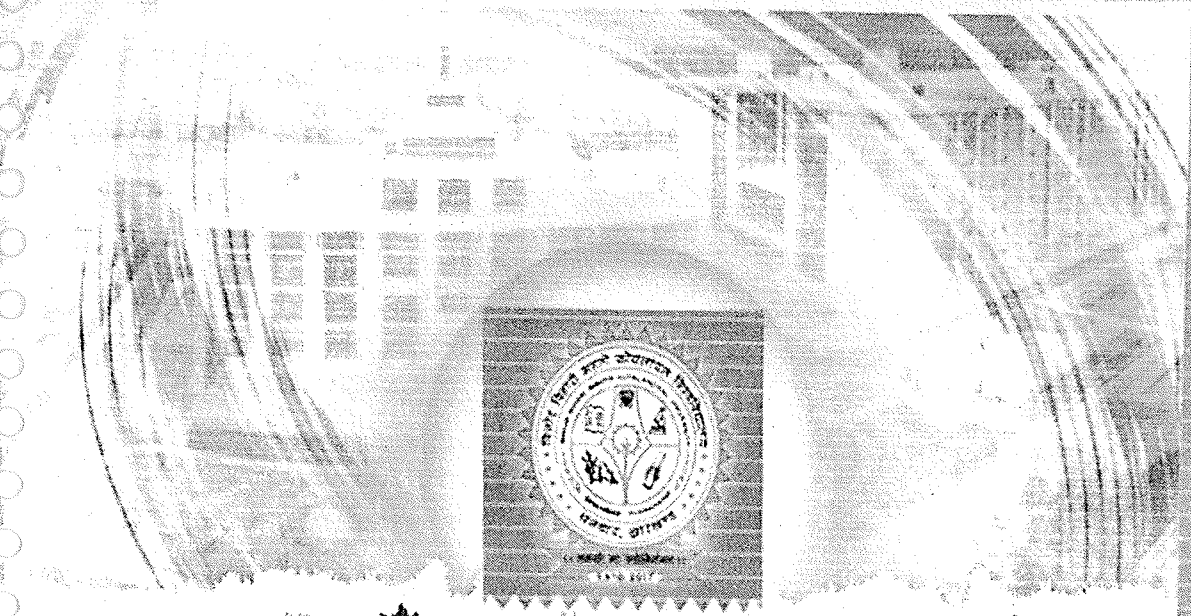
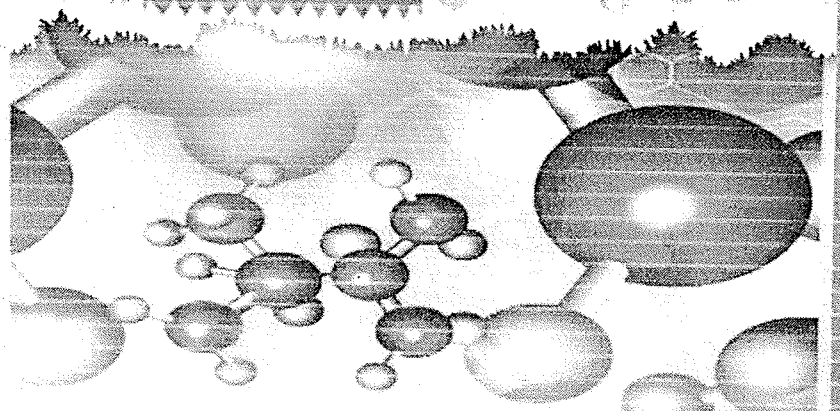
Curriculum Framework and Credit System for the Four Year Undergraduate Programme (FYUGP)





CHEMISTRY

(w.e.f. 2025)

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

DEPARTMENT OF CHEMISTRY

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

Members of Board of Studies for Undergraduate Syllabus

1	Dr. Leelawati Kumari, Head, University Department of Chemistry, BBMKU	CHAIRPERSON	
2	Dr. Y. JHA, Retired Head, Department of Chemistry, P.K.R.M. College, Dhanbad	EXTERNAL EXPERT	
3	Sri Rajendra Prasad Singh, UNIVERSITY DEPARTMENT of CHEMISTRY, BBMKU	MEMBER	
4	Dr. Dharmendra Kumar Singh, University Department of Chemistry, BBMKU	MEMBER	
5	Dr. Rajeev Pradhan, Head Department of Chemistry, P.K.R.M. College, Dhanbad	MEMBER	25/5/2021
6			

