

Maa Vindhyavasini University, Mirzapur

SYLLABUS FOR

Subject :Chemistry (3+1FYUP)

**Four Year Under Graduate Program
With
One Year P.G. Program (IX & X Semester)
And
Minor Paper (II & IV Sem)**



Department of Chemistry

Faculty of Science & Technology


Dean
Faculty of Science And Technology
Maa Vindhyavasini University, Mirzapur

Syllabus Developed by :

S.No.	Name	Designation	Department	Post	College/ University
1	Prof. Devendra Pandey	Professor Dean Faculty of Science and Technology	Chemistry	Convener	K.B.P.G. COLLEGE MIRZAPUR
2	Prof. Subedar Yadav	Professor and Principal	Chemistry	Co- Convener	Govt. Degree College Majhanwa Mirzapur
3	Dr. Sabiha Naz	Associate Professor	Chemistry	Member	GOVT. P.G. COLLEGE MANGARHA MIRZAPUR
4	Dr.. Sankatha Prasad Sonkar	Assistant Professor	Chemistry	Member	GOVT. P.G. COLLEGE CHUNAR MIRZAPUR

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




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Maa Vindhyavasini University, Mirzapur

Semester wise Titles/ Papers in Four Year (FYUP) B Sc Chemistry

Year	Semester	Course Code	Paper Title	Theory/ Practical	Credit	Marks Distribution	Number of Lecture (In Hours)
1	I	B020101T	Fundamentals of Chemistry	Theory	4	75+25	60
		B020102P	Quantitative Analysis	Practical	2	75+25	60
	II	B020201T	Bioorganic and Medicinal Chemistry	Theory	4	75+25	60
		B020201P	Biochemical Analysis	Practical	2	75+25	60
2	III	B020301T	Chemical Dynamics and Coordination Chemistry	Theory	4	75+25	60
		B020302P	Physical Analysis	Practical	2	75+25	60
	IV	B020401T	Quantum Mechanics and analytical Techniques	Theory	4	75+25	60
		B020402P	Instrumental Analysis	Practical	2	75+25	60
		B020403RP	Research Project/Internship/Field or Survey Work	Project	3	100	
3	V	B020501T	Organic Synthesis-A	Theory	4	75+25	60
		B020502T	Rearrangements and Chemistry of Group Elements	Theory	4	75+25	60
		B020503P	Qualitative Analysis	Practical	2	75+25	60
	VI	B020601T	Organic Synthesis-B	Theory	4	75+25	60
		B020602T	Chemical Energetics and Radiochemistry	Theory	4	75+25	60
		B020603P	Analytical Methods	Practical	2	75+25	60
4		(B. Sc. Honours)					
	VII	B020701T	Inorganic Chemistry-I	Theory	4	75+25	60
		B020702T	Organic Chemistry-I	Theory	4	75+25	60
		B020703T	Physical Chemistry-I	Theory	4	75+25	60
		B020704T	Analytical Chemistry	Theory	4	75+25	60
		B020705P	Inorganic, Organic, Physical, Viva Voice and Records	Practical	4	75+25	120
4	VIII	B020801T	Inorganic Chemistry-II	Theory	4	75+25	60
		B020802T	Organic Chemistry-II	Theory	4	75+25	60
		B020803T	Physical Chemistry-II	Theory	4	75+25	60
		B020804T	Research Methodology and Analytical Techniques	Theory	4	75+25	60
		B020805P	Inorganic, Organic, Physical, Viva Voice and Records	Practical	4	75+25	120
			OR				


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			Voice and Records				
4	VIII	B020801T	Inorganic Chemistry-II	Theory	4	75+25	60
		B020802T	Organic Chemistry-II	Theory	4	75+25	60
		B020803T	Physical Chemistry-II	Theory	4	75+25	60
		B020804T	Research Methodology and Analytical Techniques	Theory	4	75+25	60
		B020805P	Inorganic, Organic, Physical, Viva Voice and Records	Practical	4	75+25	120
			OR				
(B.Sc. Honours with Research) (For the students who secured 75% marks Or More in First Six Semesters)							
4	VII	B020701T	Inorganic Chemistry-I	Theory	4	75+25	60
		B020702T	Organic Chemistry-I	Theory	4	75+25	60
		B020703T	Physical Chemistry-I	Theory	4	75+25	60
		B020704RP	Research Project/Dissertation	Project	4	100	60
		B020705P	Inorganic, Organic, Physical, Viva Voice and Records	Practical	4	75+25	120
	VIII	B020801T	Inorganic Chemistry-II	Theory	4	75+25	60
		B020802T	Organic Chemistry-II	Theory	4	75+25	60
		B020803T	Physical Chemistry-II	Theory	4	75+25	60
		B020804RP	Research Project/Dissertation	Research Project/Dissertation	4	100	60
		B020805P	Inorganic, Organic, Physical, Viva Voice and Records	Practical	4	75+25	120

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One Year P.G

(IX & X Semester)

Distribution of Course or Marks

IX Semester

Course Code	Paper No	Course Title	Credit	Marks	No. of Lectures (in Hors)
B020901T	I	Application of Spectroscopy	4	100 (75+25)	60
B020902T	II	Bio Inorganic & Bioorganic Chemistry	4	100 (75+25)	60
B020903T	III	BioPhysical Chemistry and Solid -State Chemistry	4	100 (75+25)	60
B020904P	Practical	Inorganic, Organic, Physical , Viva –Voce & Records	4	100 (75+25)	120
B020905RP		Research Project/ Dissertation/ Field Survey	4	100	

X Semester

Course Code	Paper No	Course Title	Credit	Marks	No. of Lectures (in Hors)
B0201001T	I	Elective Paper-I	4	100 (75+25)	60
B0201002T	II	Elective Paper-II	4	100 (75+25)	60
B0201003T	III	Elective Paper-III	4	100 (75+25)	60
B0201004P	Practical	Inorganic, Organic, Physical , Viva –Voce & Records	4	100 (75+25)	120
B0201005RP		Research Project/ Dissertation/ Field Survey	4	100	



PROGRAM SPECIFIC OUTCOMES (PSOS)

First Year	Bioorganic and Medicinal Chemistry will give the student a basic knowledge of all the fundamental principles of chemistry like molecular polarity, bonding theories of molecules, Periodic properties of more than 111 elements, mechanism of organic Reactions, Stereochemistry, basic mathematical concepts and computer knowledge, chemistry of carbohydrates, proteins and nucleic acids: medicinal chemistry, synthetic polymers, synthetic dyes, Student will be able to do qualitative quantitative and bio chemical analysis of the compounds in the laboratory. This certificate course is definitely going to prepare the students for various fields of chemistry and will give an insight into all the branches of chemistry and enable our students to join the knowledge and available opportunities related to chemistry in the government and private sector services particularly in the field of food safety, health inspector, pharmacist etc. Have a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.
Second Year	Chemical Dynamics and Analytical Techniques will provide the theoretical as well as practical knowledge of handling chemicals, apparatus, equipment and instruments. The knowledge about feasibility and velocity of chemical reactions through chemical kinetics, chemical equilibrium, phase equilibrium, kinetic theories of Gases, solid and liquid states, coordination chemistry, metal carbonyls and bioinorganic will enable the students to work as chemists in pharmaceutical industries. The knowledge about atomic structure, quantum mechanics, various spectroscopic tools and separation technique will make the students skilled to work in industries: Achieved the skills required to succeed in the chemical industry like cement industries, agro product, paint industries, rubber industries, petrochemical industries, food processing industries, Fertilizer industries, pollution monitoring and control agencies etc. Got exposures of a breadth of experimental techniques using modern instrumentation Learn the laboratory skills and safely measurements to transfer and interpret knowledge entirely in the working environment. monitoring of environment issues: monitoring of environmental pollution problems of atmospheric sciences, water chemistry and soil chemistry and design processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
Third Year	Programme aims to introduce very important aspects of modern day course curriculum, namely, chemistry of hydrocarbons, alcohols, carbonyl compounds, carboxylic acids, phenols, amines, heterocyclic compounds, natural products main group elements, qualitative analysis, separation techniques and analytical techniques. It will enable the students to understand the importance of the elements in the periodic table including their physical and chemical nature and role in the daily life and also to understand the concept of chemistry to inter relate and interact to the other subject like mathematics, physics, biological science etc. • Upon completion of a degree, chemistry students are able to employ critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed at an entry-level position in chemical industry or a chemistry graduate program • Various research institutions and industry people in the pharmaceuticals, polymers, and food industry sectors will surely value this course.

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Semester-1,
Paper-1 (Theory)
Course Title: Fundamentals of Chemistry

Bachelor of Science		Year: First	Semester: First
Paper-1 Theory		Subject: Chemistry	
Course Code:B020101T		Course Title: Fundamentals of Chemistry	
Course outcomes: There is nothing more fundamental to chemistry than the chemical bond. Chemical bonding is the language of logic for chemists. Chemical bonding enables scientists to take the 100-plus elements of the periodic table and combine them in myriad ways to form chemical compounds and materials. Periodic trends, arising from the arrangement of the periodic table, provide chemists with an invaluable tool to quickly predict an element's properties. These trends exist because of the similar atomic structure of the elements within their respective group families or periods, and because of the periodic nature of the elements. Reaction mechanism gives the fundamental knowledge of carrying out an organic reaction in a step-by-step manner. This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective. Students will gain an understanding of			
• Molecular geometries , physical and chemical properties of the molecules. • Current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters. • The chapter Recapitulation of basics of organic chemistry gives the most primary and utmost important knowledge and concepts of organic Chemistry. • This course gives a broader theoretical picture in multiple stages in an overall chemical reaction. It describes reactive intermediates , transition states and states of all the bonds broken and formed .It enables to understand the reactants, catalyst , stereochemistry and major and minor products of any organic reaction. • It describes the types of reactions and the Kinetic and thermodynamic aspects one should know for carrying out any reaction and the ways how the reaction mechanism can be determined. • The chapters Stereochemistry gives the clear picture of two-dimensional and three-dimensional structure of the molecules, and their role in reaction mechanism.			
Credits: 4		Compulsory	
Max. Marks: 25+75		Min. Passing Marks:.....	
Total No. of Lectures = 60			
Unit	Topics		No. of Lectures
I	Introduction to Indian ancient Chemistry and contribution of Indian Chemists, in context to the holistic development of modern science and technology, should be included under Continues Evaluation (CIE)		10

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	Molecular polarity and Weak Chemical Forces : Resonance and resonance energy, formal charge, Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, dipole moment and molecular Structure (Diatomic and polyatomic molecules), Percentage ionic character from dipole moment, polarizing power and polarizability. Fajan's rules and consequences of polarization. Hydrogen bonding, van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction. Effects of weak chemical forces, melting and boiling points, solubility, energetics of dissolution process. Lattice energy and Born-Haber cycle, solvation energy, and solubility of ionic solids.	
II	Simple Bonding theories of Molecules Atomic orbitals, Aufbau principle, multiple bonding (σ and π bond approach) and bond lengths, the valence bond theory (VBT), Concept of hybridization, hybrid orbitals and molecular geometry, Bent's rule, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O , NH_3 , PCl_5 , SF_6 , SF_4 , ClF_3 , I_3^- , ClF_2^- and SO_4^{2-} and H_3O^+ . Molecular orbital theory (MOT). Molecular orbital diagrams bond orders of homonuclear and heteronuclear diatomic molecules and ions (N_2 , O_2 , C_2 , B_2 , F_2 , CO , NO , and their ions)	10
III	Periodic properties of Atoms (with reference to s & p-block): Brief discussion, factors affecting and variation trends of following properties in groups and periods. Effective nuclear charge, shielding or screening effect, Slater rules, Atomic and ionic radii, Electronegativity, Pauling's/ Allred Rochow's scales, Ionization enthalpy, Electron gain enthalpy.	05
IV	Recapitulation of basics of Organic Chemistry: Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusion compounds, Clathrates, Charge transfer complexes, hyperconjugation, Dipole moment; Electronic Displacements: Inductive, electromeric, resonance mesomeric effects and their applications	05
V	Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).	10

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VI	Stereochemistry -Concept of isomerism, Types of isomerism; Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomer, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism – determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation.	10
VII	Basic Computer system (in brief) -Hardware and Software; Input devices, Storage devices, Output devices, Central Processing Unit (Control Unit and Arithmetic Logic Unit); Number system (Binary, Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII); Numeric/String constants and variables. Operating Systems (DOS, WINDOWS, and Linux); Software languages: Low level and High Level languages (Machine language, Assembly language; QBASIC, FORTRAN and C++); Software Products (Office, chemsketch, scilab, matlab, hyperchem, etc.), internet application.	05
VIII	Mathematical Concepts for Chemistry Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like Kx , e^x , X_n , $\sin x$, $\log x$; maxima and minima, partial differentiation and reciprocity relations, Integration of some useful/relevant functions; permutations and combinations, Factorials, Probability	05

Suggested Readings:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
3. Douglas, B.E. and McDaniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
4. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
5. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
6. Singh J., Yadav L.D.S., Advanced Organic Chemistry, Pragati Edition
7. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Carey, F. A., Giuliano, R. M. *Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
9. Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press, 2008.
10. Clayden, J., Greeves, N. & Warren, S. *Organic Chemistry*, 2nd edition, Oxford University Press, 2012.
11. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.
12. Sykes, P. *A guidebook to Mechanism in Organic Chemistry*, Pearson Education, 2003
13. Francis, P. G. Mathematics for Chemists, Springer, 1984

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggested online links:

<http://heecontent.upsdc.gov.in/Home.aspx>

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<https://nptel.ac.in/courses/104/106/104106096/>

<http://heecontent.upsdc.gov.in/Home.aspx>

<https://nptel.ac.in/courses/104/106/104106096/>

[h/VirtTxtJml/intro1.htm](#)

<https://nptel.ac.in/courses/104/103/104103071/#>

This course is compulsory for the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others.

