

KOLHAN UNIVERSITY, CHAIBASA
JHARKHAND



Revised Curriculum and Credit Frame Work
As Per FYUGP, NEP-2020
For UG Chemistry (w.e.f. 2022)

University Department of Chemistry
Kolhan University, Chaibasa
West Singhbhum, Jharkhand- 833202

Kolhan University
Department of Chemistry
Semester wise course code & credit point as per FYUGP NEP – 2020

Sem	Code	Index	
		Papers	Credits (Th +P)
I	MJ-1	Major Paper-1 (Inorganic Chemistry - 1)	3 + 0
	MJ-1 Practical	Practical of MJ-1	0 + 1
	MN-1A	Minor Paper-1A (Inorganic Chemistry)	3 + 0
	MN-1A Practical	Practical of MN-1A	0 + 1
	MDC/IRC-1	Multi-Disciplinary/Introductory Regular Course	3 + 0
II	MJ-2	Major Paper -2 (Organic Chemistry - 1)	3 + 0
	MJ-3	Major Paper -3 (Physical Chemistry - 1)	3 + 0
	MJ-2 Practical	Practical of MJ-2 & MJ-3	0 + 2
	MN-2A	Minor Paper – 2A (Chemistry in Everyday Life)	3 + 0
	MN-2A Practical	Practical of MN-2A	0 + 1
III	MJ-4	Major Paper - 4 (Inorganic Chemistry - 2)	3 + 0
	MJ-5	Major Paper - 5 (Organic Chemistry - 2)	3 + 0
	MJ-3 Practical	Practical of MJ-4 & MJ-5	0 + 2
	MN-1B	Minor Paper – 1B (Physical Chemistry)	3 + 0
	MN-1B Practical	Practical of MN-1B	0 + 1
IV	MJ-6	Major Paper-6 (Inorganic Chemistry - 3)	3 + 0
	MJ-7	Major Paper -7 (Organic Chemistry - 3)	3 + 0
	MJ-8	Major Paper -8 (Physical Chemistry - 2)	3 + 0
	MJ-4 Practical	Practical of MJ-6, MJ-7 & MJ-8	0 + 3
	MN-2B	Minor Paper –2B (Analytical Chemistry)	3 + 0
	MN-2B Practical	Practical of MN-2B	0 + 1
V	MJ-9	Major Paper - 9 (Inorganic Chemistry - 4)	3 + 0
	MJ-10	Major Paper - 10 (Molecular Spectroscopy)	3 + 0
	MJ-11	Major Paper - 11 (Physical Chemistry - 3)	3 + 0
	MJ-5 Practical	Practical of MJ-9, MJ-10 & MJ-11	0 + 3
	MN-1C	Minor Paper – 1C (Organic Chemistry)	3 + 0
	MN-1C Practical	Practical of MN-1C	0 + 1
VI	MJ-12	Major Paper -12 (Analytical Chemistry)	3 + 0
	MJ-13	Major Paper -13 (Green Chemistry)	3 + 0
	MJ-14	Major Paper -14 (Heterocyclic Chemistry)	3 + 0
	MJ-15	Major Paper -15 (Biochemistry)	3 + 0
	MJ-6 Practical	Practical of MJ-12, MJ-13, MJ-14 & MJ-15	0 + 4
	MN-2C	Minor Paper – 2C (Bio-Inorganic Chemistry)	3 + 0
	MN-2C Practical	Practical of MN-2C	0 + 1
VII	MJ-16	Major Paper -16 (Environmental Chemistry)	3 + 0
	MJ-17	Major Paper -17 (Organic Chemistry – 4)	3 + 0
	MJ-18	Major Paper -18 (Group Theory & Bioinorganic Chemistry)	3 + 0
	MJ-19	Major Paper-19 (Physical Chemistry - 4)	3 + 0
	MJ-7 Practical	Practical of MJ-16, MJ-17, MJ-18 & MJ-19	0 + 4
	MN-1D	Minor Paper – 1D (Biochemistry)	3 + 0
	MN-1D Practical	Practical of MN-1D	0 + 1

VIII	MJ-20	Major Paper-20 (Application of Spectroscopy)	3 + 0
	AMJ-1	Advanced Major Paper-1 (Medicinal Chemistry)	3 + 0
	AMJ-2	Advanced Major Paper-2 (Polymer Chemistry)	3 + 0
	AMJ-3	Advanced Major Paper-3 (Material Chemistry)	3 + 0
	MJ-8 + AMJ-1 Practical	Practical of MJ-20, AMJ-1, AMJ-2 & AMJ-3	0 + 4
	MN-2D	Minor Paper – 2D (Bio-Organic Chemistry)	3 + 0
	MN-2D Practical	Practical of MN-2D	0 + 1

Semester-III
PAPER Title: Major Paper-4 (MJ-4)
Credits - 03

Learning objective:

- Oxidation-Reductions and their use in metallurgy.
- Chemistry of s and p-block elements.
- Inorganic polymers and their use.
- Chemistry of noble gases and their compounds; application of VSEPR theory in explaining structure and bonding.