SEMESTER-WISE TITLE OF THE PAPERS IN CHEMISTRY MAJOR

Year	Semester	Course Code	Paper Title	Credits	Page No.
1st	I	MJ-01 Theory	Inorganic Chemistry – 1	03	12-13
		MJ-01 Practical	Practical	01	14
	II	MJ-02 Theory	Organic Chemistry – 1	03	15-16
		MJ-02 Practical	Practical	01	17

SEMESTER-WISE TITLE OF THE PAPERS IN CHEMISTRY

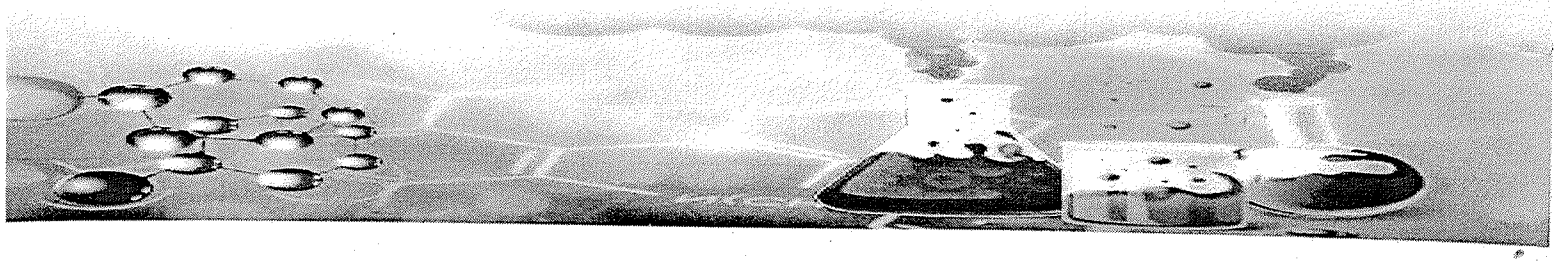
ASSOCIATED CORE COURSE

Year	Semester	Course Code	Paper Title	Credits	Page No.
1st	I / II	AC (Theory)	ASSOCIATED CORE COURSE – CHEMISTRY (THEORY)	03	18-21
		AC (Practical)	ASSOCIATED CORE COURSE – CHEMISTRY (PRACTICAL)	01	22-23

SEMESTER WISE TITLE OF THE PAPERS IN CHEMISTRY

MULTIDISCIPLINARY COURSE (MDC)

Year	Semester	Course Code	Paper Title	Credits	Page No.
I / II	I / II / III	MDC	MULTIDISCIPLINARY COURSE – CHEMISTRY	03	24-27



Academic Level	Level of Courses		MJ; Discipline Specific Courses – Core or Major (60)	AC; Associated core courses from discipline/ Interdisciplinary /vocational (8)	ELE; Elective courses may be opted from four parts [Follow table 4,5 & 6] (16)	MDC; Multidisciplinary Courses (From a pool of Courses) (9)	AEC; Ability Enhancement Courses (Modern Indian Language and English) (8)	SEC; Skill Enhancement Course (9)	VAC; Value Added Courses (6)	IKS; (i) Indian Knowledge System (2) & (ii) Social awareness (2)	RC; Research Courses (12)	AMJ; Advanced Courses instead of Research (12)	Total Credits	IAP; Internship/ Apprenticeship/ Project/ Vocational course/ Dissertation
			3 (80)	4 (32)		5	6	7	8	9	10	11	12	13
Level 4.5	Level 100-199: Foundation or Introductory courses	I	4	4		3	2	3	2				20	
		II	4		4	3	2	3	2				20	
		Exit Point: Undergraduate Certificate provided with Summer Internship/ Project/ Vocational course/ Dissertation (4 credits)												
Level 5	Level 200-299: Intermediate level courses	III	4+4		4	3	2	3					20	
		IV	4+4+4		4		2		2				20	
		Exit Point: Undergraduate Diploma provided with Summer Internship/ Project/ Vocational course/ Dissertation (4 credits)												
Level 5.5	Level 300-399: Higher-level courses	V	4+4+4+4		4								20	
		VI	4+4+4+4		4								20	
		Exit Point: Bachelor's Degree with Summer Internship/ Project/ Vocational course/ Dissertation (4 credits)											120	