Or

Assessment and presentation of Assignment/ Research Orientation assignment	(10 marks)
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04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
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Overall performance throughout the semester, Discipline, participation in different activities)	(05 marks)
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Course prerequisites: To study this course, a student must have had the chemistry in class 12th

Suggested equivalent online courses:

Further Suggestions:





Semester-I, Paper-2 (Practical)
Course Title: Quantitative Analysis

Bachelor of Science	Year: First	Semester: I
Practical paper-2		Subject: Chemistry
Course Code: B020102P	Course Title: Quantitative Analysis	
Course outcomes: Upon completion of this course the students will have the knowledge and skills to: understand the laboratory methods and tests related to estimation of metals ions and estimation of acids and alkali contents in commercial products. • Potability tests of water samples. • Estimation of metal ions in samples • Estimation of alkali and acid contents in samples • Estimation of inorganic salts and hydrated water in samples		
Credits: 2		Elective
Max. Marks: 25+75 = 100		Min. Passing Marks:
Practical		60 h
Unit	Topics	No of Lectures
I	Water Quality analysis 1. Estimation of hardness of water by EDTA. 2. Determination of chemical oxygen demand (COD). 3. Determination of Biological oxygen demand (BOD).	16
II	Estimation of Metals ions 1. Estimation of ferrous and ferric by dichromate method. 2. Estimation of copper using thiosulphate.	14
II	Estimation of acids and alkali contents 1. Determination of acetic acid in commercial vinegar using NaOH. 2. Determination of alkali content – antacid tablet using HCl. 3. Estimation of oxalic acid by titrating it with KMnO ₄ .	14
IV	Estimation of inorganic salts and hydrated water 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of calcium content in chalk as calcium oxalate by permanganometry. 3. Estimation of water of crystallization in Mohr’s salt by titrating with KMnO ₄ .	16

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Suggested Readings: 1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009. 2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5. 3. Harris, D.C. <i>Exploring Chemical Analysis</i>, 9th Ed. New York, W.H. Freeman, 2016. 4. Khopkar, S.M. <i>Basic Concepts of Analytical Chemistry</i>. New Age International Publisher, 2009. 5. Skoog, D.A. Holler F.J. and Nieman, T.A. <i>Principles of Instrumental Analysis</i>, Cengage Learning India Edition Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University	
Suggestive digital platforms web links 6. https://www.labster.com/chemistry-virtual-labs/ 7. https://www.vlab.co.in/broad-area-chemical-sciences 8. http://chemcollective.org/vlabs	
This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class	
Suggested Continuous Evaluation Methods:	
Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)
Course prerequisites: To study this course, a student must have had the chemistry in 12th Class	
Suggested equivalent online courses:	
Further Suggestions:	




Semester-II Paper-1
Course Title: Bioorganic and Medicinal Chemistry

Bachelor of Science	Year: 1	Semester: II
Paper-1	Theory	Subject: Chemistry
Course Code: B020201T	Course Title: Bioorganic and Medicinal Chemistry	
Course outcomes: Biomolecules are important for the functioning of living organisms. These molecules perform or trigger important biochemical reactions in living organisms. When studying biomolecules, one can understand the physiological function that regulates the proper growth and development of a human body. This course aims to introduce the students with basic experimental understanding of carbohydrates, amino acids, proteins, nucleic acids and medicinal chemistry. Upon completion of this course students may get job opportunities in food, beverage and pharmaceutical industries.		
Credits: 4	Elective	
Max. Marks: 25+75	Min. Passing Marks:.....	
Total No. of Lectures = 60		
Unit	Topics	No. of Lectures
I	Chemistry of Carbohydrates : Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Mechanism of mutarotation Determination of configuration of Glucose (Fischer's proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Inter conversions of sugars (ascending and descending of sugar series, conversion of aldoses to ketoses). Lobry de Bruyn-van Ekenstein rearrangement; stepping-up (Kiliani-Fischer method) and stepping-down (Ruff's & Wohl's methods) of aldoses; end-group-interchange of aldoses Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation	10
II	Chemistry of Proteins: Classification of amino acids, zwitter ion structure and Isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C-terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection & C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturation Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action(Including stereospecificity),	10

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	Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Non-competitive inhibition including allosteric inhibition).	
III	Chemistry of Nucleic Acids: Constituents of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), Nucleosides and nucleotides (nomenclature), Synthesis of nucleic acids, Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation	05
IV	Introductory Medicinal Chemistry : Drug discovery, design and development; Basic Retrosynthetic approach. Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group, –NH ₂ group, double bond and aromatic ring. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), HIV-AIDS related drugs (AZT- Zidovudine	10
V	Solid State Definition of space lattice, unit cell. Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices and iii) Symmetry elements in crystals and law of symmetry .X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).	05
VI	Introduction to Polymer Monomers, Oligomers, Polymers and their characteristics, Classification of polymers : Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers, Bonding in polymers : Primary and secondary bond forces in polymers ; cohesive energy, and decomposition of polymers. Determination of Molecular mass of polymers: Number Average molecular mass (M _n) and Weight average molecular mass (M _w) of polymers and determination by (i) Viscosity (ii) Light scattering method (iii) Gel permeation chromatography (iv) Osmometry and Ultracentrifuging. Silicones and Phosphazenes –Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.	10
VII	Kinetics and Mechanism of Polymerization Polymerization techniques, Mechanism and kinetics of copolymerization, Addition or chain-growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers, Condensation or step growth-polymerization, Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins	05

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	and polyurethanes, Natural and synthetic rubbers, Elementary idea of organic conducting polymers.	
VIII	Synthetic Dyes: Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.	05

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Suggested Readings:

1. Davis, B. G., Fairbanks, A. J., *Carbohydrate Chemistry*, Oxford Chemistry Primer, Oxford University Press
2. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.
4. Berg, J. M., Tymoczko, J. L. & Stryer, L. *Biochemistry 7th Ed.*, W. H. Freeman.
5. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
6. Patrick, G. L. *Introduction to Medicinal Chemistry*, Oxford University Press, UK, 2013.
7. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New D 2012.
8. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry Ed.*, Oxford University Press 13 (2006).
9. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
10. Castellan, G. W. *Physical Chemistry 4th Ed.* Narosa (2004).
11. R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
12. G. Odian: *Principles of Polymerization*, 4th Ed. Wiley, 2004.
13. F.W. Billmeyer: *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
14. P. Ghosh: *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggested online links:

<http://heecontent.upsdc.gov.in/Home.aspx>
<https://nptel.ac.in/courses/104/105/104105124/>
<https://nptel.ac.in/courses/103/106/105106204/>
<https://nptel.ac.in/courses/104/105/104105034/>
<https://nptel.ac.in/courses/104/103/104103121/>
<https://nptel.ac.in/courses/104/102/104102016/>
<https://nptel.ac.in/courses/104/106/104106106/>
<https://nptel.ac.in/courses/104/105/104105120/>

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Assessment and presentation of Assignment/ Research Orientation assignment	(10 marks)
04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)	(10 marks)
Overall performance throughout the semester (Discipline, participation in different activities)	(05 marks)

Course prerequisites: To study this course, a student must have Passed Sem-I, Theory paper-1

Suggested equivalent online courses:

Further Suggestions:



Semester-II , Paper-2 (Practical)
Course Title: Biochemical Analysis

Bachelor of Science	Year: 1	Semester: II
Subject: Chemistry		
Course Code: B020202P	Course Title: Biochemical Analysis	
Course outcomes: This course will provide basic qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules. Upon successful completion of this course students may get job opportunities in food, beverage and pharmaceutical industries.		
Credits: 2		Elective
Max. Marks: 25+75 = 100		Min. Passing Marks:
Practical		60-h
Unit	Topics	No of Lectures
I	Qualitative and quantitative analysis of Carbohydrates: 1. Separation of a mixture of two sugars by ascending paper chromatography 2. Differentiate between a reducing/ nonreducing sugar 3. Synthesis of Osazones.	15
II	Qualitative and quantitative analysis of Proteins, amino acids and Fats 1. Isolation of protein. 2. Determination of protein by the Biuret reaction. 3. TLC separation of a mixture containing 2/3 amino acids 4. Paper chromatographic separation of a mixture containing 2/3 amino acids 5. Action of salivary amylase on starch 6. To determine the concentration of glycine solution by formylation method. 7. To determine the saponification value of an oil/fat. 8. To determine the iodine value of an oil/fat	20
III	Determination and identification of Nucleic Acids 1. Determination of nucleic acids 2. Extraction of DNA from onion/cauliflower	12
IV	Synthesis of Simple drug molecules 1. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC. 2. Synthesis of barbituric acid 3. Synthesis of propranolol	13




Suggested Readings:

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed., Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education.
3. *Vogel's Qualitative Inorganic Analysis*, Revised by G. Svehla.
4. Vogel, A.I. *A Textbook of Quantitative Analysis*, ELBS. 1986
5. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
6. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press
7. Cooper, T.G. *Tool of Biochemistry*. Wiley-Blackwell (1977).
8. Wilson, K. & Walker, J. *Practical Biochemistry*. Cambridge University Press (2009).
9. Varley, H., Gowenlock, A.H & Bell, M.: *Practical Clinical Biochemistry*, Heinemann,

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggestive digital platforms web links

1. <https://www.labster.com/chemistry-virtual-labs/>
2. <https://www.vlab.co.in/broad-area-chemical-sciences>
3. <http://chemcollective.org/vlabs>

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)

Course prerequisites: To study this course, a student must have Opted Sem-II, Theory Paper-1.

Suggested equivalent online courses:

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Further Suggestions:

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Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
2	III	B020301T	Chemical Dynamics & Coordination Chemistry	Theory	4
		B020302P	Physical Analysis	Practical	2
	IV	B020401T	Quantum Mechanics and Analytical Techniques	Theory	4
		B020402P	Instrumental Analysis	Practical	2
		B020403R	Research Project / Internship / field or survey work	Project	3

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Semester III, Paper-1 (Theory)
Course Title: Chemical Dynamics & Coordination Chemistry

Bachelor of Science

Year: Two

Semester: III

Paper-1 Theory

Subject: Chemistry

Course Code: B020301T

Course Title: Chemical Dynamics & Coordination Chemistry

Course outcomes: Upon successful completion of this course students should be able to describe the characteristic of the three states of matter and describe the different physical properties of each state of matter. kinetic theory of gases, laws of crystallography, liquid state and liquid crystals, conductometric, potentiometric, optical methods, polarimetry and spectrophotometer technique to study Chemical kinetics and chemical equilibrium. After the completion of the course, Students will be able to understand metal-ligand bonding in transition metal complexes, thermodynamic and kinetic aspects of metal complexes.

Credits: 4

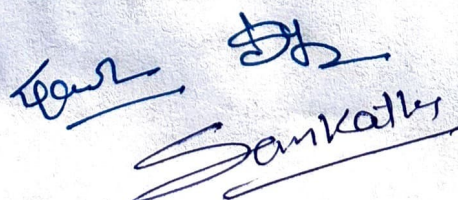
Elective

Max. Marks: 25+75

Min. Passing Marks:

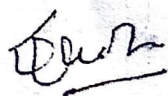
Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	Chemical Kinetics: Rate of a reaction, molecularity and order of reaction, concentration dependence of rates, mathematical characteristic of simple chemical reactions – zero order, first order, second order, pseudo order, half-life and mean life. Determination of the order of reaction – differential method, method of integration, half-life method and isolation method. Brief outline of experimental methods of studying chemical kinetics: Conductometric, potentiometric, optical methods, polarimetry and spectrophotometer Theories of chemical kinetics: Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects (no derivation).	15
II	Kinetic theories of gases Gaseous State: Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation of state. Critical phenomena. PV isotherms of real gases, continuity of states, the isotherms of Van der Waals equation, relationship between critical constants and Van der Waals constants, the law of corresponding states, reduced equation of state. Molecular Velocities: Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule-Thomson effect).	10


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III	Coordinate bonding: double and complex salts. Werner's theory of coordination complexes, classification of ligands, ambidentate ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereo isomerism, geometrical and optical isomerism in square planar and octahedral complexes.	10
IV	Theories of Coordination Chemistry I Metal- ligand bonding in transition metal complexes, limitations of valance bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, factors affecting the crystal-field parameters. II. Thermodynamic and kinetic aspects of metal complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes	15
V	Inorganic Spectroscopy and Magnetism I) Electronic spectra of Transition Metal Complexes Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d1 and d9 states, discussion of the electronic spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex ion.	10





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Suggested Readings:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Cotton, F.A, Wilkinson, G and Gaus, P. L, Basic Inorganic Chemistry, 3rd Edition, Wiley 1995
5. Lee, J.D, Concise Inorganic Chemistry 4th Edition ELBS, 1977
6. Douglas, B, McDaniel, D and Alexander, J, Concepts of Models of Inorganic Chemistry, John Wiley & Sons; 3rd edition, 1994
7. Shriver, D.E Atkins, P.W and Langford, C.H, Inorganic Chemistry, Oxford University Press, 1994.
8. Porterfield, W.W, Inorganic Chemistry, Addison Wesley 1984.
9. Sharpe, A.G, Inorganic Chemistry, ELBS, 3rd edition, 1993
10. Miessler, G.L, Tarr, D.A, Inorganic Chemistry, 2nd edition, Prentice Hall, 2001

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggestive digital platforms web links-

Suggestive digital platforms web links:

11. <https://swayam.gov.in/>
12. <https://www.coursera.org/learn/physical-chemistry>
13. <https://www.mooc-list.com/tags/physical-chemistry>
14. <https://www.openlearning.com/courses/introduction-to-physical-chemistry/>
15. <https://www.my-mooc.com/en/categorie/chemistry>
16. https://onlinecourses.swayam2.ac.in/ncel9_sc15/preview
17. <https://swayam.gov.in/>
18. <https://www.coursera.org/browse/physical-science-and-engineering/chemistry>

This course can be opted as an elective by the students of following subjects: **Chemistry in 12th Class**

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others.

Or

Assessment and presentation of Assignment/ Research	(10 marks)
Orientation assignment	
04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)	(10 marks)
Overall performance throughout the semester (Discipline, participation in different activities)	(05 marks)

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Semester III, Paper-2 (Practical):
Course Title: Physical Analysis

Bachelor of Science	Year: Two	Semester: III
Practical paper-2		Subject: Chemistry
Course Code: B020302P	Course Title: Physical Analysis	
Course Outcomes: Upon successful completion of this course students should be able to calibrate apparatus and prepare solutions of various concentrations, estimation of components through volumetric analysis; to perform dilatometric experiments: one and two component phase equilibrium experiments.		
Credits: 4		Elective
Max. Marks: 25 +75		Min. Passing Marks:
Practical		60 h
Unit	Topics	No of Lectures
I	Strengths of Solution Calibration of fractional weights, pipettes and burettes. Preparation of standards solutions. Dilution – 0.1 M to 0.001 M solutions. Mole Concept and Concentration Units :Mole Concept, molecular weight, formula weight, and equivalent weight. Concentration units: Molarity, Formality, Normality, Molality, Mole fraction, Percent by weight, Percent by volume, Parts per thousand, Parts per million, Parts per billion, pH, pOH, milli equivalents, Milli moles	20
II	Surface Tension and Viscosity 1. Determination of surface tension of pure liquid or solution 2. Determination of viscosity of liquid pure liquid or solution	06
III	Boiling point and Transition Temperature 1. Boiling point of common organic liquid compounds ANY FIVE] <i>n</i> butylalcohol, cyclohexanol, ethyl methyl ketone, cyclohexanone, acetylacetone, isobutyl methyl ketone, isobutyl alcohol, acetonitrile, benzaldehyde and acetophenone. [Boiling points of the chosen organic compounds should preferably be within 180°C]. 2. Transition Temperature, Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. MnCl ₂ .4H ₂ O/SrBr ₂ .2H ₂ O)	14
IV	Phase Equilibrium	20

1.	To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system
2.	To construct the phase diagram of two component (e.g. diphenylamine – benzophenone) system by cooling curve method.

Suggested Readings:

1. Skoog .D.A., West.D.M and Holler .F.J., “Analytical Chemistry: An Introduction”, 7th edition, Saunders college publishing, Philadelphia,(2010).
2. Larry Hargis.G” Analytical Chemistry: Principles and Techniques” Pearson©(1988)

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggestive digital platforms web links

1. <https://www.labster.com/chemistry-virtual-labs/>
2. <https://www.vlab.co.in/broad-area-chemical-sciences>
3. <http://chemcollective.org/vlabs>

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)

Course prerequisites: To study this course, a student must have Opted Sem-III, Theory Ppaer-1

Suggested equivalent online courses:

Further Suggestions:




Semester IV Paper-1 (Theory)
Course Title: Quantum Mechanics and Analytical Techniques

Bachelor of Science	Year: Two	Semester: IV
Paper-1	<i>Theory</i>	Subject: Chemistry
Course Code: BO20401T	Course Title: Quantum Mechanics and Analytical Techniques	

Course Outcomes:: Upon successful completion of this course students should be able to describe atomic structure, elementary quantum mechanics, wave function and its significance; Schrodinger wave equation and its applications; Molecular orbital theory, basic ideas – Criteria for forming molecular orbital from atomic orbitals, Molecular Spectroscopy, Rotational Spectrum, vibrational Electronic Spectrum: photo chemistry and kinetics of photo chemical reaction

Analytical chemistry plays an enormous role in our society, such as in drug manufacturing, process control in industry, environmental monitoring, medical diagnostics, food production, and forensic surveys. It is also of great importance in different research areas. Analytical chemistry is a science that is directed towards creating new knowledge so that chemical analysis can be improved to respond to increasing or new demands.

- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
- Students will be able to function as a member of an interdisciplinary problem solving team.
- Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems
- Students will gain an understanding of how to determine the structure of organic molecules using IR and NMR spectroscopic techniques
- To develop basic skills required for purification, solvent extraction, TLC and column chromatography

Credits: 4	Elective
Max. Marks: 25+75	Min. Passing Marks:.....

