press (2002)
- Experiments in Physical chemistry, J.C. Ghosh, BharatiBhavan.
- Advanced Practical Physical Chemistry, JB Yadav.

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

1. A complete records of practical exercises in Inorganic, organic and physical chemistry done during the session must be produced by the candidates in three separate record books at the time of practical examination.

2. Total duration of practical examination will be 12 hours spread over two days.

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021007R	Course Title: **Paper 7: Dissertation & Thesis Writing**	

Course Outcomes:
After completing this course, the students will be able to:
- Plan and strategize a scientific problem, and implement it within a reasonable time frame.
- Learn to work independently and how to keep accurate/readable record of assigned project.
- Know the library search and handle the data in a meaningful way.
- Interpret the spectral data independently.
- Critically examine research articles, and improve their scientific writing/communication skills and power point presentation.

Credits: **08**	Paper: **Core Compulsory**
Max. Marks: **100**	Min. Pass Marks: **……**
Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.	

Unit	Topic	No. of Lectures
I	Research Methodology	**12**
II	Data Collection	**12**
III	Research Report	**12**
IV	Computer Application	**12**
V	Concept of paper/ Thesis Writing	**12**

For project work and dissertation, the area of the work would be to be decided by the advisor/mentor. On completion of the project work, students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty members.

Recommended Books:

- Research methodology, methods & Technique by C.R. Kothari, New Age International.
- Computational chemistry, A.C. Norris.
- An Introduction to Digital Computer Design V. Rajaraman and T. Radhakishna prentic hall.
- Dissertation & Project milan, Johathn weyers, pearson.

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021008T	Course Title: **Paper 08 (A): Analytical Chemistry**	

Course Outcomes:
After completing this course, the students will acquire the knowledge of:

- Importance of analytical chemistry, Gravimetric technique and handling of reagents.
- Errors, precision, accuracy and the uses of statistics
- Food analysis, food adulteration and pesticide in food.
- Measurement of BOD and COD and Contaminant of Pollutants present in water
- Soil, Fuel, Body Fluids and Drugs analysis.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Introduction** Role of analytical chemistry, Classification of analytical methods-classical and instrumental. Types of instrumental analysis Selecting an analytical method analytical balance. Techniques of weighing, errors. Volumetric glassware-cleaning and calibration of glassware. Sample preparations-dissolution and decompositions.	**12**
II	**Errors and Evaluation** Definition of terms in mean and median. Precision-standard deviation, relative standard deviation. Accuracy-absolute error, relative error. Types of error in experimental data-determinate (systematic), indeterminate (of random) and gross. Sources of errors and the effects upon the analytical results. Methods for reporting analytical data Statistical evolution of data-inderminate errors. The uses of statistics.	**12**
III	**Food Analysis** Carbohydrates, Calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food, contamination of food for adulterants. Pesticide analysis in food products.	**12**
IV	**Analysis of Water Pollution** Origin of waste water types water pollutants and effects. Sources of water pollution domestic, industrial, agricultural soil and radioactive wastes as sources of pollution objectives of analysis-parameter for analysis-colour turbidity total solids conductivity acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, conduction in superionic conductors examples and applications of ionic conductors, phosphates and different forms of nitrogen.	**12**
V	**Analysis of Soil, Fuel, Body Fluids and Drugs** • Analysis of soil: moisture, pH, total nitrogen. Phosphorus, silicon, lime, magnesia, manganese, sulphur and alkali salts. • Fuel analysis: solid, liquid and gas, Ultimate and proximate analysis-heating values grading of coal. Liquid fuels-flash point, aniline point, octane number and carbon residue. Gaseous fuels-producer gas and water gas-calorific value.	**12**

	• Clinical chemistry: Composition of blood-collection and preservation of samples. Clinical analysis. Serum electrolytes, blood glucose, blood urea nitrogcn. uric acid albumin, globulins, bardituratess acid and alkaline phosphatases. Immunoassay; principles of radio immunoassay (R1A) and applications.	

