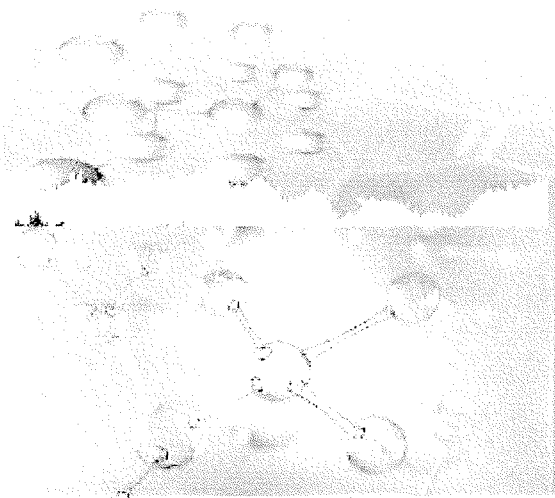
Curriculum Framework and Credit System for the Four Year Undergraduate Programme (FYUGP)

CHEMISTRY
MINOR



BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

SEMESTER - I

PAPER: MN-1A Theory (Inorganic Chemistry 1 + Organic Chemistry 1)

	Mid Semester Exam	End Semester Exam	Total
Full Marks	15	60	75
Pass Marks	(Mid Sem + End Sem)		30
Time	1 hours	3 hours	

Credits: 03

Duration of Course: 45 hours

Instructions for Question Setter

Mid Semester Examination (MSE): 1 Hrs.

The Mid Semester Examination shall have two components.

(a) One Semester Internal Assessment Test (SIA): 10 Marks.

There will be three questions of 05 marks each, out of which two are to be answered. Each question may be subdivided into two or more parts

(b) Class Attendance Score (CAS) & Day to day activities (DDA): 5 marks.

(Attendance: Upto75% = 1 mark; 75-80% = 2 marks; 80.-85% = 3 marks; 85-90% = 4 marks; >90% = 5 marks)

End Semester Examination (ESE): 3 Hrs.

There will be **two** groups of questions.
Group A is compulsory and will contain two questions. Q. No. 1 will be multiple/fill in the blank/very short type five questions of 1 mark each. Q. No. 2 & 3 will contain two short answer type questions each of 5 marks.
Group B will contain descriptive type Five (Q. No. 4 to 8) questions of 15 marks each, out of which any Three are to be answered.

Section A: Inorganic Chemistry-1

UNIT I: Atomic Structure: 10 hours

Review of: Bohr's theory and its limitations, Sommerfeld's model, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals .

UNIT II: Chemical Bonding and Molecular Structure: 15 hours

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance .

Section A: Organic Chemistry-1

UNIT III: Fundamentals of Organic Chemistry: 06 hours

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Aromaticity: Benzenoids and Hückel's rule.

UNIT IV: Stereochemistry: 07 hours

Conformations with respect to butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

UNIT V: Aliphatic Hydrocarbons: 07 hours

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes:

(Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes:

(Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Satyzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans -addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition),

Alkynes:

(Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO4.

Reference Books:

1. J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
2. F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
3. Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley.
4. James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
5. T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
6. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
7. E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill.
8. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
9. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
10. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

SEMESTER -I

PAPER: MN-1A Practical (Inorganic + Organic Chemistry)

	Mid Semester Practical	End Semester Practical	Total
Full Marks		25	25
Pass Marks		10	10
Time		3 hours	

Credits: 01

Duration of Course: 30 hours

Section A: Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Determination of M.P./B.P.

Reference Books:

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
3. Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
4. Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960.

SEMESTER - III

PAPER: MN-1B Theory (Physical Chemistry 1 + Organic Chemistry 2)

	Mid Semester Exam	End Semester Exam	Total
Full Marks	15	60	75
Pass Marks	(Mid Sem + End Sem)		30
Time	1 hours	3 hours	

Credits: 03

Duration of Course: 45 hours

Instructions for Question Setter

Mid Semester Examination (MSE): 1 Hrs.

The Mid Semester Examination shall have two components.

(a) One Semester Internal Assessment Test (SIA): 10 Marks.

There will be three questions of 05 marks each, out of which two are to be answered. Each question may be subdivided into two or more parts

(b) Class Attendance Score (CAS) & Day to day activities (DDA): 5 marks.

(Attendance: Upto75% = 1 mark; 75-80% = 2 marks; 80.-85% = 3 marks; 85-90% = 4 marks; >90% = 5 marks)

End Semester Examination (ESE): 3 Hrs.