Academic Level	Level of Courses		MJ: Discipline Specific Courses – Core or Major (60)	AC; Associated core courses from discipline/ Interdisciplinary /vocational (8)	ELE; Elective courses opted in Semester III from four parts of table 4,5 & 6 (8)	MDC; Multidisciplinary Courses (From a pool of Courses) (0)	AEC; Ability Enhancement Courses (Modern Indian Language and English) (0)	SEC; Skill Enhancement Course (0)	VAC; Value Added Courses (0)	IKS; (i) Indian Knowledge System (0) & (ii) Social awareness (0)	RC; Research Courses (12)	AMJ; Advanced Courses instead of Research (12)	Total Credits	IAP; Internship/ Apprenticeship/ Project/ Vocational course/ Dissertation (4)
			3 (80)	4 (32)							10	11	12	13
	Honours with Research													
Level 6	Level 400-499: Advanced courses	VII A	4+4+4		4						4		20	
		VIII A	4+4		4						8		20	
	Exit Point: Bachelor's Degree with Hons. with Research												OR	
OR	Honours													
Level 6	Level 400-499: Advanced courses	VII B	4+4+4		4							4	20	
		VIII B	4+4		4							4+4	20	
	Exit Point: Bachelor's Degree with Hons.												OR	
OR	P.G. Diploma													
Level 6	Level 400-499: Advanced courses	VII C	4+4+4		4							4	20	
		VIII C	4+4		4							4+4	20	
	Exit Point: P.G. Diploma Degree												160	+4

Semester-wise Course Code and Credit Points for Single Major during the First Three Years of FYUGP

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Credits	
	Code	Papers	Paper	Semester
I	AEC-I	Language and Communication Skills (MIL-I; Modern Indian language Hindi/ English)	2	20
	VAC-I	Value Added Course- I	2	
	IKS-I	Indian Knowledge System-I/Social Awareness Activities	2	
	SEC-I	Skill Enhancement Course- I	3	
	MDC-I	Multi-disciplinary Course- I	3	
	AC-I	Associated core courses from discipline/ Interdisciplinary/ vocational	4	
	MJ-I	Major paper I (Disciplinary/ Interdisciplinary Major)	4	
II	AEC-2	Language and Communication Skills (MIL-I; Modern Indian language English/ Hindi)	2	20
	VAC-2	Value Added Course-2	2	
	1KS-2	Social Awareness Activities/ Indian Knowledge System-I	2	
	SEC-2	Skill Enhancement Course-2	3	
	MDC-	Multi-disciplinary Course-2	3	
	AC-2	Associated core courses from discipline/ Interdisciplinary/ vocational	4	
	MJ-2	Major paper 2 (Disciplinary/ Interdisciplinary Major)	4	
III	AEC-3	Language and Communication Skills (MIL-2; MIL including TRL)	2	20
	SEC-3	Skill Enhancement Course-3	3	
	MDC-	Multi-disciplinary Course-3	3	
	ELC-I	Elective courses from discipline/ Interdisciplinary/ vocational	4	
	MJ-3	Major paper 3 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-4	Major paper 4 (Disciplinary/ Interdisciplinary Major)	4	
IV	AEC-4	Language and Communication Skills (MIL-2; MIL including TRL)	2	20
	VAC-3	Value Added Course-3	2	
	ELC-2	Elective courses from discipline/ Interdisciplinary/ vocational	4	
	MJ-5	Major paper 5 (Disciplinary/ Interdisciplinary Major having IKS)	4	
	MJ-6	Major paper 6 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-7	Major paper 7 (Disciplinary/ Interdisciplinary Major)	4	

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Credits	
	Code	Papers	Paper	Semester
V	ELC-3	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-8	Major paper 8 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-9	Major paper 9 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-I0	Major paper 10 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-11	Major paper 10 (Disciplinary/ Interdisciplinary Major)	4	
VI	ELC-4	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-12	Major paper 12 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-13	Major paper 13 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-14	Major paper 14 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-15	Major paper 15 (Disciplinary/ Interdisciplinary Major)	4	
		Total Credits excluding one Internship (IAP) of 4 credits =	120	120

Semester-wise Course Code and Credit Points for Single Major during the Fourth Year Years of FYUGP for Bachelor's Degree (Honours with Research)