Recommended Books:

- Analytical Chemistry, G.D. Christian, J. Wiley.
- Fundamentals of Analytical Chemistry D.A. Skoog D,M. West and FJ. holler W.B. Saunders.
- Analytical Chemistry-Principles J,S. Kennedy, W.B. Saunders.
- Analytical Chemistry-Principles and Techniques. L.G Hargis Prentice Hall.
- Principles of Instrumental Analysis, D.A. Skoog. and J,L. Loaiy. W.B. Saunders.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021009T	Course Title: **Paper 08 (B): Chemistry of Natural Product**	

Course Outcomes:

After completing this course, the students will be able to learn the:

- Classification, stereochemistry and synthesis of some important terpenoids and carotenoids.
- Nomenclature, structure elucidation, physiological action and synthesis of Alkaloids.
- Occurence, basic structure, Isolation and synthesis of some prominent Steroids.
- Types of carbohydrates, structure elucidation, biological importance and Blood sugar.
- Types of plant pigments, their structure determination, isolation and synthesis of some significant plant pigments.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**
Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.	

Unit	Topic	No. of Lectures
I	**Terpenoids and Carotenoids** Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene.	**12**
II	**Alkaloids** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, roe of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following : Ephedrine, (+)- Coniine, Nicotine, Atropine, Quinine and Morphine.	**12**
III	**Steroids** Occurrence, Nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Biosynthesis of steroids.	**12**
IV	**Carboydrates** Structure, function, configuration & conformation of important derivatives of monosaccharides & glycosides; disaccharides (lactose, maltose and sucrose); Polysaccharides – structural polysaccharide (cellulose, chitin); storage polysaccharides (starch and glycogen). Role of sugars in biological recognition. Blood group determinants.	**12**
V	**Plant Pigments** Occurence, nomenclature and general methods of structure determination. Isolation and synthesis ofApigenin, Luteolin, Quercetin, Myrcetin, Quercetin 3-glucoside, Cyanidin, Hirsutidine.	**12**

Recommended Books:

- Natural Products: Chemistry and Biological, J. Mann. R.S. Davidson, J.B, Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
- Organic Chemistry, Vol 2, I.L. Finar, ELBS.
- Stereoselective Synthesis: A Practical Approach, M. Nogradi, VCH.
- Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
- Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston, Harwood Academic publishers.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021010T	Course Title: **Paper 08 (C): Chemistry of Materials**	

Course Outcomes:

After completion of the course the students will acquire the knowledge of:

- Properties of ferrous and non-ferrous alloys with their application, Nanocrystalline phase, preparation, procedures and their properties.
- Langmuir-Blodgett Films, photolithography, Liquid crystals.
- Molecular shape, structure and configuration, ionic conductors and supersonic conductors
- Anisotropy, superconducting state, high Tc materials with their application.
- Rectifiers, transistors, capacitors – IV, V compounds conducting organics, fullerenes and molecular devices.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Liquid Crystals** Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic-nematic transtion and clearing temperature-homeotropic, planar and schlieren textures, twisted nematics, chiral nemations, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptidility and dielectric comstants. Lyotropic phases and their description of ordering in liquid crystais.	**12**
II	**Polymeric Materials** Molecular shape, structure and configuration, crystallinity, and their applications. conducting and ferro-electric polymers. **Ionic Conductors** Types of ioninc conductors mechanism of ionia conduction, interstitial jumps (Frenkel). vacancy mechanism. diffusion superiohic conductors phase teransitions and mechanism of conduction in superionic conductors examples and applications of ionic conductors.	**12**
III	**High Tc Materials**	**16**