Total No. of Lectures- = 60

Unit	Topics	No. of Lectures
I	Atomic Structure: Idea of de-Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of Ψ and Ψ^2 , quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d, orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule.	5
II	Elementary Quantum Mechanics : Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. de-Broglie hypothesis. Heisenberg uncertainty principle. Hamiltonian Operator.	15

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	Schrödinger wave equation (time dependent and time independent) and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions. Molecular orbital theory, basic ideas – Criteria for forming MO from AO, construction of MO by LCAO – H_2^+ ion, calculation of energy levels from wave functions, physical picture of bonding and anti-bonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics.	
III	Molecular Spectroscopy: Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom Rotational Spectrum: Diatomic molecules . Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect . Vibrational Spectrum: Infrared spectrum : Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups. Raman spectrum: Concept of polarizability , pure rotational and pure vibrational, Raman spectra of diatomic molecules, selection rules. Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.	10
IV	UV-Visible Spectroscopy : Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules. Types of electronic transitions, λ_{max}, chromophores and auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; application of Woodward Rules for calculation of λ_{max} for the conjugated dienes: alicyclic, homoannular and heteroannular; extended conjugated systems distinction between cis and trans isomers.	5
V	Infrared Spectroscopy: IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; Hooke's law selection rule, IR absorption positions of various functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance;	5

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	application in functional group analysis and interpretation of I.R. spectra of simple organic compounds.	
VI	¹H-NMR Spectroscopy (PMR) NMR Spectroscopy: introduction; nuclear spin; NMR active molecules; basic principles of Proton Magnetic Resonance; choice of solvent and internal standard; equivalent and non-equivalent protons; chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; spin coupling and coupling constant (1st order spectra); relative intensities of first-order multiplets: Pascal's triangle; chemical and magnetic equivalence in NMR ; anisotropic effects in alkene, alkyne, aldehydes and aromatics; NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds; interpretation of NMR spectra of simple compounds. Applications of ¹ H-NMR Spectroscopy in identification of simple organic compounds.	10
VII	Introduction to Mass Spectrometry: Principle of mass spectrometry, the mass spectrum, mass spectrometry diagram, molecular ion, metastable ion, fragmentation process, McLafferty rearrangement.	3
VIII	Separation Techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.	07

Suggested Readings:

1. Alberty, R A, Physical Chemistry, 4th edition Wiley Eastern Ltd, 2001.
2. Atkins, P W, the elements of physical chemistry, Oxford, 1991
3. Barrow, G .M., International student Edition .McGraw Hill, McGraw-Hill, 1973.
4. Cotton, F.A, Wilkinson, G and Gaus, P. L ,Basic Inorganic Chemistry, 3rd Edition ,Wiley 1995
5. Lee, J.D, Concise Inorganic Chemistry 4th Edition ELBS, 1977
6. Clayden, J., Greeves, N., Warren, S., *Organic Chemistry*, Second edition, Oxford University Press 2012.
7. Silverstein, R. M., Bassler, G. C., Morrill, T. C. *Spectrometric Identification of Organic Compounds*, John Wiley and Sons, INC, Fifth edition.
8. Pavia, D. L. *et al. Introduction to Spectroscopy*, 5th Ed. Cengage Learning India Ed.
9. Willard, H.H. *et al.: Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
10. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
11. Harris, D.C.: *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
12. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.

Suggestive digital platforms web links




1. <https://www.coursera.org/courses?query=chemistry&languages=en>
2. <https://www.mooc-list.com/tags/physical-chemistry>
3. <https://www.coursera.org/learn/physical-chemistry>
4. <https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2017/>
5. <http://heecontent.upsdc.gov.in/Home.aspx>
6. <https://nptel.ac.in/courses/104/108/104108078/>
7. <https://nptel.ac.in/courses/104/108/104108124/>
8. <https://nptel.ac.in/courses/104/106/104106122/>

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others.

Or

Assessment and presentation of Assignment/ Research Orientation assignment	(10 marks)
04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)	(10 marks)
Overall performance throughout the semester (Discipline, participation in different activities)	(05 marks)

Course prerequisites: To study this course, a student must have had the chemistry in class 12th

Suggested equivalent online courses:

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Further Suggestions:

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Semester IV, Paper-2 (Practical)
Course Title: Instrumental Analysis

Bachelor of Science.	Year: Two	Semester: V
Practical paper 2		Subject: Chemistry
Course Code: B020402P	Course Title: Instrumental Analysis	
Course outcomes: Upon completion of this course, chemistry majors are able to employ critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed at an entry-level position in chemical industry or a chemistry graduate program. - Students will be able to explore new areas of research in both chemistry and allied fields of science and technology. - Students will be able to function as a member of an interdisciplinary problem solving team. - Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems - Students will gain an understanding of how to determine the structure of organic molecules using IR and NMR spectroscopic techniques - To develop basic skills required for purification, solvent extraction, TLC and column chromatography		
Credits: 2		Elective
Max. Marks: 25 + 75		Min. Passing Marks:
Practical		60 h
Unit	Topics	No of Lectures
I	Molecular Weight Determination 1. Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method. 2. Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy	10
II	Spectrophotometry 1. To verify Beer – Lambert Law for KMnO ₄ /K ₂ Cr ₂ O ₇ and determining the concentration of the given solution of the substance from absorption measurement 2. Determination of pK _a values of indicator using spectrophotometry. 3. Determination of chemical oxygen demand (COD).	20

	4. Determination of Biological oxygen demand (BOD).	
III	Spectroscopy 1. Assignment of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (C-H, O-H, N-H, C-O, C-N, C-X, C=C, C=O, N=O, C≡C, C≡N stretching frequencies; characteristic bending vibrations are included. Spectra to be provided). 2. Assignment of labelled peaks in the ¹H NMR spectra of the known organic compounds explaining the relative δ-values and splitting pattern. 3. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).	10
IV	Chromatographic Separations 1. Paper chromatographic separation of following metal ions: i. Ni (II) and Co (II) ii. Cu(II) and Cd(II) 2. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer Chromatography (TLC) 3. Separation and identification of the amino acids present in the given mixture by paper chromatography. Reporting the R_f values 4. TLC separation of a mixture of dyes (fluorescein and methylene blue)	20

Suggested Readings:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.
2. Willard, H.H. *et al.: Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, D.C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition.
7. Mikes, O. & Chalmes, R.A. *Laboratory Handbook of Chromatographic & Allied Methods*, Elles Harwood Ltd. London.
8. Ditts, R.V. *Analytical Chemistry: Methods of separation*. Van Nostrand, New York, 1974.

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggestive digital platforms web links

1. <https://www.labster.com/chemistry-virtual-labs/>
2. <https://www.vlab.co.in/broad-area-chemical-sciences>
3. <http://chemcollective.org/vlabs>

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)

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Course prerequisites: To study this course, a student must have had the chemistry in class

Suggested equivalent online courses:

Further Suggestions:

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Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
3	V	B020501T	Organic Synthesis-A	Theory	4
		B020502T	Rearrangements and Chemistry of Group Elements	Theory	4
		B020503P	Qualitative Analysis	Practical	2
	VI	B020601T	Organic Synthesis-B	Theory	4
		B020602T	Chemical Energetics and Radiochemistry	Theory	4
		B020603P	Analytical Methods	Practical	2




Semester V, Paper-1 (Theory)
Course Title: Organic Synthesis A

Programme: Bachelor of Science		Year: Three	Semester: V
Paper- 1 Theory		Compulsory	Subject: Chemistry
Course Code: B020501T		Course Title: Organic Synthesis A	
Course outcomes: Hydrocarbons are the principal constituents of petroleum and natural gas. They serve as fuels and lubricants as well as raw materials for the production of plastics, fibers, rubbers, solvents and industrial chemicals. This course will provide a broad foundation in for the synthesis of hydrocarbons. Hydroxy and carbonyl compounds are industrially important compounds The industries of plastics, fibers, petroleum and rubbers will specially recognize this course. Students will gain an understanding of which are used as solvents and raw material for synthesis of drug and other pharmaceutically important compounds.			
• Synthesis and chemical properties of aliphatic and aromatic hydrocarbons • Synthesis and chemical properties of alcohols, halides carbonyl compounds, carboxylic acids and esters • How to design and synthesize aliphatic and aromatic hydrocarbons. • How to convert aliphatic and aromatic hydrocarbons to other industrially important compounds • Functional group interconversion.			
Credits: 4		Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures- = 60			
Unit	Topics		No. of Lectures
I	Chemistry of Alkanes and Cycloalkanes A) Alkanes : Classification of carbon atom in alkanes, General methods of preparation, physical and chemical properties of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity B) Cycloalkanes: Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Chair, Boat and Twist boat forms of cyclohexane with energy diagrams ring strain in small rings, theory of strain less rings. The case of cyclopropane ring, banana bonds.		8
II	Chemistry of Alkenes Methods of formation of alkenes, Addition to C=C : mechanism (with evidence wherever applicable), reactivity, regioselectivity (Markownikoff and anti-Markownikoff additions) and stereoselectivity; reactions: hydrogenation, halogenation, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, epoxidation, <i>syn</i> and <i>anti</i> -hydroxylation, ozonolysis, addition of singlet and triplet carbenes; Simmons-Smith cyclopropanation reaction; electrophilic		12

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	addition to diene (conjugated dienes and allene); radical addition: HBr addition; mechanism of allylic and benzylic bromination in competition with brominations across C=C; use of NBS; interconversion of E- and Z- alkenes; contra-thermodynamic isomerization of internal alkenes	
III	Chemistry of Alkynes Methods of formation of alkynes, Addition to C≡C, mechanism, reactivity, regioselectivity and stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; inter conversion of terminal and non-terminal alkynes.	06
IV	Aromaticity and Chemistry of Arenes Nomenclature of benzene derivatives, MO picture of benzene, Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their Mechanism. Directing effects of the groups. Birch reduction, Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and anthracene.	10
V	Chemistry of Alcohols Classification and nomenclature, Monohydric alcohols – nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc) ₄ and HIO ₄] and pinacol pinacolone rearrangement. Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol.	8
VI	Chemistry of Phenols : Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction	06
VII	Chemistry of Ethers and Epoxides : Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.	05
VIII	Chemistry of Organic Halides Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN ₂ and SN ₁ reactions with energy profile	05

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diagrams; Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions; Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.

Suggested Readings:

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

Note: For the promotion of Hindi language,

Suggested online links:

<https://nptel.ac.in/courses/104/103/104103071/intro1.htm>

<https://nptel.ac.in/courses/104/103/104103071/#>

<https://nptel.ac.in/courses/104/106/104106096/>

This course is compulsory for the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others.

Or

Assessment and presentation of Assignment	(10 marks)
04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)	(10 marks)
Overall performance throughout the semester (Discipline, participation in different activities)	(05 marks)

Course prerequisites: To study this course, a student must have Passed Sem-I, Theory paper

Suggested equivalent online courses:

Further Suggestions:

Semester-V Paper-2

Course Title: Rearrangements and Chemistry of Group Elements

Programme: Bachelor of Science		Year: Three	Semester: V
Paper-2	Theory	Elective	Subject: Chemistry
Course Code: B020502T		Course Title: Rearrangements and Chemistry of Group Elements	
Course outcomes: This paper provides detailed knowledge of synthesis of various class of organic compounds and functional groups inter conversion. Organic synthesis is the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG etc. industries. • It relates and gives an analytical aptitude for synthesizing various industrially important compounds. • This paper also provides a detailed knowledge on the elements present in our surroundings, their occurrence in nature. Their position in periodic table, their physical and chemical properties as well as their extraction. This paper also gives detailed understanding of the s, p, d and f block elements and their characteristics.			
Credits: 4		Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures- = 60			
Unit	Topics		No. of Lectures
I	Rearrangements A detailed study of the following rearrangements: Pinacol-pinacolone, Demjanov, BenzilBensilic acid, Favorskii, Hofman, Curtius, Schmidt, Baeyer-Villiger and Fries rearrangement		6
II	Catalysis General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts. Enzyme catalysis; Michaelis-Menten equation, Lineweaver-Burk plot, turn-over number.		8
III	Chemistry of Main Group Elements		10

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	s-Block Elements: Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls. p-Block Elements: Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of group 13-16, hydrides of boron-diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides. Chemistry of Noble Gasses: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.	
IV	Chemistry of Transition Elements Chemistry of Elements of First Transition Series -Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry. Chemistry of Elements of Second and Third Transition Series- General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	06
V	Chemistry of Lanthanides Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses.	4
VI	Chemistry of Actinides Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.	4
VII	Metal Carbonyls Metal carbonyls: 18-electron rule, preparation, structure and nature of bonding in the mononuclear and dinuclear carbonyls.	6
VIII	Bioinorganic Chemistry Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}. Nitrogen fixation.	6

Suggested Readings:

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

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7. Smith, J. G. *Organic Chemistry*, Tata McGraw-Hill Publishing Company Limited.
8. March, J. *Advanced Organic Chemistry*, Fourth edition, Wiley. Pearson Education 2010
9. Lee, J.D. Concise Inorganic Chemistry, L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and
10. Huheey, J.E., Keiter, E.A., Keiter, R. Reactivity, Pearson Education 2006 Concepts & Models of Inorganic Chemistry, Oxford, 1970
11. Douglas, B.E. and Mc Daniel, D.H., *Chemistry 2nd Ed.*, Oxford University Press, 1994.
12. Shriver, D.D. & P. Atkins, *Inorganic Inorganic Chemistry*, ACS Publications 1962.
13. Day, M.C. and Selbin, J. Theoretical Springer, 1984
14. Francis, P. G. Mathematics for Chemists, Iyadan R.D., Advanced inorganic Chemistry, S.Chand publishing.
15. Prakash Satya, Tuli G.D., Basu course books published in Hindi may be prescribed by the University

Note: For the promotion of Hindi language,

Suggested online links:

[eusch/VirtTxtJml/intro1.htm](https://nptel.ac.in/courses/104/103/104103071/#)

<https://nptel.ac.in/courses/104/103/104103071/#>

<https://swayam.gov.in/>

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others .