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Credits	
	Code	Papers	Paper	Semester
VII A	ELC-5	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-16	Major paper 16 (Research Methodology)	4	
	MJ-17	Major paper 1 7 (Disciplinary/Interdisciplinary Major)	4	
	MJ-18	Major paper 18 (Disciplinary/Interdisciplinary Major)	4	
	RC-I	Research proposal — Planning & Techniques (Disciplinary/Interdisciplinary Major)	4	
VIII A	ELC-6	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-19	Major paper 20 (Disciplinary/Interdisciplinary Major)	4	
	MJ-20	Major paper 20 (Disciplinary/Interdisciplinary Major)	4	
	RC-2	Research Internship/Field Work/Project/Dissertation/Thesis	8	
		Total Credits excluding one Internship of 4 credits =	160	160

Semester-wise Course Code and Credit Points for Single Major during the Fourth Year Years of FYUGP for Bachelor's Degree (Honours)

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Credits	
	Code	Papers	Paper	Semester
VII B	ELC-5	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-16	Major paper 16 (Disciplinary/Interdisciplinary Major)	4	
	MJ-17	Major paper 1 7 (Disciplinary/Interdisciplinary Major)	4	
	MJ-18	Major paper 18 (Disciplinary/Interdisciplinary Major)	4	
	AMJ-I	Major paper 19 (Disciplinary/Interdisciplinary Major)	4	
VIII B	ELC-6	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-19	Major paper 20 (Disciplinary/Interdisciplinary Major)	4	
	MJ-20	Major paper 20 (Disciplinary/Interdisciplinary Major)	4	
	AMJ-I	Advanced Major paper-I (Disciplinary/Interdisciplinary Major)	4	
	AMJ-2	Advanced Major paper-2 (Disciplinary/Interdisciplinary Major)	4	
		Total Credits excluding one Internship of 4 credits =	160	160

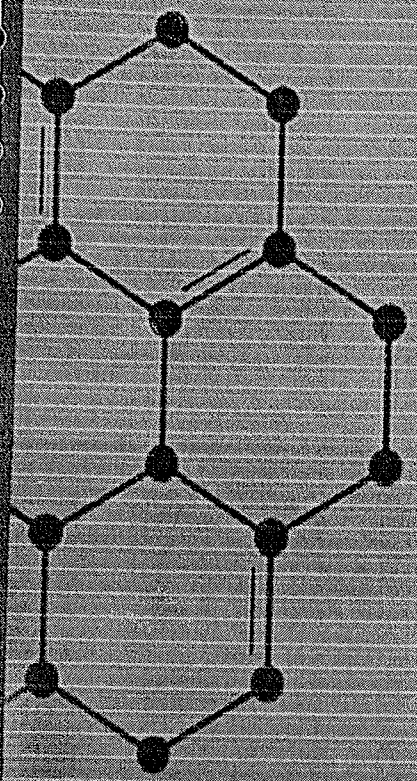
Course Points for Single Major during the Fourth Year Years of FYUGP for Bachelor's Degree (with Postgraduate Diploma)

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Credits	
	Code	Papers	Paper	Semester
VII C	ELC-5	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-16	Major paper 16 (Disciplinary/Interdisciplinary Major)	4	
	MJ-17	Major paper 17 (Disciplinary/Interdisciplinary Major)	4	
	MJ-18	Major paper 18 (Disciplinary/Interdisciplinary Major)	4	
	JOC-I	Skill based Job Oriented paper (Disciplinary/Interdisciplinary Major)	4	
VIII C	ELC-6	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-19	Major paper 20 (Disciplinary/Interdisciplinary Major)	4	
	MJ-20	Major paper 20 (Disciplinary/Interdisciplinary Major)	4	
	JOC-2	Skill based Job Oriented paper (Disciplinary/Interdisciplinary Major)	4	
	JOC-3	Skill based Job Oriented paper (Disciplinary/Interdisciplinary Major)	4	
		Total Credits excluding one Internship of 4 credits =	160	160

Note: Abbreviations used in Tables:

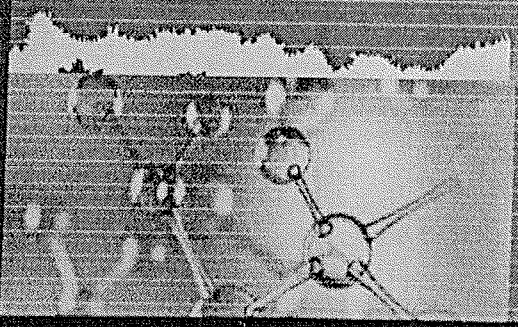
AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses
IAP	Internship/Apprenticeship/ Project
IKS	Indian Knowledge System
MDC	Multidisciplinary Courses
ELC	Elective Courses
MJ	Major Disciplinary / Interdisciplinary Courses
AC	Associated core courses from discipline/ Interdisciplinary/ vocational
MN	Minor Disciplinary/Interdisciplinary /vocational Courses
AMJ	Advanced Major Disciplinary/Interdisciplinary Courses
RC	Research Courses
JOC	Skill based Job Oriented course