	Defect perovskites, high Tc superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; anisotropy; temperature dependence of electrical resistance; optical phonon modes, supenerconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high Tc materials applications of hich tc materials **Glasses, Ceramics, Composites and nonmaterial's** Glassy State, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and application. Microscopic composite. Nanocrystalling phase, preparation procedures, special properties aplications.	
IV	**Organic Solids, Fullerences. Molecular Devices:** Conducting organics, organic superconductors, magnetism in organic materials. Fullerences-doped, fullerences as superconductors. Molecular rectifiers and transistros, articicial photosynthetic devices. optical storage memory and switces-sensors. Nonlinear optical materials: nonlinear optical effects. second and third order-molecular hyperpolarisability and second order electric susceptibility- materials for second and third harmonic generation.	**10**
V	**Multiphase Materials** Ferrous alloys: Fe-C phase transformation in ferrous alloys: stainless steels, non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications. **Thin films and Langmuir-Blodgett Films** Preparation techniques; evaporation/sputtering. chemical processes, MOCVD, sol-get etc. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB lilms.	**10**

Recommended Books:

- Solid State Physics, N.W. Ashcroft and N.D. Mermin Saunders College.
- Material Science and Engineering. An Introduction. W.D. Callister. Wiley.
- Principles of the Solid State, H.V. Keer. Wiley Eastern.
- Materials Science, J.C. Anderson, K.D. Leaver, J.M. alexander and R.D. Rawlings, ELBS
- Thermotropic Liquid Crystalsm Ed. G.W. Gray. John Wiley.
- Handbook of Liquid Crystals. Kelker and Hafz. Chemie Verlag.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**

Subject: **CHEMISTRY**	
Course Code: - B021011T	Course Title: **Paper 09 (A): Photo Inorganic Chemistry**

Course Outcomes:

After completion of the course the students will get the knowledge of:

- Photochemical laws, flash photolysis, radiative and nonradiative processes and Frank-Condon principle.
- Photochemical kinetics, calculation of rates of radiatiove processes
- Excited states of metal complexes, charge transfer spectra
- Photosubstitution, photooxidation and phareduction reactions and development of the equations for redox potentials of the excited states.
- The application of redox process of electromically excited state for catalytic purpose and metal complex sensitizers.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	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.	**12**
II	**Properties of Excited States** Structure, dipole moment, acid-base strengths, reactivity Photochemical kinetics calcuation of rates of radiavite processes. Bimolecular deactivation-quenching.	**12**
III	**Excited States of Metal Complexes** Excited States of metal complexes: comparison with organic compound,s electronically excited states of metal complexes, charge-transfer spectra, charge transfer excitations methods for obtaining charge-transfer spectra.	**10**
IV	**Ligand Field Photochemistry** Photosubstitution 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	**Redox Reactions by Excited metal Complexes**	**16**

	Energy transfer under conditions of weak interaction and strong interaction-exciplex formation; conditions of the excited states to be useful as redox reactants, excided electron transfer, metal complexes as attractive candidates (2, 2-bipyridine and 1.10- phenontroline complexes), illustration of reducing and oxidising character of Ruthenium+2 (bipyridal complex, comparision with Fe $(bipy)_3$ role of spin-orbit coupling-life time of these complexes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants into high energy products, chemical energy into light. Radionuclide analysis. Disposal of wastes and their management.	

Recommended Books:

- Concept of Inorganic photochemistry, A.W., Adamson & P.D. Fleischauer, Wiley.
- Inorganic Photochemistry, J. Chem.. Edu. vol. 60 No. 10, 1983.
- Progress in Inorganic Chemistry vol. 30. ed. S.J. Lippard, Wiley.
- Photochemistry of Coordination compounds V-Balzan and V. Carassiti, Academic press.
- Elements of Inorganic photochemistry G.J. Ferraudi, Wiley.

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021012T	Course Title: **Paper 09 (B): Organic Synthesis**	

Course Outcomes:
After completing this course, the students will be able to:

- Describe methods for synthesis and transformation of the most common functional groups
- Describe and apply stereochemical concepts such as chirality, stereoisomerism, an stereoselectivity in relation to chemical transformations
- Identify, analyse and evaluate synthetic routes to target molecules using retrosynthesis
- Apply organometallic reagents and reactions in organic synthesis

Credits: **04**	Paper: **Core Compulsory**

Max. Marks: **25+75**	Min. Pass Marks: **……**
Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.	