Inorganic Chemistry - 2

Unit	FM-60	Content	Time 3hrs	Hours
1		Oxidation-Reduction and general principle of metallurgy: Redox equations, Standard Electrode Potential and its application to inorganic reactions. Occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon or carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel- de Boer process and Mond's process, Zone refining.		12h
2		Noble Gases: Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF ₂ , XeF ₄ and XeF ₆ ; Bonding in noble gas compounds (Valence bond and MO treatment for XeF ₂), Shapes of noble gas compounds (VSEPR theory).		08h
3		Chemistry of s and p Block Elements: Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate. Structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Per-oxo acids of Sulphur inter-halogen compounds, polyhalide ions, pseudo-halogens, properties of halogens.		15h
4		Inorganic Polymers: Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.		10h

Sessional Internal Assessment (SIA) Full Marks – 15 Marks

A – Internal written Examination – 10 Marks (1 Hr.)

B – Over All Performance including Regularity – 05 Marks

Books Recommended:

- (i) Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
- (ii) Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.
- (iii) Greenwood, N.N., Earnshaw. Chemistry of the Elements, Butterworth-Heinemann. 1997.
- (iv) Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.
- (v) Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
- (vi) Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry Fourth Ed., Pearson, 2010.
- (vii) Atkins, P. W and Shriver D. N. Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

Semester-III
PAPER Title: Major Paper-5 (MJ-5)
Credits - 03

Learning objective:

- Basic uses of reaction mechanisms.
- Name reactions, uses of various reagents and the mechanism of their action.
- Organometallic compounds and their uses
- Use of reagents in various organic transformation reactions

Organic Chemistry - 2

Unit	FM-60	Content	Time 3hrs Hours
1		<p>Chemistry of Halogenated Hydrocarbons: Alkyl halides: Methods of preparation, Nucleophilic substitution reactions – SN_1, SN_2 and SN_i mechanisms with stereochemical aspects and effect of solvent etc.; Nucleophilic substitution vs. elimination. Aryl halides: Preparation, including preparation from diazonium salts. Nucleophilic aromatic substitution; SN_{Ar}, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards Nucleophilic substitution reactions. Organometallic compounds of Mg and Li and their use in synthesis.</p>	12h
2		<p>Alcohols, Phenols, Ethers and Epoxides: Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Preparation and properties of glycols: Oxidation by periodic acid and lead tetra acetate, Pinacol-Pinacolone rearrangement. Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements with mechanism. Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxies with alcohols, ammonia derivatives and $LiAlH_4$</p>	10h
3		<p>Carbonyl Compounds: Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition. Active methylene compounds: Keto-enol tautomerism.</p>	10h
4		<p>Carboxylic Acids and their Derivatives: Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement.</p>	10h
5		<p>Sulphur containing compounds: Preparation and reactions of thiols, thioethers and sulphonic acids,</p>	03h

Sessional Internal Assessment (SIA) Full Marks – 15 Marks
A – Internal written Examination – 10 Marks (1 Hr.)
B – Over All Performance including Regularity – 05 Marks

Books Recommended:

- (i) Solomons, T.W G., Fryhle, B. Craig. Organic Chemistry, John Wiley & Sons, Inc (2009).
- (ii) McMurry, J.E. Fundamentals of Organic Chemistry, Seventh edition Cengage Learning, 2013.
- (iii) P Sykes, A Guide Book to Mechanism in Organic Chemistry, 6th Edition (1997), Orient Longman, New Delhi.
- (iv) Morrison R. T. and Boyd R. N. Organic Chemistry, Sixth Edition Prentice Hall India, 2003.
- (v) Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
- (vi) Kalsi, P. S. Organic reactions and their mechanisms, New Age Science (2010).
- (vii) Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press Inc., New York (2001).

Semester-III
PAPER Title: Chemistry Practical - MJ-3 LAB
Credits- 02

FM - 50

Pass Marks- 20

Content

(A) Iodo / Iodimetry Titrations

- (i) Estimation of Cu (II) using sodium thiosulphate solution.
- (ii) Estimation of Arsenite and Antimony Iodimetrically
- (iii) Estimation of available chlorine in bleaching powder iodometrically.

(B) Inorganic preparations

- (i) Cuprous Chloride, Cu_2Cl_2
- (ii) Preparation of Aluminum potassium sulphat (Potash alum) or Chrome alum.
- (iii) Preparation of Sodium Nitroprusside.