Or

Assessment and presentation of Assignment	(10 marks)
04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)	(10 marks)
Overall performance throughout the semester (Discipline, participation in different activities)	(05 marks)

Course prerequisites: To study this course, a student must have Passed Sem-I, Theory paper

Suggested equivalent online courses:

Further Suggestions:




Semester V, Paper-3 (Practical)
Course Title: Qualitative Analysis

Programme: Bachelor of Science	Year: Three	Semester: V
Practical paper-3		Subject: Chemistry
Course Code: B020503P	Course Title: Qualitative Analysis	
Course outcomes: Upon completion of this course the students will have the knowledge and skills to: understand the laboratory methods and tests related to inorganic mixtures and organic compounds. • Identification of acidic and basic radicals in inorganic mixtures • Separation of organic compounds from mixture • Elemental analysis in organic compounds • Identification of functional group in organic compounds • Identification of organic compound		
Credits: 2		Elective
Max. Marks: 25+75		Min. Passing Marks:
Practical		60 h
Unit	Topics	No of lectures
I	Inorganic Qualitative Analysis Semi micro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis. Mixture containing 6 radicals-2 +4 or 4+ or 3+3	16
II	Elemental analysis and identification of functional groups Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.	14
III	Separation of Organic Mixture Analysis of an organic mixture containing two solid components using water, NaHCO ₃ , NaOH for separation and preparation of suitable derivatives	18
IV	Identification of organic compounds Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.	12




Suggested Readings:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
5. Harris, D.C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
6. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggestive digital platforms web links

4. <https://www.labster.com/chemistry-virtual-labs/>
5. <https://www.vlab.co.in/broad-area-chemical-sciences>
1. <http://chemcollective.org/vlabs>

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)

Course prerequisites: To study this course, a student must have Opted Sem-V Theory Ppaer-1 &2

Suggested equivalent online courses:**Further Suggestions:**

Semester-VI Paper-1
Course Title: Organic Synthesis B

Programme: Bachelor of Science		Year: Three	Semester: VI
Paper-1	Theory	Compulsory	Subject: Chemistry
Course Code:B020601T		Course Title: Organic Synthesis B	
Course outcomes: This paper provides detailed knowledge of synthesis of various class of organic compounds and functional groups inter conversion. Organic synthesis is the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG etc. industries. The study of natural products and heterocyclic compounds offers an excellent strategy toward identifying novel biological probes for a number of diseases. Historically, natural products have played an important role in the development of pharmaceutical drugs for a number of diseases including cancer and infection. • It relates and gives an analytical aptitude for synthesizing various industrially important compounds. • Learn the different types of alkaloids, & terpenes etc and their chemistry and medicinal importance. • Explain the importance of natural compounds as lead molecules for new drug discovery.			
Credits: 4		Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures- = 60			
Unit	Topics		No. of Lectures
I	Reagents in Organic Synthesis A detailed study of the following reagents in organic transformations Oxidation with DDQ, CAN and SeO₂, mCPBA, Jones Oxidation, PCC, PDC, PFC, Collin's reagent and ruthenium tetroxide. Reduction with NaBH₄, LiAlH₄, Meerwein-Ponndorf-Verley (MPV) reduction, Wilkinson's catalyst, Birch reduction, DIBAL-H		6
II	Organometallic Compounds-Organomagnesium compounds: the Grignard reagents, formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.		4

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III	Chemistry of Aldehydes and ketones: Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones uses 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Oxidation of aldehydes, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, LiAlH_4 and NaBH_4 reductions. Halogenation of enolizable ketones An introduction to α, β unsaturated aldehydes and Ketones.	10
IV	Carboxylic acids and their Functional Derivatives Nomenclature and classification of aliphatic and aromatic carboxylic acids. Preparation and reactions. Acidity (effect of substituents on acidity) and salt formation, Reactions: Mechanism of reduction, substitution in alkyl or aryl group. Preparation and properties of dicarboxylic acids such as oxalic, malonic, succinic, glutaric, adipic and phthalic acids and unsaturated carboxylic acids such as acrylic, crotonic and cinnamic acids, Reactions: Action of heat on hydroxy and amino acids, and saturated dicarboxylic acids, stereospecific addition to maleic and fumaric acids. Preparation and reactions of acid chlorides, acid anhydrides, amides and esters, acid and alkaline hydrolysis of esters, trans-esterification.	8
V	Organic Synthesis via Enolates Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines.	5
VI	Organic Compounds of Nitrogen- Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid. Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrites), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling	10

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VII	Heterocyclic Chemistry Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives, Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six membered heterocycles, Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline	10
VIII	Natural Products Alkaloids & Terpenes: Natural occurrence, General structural features, their physiological action, Hoffmann's exhaustive methylation, Emde's modification;. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine. Natural Occurrence and classification of terpenes, isoprene rule.	7

Suggested Readings:

- Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Sykes, P. *A guidebook to Mechanism in Organic Chemistry*, Pearson Education, 2003.
- Carey, F. A., Giuliano, R. M. *Organic Chemistry*, Eighth edition, Graw Hill Education, 2012.
- Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press, 2008.
- Clayden, J., Greeves, N. & Warren, S. *Organic Chemistry*, 2nd edition, Oxford University Press, 2012.
- Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.
- Smith, J. G. *Organic Chemistry*, Tata McGraw-Hill Publishing Company Limited.
- March, J. *Advanced Organic Chemistry*, Fourth edition, Wiley.
- Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Wiley & Sons (1976).
- Finar, I. L. *Organic Chemistry* (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (Volume 2: Stereochemistry and the Chemistry of Natural
- Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Agati Prakashan (2010).

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggested online links:

<http://heecontent.upsdc.gov.in/Home.aspx>

<https://nptel.ac.in/courses/104/103/104103111/>

[eusch/VirtTxtJml/intro1.htm](https://nptel.ac.in/courses/104/103/104103111/eusch/VirtTxtJml/intro1.htm)

<https://nptel.ac.in/courses/104/103/104103071/#>

<https://swayam.gov.in/>

This course compulsory for the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others.

Or

Assessment and presentation of Assignment	(10 marks)
04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)	(10 marks)
Overall performance throughout the semester (Discipline,	(05 marks)

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participation in different activities)	
Course prerequisites: To study this course, a student must have Passed Sem-V Theory paper-1	
Suggested equivalent online courses:	
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Further Suggestions:	
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Semester-VI Paper-2
Course Title: Chemical Energetics and Radio Chemistry

Programme: Bachelor of Science		Year: Three	Semester: VI
Paper-2 Theory		Subject: Chemistry	
Course Code: B020602T		Course Title: Chemical Energetics and Radio Chemistry	
Course outcomes: Upon successful completion of this course students should be able to describe laws of thermodynamics and its applications, phase equilibria of one and two component system, electro chemistry ,ionic equilibrium applications of conductivity and potentiometric measurements			
Credits: 4			
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures- = 60			
Unit	Topics		No. of Lectures
I	Thermodynamics-1 : First Law of Thermodynamics : Statement , definition of internal energy and enthalpy. Heat capacity ,heat capacities at constant volume and pressure and their relationship. Joule's law – Joule-Thomson coefficient and inversion temperature . Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Thermochemistry: Standard state, standard enthalpy of formation – Hess's law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume . Enthalpy of neutralization . Bond dissociation energy and its calculation from thermo-chemical data , temperature dependence of enthalpy. Kirchhoff's equation.		8
II	Thermodynamics II Second Law of Thermodynamics, Need for the law, different statements of the law, Carnot cycle and its efficiency. Carnot theorem. Thermodynamic scale of temperature. Concept of Entropy, Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality , entropy as a criteria of		10

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	spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Gibbs and Helmholtz Functions Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities. A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. Third Law of Thermodynamics ; Nernst heat theorem , statement and concept of residual entropy. Nernst distribution law – Thermodynamic derivation, applications .	
III	Electrochemistry: Electrical transport:- Conduction in metals and in electrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation of molar, equivalent and specific conductances with dilution. Migration of ions and Kohlrausch law , Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes . Ostwald's dilution law, its uses and limitations . Debye-Huckel-Onsager equation for strong electrolytes (elementary treatment only) . Transport number, definition and determination by Hittorf method and moving boundary method.	8
IV	Ionic Equilibrium: Types of reversible electrodes – Gas-metal ion, metal-metal ion, metal insoluble salt-anion and redox electrodes . Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, Electrolytic and Galvanic cells–Reversible and irreversible cells, conventional representation of electrochemical cells . EMF of a cell and its measurement. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Definition of pH and pKa , determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Buffers – Mechanism of buffer action, Henderson-Hassel equation, application of buffer solution. Hydrolysis of salts	10
V	Photo Chemistry: Interaction of radiation with matter, difference between thermal and photochemical processes . Laws of photochemistry: Grothus- Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions – energy transfer processes (simple examples), kinetics of photochemical reaction.	04




VI	Colligative Properties-Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, Elevation of boiling point and depression of freezing, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.	6
VI I	Surface Chemistry Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs adsorption isotherm and surface excess; Heterogenous catalysis (single reactant); Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Stability of colloids and zeta potential; Micelle formation Dipole moment and polarizability: Polarizability of atoms and molecules, dielectric constant and polarisation, molar polarisation for polar and non-polar molecules; Clausius-Mosotti equation and Debye equation (both without derivation) and their application; Determination of dipole moments	07
VI II	Radiochemistry Natural and induced radioactivity; radioactive decay-α-decay, β-decay, γ-decay; neutron emission, positron emission, electron capture; unit of radioactivity (Curie); half life period; Geiger-Nuttall rule, radioactive displacement law, radioactive series. Measurement of radioactivity: ionization chamber, Geiger counters, scintillation counters. Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labelling studies, nuclear medicine-^{99m}Tc radiopharmaceuticals	07

Suggested Readings:

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

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggested online links:

<http://heecontent.upsdc.gov.in/Home.aspx>

<https://swayam.gov.in/>

[org/learn/physical-chemistry](#)
[com/tags/physical-chemistry](#)

[-to-physical-chemistry/](#)

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others.

Or

Assessment and presentation of Assignment	(10 marks)
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04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)	(10 marks)
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Overall performance throughout the semester (Discipline, participation in different activities)	(05 marks)
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Course prerequisites: To study this course, a student must have had the chemistry in class 12th, Physics in 12th

Suggested equivalent online courses:

Further Suggestions:





Semester VI, Paper-3 (Practical)
Course Title: Analytical Methods

Programme: Bachelor of Science		Year: Three	Semester: <u>VI</u>
Practical paper-3		Subject: Chemistry	
Course Code: B020603P	Course Title: Analytical Methods		
Course Outcomes: Upon successful completion of this course students should be able to quantify the product obtained through gravimetric method; determination of R_f values and identification of organic compounds through paper and thin layer chromatography laboratory techniques: perform thermo chemical reactions			
Credits: 2		Theory	
Max. Marks: 25+75		Min. Passing Marks:	
Practical		60 h	
Unit	Topics		No of Lectures
I	Gravimetric Analysis 1. Analysis of Cu as CuSCN, 2. Analysis of Ni as Ni (dimethylglyoxime) 3. Analysis of Ba as BaSO ₄ .		30
II	Paper Chromatography Ascending and Circular. Determination of R_f values and identification of organic compounds: Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid Leucine and glutamic acid. Spray reagent – ninhydrin. Separation of a mixture of D, L – alanine, glycine, and L-leucine using n-butanol:acetic acid: water (4:1:5). Spray reagent – ninhydrin. Separation of monosaccharaides – a mixture of D- galactose and D -fructose using n- butanol: acetone: water (4:5:1). Spray reagent – aniline hydrogen phthalate		8
III	Thin Layer Chromatography Determination of R_f values and identification of organic compounds: Separation of green leaf pigments (spinach leaves may be used) Preparation of separation of 2,4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40:60) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5)		8

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IV	Thermochemistry 1. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process 2. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base 3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born-Haber cycle	14
Suggested Readings: 1. Skoog .D.A., West.D.M and Holler .F.J., "Analytical Chemistry: An Introduction", 7th edition, Saunders college publishing, Philadelphia,(2010). 2. Larry Hargis.G" Analytical Chemistry: Principles and Techniques" Pearson©(1988) Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University Suggestive digital platforms web links 4. https://www.labster.com/chemistry-virtual-labs/ 5. https://www.vlab.co.in/broad-area-chemical-sciences 6. http://chemcollective.org/vlabs		
This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class		
Suggested Continuous Evaluation Methods:		
Viva voce	(10 marks)	
Mock test	(10 marks)	
Overall performance	(05marks)	
Course prerequisites: To study this course, a student must have had the chemistry in 12th class		
Suggested equivalent online courses:		
Further Suggestions:		




Purpose Of Program

The purpose of a four-year undergraduate degree in chemistry is to provide students with a comprehensive understanding of chemical principles, laboratory techniques, and scientific methods. The program aims to develop critical thinking, problem-solving, and practical lab skills. Graduates are equipped for careers in research, industry, or advanced studies, with outcomes including mastery of core chemistry disciplines, hands-on lab proficiency, and the ability to apply chemical knowledge to solve real-world problems."

Specific Outcomes of 4-Year UG Program in Chemistry

1. Acquire fundamental knowledge of Organic, Inorganic, Physical, Analytical, and Environmental Chemistry.
2. Understand chemical reactions, molecular structure, bonding, thermodynamics, kinetics, and spectroscopy.
3. Apply chemical concepts to solve scientific, industrial, and environmental problems.
4. Perform laboratory experiments safely using standard chemical techniques and instruments.
5. Develop skills in qualitative and quantitative chemical analysis.
6. Use modern analytical instruments and digital tools for chemical investigations.
7. Interpret experimental data and prepare scientific reports accurately.
8. Develop critical thinking, problem-solving, and analytical abilities in chemistry.
9. Gain research aptitude through project work, literature survey, and data analysis.
10. Understand principles of green chemistry, chemical safety, and environmental sustainability.
11. Communicate scientific ideas effectively through presentations, seminars, and technical writing.
12. Work efficiently as an individual and as a member of multidisciplinary teams.
13. Develop professional ethics, leadership qualities, and social responsibility.
14. Acquire practical and technical skills required for employment in chemical, pharmaceutical, food, and related industries.
15. Prepare for higher studies, competitive examinations, research, and entrepreneurship in chemical sciences.
16. Demonstrate competency in handling chemicals, laboratory equipment, and scientific procedures responsibly.
17. Apply computational and statistical methods in chemical data interpretation.
18. Develop innovation and scientific temper for lifelong learning in chemistry and allied sciences.
19. Understand the role of chemistry in health, agriculture, energy, and sustainable development.
20. Undertake independent research projects and dissertation work in the fourth year of the programme



Fourth. Year (B.Sc. Honours)

Year	Sem	Course Code	Paper Title	Theory/ Prtical	Credit
4	VII	BO20701T	Inorganic Chemistry-I	Theory	4
		BO20702 T	Organic Chemistry-I	Theory	4
		BO20703 T	Physical Chemistry-I	Theory	4
		BO20704 T	Analytical Chemistry	Theory	4
		BO20705P	Inorganic. Organic, Physical , Viva Voice and Records	Practical	4
					20
	VIII	BO20801T	Inorganic Chemistry-II	Theory	4
		BO20802T	Organic Chemistry-II	Theory	4
		BO20803T	Physical Chemistry-II	Theory	4
		BO20804T	Research Methodology and Analytical Techniques	Theory	4
		BO20805P	Inorganic. Organic, Physical, Viva Voice and Records	Practical	4
					20

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Programme /Class- Bachelor, s Degree	Year – 4	Semester – Seven
Course Code- B020701T	Course Title	Credit-4
Paper-I	Inorganic Chemistry-I	

Inorganic Chemistry-I

UNIT-I: Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operation, definitions of groups, subgroups, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group. Schonflies symbols, representation of groups by matrices (representation of the C_n , C_{nv} , C_{nh} , D_{nh} etc groups to be worked out explicitly). Character of a representation. Character tables and their use in spectroscopy.

UNIT-II: Stereochemistry and Bonding in Main Group Compounds

VSEPR, of Walsh hybridization, diagrams (tri and penta-atomic Molecules), $d\pi$ - $p\pi$ bonds, bent rule and some simple reactions of covalently bonded molecules.

UNIT-III: Metal-Ligand Equilibria in Solution

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

UNIT-IV: Metal-Ligand Bonding

Limitation of crystal field theory, molecular orbital theory. Octahedral, tetrahedral and square Planar complexes, π -bonding and molecular orbital theory.

Books Recommended

1. F.A.Cotton and G. Wilkinson Advanced Inorganic Chemistry, 6th Edn.(1999),John Wiley & Sons, New York.
2. James E.Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison-Wesley York. Pub. Co., New
3. Chemistry of the elements, N.N.Greenwood and A.Earnshaw,
4. Pergammon. Inorganic Electronic Spectroscopy, A.B.P.Lever, Elsevier.
5. Comprehensive Coordination Chemistryeds., G.Wilkinson, R.D.Gillars Cleverty. and J.A.Mc Pergammon.
6. Magneto Chemistry, R.L.Carlin, Springer Verlag.




Programme /Class- Bachelor, s Degree	Year – 4	Semester – Seven
Course Code- B020702T	Course Title	Credit-4
Paper-II	Organic Chemistry-I	

Paper II-Organic Chemistry-I

UNIT-I:

Nature of bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes. Aromaticity in benzenoid and non-benzenoid Compounds, Huckel's rule, energy level of pi- molecular orbitals, annulenes, antiaromaticity.

UNIT-II

A-Stereochemistry Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity Elements of symmetry, chirality, molecule with more than one chiral center, threo and erythro isomers, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon biphenyls, allenes and spiranes

B-Reaction mechanism, Structure and reactivity Methods of determining mechanism, isotope effect. Generation structure, stability and reactivity of benzyne, carbenes and nitrenes. Effect of structure on reactivity resonance and field effect, steric effect, quantitative treatment.

UNIT-III:

Aliphatic nucleophilic substitution

The SN₂, SN₁, mixed SN₁ and SN₂, the neighboring group mechanism, neighboring group participation by Pi and Sigma bonds, anchimeric assistance Classical and non classical carbocations. The SN₁ mechanism nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile. Leaving group and reaction medium, ambident nucleophile, regioselectivity.