Unit	Topic	No. of Lectures
I	**Oxidation** Introduction. Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) nitrate.	**12**
II	**Protecting Groups** Principle of protection of alcohol, amine, carbonyl and carboxyl group **Ring Synthesis** Saturated heterocycles, synthesis of aziridines, oxiranes, thiiranes, azitidine, oxetane, thietane, pyrones, pyrols, indole, coumarin.	**12**
III	**Reduction** Introduction. Different reductive processes. Hydrocarbon salkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. **Disconnection Approach** Introduction to synthons as synthetic equivalents, disconnection approach, functional group interconversions, the importance of the order of the events in organic synthesis. **Two Group C-C Disconnections** Diels-Alder reaction, 1,3-difunctionalized compounds, α/β-unsaturated carbonyl compounds, - difunctionlized compounds. Micheal addition and Robinson annelation.	**16**
IV	**Rearrangements** General mechanistic considerations – nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements-Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Schimdt, Baeyer-Villiger, Shapiro reaction.	**10**
V	**Synthesis of Some Complex molecules**	**10**

	Application of the above in the synthesis of following compounds: Camphor, Longifoline, Cortisone, Reserpine, Vitamin D.	

Recommended Books:

- Synthetic Organic Chemistry, Benjamin-Cummings Publishing Co.
- Organic Chemistry J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford Press.
- Organic Synthesis, Jagdamba Singh and L.D.S Yadav. Pragati Edition,
- Some modern methods of organic synthesis, W. Carruthers, Cambridge University Press.
- Organic Reactions and Their Mechanisms, P. S. Kalsi, New Age International.
- Workbook for Organic Synthesis, Stuart Warren,John Wiley & Sons.
- Organic Chemistry, Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. John Wiley & Sons.
- The Chemistry of Heterocycles (Nomenclature and Chemistry of three to five membered Heterocycles) Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), Elsevier publication.
- The Chemistry of Heterocycles (Chemistry of six to eight membered N, O, S, P and Se heterocycles), Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; Elsevier publication.

This course can be opted as an elective by the students of following subjects:
Open to all

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class:	Year:	Semester:
Bachelor's Degree (with Research)/M.Sc. II	**Fifth**	**Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021013T	Course Title: **Paper 09 (C): Electrochemistry**	

Course Outcomes:

After completing this course, the students will be able to gain the knowledge of:

- Electro kinetic phenomenon, electro- osmosis, streaming potential and sedimentation potential.
- The chemical basis of biological phenomenon, cellular structure and donnanmembrane equilibrium.
- The concept of physics and physical chemistry for the study of biological systems e.g. core conductor model, limiting current in semi conductors etc.

- Theories and importance of over voltage and different types of polarography e.g. pulse, Ac and square wave.
- General principles of semi conductivity, semiconductors, conducting polymers and fullerene – doped conductors.
- Brief ideas of electrochemistry of molten electrolytes and non aqueous solvents.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Electrokinetic Phenomenon** Electrokinetic Effects, Electrokinetic potential/Zeta potentials, Determination of zeta potential, influence of ions on electrokinetic phenomena, Electro-Osmosis, Streaming potential, Sedimentation potential. Theoretical and quantitative treatment of electrokinetic phenomena, Electrophonetic Mobility and Bound hydrogen ion.	**12**
II	**Bioelectrochemistry** Threshold phenomena, Donnan Membrane Equilibrium, Membrane Potential, Application of DonnanMembrance Equilibrium, Hodges-Huxely Equation, Core conductor model. Quantum Aspects of Charge transfer at electrode-solution interfaces, quantization of charge transfer tunneling. Semiconductor Interfaces: Theory of double layer semiconductor solution interfaces, Limiting current in semiconductor electrode.	**12**
III	**Polarography and Voltametry** Principle of polarography, variations of the conventional polarographic methods, Pulse Polarography, AC polarography, square wave polarography, Anodic stripping and Cyclic voltametry, Qualitative and quantitative application of polarography, Determination of stoichiometry and formation constants of complexes. Amperometric titrations and advantages.	**12**
IV	**Fuel Cells and Batteries** Fuel cell and its theory, different types of fuel cell, Solid oxide fuel cells(SOFC), Polymer electrolyte fuel cell(PEM), Direct Electrolyte Fuel Cell(DAFC), Super Capacitors. Theory Measurements and importance. Theories of Batteries : Solid state batteries.	**12**
V	**Conductors and Semiconductors** General principles of semiconductivity and semiconductors, Temperature dependence of electrical resistances, Coherent Length, Piezoelectric effect, Piezoelectric and pyroelectric materials. Fullerenes-Doped conductors. Brief idea of Electrochemistry of molten electrolytes and non-aqueous solvents.	**12**