There will be **two** groups of questions.
Group A is compulsory and will contain two questions. Q. No. 1 will be multiple/fill in the blank/very short type five questions of 1 mark each. Q. No. 2 & 3 will contain two short answer type questions each of 5 marks.
Group B will contain descriptive type Five (Q. No. 4 to 8) questions of 15 marks each, out of which any Three are to be answered.

Section A: Physical Chemistry-1

UNIT I: Chemical Energetics: 08 hours

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.

Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. effect of pressure on enthalpy, Adiabatic flame temperature.

UNIT II: Chemical Equilibrium: 06 hours

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^0, Le Chatelier's principle. Definitions of K_P, K_C and K_X. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases.

UNIT III: Ionic Equilibria: 06 hours

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. . .

Section B: Organic Chemistry-2

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

UNIT IV: Aromatic hydrocarbons: 07 hours

Structure and aromatic character of benzene.

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).

UNIT V: Alkyl and Aryl Halides: 08 hours

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (S_N1, S_N2 and S_Ni) reactions. *Preparation:* from alkenes *and* alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituents.

UNIT VI: Alcohols and Phenols (Upto 5 Carbons): 10 hours

Alcohols: *Preparation:* Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Fries rearrangement.

Reference Books:

1. T. W. Graham Solomons: Organic Chemistry, John Wiley and Sons.
2. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
3. I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
4. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
5. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.
6. G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007).
7. G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
8. J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage □ Lening India Pvt. Ltd., New Delhi (2009).
9. B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
10. R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

SEMESTER - III

PAPER: MN-1B Practical (Physical + Organic Chemistry)

	Mid Semester Practical	End Semester Practical	Total
Full Marks		25	25
Pass Marks		10	10
Time		3 hours	

Credits: 01

Duration of Course: 30 hours

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. Ionic equilibria pH measurements
   a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pHmeter.
   b) Preparation of buffer solutions: (i) Sodium acetate-acetic acid. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.
   c) Study of the solubility of benzoic acid in water.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
   (a) Bromination of Phenol/Aniline
   (b) Benzoylation of amines/phenols
   (c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone.

Reference Books:

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

SEMESTER - V

PAPER: MN-1C Theory (Physical Chemistry 2 + Organic Chemistry 3)

	Mid Semester Exam	End Semester Exam	Total
Full Marks	15	60	75
Pass Marks	(Mid Sem + End Sem)		30
Time	1 hours	3 hours	

Credits: 03

Duration of Course: 45 hours

Instructions for Question Setter

Mid Semester Examination (MSE): 1 Hrs.

The Mid Semester Examination shall have two components.

(a) One Semester Internal Assessment Test (SIA): 10 Marks.

There will be three questions of 05 marks each, out of which two are to be answered. Each question may be subdivided into two or more parts

(b) Class Attendance Score (CAS) & Day to day activities (DDA): 5 marks.

(Attendance: Upto75% = 1 mark; 75-80% = 2 marks; 80.-85% = 3 marks; 85-90% = 4 marks; >90% = 5 marks)

End Semester Examination (ESE): 3 Hrs.

There will be **two** groups of questions.
Group A is compulsory and will contain two questions. Q. No. 1 will be multiple/fill in the blank/very short type five questions of 1 mark each. Q. No. 2 & 3 will contain two short answer type questions each of 5 marks.
Group B will contain descriptive type Five (Q. No. 4 to 8) questions of 15 marks each, out of which any Three are to be answered.

Section A: Physical Chemistry-2

UNIT I: Solutions: 07 hours

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

UNIT II: Phase Equilibrium: **05 hours**

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur)

UNIT III: Conductance: **04 hours**

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Conductometric titrations (only acid-base).

UNIT IV: Electrochemistry: **04 hours**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical Series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data.

Section B: Organic Chemistry-3

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

UNIT V: Carboxylic acids and their derivative: **05 hours**

Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard – Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons)

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

UNIT VI: Amines and Diazonium Salts: 05 hours

Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.

UNIT VII: Amino Acids, Peptides and Proteins: 10 hours

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. Reactions of Amino acids: ester of –COOH group, acetylation of –NH2 group, complexation with Cu2+ ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

UNIT VIII: Carbohydrates: 05 hours

Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose).

Reference Books:

1. G. W. Castellan: Physical Chemistry 4th Ed. Narosa (2004).
2. J. C. Kotz, P. M. Treichel, J. R. Townsend, General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
3. B. H. Mahan: University Chemistry, 3rd Edn. Narosa (1998).
4. R. H. Petrucci, General Chemistry, 5th Edn., Macmillan Publishing Co.: New York (1985). (Pearson Education).
5. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7 th Ed., W. H. Freeman.