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



CHEMISTRY

MAJOR



BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

SEMESTER -I

PAPER: MJ-01 (Inorganic Chemistry – 01)

	Mid Semester Exam	End Semester Exam	Total
Full Marks	15	60	75
Pass Marks	06	24	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: Up to 45%=1 mark; 45.01-55%=2 marks; 55.01-65%=3 marks; 65.01-75%=4 marks; >75% = 5 marks)

End Semester Examination (ESE): 3 Hrs.

There will be **two** groups of questions.

Group A is compulsory and will contain three questions. Q. No. 1 will be multiple/fill in the blank/very short type six questions of 1 mark each. Q. No. 2 & 3 will contain two short answer type questions each of 3 marks.

Group B will contain descriptive type six (Q. No. 4 to 8) questions of 12 marks each, out of which any four are to be answered.

UNIT I: Atomic Structure — 11 hours

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de' Broglie equation. Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi 2$. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT 2: Periodicity of Elements — 12 hours

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
(b) Atomic radii (van'der Waals)
(c) Ionic and crystal radii.
(d) Covalent radii (octahedral and tetrahedral)
(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
(f) Electron gain enthalpy, trends of electron gain enthalpy.
(g)Electronegativity, Pauling, Mullikan, Allred Rachow scales, electronegativity and bond order, partial charge, hybridization, group electronegativity. Sanderson electron density ratio.

UNIT 3: Chemical Bonding — 16 hours

(i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation, expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

(ii) Covalent bond: Lewis structure, Valence Shell Electron Pair Repulsion Theory (VSEPR), Shapes of simple molecules and ions containing lone-and bond-pairs of electrons multiple bonding, sigma and pi-bond approach, Valence Bond theory, (Heitler-London approach). Hybridization containing s, p and s, p, d atomic orbitals, shapes of hybrid orbitals, Bents rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of simple homonuclear and heteronuclear diatomic molecules, MO diagrams of simple tri and tetra-atomic molecules, e.g., N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, HCHO. (idea of s-p mixing and orbital interaction to be given). Covalent character in ionic compounds, polarizing power and polarizability. Fajan rules, polarization. Ionic character in covalent compounds: Bond moment and dipole moment. ionic character from dipole moment and electronegativities.

UNIT 4: Metallic bonding and Weak chemical forces — 6 hours

Metallic Bond: Qualitative idea of free electron model, Semiconductors, Insulators. Weak Chemical Forces: Vander Waals, ion-dipole, dipole-dipole, induced dipole induced dipole interactions, Lenard-Jones 6-12 formula, hydrogen bond, effects of hydrogen bonding on melting and boiling points, solubility, dissolution.

Recommended Books/References:

1.Lee, J. D. Concise Inorganic Chemistry, Wiley, 5th Edn.

2.Douglas, B.E., McDaniel, D.H., Alexander J.J., Concepts & Models of Inorganic Chemistry, (Third Edition) John Wiley & Sons,1999.

3.Atkins, P. W. and DePaula, J. Physical Chemistry, Tenth Edition, Oxford University Press, 2014.

4. Rodger, G. E. Inorganic and Solid State Chemistry, Cengage Learning, 2002.

SEMESTER -I

PAPER: MJ-01 (Practical)

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

Credits: 01

Duration of Course: 30 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 questions/experiments to be performed in the laboratory and report that in the note book/Answer book: 15 marks.
Group B will contains

(1) Class Records/Note book: 05 marks

(2) Viva voce: 05 marks

(A) Titrimetric Analysis

(i) Calibration and use of apparatus.

(ii) Preparation of solutions of different Molarity/Normality of titrants.

(iii) Use of primary and secondary standard solutions.

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.

(ii) Estimation of carbonate and bicarbonate present together in a mixture.

(iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe (II) and oxalic acid using standardized $KMnO_4$ solution.

(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii) Estimation of Fe (II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Recommended Books/References:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.

2. Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.