Recommended Books:

- ModernElectrochemistry,Vol.1&2,J.M.Bockrisand A.K.N Reddy.Plenum
- Introduction to electrochemistry, S.Glasston,VanNostrand.
- Electro-Analytical Chemistry,J.J. Lingane,WilleyInterscience.
- Polarography, D.R.Crow.J.V. Westwood, Methuen and Co.
- Principle of Polarography, J. Heyrovsky, P>Zuman and L. Kuta
- Solid state Electrochemistry, Haldil, Academis Press.
- Ions, Electrodes and Membranes, J. Koryta, Willey and Sons.
- Electrochemistry, C. W Devis, George Newone, London.
- Polarography and voltammetry, H.H Bauer & J.E.O" Reily.
- Principal of physical chemistry, S.H.Maron and C..F. Prutton, Oxford.
- Electrochemical Methods: Fundamental &applications(2ndEd.), Bard & L. R. Faulkner, John Wiley & Sons, New York

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class:	Year:	Semester:
Bachelor's Degree (with Research)/M.Sc. II	**Fifth**	**Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021014T	Course Title: **Paper 10 (A): Organo Transition Metal Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Know and understand the different properties and structures for organometallic compounds from different parts of the periodic table and their trends.
- Know principal synthetic routes to various classes of organometallic compounds.
- Know and understand the reactivity of organometallic compounds including their application in synthesis.

- Know methods and examples for the study of organometallic compounds in the gas phase, solution phase and solid state.
- Know common ligand classes in organometallic chemistry, their effects on organometallic compounds, and influence on reactivity and catalysis.
- Know and understand key mechanistic steps in reactions involving organometallic compounds.
- Know about synthetically useful transformations including oxidations, reductions, enolate reactions, pericyclic reactions, organometallic reactions, and reactions of electron deficient species. The emphasis will be on developing a mechanistic understanding of selectivity and synthetic strategy.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Compounds of Transition Metal-Carbon Multiple bonds** Alkylidenes, alkylidynes, low valent carbenes and carbines – synthesis, nature of bonds, structural characteristics, nucleophilic and electrophilic reactions on the ligands. **Transition Metal Compounds with Bonds to Hydrogen** Covalent hydrides: synthesis and important reactions.	**12**
II	**Transition metal ð–Complexes with unsaturated organic molecules** Alkenes, alkynes, allyl, dienes, dienyl and arene complexes – preparations, properties, nature of bonding and structural features. Important reactions related to nucleophilic and electrophilic attack on ligands.	**12**
III	**Transition Metal Compounds with Bonds to Carbon in Catalysis** General idea of important catalytic steps: ligand coordination and dissociation, insertion and elimination, nucleophilic attack on coordinated ligands, oxidative addition and reductive elimination reactions.	**12**
IV	**Homogeneous Catalysis** Hydrogenation of alkenes using Wilkinson's catalyst, Hydroformylation of alkenes using Co and Rh catalysts, Carbonylation of methanol to acetic acid (Monsanto process), Oxidation of alkenes (Wacker process)	**12**
V	**Fluxional Organometallic Compounds** Fluxionality and dynamic equillibria in compounds such as h2-olefine, h3 allyl and dienyl complexes. **Organometallic Compounds of Lanthamides and Actinides** Methods of preparation, properties and structural features.	**12**