UNIT-IV:

A- Aromatic electrophilic substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The Ortho/Para ratio, ipso attack, orientation in other ring systems. Vilsmeier reaction, Gattermann-Koch reaction.

B- Aromatic nucleophilic substitution

The S_NAr. SN₂, benzyne and S_{RN}1, mechanism. Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet Hauser, and Smiles rearrangements.

BOOKS SUGGESTED

1. Advanced Organic Chemistry- Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A.Carey and R.J.Sundberg. Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University press.
5. Organic Chemistry, R.T.Morrison and R.N.Boyd. Prentice Hall.
6. Modern Organic Reactions H.O.House, Benjamin
7. Principles of Organic Synthesis, R.O.C.Norman and J.M. professional.
8. Pericyclic Reactions. S.M.Mukherji, Macmillan India. Coxon, Blackie Academic and 9. Reaction Mechanism in Organic Chemistry: S.M.Mukherji and S.P.Singh, Macmillan.
10. Stereochemistry of Organic Compounds D.Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S.Kalsi, New Age, International.

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Seven
Course Code- B020703T	Course Title	Credit-4
Paper-III	Physical Chemistry-I	

Paper-III: Physical Chemistry-I

UNIT-I

A-Unifying Principles

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, selection rules, intensity of spectral lines, Born Oppenheimer approximation, rotational, vibrational and electronic energy levels.

B- Microwave Spectroscopy

Classification of molecules, rigid rotor model, Effect of isotopic substitution on the transition frequencies intensities, non rigid rotor. Stark effect. Applications.

UNIT-II: Vibrational Spectroscopy

A. Infrared Spectroscopy

Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strength; anharmonicity, P.Q.R. branches, vibrations of polyatomic molecules, Selection rules, normal modes of vibration, factors affecting the band positions and intensities.

B. Raman Spectroscopy

Classical and quantum theories of Raman effect Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle. Applications of Raman spectroscopy.

UNIT-III: Quantum Chemistry

A. Fundamental Background

Operators, Postulates of Quantum Mechanics, Hamiltonian for different systems, Angular momentum.

B. Introduction to Exact quantum Mechanical Results:

The Schrodinger equation, discussion of solutions of the Schrodinger equation to some model system viz, particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

C. Approximate Methods:

The Variation theorem, linear variation principle. Perturbation theory (First order and non-degenerate)\ Application of variation method and perturbation theory to the Helium atom.

D. Electronic structures of Atoms:

Russel-Saunders terms and coupling schemes, term symbols for the pⁿ and dⁿ configurations Spin orbit coupling and Zeeman splitting, introduction to the methods of self-consistent field, Slater's type orbitals.

E. Molecular orbital theory:

Huckel theory of conjugated systems, bond order and charged density calculations. Application to ethylene, butadiene, cyclo-butadiene and Benzene molecules.

UNIT-IV: Chemical Dynamics

Methods of determining rate law, collision theory of reaction rates steric factors Activated complex theory, Arrhenius equation and the activated complex theory, ionic reactions kinetic salt effect, steady state kinetics. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde) photochemical (hydrogen-bromine reaction hydrogen-chloride reactions) and oscillatory reactions (Belousov Zhabotinsky reaction) homogeneous catalysis, kinetics of enzyme reaction General features of fast reaction study of fast reaction by relaxation method flash photolysis and the nuclear magnetic resonance method. Dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-kassel-marcus (RRKM) theories of unimolecular reactions).

BOOKS SUGGESTED:-

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Physical methods in Chemistry, R.S. Drago, Saunders College.
3. Introduction to Molecular Spectroscopy G.M. Barrow, McGraw Hill.
4. Physical Chemistry P.W. Atkins, ELBS.
5. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
6. Quantum Chemistry, Ira N. Levine. Prentice Hall.
7. Coulson's Valence, R. Mc Weeny, ELBS.
8. Chemical Kinetics, K.J. Laidler, McGraw-Hill.

Programme/Class-Bachelor, s Degree	Year-4	Semester-Seven
Course Code-B020704 T	Course Title	Credit-4
Paper-IV	Analytical Chemistry	

Analytical chemistry

Unit-I

Introduction

Role of analytical chemistry. Classification of analytical methods-classical and instrumental. Types of instrumental analysis, selecting an analytical method. Neatness and cleanliness, laboratory operations and practices, analytical balance. Techniques of weighing. errors. Volumetric glassware-cleaning and calibration of glassware. Sample preparations, dissolution and decompositions. gravimetric techniques. Selecting and handling of reagents. Laboratory notebooks. Safety in the analytical laboratory.

Unit-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 evaluation of data-in determine errors. the uses of statistics.

Unit-III

A-Food analysis

Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food, contamination in foodstuffs. Microscopic examination of food for adulterants. Pesticide analysis in food products. Extraction and purification of sample. HPLC.gas chromatography for organophosphates. Thin layer chromatography for identification of chlorinated pesticides in food products.

B-Analysis of water pollution

Origin of waste types water pollutants and effects. Sources of water pollution domestic, industrial, agricultural, soil and radioactive waste as sources of pollution, objectives of analysis parameter for analysis-colour turbidity total solid conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of Microgen. Heavy metal pollution, public health significance of Cadmium, Chromium, copper, lead, zinc, manganese, mercury and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueous systems. Measurement at Do, BOD, COD. Pesticides as water pollutants and analysis. Water pollution law and standards.

Unit-IV

Analysis of soil. fuel. body fluids and drugs

- (a) Analysis of soil: moisture, pH, total nitrogen, phosphorus, silicon, lime, magnesia, manganese, sulphur and alkali salts. of
- (b) Fuel analysis: solid, liquid and gas, ultimate and proximate analysis-heating and value grading coal. Liquid fuels-flash point, aniline point, octane number and carbon residue. Gaseous fuels-producer gas and water gas-calorific value.
- (c) Chemical chemistry: Composition of blood collection and preservation of samples. Clinical analysis, serum electrolytes, blood glucose, blood urea, nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphatases. Immunoassay: principles of radioimmunoassay (RIA) and applications. The blood gas analysis trace elements in the body.
- (d) Drug analysis: Narcotic and dangerous drugs. Screening by gas and thin layer chromatography and (spectrophotometric) measurements.





Books suggested

1. Analytical chemistry, G.D. Christian, J. Wiley.
2. Fundamentals of analytical chemistry, D.A. Skoog, D.M. West and F.J. Holler, W.B. Saunders.
3. Analytical chemistry principles, J.S. Kennedy, W.B. Saunders.
4. Analytical chemistry principles and techniques, L.G. Hargis, Prentice Hall.
5. Principles of instrumental analysis, D.A. Skoog, J.L. Loary, W.B. Saunders.
6. Principles of instrumental analysis, D.A. Skoog, W.B. Saunders.
7. Quantitative analysis, R.A. Day Jr and A.L. Underwood, Prentice
8. Environmental solution analysis, S.M. Khopkar, Wiley Eastern. Hall.
9. Basic concepts of analytical chemistry, S.M. Khopkar, Wiley Eastern.
10. Handbook of instrumental techniques for analytical chemistry, F. Settle, Prentice Hall.

by

for

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Seven
Course Code- B020705P	Course Title	Credit-4
Practical	Inorganic, Organic, Physical Viva Voice and reeords	

Practicals

Note:-

- i) 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.

Inorganic Chemistry

20

1. Qualitative analysis of mixtures Qualitative analysis of mixture containing trace elements Tl, Mo, W, Zr, Ti,Th,V, U(Two metal ions in cationic/anionic forms) and insoluble oxides, sulphates and halides. The mixture should not contain more than five cations and should be analyzed by semi micro technique.
2. Paper chromatography Paper chromatography separation of a mixture of the following and measurements of R_f-values.

a) Pb ,Ag , Hg , (b)Co , Ni , Cu (c) Ba ,Ca Sr

05

Organic Chemistry

15

1. Qualitative Analysis Separation, purification, and identification of binary mixture. Preparation of derivatives if possible

2. Organic Synthesis

10

- i. Adipic acid by chromic acid oxidation of cyclohexanol.
- ii. Triphenyl methanol from Benzoicacid.
- iii. Dibenzal acetone from Benzalehyde.
- iv. p-chlorotolune from p-toludine
- v. Synthesis of p-nitroaniline and p-bromoaniline.

Physical Chemistry(Anyone)

25

1. Study the adsorption of acetic acid on charcoal and draw the Freundlich isotherm.
2. Show that the order of reaction between acetone and Iodine is zero with respect to Iodine
3. Determination of congruent composition and temperature of a binary mixture e.g. diphenylamine-benzophenone system.
4. Determination of glass transition temperature of a given salt (e.g.CaCl₂) conductometrically.
5. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
6. Determination of the velocity Constant of decomposition of Benzene diazonium chloride.

Viva

15

Record

10

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Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020801T	Course Title	Credit-4
Paper-I	Inorganic Chemistry-II	

UNIT-I: Reaction mechanism of Transition Metal Complexes

Energy profile of a reaction, reaction reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reaction, reactions without metal ligands bond cleavage. Substitution reaction in square planar complexes. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross- reactions and Marcus-Hush theory, inner sphere type reactions.

UNIT-II: Electronic spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states; Orgel energy level and Tanabe-Suganodiagrams for transition metal complexes (d^1 - d^9 states); Charge transfer spectra; electronic spectra of octahedral and tetrahedral Co(II) and Ni(II) complexes and calculation of ligand-field parameters.

UNIT-III: Metalz-Complexes

Metal carbonyls, structure and bonding, vibrational spectra of Metal carbonyls for bonding and structural elucidation, important reactions of Metal carbonyls, preparation, bonding. Structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphine as ligand.

UNIT-IV: A-Metal Clusters

Higher boranes, carboranes, metallocarboranes

B-Isopolv and hetero poly acids and salts

Books Recommended

1. F.A.Cotton and G.Wilkinson Advanced Inorganic Chemistry, 6hEdn.(1999), John Wiley & Sons, New York.
2. James E.Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison-Wesley Pub.Co., New York.
3. Chemistry of the elements, N.N.Greenwood and A.Earnshaw, Pergammon.
4. Inorganic Electronic Spectroscopy, A.B.P.Lever, Elsevier.
5. Comprehensive Coordination Chemistry eds., G.Wilkinson, R.D.Gillars and J.A. Mc Cleverty. Pergammon.

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020802T	Course Title	Credit-4
Paper-II	Organic Chemistry-II	

UNIT-1: Free radical reactions:

Free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridge head. The effect of solvent on reactivity. Arylation of aromatic compounds by diazonium salt, Hunsdiecker reaction.

UNIT-II: A-Addition to carbon-carbon multiple bond:

Mechanistic and stereo-chemical aspects of addition reactions involving electrophile, nucleophile and free radicals, regio and chemo selectivity, orientation and reactivity. Hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

B - Addition to carbon hetero atom multiple bonds:

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles, Wittig reaction mechanism of condensation reactions involving enolate, Knoevenagel, Mannich, Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

UNIT-III: Elimination reactions:

The E2, E1 and E1cB mechanism. Orientation of double bond. Reactivity effect of substrate structures. Attacking base, the leaving group and the medium. Mechanism and orientation on Pyrolytic elimination.

UNIT-IV: Pericyclic reactions:

Molecular orbital symmetry, frontier orbitals of ethylene, 1, 3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems. Cycloadditions-antarafacial and Suprafacial 'additions, $4n$ and- $4n+2$ system, Sigma tropic rearrangements-suprafacial and antarafacial shift of H, sigmatropic shifts involving carbon moieties, 3, 3 and 5,5 sigmatropic rearrangements. Claisen-Cope and Aza Cope rearrangement. Fluxional tautomerism. Ene reaction.

BOOKS SUGGESTED

1. Advanced Organic Chemistry- Reactions, Mechanism and Structure, Jerry March, JohnWiley.
2. Advanced Organic Chemistry, F.A.Carey and R.J.Sundberg. Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, K.Ingold, Cornell University press.
5. Organic Chemistry, R.T.Morrison and R.N.Boyd. Prentice Hall.
6. Modern Organic Reactions H.O.House, Benjamin
7. Principles of Organic Synthesis, R.O.C.Norman and J.M. Coxon, Blackie Academic and professional.
8. Pericyclic Reactions. S.M.Mukherji, Macmillan India.
9. Reaction Mechanism in Organic Chemistry S.M.Mukherji and S.P.Singh, Macmillan.
10. Stereochemistry of Organic Compounds D.Nasipuri, New Age International.

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020803T	Course Title	Credit-4
Paper-III	Physical Chemistry-II	

UNIT-I: Thermodynamics

A-Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy and chemical potential. Partial, molar properties partial molar free energy, partial molar volume and its determination, Gibbe -Duhem equation, concept of fugacity (by graphical method), Activity and Activity coefficient.

B-Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution. Canonical, grand canonical and micro canonical ensembles, The Boltzmann distribution law. Partition Functions-translational, rotational, vibrational and electronic partition function. Calculation of thermodynamic properties and equilibrium constant in terms of partition function. Fermi-Dirac and BoseEinstein statistics.

C-Non-Equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, Entropy balance equation for different irreversible processes (e.g heat flow chemical reaction etc. Transformation of the generalized fluxes and forces non-equilibrium stationary phenomenological equations, Onsager' sreciprocity relation, electrokinetic phenomena.

UNIT-II: Surface chemistry:

A-Adsorption: Gibbs adsorption isotherm estimation of surface area (BET equation), surface films on liquids (Electro kinetic phenomenon), catalytic activity at surfaces.

B-Micelles: Surface active agents, classification of surface active agents, micellization hydrophobic interactions, Critical micellar concentration (CMC) Factors affecting CMC of surfactants counterion binding to Micelles, solubilization micro emulsion reverse micelles.

UNIT-III: Macromolecules:

Polymer-definition, types of polymer, electrically conducting fire resistant, liquid crystal polymer, Kinetics of polymerization, Molecular mass, number and mass average molecular mass molecular mass determination (Osmometry, Viscometry diffusion and light scattering method) sedimentation chain configuration of macromolecules, Calculation of average dimension of various chain structures.

UNIT-IV: Electrochemistry:

Debye- Huckel theory of activity coefficient of electrolytic solutions, applicability and limitations of DebyeHuckel limiting law, ionic strength, stucture of electified interfaces, Helmholtz- perrin, Guoy-Chapman and stern models. Over potentials, exchange current density, derivation of Butler-volmer equation, Tafel plot. Electrocatalysis, Influence of various parameters, Hydrogen electrode. Polarographytheory, interpretation of a polarographic curve, instrumentation, limiting current, residual and charging current, diffusion current. Supporting electrolytes, Llkovicequation, half wave potential and its significance. Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

BOOKS SUGGESTED

1. Kinetics and Mechanism of Chemical Transformations J. Rajaraman and J. Kuriacose Me Millan.
2. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
3. Modem Electrochemistry Vol. I and Vol. II J.O.M. Bockris and AK.N. Reddy, Plenum.
4. Introduction to Polymer Science V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
5. Physical Chemistry P.W. Atkins, ELBS

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B02804T	Course Title	Credit-4
Paper-IV	Research Methodology and Analytical Techniques	

Unit- 1 Research Methodology Meaning, Objective Motivation and types of research Approaches its significance and methods vs methodology, Scientific methods of research. Research Problem Selection Necessity Basic Principal of Experimental and different Research design Separation technique involved in research– Distillation, Crystallization, Filtration, Evaporation, Extraction, Adsorption Centrifugation, TLC, GLC, and HPLC, Paper Chromatography

Unit- 2 Polarography: Coulometry and Current Voltage Curve, High Frequency Titrations Polarography, Differential Polarography, Derivative Polarography and Tast Polarography, Polarography of Inorganic Complexes and molten salts.

Optical Rotatory Dispersion & Circular Dichroism:

Chiroptical properties of Organic Molecules: Origin Theory CD, ORD-VCD- principles and application , haloketone rules, sector rules, helicity rules.