SEMESTER - V

PAPER: MN-1C Practical (Physical + Organic Chemistry)

	Mid Semester Practical	End Semester Practical	Total
Full Marks		25	25
Pass Marks		10	10
Time		3 hours	

Credits: 01

Duration of Course: 30 hours

Section A: Physical Chemistry

Conductance

1. Determination of cell constant
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
3. Perform the following conductometric titrations: i) Strong acid vs. strong base ii) Weak acid vs. strong base iii) Weak acid vs. strong base.

Potentiometry

Perform the potentiometric titrations of (i) Strong acid vs strong base and (ii) Weak acid vs strong base.

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Reference Books:

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960). 3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

SEMESTER - VII

PAPER: MN-1D Theory (Inorganic Chemistry 2 + Physical Chemistry 3)

	Mid Semester Exam	End Semester Exam	Total
Full Marks	15	60	75
Pass Marks	(Mid Sem + End Sem)		30
Time	1 hours	3 hours	

Credits: 03

Duration of Course: 45 hours

Instructions for Question Setter

Mid Semester Examination (MSE): 1 Hrs.

The Mid Semester Examination shall have two components.

(a) One Semester Internal Assessment Test (SIA): 10 Marks.

There will be three questions of 05 marks each, out of which two are to be answered. Each question may be subdivided into two or more parts

(b) Class Attendance Score (CAS) & Day to day activities (DDA): 5 marks.

(Attendance: Upto75% = 1 mark; 75-80% = 2 marks; 80.-85% = 3 marks; 85-90% = 4 marks; >90% = 5 marks)

End Semester Examination (ESE): 3 Hrs.

There will be **two** groups of questions.
Group A is compulsory and will contain two questions. Q. No. 1 will be multiple/fill in the blank/very short type five questions of 1 mark each. Q. No. 2 & 3 will contain two short answer type questions each of 5 marks.
Group B will contain descriptive type Five (Q. No. 4 to 8) questions of 15 marks each, out of which any Three are to be answered.

Section A: Inorganic Chemistry-2

UNIT I: General Principles of Metallurgy: 04 hours

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

UNIT II: s- and p-Block Elements: 16 hours

Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred- Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation

states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

Compounds of s- and p-Block Elements Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry. Hydrides of nitrogen (NH3, N2H4, N3H, NH2OH)

Section B: Physical Chemistry-3

UNIT III: Kinetic Theory of Gases: 08 hours

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from Van der Waals equation.

UNIT IV: Solids: 07 hours

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography – Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

UNIT V: Chemical Kinetics: 10 hours

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Reference Books:

1. G. W. Castellan: Physical Chemistry 4th Ed. Narosa (2004).
2. J. C. Kotz, P. M. Treichel, J. R. Townsend, General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
3. B. H. Mahan: University Chemistry, 3rd Edn. Narosa (1998).
4. R. H. Petrucci, General Chemistry, 5th Edn., Macmillan Publishing Co.: New York (1985). (Pearson Education).
5. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7 th Ed., W. H. Freeman.

SEMESTER - VII

PAPER: MN-1D Practical (Physical + Organic Chemistry)

	Mid Semester Practical	End Semester Practical	Total
Full Marks		25	25
Pass Marks		10	10
Time		3 hours	

Credits: 01

Duration of Course: 30 hours

Section A: Inorganic Chemistry

Semi-micro qualitative analysis of mixtures using H2S or any other scheme- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations: NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions: CO_3^{2-}, S^{2-}, SO_3^-, NO_2^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-,SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^-.

(Spot tests should be carried out wherever feasible).

Section B: Physical Chemistry

1. Surface tension measurement (use of organic solvents excluded).
   (a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
   (b) Study of the variation of surface tension of a detergent solution with concentration.
2. Viscosity measurement (use of organic solvents excluded):
   (a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald viscometer.
   (b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

Reference Books:

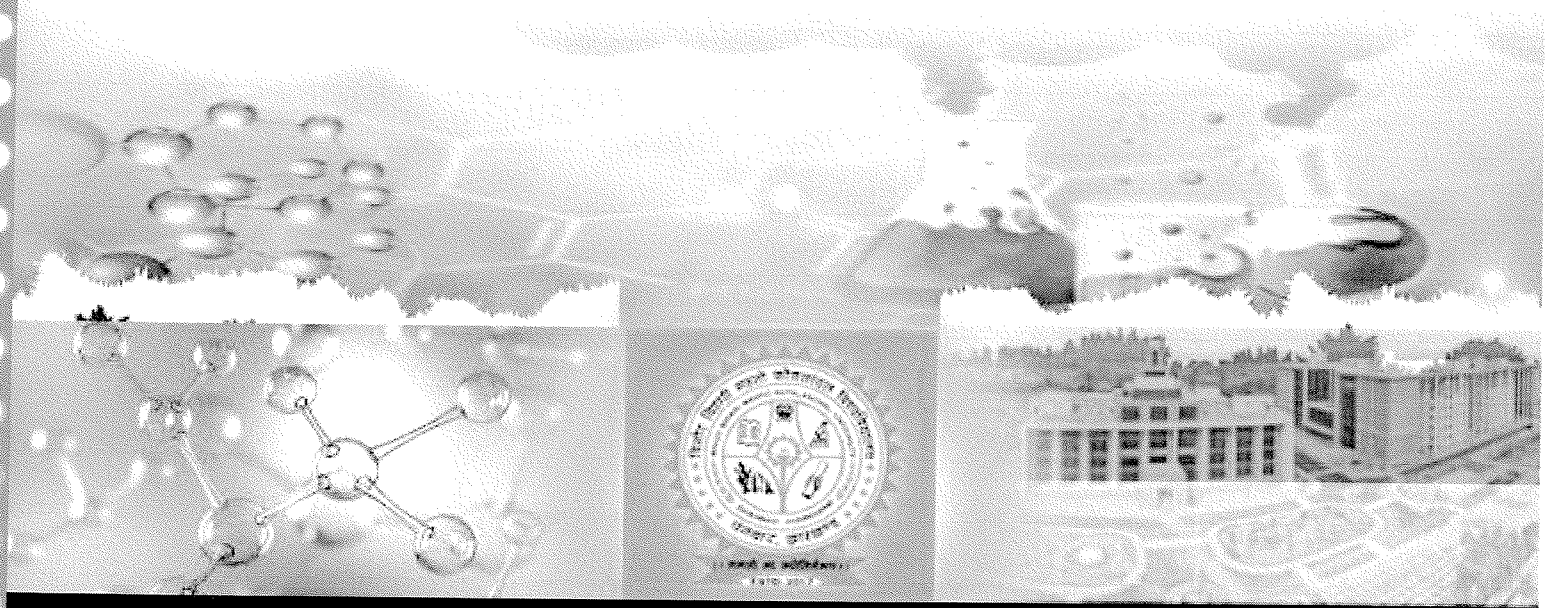
1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960). 3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

Curriculum Framework and Credit System for the Four Year Undergraduate Programme (FYUGP)

CHEMISTRY

MULTIDISCIPLINARY COURSE

(MDC)



BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

MULTIDISCIPLINARY COURSE (MDC) - CHEMISTRY

	Mid Semester Exam	End Semester Exam	Total
Full Marks		75	75
Pass Marks		30	30
Time		3 hours	

Credits: 03

Duration of Course: 45 hours

Instructions for Question Setter

End Semester Examination (ESE): 3 Hrs.

There will be **two** groups of questions.
Group A is compulsory and will contain two questions. Q. No. 1 will be multiple/fill in the blank/very short type five questions of 1 mark each. Q. No. 2 & 3 will contain two short answer type questions each of 5 marks.
Group B will contain descriptive type six (Q. No. 4 to 9) questions of 15 marks each, out of which any four are to be answered.

UNIT I: Atomic Structure: 07 hours

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation,

Heisenberg's Uncertainty Principle and its significance, Quantum numbers and their significance. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT II: Periodicity of Elements: 07 hours

Basic ideas of the following periodic properties-

(a) Effective nuclear charge, shielding or screening effect, Slater rules,

(b) Atomic radii

(c) Ionic and crystal radii.

(d) Covalent radii

(e) Ionization enthalpy.

(f) Electron gain enthalpy

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales.

UNIT III: Chemical Bonding: 12 hours

Ionic bond: Defination, General characteristics, Factors favouring formation of ionic bond.

Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths.

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Weak Chemical Forces: Hydrogen bonding: definition, types of hydrogen bond, Effect of hydrogen bonding on physical and chemical properties.

UNIT IV: Basics of Organic Chemistry-I: 05 hours

Organic Compounds: Classification and Nomenclature.

Electronic Displacements: Inductive, electromeric resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

UNIT V: Basics of Organic Chemistry-II: 05 hours

Reaction mechanism, Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges;

Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

UNIT VI: Ionic equilibria: 09 hours

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases,

pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).

Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Solubility and solubility product of sparingly soluble salts –applications of solubility product principle.

References Books-

1. Inorganic Chemistry by J. D. Lee
2. Inorganic Chemistry by Puri Sharma Kalia
3. Organic Chemistry by A Bahl and B. S. Bahl
4. Organic Chemistry Volume-1 by I. L. FINAR
5. Physical Chemistry by Puri Sharma Pathania