Recommended Books:

- Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, John Wiley
- Inorganic Chemistry, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
- Chemistry of the Elements, N. N. Greenwood and A. Earnshow, Pergamon.
- Organometallic Chemistry: A Unified Approach, R. C. Mehrotra and A. K. Singh, New Age International.
- Principles of Organometallic Chemistry, G. E. Coates, M. L. H. Green, P. Powell and K, Wade, Chapman and Hall, London.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021015T	Course Title: **Paper 10 (B): Medicinal Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Describe the drug design, action of drug
- Describe the concept of receptors, thermokinetics and thermodynamics
- Describe the antineoplastic agents, cardiovascular agents and psychoactive agents and antibiotics.
- Describe the various stages involved in the development of a drug,
- Describe the "interaction between ligand and receptor" concept
- Identify and describe the connection between chemical structure and physical-chemical properties,
- Describe the design of organic compounds, for example, statistical or structure-based design

- Plan and conduct a medicinal chemistry project,
- Do independently acquire and critically assess biological and medicinal information from databases
- Actively participate in discussions during seminars and group exercises,
- Present results verbally and in writing, and
- Communicate principles, problems and research results with specialists and non-specialists on issues within the scope of the content of the course.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Drug design**: Development of new drugs, procedures followed in drug design, concepts of lead modification, concepts of prodrugs and soft drugs, structure-activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism spatial considerations. Theories of drug activity: occupancy theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptor interactions. Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Shelton and surface activity parameters and redox potentials. Free-Wilson analysis, Hansch analysis, relationships between Free-Wilson and Hansch analysis LD-50, ED-50 (Mathematical derivations of equations excluded).	**12**
II	**Pharmacokinetics**: Elementary kinetics of ADME: concentration-time curve and its parameters, bioavailability, volume of distribution, clearance, Elementary One and two compartment models. **Pharmacodynamics**: Biochemistry of enzymes: Enzymes as biocatalysts, binding and catalytic sites, cofactor: Apoenzyme and Holoenzyme, enzyme-substrate complex, Michaelis-Constant and Michaelis Menten equation. Effect of inhibitors on enzyme activity: Reversible, competitive, noncompetitive and uncompetitive inhibitors. Elementary drug-receptor complex formation and dissociation, drug-receptor binding parameters, drug- affinity, -efficacy and -potency, agonists and antagonists. Pharmacodynamic drug-drug interaction	**12**
III	**Antineoplastic Agents** Introduction, cancer chemotheroy, special problemes, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6mercaptopurine. Recent development in cancer chemotherapy. Hormone and natural products.	**12**

IV	**Cardiovascular Drugs** Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol, oxyprenolol **Local Antiinfective Drugs** Introduction and general mode of action. Synthesis of sulphonamides, furrazolidone, nalidixin acid, ciproolloxacin, norfioxacin,dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, fluconazole, econozole, griseofulvin, chloroquin and primaquin.	**12**
V	**Psychoactive Drugs-The Chemotherapy of mind** Introduction, neurotransmitters, CNS depressants, general anaesthetics, mode of action hypnotics, sedatives, anti-anxiety drugs ,benzodiazepines, buspirone, neurochemistry of mental diseases. Antipsychotic drugs-the neuroleptics antidepressants, butyrophenones, serendipity and drugs development, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, oxazepam, chloroazepum, alprazolam phenytoin, ethosuximde, trimethadione, barbiturates, thiopental sodium, guletehimide. **Antibiotics** Cell wall biosynthesis, inhiitors, -lactonem rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, ampicillin, amoxicillin, chloramphenicol, cephalosporin, tetracycline and streptomycin.	**12**