Unit- 3 Thermal Analysis : Theory, methodology and application of thermogravimetric analysis (TGA), Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC), Principles, techniques and application of thermometric titration methods.

Unit- 4 Radiochemical Analysis : Radiochemical analysis, Dilution analysis activation analysis, Szilard chalmers reaction, Tracer technique and mass spectrography.

Recommended Books:

- Analytical Chemistry, G.D. Christian, J. Wiley,
- Fundamentals of Analytical chemistry D.A. Skoog D.A. Skoog D.M. West F.J. Holler W.B. Saunders.
- Analytical Chemistry–Principles J.S. Kennedy, W.B. Saunderson.
- Analytical Chemistry–Principles and Techniques. L.G. Hargis Prentice Hall
- Principles of Instrumental Analysis, D.A. Skoog. And J.L. Loaiy. W.B. Saunders

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020805P	Course Title	Credit-4
Practical	Inorganic, Organic, Physical Viva Voice and records	

Practicals

A complete record 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.

Inorganic Chemistry

- I. Quantitative estimation of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc involving volumetric and gravimetric methods.
- II. Preparation of selective inorganic compounds (any one)
 - (a) VO(acac)₂,
 - (b) Na[Cr(NH₃)₂(SCN)₄]
 - (c) K₃[Fe(C₂O₄)₃]
 - (d) Prussian Blue
 - (e) [Co(Py)₂Cl₂]
 - (f) [Cu(NH₃)₄]SO₄ · H₂O

Organic Chemistry Quantitative Synthesis (Any Two)

- I. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
- II. Estimation of amine/phenols using bromated bromide solution or acetylation method.
- III. Determination of iodine and saponification values of an oil sample.
- IV. Determination of DO, COD and BOD of water sample.

Physical Chemistry (Anyone)

- I. Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by Π . III. cryoscopic method and to determine the activity coefficient of an electrolyte.
- II. Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.
- III. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
- IV. Determination of solubility and solubility product of sparingly soluble salts (e.g PbSO₄, BaSO₄) conductometrically.
- V. Determination of the strength of strong and weak acids in a given mixture conductometrically

Signature

Signature

Fourth. Year (B.Sc. Honours With Research)

For the students who secured 75% marks or More in First Six Semesters

Year	Sem	Course Code	Paper Title	Theory/ Prtical	Credit
4	VII	BO2O701T	Inorganic Chemistry-I	Theory	4
		BO2O702 T	Organic Chemistry-I	Th eory	4
		BO2O703 T	Physical Chemistry-I	Theory	4
		BO2O704RP	Research Project/ Dissertation/ Field Survey	Theory	4
		BO2O705P	Inorganic. Organic, Physical , Viva Voice and Records	Practical	4
					20
	VIII	B020801T	Inorganic Chemistry-II	Theory	4
		B020802T	Organic Chemistry-II	Theory	4
		B020803T	Physical Chemistry-II	Theory	4
		B020804RP	Research Project/ Dissertation/ Field Survey	Theory	4
		B020805P	Inorganic. Organic, Physical, Viva Voice and Records	Practical	4
					20

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Seven
Course Code- B020701T	Course Title	Credit-4
Paper-I	Inorganic Chemistry-I	

Inorganic Chemistry-I

UNIT-I: Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operation, definitions of groups, subgroups, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group. Schonflies symbols, representation of groups by matrices (representation of the C_n , C_{nv} , C_{nh} , D_{nh} etc groups to be worked out explicitly). Character of a representation. Character tables and their use in spectroscopy.

UNIT-II: Stereochemistry and Bonding in Main Group Compounds

VSEPR, of Walsh hybridization, diagrams (tri and penta-atomic Molecules), $d\pi$ - $p\pi$ bonds, bent rule and some simple reactions of covalently bonded molecules.

UNIT-III: Metal-Ligand Equilibria in Solution

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

UNIT-IV: Metal-Ligand Bonding

Limitation of crystal field theory, molecular orbital theory. Octahedral, tetrahedral and square Planar complexes, π -bonding and molecular orbital theory.

Books Recommended

1. F.A.Cotton and G. Wilkinson Advanced Inorganic Chemistry, 6th Edn.(1999), John Wiley & Sons, New York.
2. James E.Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison-Wesley York. Pub. Co., New
3. Chemistry of the elements, N.N.Greenwood and A.Earnshaw,
4. Pergammon. Inorganic Electronic Spectroscopy, A.B.P.Lever, Elsevier.
5. Comprehensive Coordination Chemistryeds., G.Wilkinson, R.D.Gillars Cleverty. and J.A.Mc Pergammon.
6. Magneto Chemistry, R.L.Carlin, Springer Verlag.

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Seven
Course Code- B020702T	Course Title	Credit-4
Paper-II	Organic Chemistry-I	

Paper II-Organic Chemistry-I

UNIT-I:

Nature of bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes. Aromaticity in benzenoid and non-benzenoid Compounds, Huckel's rule, energy level of pi- molecular orbitals, annulenes, antiaromaticity.

UNIT-II

A-Stereochemistry Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity Elements of symmetry, chirality, molecule with more than one chiral center, threo and erythro isomers, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon biphenyls, allenes and spiranes

B-Reaction mechanism, Structure and reactivity Methods of determining mechanism, isotope effect. Generation structure, stability and reactivity of benzyne, carbenes and nitrenes. Effect of structure on reactivity resonance and field effect, steric effect, quantitative treatment.

UNIT-III:

Aliphatic nucleophilic substitution

The SN₂, SN, mixed SN₁; and SN₂, the neighboring group mechanism, neighboring group participation by Pi and Sigma bonds, anchimeric assistance Classical and non classical carbocations. The SN₁, mechanism nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile. Leaving group and reaction medium, ambident nucleophile, regioselectivity.

UNIT-IV:

A- Aromatic electrophilic substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The Ortho/Para ratio, ipso attack, orientation in other ring systems. Vilsmeier reaction, Gattermann-Koch reaction.

B- Aromatic nucleophilic substitution

The S_NAr. SN, benzyne and S_{RN}, mechanism. Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet Hauser, and Smiles rearrangements.

BOOKS SUGGESTED

1. Advanced Organic Chemistry- Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A.Carey and R.J.Sundberg. Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University press.
5. Organic Chemistry, R.T.Morrison and R.N.Boyd. Prentice Hall.
6. Modern Organic Reactions H.O.House, Benjamin
7. Principles of Organic Synthesis, R.O.C.Norman and J.M. professional.
8. Pericyclic Reactions. S.M.Mukherji, Macmillan India. Coxon, Blackie Academic and 9. Reaction Mechanism in Organic Chemistry: S.M.Mukherji and S.P.Singh, Macmillan.
10. Stereochemistry of Organic Compounds D.Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S.Kalsi, New Age, International.

Programme /Class - Bachelor's Degree	Year - 4	Semester- Seven
Course Code-B020703T	Course Title	Credit -4
Paper - 3	Physical Chemistry-I	

Paper-III: Physical Chemistry-I

Credit-4

UNIT-I

A-Unifying Principles

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, selection rules, intensity of spectral lines. Born Oppenheimer approximation, rotational, vibrational and electronic energy levels.

B- Microwave Spectroscopy

Classification of molecules, rigid rotor model, Effect of isotopic substitution on the transition frequencies intensities, non rigid rotor. Stark effect. Applications.

UNIT-II: Vibrational Spectroscopy

A. Infrared Spectroscopy

Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strength; anharmonicity, P.Q.R. branches, vibrations of polyatomic molecules, Selection rules, normal modes of vibration, factors affecting the band positions and intensities.

B. Raman Spectroscopy

Classical and quantum theories of Raman effect Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle. Applications of Raman spectroscopy.

UNIT-III: Quantum Chemistry

A. Fundamental Background

Operators, Postulates of Quantum Mechanics, Hamiltonian for different systems, Angular momentum.

B. Introduction to Exact quantum Mechanical Results:

The Schrodinger equation, discussion of solutions of the Schrodinger equation to some model system viz, particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

C. Approximate Methods:

The Variation theorem, linear variation principle. Perturbation theory (First order and non-degenerate)\ Application of variation method and perturbation theory to the Helium atom.

D. Electronic structures of Atoms:

Russel-Saunders terms and coupling schemes, term symbols for the p^n and d^n configurations Spin orbit coupling and Zeeman splitting, introduction to the methods of self-consistent field, Slater's type orbitals.

E. Molecular orbital theory:

Huckel theory of conjugated systems, bond order and charged density calculations. Application to ethylene, butadiene, cyclo-butadiene and Benzene molecules.

UNIT-IV: Chemical Dynamics

Methods of determining rate law, collision theory of reaction rates steric factors Activated complex theory, Arrhenius equation and the activated complex theory. Ionic reactions kinetic salt effect, steady state kinetics. Dynamic chain(hydrogen-bromine reaction, pyrolysis of acetaldehyde) photochemical (hydrogen- bromine reaction hydrogen-chloride reactions) and oscillatory reactions (Belousov Zhabotinsky reaction) homogeneous catalysis, kinetics of enzyme reaction General features of fast reaction study of fast reaction by relaxation method flash photolysis and the nuclear magnetic resonance method. Dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Rampersperger-kassel-marcus (RRKM) theories of unimolecular reactions).

BOOKS SUGGESTED:-

1. Modern Spectroscopy, J.M.Hollas, John Wiley.
2. Physical methods in Chemistry, R.S.Drago, Saunders College.
3. Introduction to Molecular Spectroscopy G.M.Barrow, McGraw Hill.
4. Physical Chemistry P.W.Atkins, ELBS.
5. Introduction to Quantum Chemistry, A.K.Chandra, Tata McGraw Hill.
6. Quantum Chemistry, Ira N.Levine, Prentice Hall.
7. Coulson's Valence, R.McWeeny, ELBS.
8. Chemical Kinetics, K.J.Laidler, McGraw-Hill.
9. Kinetics and Mechanism of Chemical Transformations J.Rajaraman and J.Kuriacose McMillan.

Note:- Code B020704 RP Research Project/Dissertation
is Paper-IV

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Programme /Class- Bachelor, s Degree	Year – 4	Semester – Seven
Course Code- B020705P	Course Title	Credit-4
Practical	Inorganic, Organic, Physical Viva Voice and reeords	

Practicals

4 Note:-

- i) 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.

Inorganic Chemistry

1. Qualitative analysis of mixtures 20 Qualitative analysis of mixture containing trace elements Tl, Mo, W, Zr, Ti,Th,V, U(Two metal ions in cationic/anionic forms) and insoluble oxides, sulphates and halides. The mixture should not contain more than five cations and should be analyzed by semi micro technique.
2. Paper chromatography Paper chromatography separation of a mixture of the following and measurements of Rf-values. a)Pb²⁺,Ag,Hg²⁺(b)Co³⁺,Ni²⁺, Cu²⁺(c)Ba²⁺,Ca²⁺,Sr²⁺

Organic Chemistry

1. Qualitative Analysis Separation, purification, and identification of binary mixture. Preparation of derivatives if possible
2. Organic Synthesis
 - i. Adipic acid by chromic acid oxidation of cyclohexanol.
 - ii. Triphenyl methanol from Benzoicacid.
 - iii. Dibenzal acetone from Benzalehyde.
 - iv. p-chlorotolune from p-toludine
 - v. Synthesis of p-nitroaniline and p-bromoaniline.

Physical Chemistry(Anyone)

1. Study the adsorption of acetic acid on charcoal and draw the Freundlich isotherm.
2. Show that the order of reaction between acetone and Iodine is zero with respect to Iodine
3. Determination of congruent composition and temperature of a binary mixture e.g. diphenylamine-benzophenone system.
4. Determination of glass transition temperature of a given salt (e.g.,CaCl₂) conductometrically.
5. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
6. Determination of the velocity Constant of decomposition of Benzene diazonium chloride.

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020801T	Course Title	Credit-4
Paper-I	Inorganic Chemistry-II	

UNIT-I: Reaction mechanism of Transition Metal Complexes

Energy profile of a reaction, reaction reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reaction, reactions without metal ligands bond cleavage. Substitution reaction in square planar complexes. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross- reactions and Marcus-Hush theory, inner sphere type reactions.

UNIT-II: Electronic spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states; Orgel energy level and Tanabe-Suganodiagrams for transition metal complexes (d^1 - d^9 states); Charge transfer spectra; electronic spectra of octahedral and tetrahedral Co(II) and Ni(II) complexes and calculation of ligand-field parameters.

UNIT-III: Metalz-Complexes

Metal carbonyls, structure and bonding, vibrational spectra of Metal carbonyls for bonding and structural elucidation, important reactions of Metal carbonyls, preparation, bonding. Structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphine as ligand.

UNIT-IV: A-Metal Clusters

Higher boranes, carboranes, metallocarboranes

B-Isopolv and hetero poly acids and salts

Books Recommended

1. F.A.Cotton and G.Wilkinson Advanced Inorganic Chemistry, 6hEdn.(1999), John Wiley & Sons, New York.
2. James E.Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison-Wesley Pub.Co., New York.
3. Chemistry of the elements, N.N.Greenwood and A.Earnshaw, Pergammon.
4. Inorganic Electronic Spectroscopy, A.B.P.Lever, Elsevier.
5. Comprehensive Coordination Chemistry eds., G.Wilkinson, R.D.Gillars and J.A. Mc Cleverty. Pergammon.

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Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020802T	Course Title	Credit-4
Paper-II	Organic Chemistry-II	

UNIT-1: Free radical reactions:

Free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridge head. The effect of solvent on reactivity. Arylation of aromatic compounds by diazonium salt, Hunsdiecker reaction.

UNIT-II: A-Addition to carbon-carbon multiple bond:

Mechanistic and stereo-chemical aspects of addition reactions involving electrophile, nucleophile and free radicals, regio and chemo selectivity, orientation and reactivity. Hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

B - Addition to carbon hetero atom multiple bonds:

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles, Wittig reaction mechanism of condensation reactions involving enolate, Knoevenagel, Mannich, Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

UNIT-III: Elimination reactions:

The E2, E1 and E1cB mechanism. Orientation of double bond. Reactivity effect of substrate structures. Attacking base, the leaving group and the medium. Mechanism and orientation on Pyrolytic elimination.

UNIT-IV: Pericyclic reactions:

Molecular orbital symmetry, frontier orbitals of ethylene, 1, 3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems. Cycloadditions-antarafacial and Suprafacial 'additions, $4n$ and- $4n+2$ system, Sigma tropic rearrangements-suprafacial and antarafacial shift of H, sigmatropic shifts involving carbon moieties, 3, 3 and 5,5 sigmatropic rearrangements. Claisen-Cope and Aza Cope rearrangement. Fluxional tautomerism. Ene reaction.

BOOKS SUGGESTED

1. Advanced Organic Chemistry- Reactions, Mechanism and Structure, Jerry March, JohnWiley.
2. Advanced Organic Chemistry, F.A.Carey and R.J.Sundberg.Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, K.Ingold, Cornell University press.
5. Organic Chemistry, R.T.Morrison and R.N.Boyd. Prentice Hall.
6. Modern Organic Reactions H.O.House, Benjamin
7. Principles of Organic Synthesis, R.O.C.Norman and J.M. Coxon, Blackie Academic and professional.
8. Pericyclic Reactions. S.M.Mukherji, Macmillan India.
9. Reaction Mechanism in Organic Chemistry S.M.Mukherji and S.P.Singh, Macmillan.
10. Stereochemistry of Organic Compounds D.Nasipuri, New Age International.

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020803T	Course Title	Credit-4
Paper-III	Physical Chemistry-II	

UNIT-I: Thermodynamics

A-Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy and chemical potential. Partial, molar properties partial molar free energy, partial molar volume and its determination, Gibbs-Duhem equation, concept of fugacity (by graphical method), Activity and Activity coefficient.

B-Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution. Canonical, grand canonical and micro canonical ensembles, The Boltzmann distribution law. Partition Functions-translational, rotational, vibrational and electronic partition function. Calculation of thermodynamic properties and equilibrium constant in terms of partition function. Fermi-Dirac and Bose-Einstein statistics.