SEMESTER -II

PAPER: MJ-02 (Organic Chemistry – 01)

	Mid Semester Exam	End Semester Exam	Total
Full Marks	15	60	75
Pass Marks	06	24	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: Up to 45%=1 mark; 45.01-55%=2 marks; 55.01-65%=3 marks; 65.01-75%=4 marks; >75% = 5 marks)

End Semester Examination (ESE): 3 Hrs.

There will be **two** groups of questions.

Group A is compulsory and will contain three questions. Q. No. 1 will be multiple/fill in the blank/very short type six questions of 1 mark each. Q. No. 2 & 3 will contain two short answer type questions each of 3 marks.

Group B will contain descriptive type six (Q. No. 4 to 8) questions of 12 marks each, out of which any four are to be answered.

UNIT 1: Basics of Organic Chemistry — 12 hours

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals and Carbenes).

Organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

UNIT 2: Stereochemistry — 8 hours

Concept of asymmetry, Fischer Projection, Newmann and Sawhorse projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z

notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixtures, Relative and absolute configuration: D/L and R/S designations.

UNIT 3: Chemistry of Aliphatic Hydrocarbons — 18 hours

Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity.

Carbon-Carbon pi-bonds

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercurationdemercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated dienes and, DielsAlder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions.

Cycloalkanes and Conformational Analysis

Cycloalkanes and stability, Baeyer strain theory, Conformation analysis, Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms.

UNIT 4: Aromatic Hydrocarbons — 7 hours

Aromaticity: Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of substituent groups.

Recommended Books/References:

1. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, 6th Edn., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Pine S. H. Organic Chemistry, Fifth Edition, McGraw Hill, (2007)
3. F. A. Carey, Organic Chemistry, Seventh Edition, Tata McGraw Hill (2008).
4. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd Ed., (2012), Oxford University Press.
5. F. A. Carey, R. J. Sundberg, Advanced Organic Chemistry, Part A: Structure and mechanism, Kluwer Academic Publisher, (2000).

SEMESTER -II

PAPER: MJ-02 (Practical)

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

Credits: 01

Duration of Course: 30 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 questions/experiments to be performed in the laboratory and report that in the note book/Answer book: 15 marks.
Group B will contains

(1) Class Records/Note book: 05 marks

(2) Viva voce: 05 marks

1. Checking the calibration of the thermometer.
2. Purification of organic compounds by crystallization using the following solvents:
   a. Water b. Alcohol c. Alcohol-Water
3. Determination of the melting points of given organic compounds and unknown organic compounds (using Kjeldahl method and electrically heated melting point apparatus).
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
6. Chromatography
   a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
   b. Separation of a mixture of two sugars by ascending paper chromatography
   c. Separation of a mixture of *o*-and *p*-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

Recommended Books/Reference:

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)

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

CHEMISTRY

ASSOCIATED CORE COURSE

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

SEMESTER –I/II

PAPER: ASSOCIATED CORE COURSE, AC (THEORY)

For other Department/Disciplines

	Mid Semester Exam	End Semester Exam	Total
Full Marks	15	60	75
Pass Marks	06	24	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: Up to 45%=1 mark; 45.01-55%=2 marks; 55.01-65%=3 marks; 65.01-75%=4 marks; >75% = 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 (A) will be multiple/fill in the blank/very short type five questions of 1 mark each. Q. No. 1 (B) will contain two short answer type questions (max.50 words) each of 5 marks.
Group B will contain descriptive type five questions of 15 marks each, out of which any three are to be answered.

CHEMICAL ENERGETICS EQUILIBRIA, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Section A: Physical Chemistry-1

20 hours

Unit 1: Chemical Energetics

8 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 2: Chemical Equilibrium — 6 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 KP, KC and KX. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

Unit 3: Ionic Equilibria — 6 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-1 — 25 hours

Unit 3: Fundamentals of Organic Chemistry — 6 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 4: Stereochemistry — 8 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 5: Aliphatic Hydrocarbons — 11 hours

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. KMnO4) and trans -addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition).

Alkynes:

(Upto 5 Carbons) Preparation: Acetylene from CaC2 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/II

PAPER: ASSOCIATED CORE COURSE, AC (PRACTICAL)

For other Department/Disciplines

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

Credits: 01

Duration of Course: 30 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 questions/experiments to be performed in the laboratory and report that in the note book/Answer book: 15 marks.
Group B will contains

(1) Class Records/Note book: 05 marks

(2) Viva voce: 05 marks

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. 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.

Curriculum Framework and Credit System [illegible]

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