Recommended Books:

- Medicinal Chemistry, D. Sriram, P. Yogeeswari, Pearson Education**.**
- An Introduction to Medicinal Chemistry, Graham L. Patrick, Oxford University Press.
- Textbook of Medicinal Chemistry, V. Alagarsamy, Elsevier Health Sciences.
- The Practice of Medicinal Chemistry, Camille G. Wermuth, Elsevier Health Sciences.
- Drug-like Properties: Concepts, Structure Design and Methods: From ADME to Toxicity Optimization, Edward H Kerns, Li Di, Elsevier Health Sciences.
- The Chemistry of Heterocycles (Nomenclature and Chemistry of three to five membered Heterocycles), Ram V. J.; Sethi, A.; Nath, M.; Pratap, R. Elsevier publication.
- The Chemistry of Heterocycles (Chemistry of six to eight membered N, O, S, P and Se heterocycles), Ram V. J.; Sethi, A.; Nath, M.; Pratap, R. Elsevier publication.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

Programme/Class: **Bachelor's Degree (with Research)/M.Sc. II**	Year: **Fifth**	Semester: **Tenth**
Subject: **CHEMISTRY**		
Course Code: - B021016T	Course Title: **Paper 10 (C): Polymer Chemistry**	

Course Outcomes:

After completing this course, the students will be able to:

- Define related concepts of polymers.
- Summarize historical evolution of the polymers.
- Recognize monomers and polymers.
- Evaluate the structure of polymers.
- Recognize bonds between polymer chains.
- Debate thermal character and affecting factors of thermal behaviours.
- Use determining method of molecular weights.
- Categorize polymers.
- Explain polymers production processes.

Credits: **04**	Paper: **Core Compulsory**
Max. Marks: **25+75**	Min. Pass Marks: **……**

Total No. of Lectures-Tutorials-Practical (in hours per week): **6-0-0**.

Unit	Topic	No. of Lectures
I	**Polymerisation reaction** Step growth Polymerization: Theory of reactivity of large monomeric molecules, ring formation vs. chain formation. Polymerization: Chain Reaction, Free radical, Cationic, Anionic and living polymers. Coordination and co-polymerization. Polymerization conditions and polymer reactions. Three dimensional network polymerisation.	**12**
II	**Polymer Charcterisation** Analysis and testing of polymers; chemical analysis, IR and NMR of polymers. X-ray diffraction study. Microscopy. Thermal analysis and physical testing hardness, tensile strength. Fatigue, impact, Tear resistance and abrasion resistance.	**12**
III	**Structure and Properties** Morphology and order in crystalline polymer-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and property relationship. Melting point (Tm), effect of chain flexibility and other steric factors. Entropy and heat of fusion. The glass transition temperature (Tg), Relationship between Tm and Tg.	**12**

IV	**Polymer processing** General ideas about elastomers, plastics and fibres. Compounding and valcanization of elastomers. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming	**12**
V	**Some Commercial and Speciality Polymers** Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins silicone and PTFE polymers. Speciality polymers: Fire retarding polymers Bio polymers, Bio degradable polymers, poly hydroxybutyrate (PHB), Application of Biopolymer	**12**

Recommended Books:

- Textbooks of Polymer science, F.W. Billmeyer, Jr. Wiley.
- Polymer Science,V.R.Gowariker, N.V.Vishwanathan and J. Sreedhar, Wiley-Estern.
- Functional Monomers and Polymers, K. Takemoto, Y.Inaki and R.M. Ottanbrite.
- Contemporary Polymer Chemistry, H. R. Alcock and F.W. Lambe, Prentice hall.
- Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie Academic and Professional.

This course can be opted as an elective by the students of following subjects:

Open to all

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on Project/ Assignment and Internal Class Test. The marks shall be as follows:

Project/Assignment	**10 Marks**
Internal Class test	**15 Marks**
Course prerequisites:	To study this course, a student must have passed/opted **Chemistry in B.Sc. III**

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