C-Non-Equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, Entropy balance equation for different irreversible processes (e.g. heat flow, chemical reaction etc). Transformation of the generalized fluxes and forces, non-equilibrium stationary phenomenological equations, Onsager's reciprocity relation, electrokinetic phenomena.

UNIT-II: Surface chemistry:

A-Adsorption: Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electrokinetic phenomenon), catalytic activity at surfaces.

B-Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interactions, Critical micellar concentration (CMC) Factors affecting CMC of surfactants, counterion binding to micelles, solubilization, microemulsion, reverse micelles.

UNIT-III: Macromolecules:

Polymer-definition, types of polymer, electrically conducting, fire resistant, liquid crystal polymer, Kinetics of polymerization, Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, Viscometry, diffusion and light scattering method), sedimentation, chain configuration of macromolecules, Calculation of average dimension of various chain structures.

UNIT-IV: Electrochemistry:

Debye-Huckel theory of activity coefficient of electrolytic solutions, applicability and limitations of Debye-Huckel limiting law, ionic strength, structure of electrified interfaces, Helmholtz-Perrin, Gouy-Chapman and Stern models. Overpotentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot. Electrocatalysis, Influence of various parameters, Hydrogen electrode. Polarography-theory, interpretation of a polarographic curve, instrumentation, limiting current, residual and charging current, diffusion current. Supporting electrolytes, Llovic equation, half-wave potential and its significance. Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

BOOKS SUGGESTED

1. Kinetics and Mechanism of Chemical Transformations J. Rajaraman and J. Kuriacose Me Millan.
2. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
3. Modern Electrochemistry Vol. I and Vol. II J.O.M. Bockris and A.K.N. Reddy, Plenum.
4. Introduction to Polymer Science V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
5. Physical Chemistry P.W. Atkins, ELBS

Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020805P	Course Title	Credit-4
Paper- IV	Research Project Com Dissertation	

Research Project Com Dissertation

For Projcet work and Dissrtation, the area of the work would to be decided by the advisor/mentor. On completion of the project work, studentes have to submit the work in Form of a thesis followed by oral presentation in the presence of Internal exminor provided by university

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Programme /Class- Bachelor, s Degree	Year – 4	Semester – Eighth
Course Code- B020805P	Course Title	Credit-4
Practical	Inorganic, Organic, Physical Viva Voice and records	

Practicals

A complete record 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.

Inorganic Chemistry

- I. Quantitative estimation of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc involving volumetric and gravimetric methods.
- II. Preparation of selective inorganic compounds (any one)
 - (a) VO(acac)₂,
 - (b) Na[Cr(NH₃)₂(SCN)₄]
 - (c) K₃[Fe(C₂O₄)₃]
 - (d) Prussian Blue
 - (e) [Co(Py)₂Cl₂]
 - (f) [Cu(NH₃)₄]SO₄ · H₂O

Organic Chemistry Quantitative Synthesis (Any Two)

- I. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
- II. Estimation of amine/phenols using bromated bromide solution or acetylation method.
- III. Determination of iodine and saponification values of an oil sample.
- IV. Determination of DO, COD and BOD of water sample.

Physical Chemistry (Anyone)

- I. Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by Π . III. cryoscopic method and to determine the activity coefficient of an electrolyte.
- II. Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.
- III. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
- IV. Determination of solubility and solubility product of sparingly soluble salts (e.g PbSO₄, BaSO₄) conductometrically.
- V. Determination of the strength of strong and weak acids in a given mixture conductometrically.

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One Year P.G

(IX & X Semester)

Distribution of Course or Marks

IX Semester

Course Code	Paper No	Course Title	Credit	Marks	No. of Lectures (in Hors)
B020901T	I	Application of Spectroscopy	4	100 (75+25)	60
B020902T	II	Bio Inorganic & Bioorganic Chemistry	4	100 (75+25)	60
B020903T	III	BioPhysical Chemistry and Solid -State Chemistry	4	100 (75+25)	60
B020904P	Practical	Inorganic, Organic, Physical , Viva –Voce & Records	4	100 (75+25)	120
B020905RP		Research Project/ Dissertation/ Field Survey	4	100	

X Semester

Course Code	Paper No	Course Title	Credit	Marks	No. of Lectures (in Hors)
B0201001T	I	Elective Paper-I	4	100 (75+25)	60
B0201002T	II	Elective Paper-II	4	100 (75+25)	60
B0201003T	III	Elective Paper-III	4	100 (75+25)	60
B0201004P	Practical	Inorganic, Organic, Physical , Viva –Voce & Records	4	100 (75+25)	120
B0201005RP		Research Project/ Dissertation/ Field Survey	4	100	



One Year P.G **(IX Semester)**

Distribution of Course or Marks

IX Semester

Course Code	Paper No	Course Title	Credit	Marks	No. of Lectures (in Hors)
B020901T	I	Application of Spectroscopy	4	100 (75+25)	60
B020902T	II	Bio Inorganic & Bioorganic Chemistry	4	100 (75+25)	60
B020903T	III	BioPhysical Chemistry and Solid -State Chemistry	4	100 (75+25)	60
B020904P	Practical	Inorganic, Organic, Physical , Viva –Voce & Records	4	100 (75+25)	120
B020905PR		Research Project	4	100	



Program / Class One Year PG Program	Year- 1	Semester - IX
Course Code – B020901T	Course Title	Credit- 4
PAPER – I	Application of Spectroscopy	

UNIT-I: Applications of Spectroscopy in Inorganic Chemistry A

Vibrational Spectroscopy

Symmetry and shapes of AB₂, AB₃ and AB_n, mode of bonding of ambidentate ligands such as thiocyanate, nitrate, sulphate and urea, application of Raman spectroscopy particularly for the study of ionic equilibrium in solution.

B-Electron Spin Resonance Spectroscopy

Hyperline coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes having one unpaired electron and inorganic free radicals such as PH₄, F₂ and BH₃.

C- Mossbauer Spectroscopy

Basic principles, spectral parameters and spectrum display. Application of the techniques to the studies of (1) bonding and structures of Fe²⁺ and Fe³⁺ compounds including those of intermediate spin and (2) Sn²⁺ and Sn compounds nature of M-L bond, coordination number, structure.

UNIT-II: Applications of Spectroscopy-I inorganic Chemistry A

Ultraviolet and Visible Spectroscopy

Various electronic transitions (185-800 nm). Beer Lambert law. Effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, ultraviolet spectra of aromatic and heterocyclic compounds.

B-Infrared Spectroscopy

Characteristic vibrational frequencies of aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides and acids), effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonances.

UNIT-III: Applications of Spectroscopy-II inorganic Chemistry A

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 and carboxylic acids) chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra).

B-Carbon-13 NMR Spectroscopy

General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Spectrometry

UNIT-IV: Applications of Spectroscopy-III inorganic Chemistry Mass Spectrometry

Introduction, ion production- E1, C1, FD and FAB, factors affecting the fragmentation, ion analysis, ion abundance, mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement, Nitrogen rule.

Books suggested

1. Physical Methods for Chemistry, R.S.Dargo, Saunders Company
2. Structural Methods in Inorganic Chemistry, E.A.V.Ebsworth, Rankin and Cradock-ELBS.
3. Infrared and Raman Spectra Inorganic and Coordination Compounds, K.Nakamoto, Wiley.
4. Progress in Inorganic Chemistry, 8 edition, F.A.Cotton
5. Transition Metal Chemistry, R.L.Carlin, vol.3, Dekker.
6. Inorganic Electronic Spectroscopy, A.P.B.Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Horwood.
8. Practical NMR Spectroscopy, M.L.Martin, J.J.Delpeuch and G.J.Martin, Heyden.
9. Spectrometric Identification of Organic Compounds, R.M.Silverstein. G.C. Bassler and T.C. Morill,
10. Introduction to NMR Spectroscopy, R.J.Abraham, J.Fischer and P.Loftus, Wiley
11. Application of Spectroscopy of Organic Compounds, J.R.Dyer, Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I.Fleming, TataMc-GrawHill

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Program / Class One Year PG Program	Year- 1	Semester - IX
Course Code – B020902T	Course Title	Credit- 4
PAPER – II	Bioinorganic Chemistry & Bioorganic Chemistry	

Section-'A': (Bioinorganic Chemistry)

UNIT-I

A-Metal Ions in Biological Systems

Essential and trace metals

B-Na/K Pump

Role of metal ions in biological processes

UNIT-II

A-Bioenergetics and ATP Cycle

DNA polymerization, glucose storage, metal complexes in transmission of energy: chlorophylls

B-Transport and Storage of Dioxygen

Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanins and hemerythrin model synthetic complexes in iron, cobalt and copper

UNIT-III

Electron Transfer in Biology

Structure and function of metalloproteins in electron transport processes- cytochromes and iron-sulphur proteins.

UNIT-IV

Nitrogenase

Biological nitrogen fixation, molybdenum nitrogenase Books suggested

1. Principle of Bioinorganic Chemistry, S.J.Lippard and J.M.Berg, University Science Books
2. Bioinorganic Chemistry, Bertini H.B. Gray, S.J.Lippard and J.S.Valentine, University Science Books
3. Inorganic Biochemistry, vols.I and II, G.L.Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, Vols 18 & 38, J.J.Lippard, Wiley.

Section-'B' Bioorganic Chemistry

UNIT-I

A-Introduction

Basic consideration Proximity effects and molecular adaptation

B-Enzymes

Introduction and historical perspective chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition

UNIT-II

A-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.

B-Kinds of Reactions Catalysed by Enzymes

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes Transfer of sulphate, addition and elimination reactions,

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enolic intermediates in isomerization reactions, 1,3-cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

UNIT-III

A-Co-Enzyme Chemistry

Cofactor as derived from vitamins coenzyme S, Prosthetic groups, apoenzymes structure and biological functions of coenzyme A thiamine pyrophosphate, pyridoxal phosphate. NAD I, NADP FMN, FAD, lipoic acid, vitamin B

B-Enzyme Models.

Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry prochirality. Biomimetic chemistry crown ethers, cryptates Cyclodextrins. cyclodextrin- based enzyme models calixarenes ionophores. micelles. synthetic enzymes or synzymes

UNIT-IV

1 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, use of enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy.

Books Suggested

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penmy. Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall
3. Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suck Chapman and H Hall
4. Enzyme Mechanisms De.M.1. Page and A. Williams. Royal Society of Chemistry 6
5. Fundamentals of Enzymology. N.C. Price and L Stevens. Oxford University Press
6. Immobilized Enzymes: An introduction and application in Biotechnology-Michael D. Trevan-John Wiley.
7. Enzyme Structure and Mechanism, A. Fersht, W H. Freeman
8. Biochemistry: The Chemical Reactions of Living Cells. D.E. Metzler. Academic Press



Program / Class One Year PG Program	Year- 1	Semester - IX
Course Code – B020903T	Course Title	Credit- 4
PAPER – III	BioPhysical Chemistry& Solid State Chemistry	

UNIT-I: BioPhysical Chemistry& Solid State Chemistry

A-Biological cell and its Constituents

Biological cell, structure and functions of proteins, enzymes. DNA and RNA in living systems. Helix coil transition.

B-Bioenergetics

Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

UNIT-II

A-Biopolymer Interactions

Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic force, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.

B-Thermodynamics of Biopolymer Solutions Thermodynamics of biopolymer solutions, osmotic pressure membrane equilibrium, muscular contraction and energy generation in mechano-chemical system.

UNIT-III

A-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.

B-Biopolymers and their Molecular Weights Evaluation of size shape molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity viscosity electrophoresis and rotational motions.

UNIT-IV : A-Solid State Reactions

A-Solid State Reactions

Solid state chemistry General Principles for reaction between two solids: Reaction conditions, structural considerations, surface area, reactivity, kinetics of solid state reactions.

B-Crystal Defects and Non-Stoichiometry

Perfect and imperfect crystals, intrinsic and extrinsic defects- point defects, vacancies- Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, non-stoichiometry and defects.

C-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- photoelectric effects.

Book Suggested

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry, E.E. Conn and F. K. Stumpf, John Wiley.
6. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H. Dugas and C. Penny, Springer Verlag.

Signature

Signature

7. Macromolecules: Structure and Functions, F.Wold, Prentice Hall.
8. Solid state Chemistry and its Applications, A.R. West, Plenum.
9. Principles of the Solid State, H.V. Keer, Wiley Eastern.
10. Solid State Chemistry, N.B. Hannay.
11. Solid State Chemistry, D.K. Chakrabarty, New Age International.

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Program / Class One Year PG Program	Year- 1	Semester - IX
Course Code – B020904P	Course Title	Credit- 4
Practical	Inorganic, Organic, Physical, Viva-Voce & Records	

Inorganic Practicals

25

- I. Preparation of selected inorganic compounds and structural elucidation on the basis of given spectra (IR, ESR and MS) Selection can be made from the following
 - 1 Sodium amide 2- Dichlorophenyl borane PhBCl_2
 - 2 Sn(IV) Iodide, Sn(IV) chloride and Sn(II) iodide
 - 3 Ammonium hexa chorostannate $\text{CNH}_4\text{SnCl}_6$,
 - 4 Trichlorodiphenyl antimony(v) hydrate
 - 5 Sodium Tetrathionate, $\text{Na}_2\text{S}_4\text{O}_6$
 - 6 Metal Complexes of dimethyl Sulfoxide, CuCl_2 , 2DMSO.
 - 7 Metal acetylacetonate.
 - 8 Ionexchange separation of oxidation state of V.
 - 9 Preparation of Fe(II) Chloride.
 - 10 Phosphine Ph_3P and its transition metal complexes.
 - 11 Ferrocene
 - 12 Copper glycine Complex
- II. Chromatographic Separations:
 - a- Thin layer chromatographic separation of Nickel, Manganese Cobalt and Zinc. Determination of R_f values.
 - b- Cadmium and Zinc
 - c- Zinc and Magnesium

ORGANIC CHEMISTRY

1. Qualitative Analysis

25

Separation and identification of components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid). Suitable derivatives to be prepared where possible. Purity of the separated components should also be checked on TLC plates, Chemical analysis.

II. Isolation of the following

- i) Caffeine from tea leaves.
- ii) Casein from milk
- iii) Lactose from milk
- iv) Nicotine dipicrate from tobacco
- v) Lycopene from tomatoes.

PHYSICAL CHEMISTRY

10

Thermodynamics:

Determination of partial molar volume of solute (e.g., KCl) and solvent in a binary mixture.'

- I- Determination of the temperature dependence of the solubility of a compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO water mixture) and to calculate the partial molar heat solution

Spectroscopy

I Determination of pK of an indicator (e.g. methyl red) 10 (a) aqueous and (b) micellar media.

ii. Determination of stoichiometry and stability constant of inorganic (e.g. ferric-salicylic acid) and organic (e. g. amine iodine) complexes. Characterization of the complexes by electronic and IR spectral data.

Viva-voce

10

Records

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Programme /Class- Bachelor, s Degree	Year – 4	Semester – Nine
Course Code- B020905PR	Course Title	Credit-4
Paper – VI	Research Project Com Dissertation	

Research Project Com Dissertation

For Projcet work and Dissrtation, the area of the work would to be decided by the advisor/mentor. On completion of the project work, studentes have to submit the work in Form of a thesis followed by oral presentation in the presence of Internal exminor.

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One Year P.G
(X Semester)

Distribution of Course or Marks

X Semester

Course Code	Paper No	Course Title	Credit	Marks	No. of Lectures (in Hors)
B0201001T	I	Elective Paper-I	4	100 (75+25)	60
B0201002T	II	Elective Paper-II	4	100 (75+25)	60
B0201003T	III	Elective Paper-III	4	100 (75+25)	60
B0201004P	Practical	Inorganic, Organic, Physical , Viva –Voce & Records	4	100 (75+25)	120
B0201005RP		Research Project/ Dissertation/ Field Survey	4	100	



Elective Papers

1. organotransition metal chemistry
2. Polymer chemistry
3. Bioinorganic and Supramolecular Chemistry
4. Photo Inorganic Chemistry
5. Organic Synthesis- I
6. Heterocyclic chemistry
7. Chemistry of Natural Products
8. Medicinal Chemistry

Note: Out of Eight Elective Papers, students select any Three papers.

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Program / Class One Year PG Program	Year- 1	Semester - X
Course Code – B0201001T	Course Title	Credit- 4
Elective PAPER – I	Organo transition metal chemistry	

Organo transition metal chemistry

UNIT-I

A-Alkyls and Aryls of Transition metals

Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis

B-Compounds of Transition metal-Carbon Multiple Bonds

Alkylidenes, alkylidynes, low valent carbenes and carbenes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis.

UNIT-II

A-Transition Metal π -Complexes

Transition metal π -complexes with unsaturated organic molecules, alkenes, alkynes, allyldiene, dienyl, arene and trienyl complexes preparations, properties, nature of bonding and structural features, Important Reaction relationing to nucleophilic and electrophilic attack on ligands and to organic synthesis.

B-Transition metal compounds with Bonds to Hydrogen

UNIT-I

Homogeneous Catalysis

Stoichiometric reaction for catalysis, homogenous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reaction involving carbon monoxide such as hydrocarbonylation olefin (oxo reaction), oxopalladation reaction, activation of C-H bond.

UNIT-IV

Fluxional Organometallic Compounds

Fluxionality and dynamic equilibria in compounds such as nolefine, n-allyl and dienyl complexes.

Books Suggested

1. Principles and application of organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, JR Norton and R.G. Finke, University Science books
2. The organometallic chemistry of transition metals, R.H.Crabtree, John Wiley
3. Metallo-organic Chemistry, A.J. Pearson Wiley
4. Organometallic Chemistry, R.C.Mehrotra and A.Singh, New age International.

Program / Class One Year PG Program	Year- 1	Semester - X
Course Code – B0201002T	Course Title	Credit- 4
Elective PAPER – II	Polymer Chemistry	

Polymers Chemistry

UNIT-I

Basics

Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers, Classification of polymers Polymerization: condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

UNIT-II

Polymer Characterization

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

UNIT- III

Structure and Properties

Morphology and order in crystal fine polymers-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point T_m -melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, T_g -Relationship between T_m and T_g , Effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

UNIT- IV

A-Polymer Processing

Plastics, elastomers and fibers Compounding Processing techniques Calendering diecasting, rotational casting film casting injection moulding. blow moulding. extrusion moulding thermolforming, foaming, reinforcing and fibre spinning.

B- Properties of Commercial Polymers

Polyethylene, Polyvinyl chloride polyamides polyesters, phenolic resins. epoxy resins and silicone polymers. Functional polymers, fire retarding polymers and electrically conducting polymers. Biomedical polymers-contact lens, dental polymers, artificial heart. kidney, skin and blood cells.

Books Suggested

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

Bioinorganic and Supramolecular Chemistry.

UNIT- I

A-Metal Storage Transport and Biomineralization Ferritin, transferrin, and siderophores

B-calcium in Biology

Calcium in living cells, transport and regulation, molecular aspects of intramolecular processes, extracellular binding proteins.

UNIT- II

Metalloenzymes

Zinc enzymes-carboxypeptidase and carbonic anhydrase, Iron enzymes-catalase, peroxidase and cytochrome P-450, Copper- enzymes-superoxide dismutase, Molybdenum oxotransferase enzymes-xanthine oxidase, Coenzyme vitamin B12:

UNIT- III

A-Metal-Nucleic Acid Interactions

Metal ion and metal complex interactions, Metal complexes-nucleic acids

B- Metals in Medicine

Metal deficiency and disease, toxic effects of metals, metals for diagnosis and chemotherapy with particular reference to anticancer drugs.

UNIT- IV

supramolecular Chemistry

(A) molecular recognition: Molecular receptors for different types of molecules including arisonic substrates. Design and synthesis of coreceptor molecules and multiple recognition,

(B) Supramolecular reactivity

(C) Transport processes and carrier design

(D) Supramolecular devices: supramolecular photochemistry, supramolecular electronic. ionic and switching devices, Some example of self-assembly in supramolecular chemistry.

Books Suggested

1. Principles' of Bioinorganic Chemistry S J. Lippard and J. M. Borg University Science Books.
2. Bioinorganic Chemistry. T. Bertini. R.B. Gray. S.J. Lippard J.S. Valentine, University Science Books.
3. Inorganic Biochemistry vols I and II. ed. G.T. Eichborn, Eisevier.
4. Progress in Inorganic Chemistry. Vols 18 and 38 ed. J.J. Lipard. Wiley.
5. Supramolecular Chemistry. J. M. Lehn, VCH

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Photoinorganic chemistry
UNIT- I

Basics of Photochemistry

Absorption excitation, photochemical laws, quantum yield electronic 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.

UNIT- IIA- Properties of excited states

Structure, dipole moment, acid-base strengths, reactivity, photochemical kinetics calculation of rates of radiative processes. Biomolecular deactivation-quenching.

B- Excited states of metal complexes

Excited states of metal complexes: comparison with organic compounds, electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations methods for obtaining charge-transfer spectra.

UNIT- IIIA- 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 excited states.

B- Redox reactions by excited metal complexes

Energy transfer under conditions of weak interaction and strong interaction-exciplex formation; conditions of the excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2-bipyridine and 1,10-phenanthroline complexes), illustration of reducing and oxidising character of ruthenium²⁺ (bipyridil complex, comparison with Fe (bipy)₃ role of spin coupling life time of these complexes. Application of redox processes of low energy reactants into high energy products, chemical energy into light.

UNIT- IVMetal complex sensitizers

Metal complex sensitizer, electron relay, metal colloid systems, semiconductor supported metal or oxide systems, water photolysis nitrogen fixation and carbon dioxide reduction.

Books suggested

1. Concepts of inorganic photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
2. Inorganic photochemistry, J.Chem.Educ. Vol. 60, no. 10, 1983
3. Progress in inorganic chemistry, vol, 30. Ed. S.J. Lippard, Wiley.
4. Coordination chem. revs. 1981, vol.39, 121, 131:1975, 153:1990, 973:13.
5. photochemistry of coordination compounds, V. Balzan and V. Carassiti, academic press.
6. Elements of inorganic photochemistry. G.J. Ferraudi, Wiley.




Organic Synthesis-I
UNIT- I

Organometallic reagents

Principles, preparations, properties and applications of the following in organic synthesis with mechanistic details.

A. Group I and II metal organic compounds

Li, Mg, Hg, Cd, Zn compounds.

B. Transition metals

Cu, Pd, Ni, Fe, Co, Ti compounds.

UNIT- II

A-Oxidation

Introduction different oxidative processes.

Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acid.

Amines, hydrazines and sulphides.

Oxidation with ruthenium tetroxide, iodobenzene diacetate and thallium(III) nitrate.

B- Reduction

Introduction, different reductive processes.

Hydrocarbons-alkanes, alkynes and aromatic rings.

Carbonyl compound-aldehydes, ketones, acids and their derivatives. Epoxides.

Nitro, nitroso, azo and oxime groups. Hydrogenolysis.

UNIT- III

Rearrangements

General mechanistic consideration: 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, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction.

UNIT- IV

Metallocenes, Nonbenzenoid Aromatic and polycyclic aromatic compound

General consideration, synthesis and reactions of some representative compounds.

Books suggested

1. Modern synthetic reactions, H.O. House, W.A. Benjamin.
2. Some modern methods of organic synthesis, W. Carruthers, Cambridge Univ. Press.
3. Advanced organic chemistry, reactions mechanisms and structure, J. March, John Wiley.
4. Principles of organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie academic and professional.
5. Advanced organic chemistry part B, F.A. Carey and R.J. Sundberg, Plenum Press.
6. Rodd's chemistry of carbon compounds, Ed. S. Coffey Elsevier.

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Heterocyclic chemistry

UNIT- I

A- Nomenclature of Heterocycles

Replacement and systematic nomenclature (Hantzsch Widman system) for monocyclic, fused and bridged heterocycles.

B- Aromatic heterocycles

General chemical behavior of aromatic heterocycles, classification (Structural type), criteria of aromaticity (bond lengths ring current and chemical shifts in $^1\text{H-NMR}$ spectra. Empirical resonance energy) resonance energy, delocalization energy and deqar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

C-Non-aromatic Heterocycles

Strain bond angle and torsional strains and their consequence in small ring heterocycles.

Conformation of six- membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3- diaxial interaction. Stereo-electronic effects-anomeric and related effects. Attractive interactions-hydrogen bonding and intermolecular nucleophilic interactions.

UNIT- II

A- Heterocyclic Synthesis

Principles of heterocyclic synthesis, cyclization reactions and cycloaddition reactions.

B- Small Ring Heterocycles

Three membered and four membered heterocycles-synthesis and reaction of aziridine, oxiranes. Thiranes, azetidines, oxetanes and thietanes.

UNIT- III

A- Benzo-Fused Five-membered Heterocycles

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

B- Meso-ionic Heterocycles

General classification, chemistry of some important mesoionic heterocycles of type A and B and their applications.

C- Six-membered Heterocycles with one Heteroatoms

Synthesis and reaction of pyrylium salts and pyrones and their comparison with pyridinium and thiopyrylium salts and pyridines.

Synthesis and reactions of quinolizinium and benzpyrinium salts, coumarins and chromones.

UNIT- IV

A- Six-membered Heterocycles with two or more Heteroatoms

Synthesis and reaction of diazines, triazines and thiazines.

B- Seven-and large -Membered Heterocycles

Synthesis and reaction of azepines, oxepines, thiepinines, diazepines, thiazepines, azocine, diazocines, dioxocines and dithiocines.

Books Suggested

1. "Heterocyclic Chemistry" Vol, 1-3 R.R. Gupta, M.Kumar and V. Gupta, Springer, Verlag
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry, J.A. Joule, K. Mills and G.F.Smith, Chapman and Hall.
4. Heterocyclic chemistry, T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic chemistry. G.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M. Acheson, John Wiley.
7. Comprehensive Heterocyclic Chemistry, A. R. Katritzky and C.W. rees. Eds. Pergamon Press.

Trapezoids and Carotenoids**Chemistry of Natural products****UNIT- I**

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, Ziniberene, Santonin, Phytol, Abietic acid and β -Carotene.

UNIT- II**A- Alkaloids**

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following : ephedrine, (+)-Conline, Nicotine, Atropine, Quinine and morphine.

B- Steroids

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry.

Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone. Biosynthesis of steroids.

UNIT- III**A- Plant Pigments**

Occurrence, nomenclature and general methods of structure determination, Isolation and synthesis of Apigenin, Luteolin, quercetin, myrcetin, Quercetine 3-glucoside, Vitexi Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, acid pathway.

B- Porphyrins

Structure and synthesis of Haemoglobin and Chlorophyll.

UNIT- IV**A- Prostaglandins**

Occurrence, nomenclature, classification, biogenesis and physiological effects, Synthesis of PGE_2 and $\text{PGF}_{2\alpha}$.

B- Pyrethroids and Rotenones

Synthesis and reaction of Pyrethroids and Rotenones (For structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible).

Books Suggested

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

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Medicinal Chemistry

UNIT- I

A- Drug design :

Relationship between Chemical structure and biological activity (SAR). Receptor site theory approach to drug design. Introduction to combinatorial synthesis in drug discovery.

B- Pharmacokinetics:

Introduction of drug absorption, desorption, elimination using pharmacokinetics, important pharmacokinetics parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

UNIT- II

A- Antineoplastic Agents:

Introduction, cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Synthesis of mechlorethamine, cyclophosphamide, melphan, mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6- mercaptopurine.

B- Cardiovascular Drug:

Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function central intervention of cardiovascular output. Directacting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, deltizem, quintridine, veramil and atenolol.

UNIT- III

A- Local Antimicrobial Drugs:

Introduction and general mode of action. Synthesis of sulphonamides, turatolidone, ciprofloxacin, norfloxacin, doxycycline, aminosalicylic acid, isoniazid, ethionamide, thambutol, fluconazole, acyclovir, chloroquine, primaquine.

B- Psychoactive Drugs- The Chemotherapy of mind

Introduction, neurotransmitters, CNS depressant, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, Antipsychotic drugs- the neuroleptics, antidepressant, butyrophenones, serendipity and drug development. Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, 2 barbiturates.

UNIT- IV

Antibiotics:

Cell wall biosynthesis inhibitors, β -lactam rings antibiotics inhibiting protein synthesis, synthesis of penicillin, chloramphenicol, cephalosporin and streptomycin.

Books Suggested

1. Introduction to Medical Chemistry, A. Gringuage, Wiley-VCH.
2. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry. Ed. Robert F. dorge
3. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock, New Age International.
4. Burger's Medicinal Chemistry and Drug Discovery, Vol-I (Chapter-9 and Ch-14) Ed.M.E. Wolff, John Wiley.
5. Goodman and Gilman's Pharmacological Basis of Therapeutics, Mc Graw-Hill.
6. The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic Press.
7. Strategies for Organic Drug Synthesis and Design. D. Lednicer, John Wiley.

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Programme /Class- Bachelor, s Degree	Year – 4	Semester – Tenth
Course Code- B0201005P	Course Title	Credit-4
Practical	Inorganic, Organic, Physical Viva Voice and records	

Practical

Inorganic Chemistry (25)

Any two of

(A) Spectrophotometric Determination

- a- Manganese/chromium/vanadium in steel sample.
- b- Nickel/molybdenum/tungsten/vanadium/uranium by extractive spectrophotometric method.
- c- Fluoride/nitrate/phosphate
- d- Iron-phenanthroline complex: job Method.

(B) Flame Photometric Determinations:

- a- Sodium and Potassium when Present together
- b- Lithium/calcium/Barium/Strontium
- c- Cadmium and Magnesium in tap water.

Organic Chemistry (25)

(A) Multi Step Synthesis of organic Compounds

Preparation of organic compounds involving not more than three stages.

- i) Benzanilide from Benzene
- ii) Benzilic acid from Benzoin
- iii) Quinoline from Aniline
- iv) 2-phenylindole from phenyl hydrazine.
- V) Alkylation of diethyl malonate with an alkyl halide.

(B) Paper Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of R_f values. Identification of organic compounds on the basis of given spectral data (UV, IR, PMR, CMR and MS)

Physical Chemistry (25)

(A) Polarography

i- Estimation of Pb^{2+} and Cd^{2+}/Zn^{2+} and Ni^{2+} ions in a mixture of Pb^{2+} and Cd^{2+}/Zn^{2+} and Ni^{2+} by polarography. Determination of dissolved oxygen in aqueous solution of organic solvents.

(B) E.M.F. Measurement



- i- Determination of the equilibrium constant of the reaction $\text{H}_2\text{Q} + 2 \text{Ag}$
(Hydro quinone) $\text{Q} + 2\text{W} + 2\text{Ag}$ (Quinhydrone)
- ii-Determination of activity coefficient of electrolytes.
- iii-Potentiometric titration of a solution of Fe^{2+} against Cr-O, and the determination of the redox potential of $\text{Fe}^{2+}/\text{Fe}^{3+}$ system.
- (iv) Determination of ionic product of water (K_w)

Viva voce

Records Book Suggested

1. Inorganic Experiments. 1. Derek Woollin VCH
2. 15 10 Microscale Inorganic Chemistry, Z Szafrn R.M. Pike, M.M. Singh. Wiley.
3. Practical Inorganic Chemistry, G. Mar and B.W. Bookett. Van Nostrand.



Programme /Class- Bachelor, s Degree	Year – 4	Semester – Tenth
Course Code- B0201005PR	Course Title	Credit-4
Paper	Research Project Com Dissertation	

Dissertation

For Projcet work and Dissrtation, the area of the work would to be decided by the advisor/mentor. On completion of the project work, studentes have to submit the work in Form of a thesis followed by oral presentation in the presence of External exminor provided by university