(C) Organic preparations

Acetylation

- (i) Preparation of Acetanilide from aniline
- (ii) Preparation of Aspirin from salicylic acid

Benzoylation

- (i) Preparation of Benzanilide from aniline
- (ii) Preparation of Benzoyl p – toluidine

Nitration

- (i) Preparation of m-dinitrobenzene
- (ii) Preparation of picric acid from Phenol

Experiments – 30 Marks

Viva-Voice – 10 Marks

Notebook – 10 Marks

Semester-III
Course Title: Minor Paper-1B (MN-1B)
Credits -03

Learning objective:

- Familiarization with various states of matter
- Understanding Kinetic model of gas and its properties
- Ionic equilibria – electrolyte, ionization, dissociation

Physical Chemistry

Unit	FM-60	Content	Time- 3hrs	Hours
1		Chemical kinetics: Rate of reaction, order and Molecularity of reaction. First and second order reaction. Determination of order of reaction effect of temperature on reaction rate. Activation energy. Catalysis Characteristics of catalysts, types of catalysts, enzyme catalyst. Theory of catalysis, autocatalysis.		05h
2		Thermodynamics-I: System & surrounding, types of system, heat, work and internal energy. First law of Thermodynamics, Enthalpy, Heat Capacities, Relation between Cp and Cv. Calculation of W, Q, E and H in isothermal and adiabatic expansion of gases.		08h
3		Thermodynamics-II: Second law of thermodynamics. Conversion of heat into work. Carnot theorem and camot cycle. Entropy, entropy changes in reversible and irreversible processes Entropy of expansion of ideal gases. Entropy of mixing of gases.		08h
4		Colloidal chemistry Classification, preparation, purification and properties of colloidal solution. Peptization of colloids. Protection of colloids. Origin of charge on colloids. Electrophoresis, coagulation, dialysis, Brownian movement, Gold number.		04h
5		Electrochemistry Specific, Equivalent and molecular conductivities. Effect of dilution on different types of conductivities. Experimental determination of conductivities. Conductivity cell and cell constant. Ionic mobilities, Kohlrausch's law, Transference number. Arrhenius theory of electrolytes. Dissociation of weak and strong electrolytes.		10h
6		Gaseous State: Kinetic theory of gases Postulates, Kinetic gas equation, Deduction of gas laws from kinetic gas equation, R.M.S. Velocity, Average velocity and Kinetic Energy of Gas molecules, Deviations from ideal behaviour. Vender Waal's equation of state. Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals : difference between liquid crystal, solid and liquid. Classification, structures of nematic, smectic and cholesteric phases. Thermography and seven segment cell.		10h

Sessional Internal Assessment (SIA) Full Marks – 15 Marks

A – Internal written Examination – 10 Marks (1 Hr.)

B – Over All Performance including Regularity – 05 Marks

Books Recommended:

- Pradeep's Physical Chemistry, Vol.-I, II and III
- Dinesh Physical Chemistry, Vol.-I, II and III
- Text Book of Physical Chemistry by Puri Sharma and Pathania
- Advanced Physical Chemistry by D.N. Bajpai
- UGC Advanced Physical Chemistry by J.N. Gurtu and A. Gurtu, Vol.-I, II and III

Semester-III
Course Title: Chemistry Practical - MN-1B LAB
Credits- 01

FM - 25

Content

Pass Marks- 10

Determination of surface tension of liquids using Stalagmometer.
Determination of co-efficient of viscosity liquids using Ostwald's viscometer.
Determination of Heat of solution.
Determination of Heat neutralization of strong acid and strong base.
Determination of Partition co-efficient of solute between two immiscible liquids.
e.g., Iodine between carbon tetrachloride and water.

Experiments – 15 Marks

Viva-Voice – 05 Marks

Notebook – 05 Marks

Semester-IV
PAPER Title: Major Paper- 6 (MJ-6)
Credits -03

Learning objective:

- Coordination compounds – its nomenclature, theories, d-orbital splitting in complexes, chelate.
- Transition metals, its stability, color, oxidation states and complexes.
- Bioinorganic chemistry – metal ions in biological system, its toxicity; hemoglobin.

Inorganic Chemistry -3

Unit	FM-60	Content	Time- 3hrs	Hours
1	Coordination Chemistry:	Werner's theory, EAN rule, valence bond theory (inner and outer orbital complexes), Crystal field theory, d-orbital splitting, , weak and strong fields, pairing energies, factors affecting the magnitude of (Δ). Octahedral vs. tetrahedral coordination, square planar complexes, d orbital splitting in trigonal bipyramidal, square pyramidal and cubic Ligand field environments, CFSE, Qualitative aspect of Ligand field theory, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with the coordination number 4 and 6, Chelate effect.		15h
2	Transition Elements:	General group trends with special reference to electronic configuration, color, variable valency, magnetic and catalytic properties, and ability to form complexes. Difference between the first, second and third transition series. Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excluding their metallurgy).		10h
3	Lanthanides and Actinides:	Electronic configuration, oxidation states, color, spectra and magnetic behavior, lanthanide contraction, separation of lanthanides (ion-exchange method only).		10h
4	Bioinorganic Chemistry:	Metal ions present in biological systems, Sodium / K-pump, Toxicity of metal ions (Hg, Pb, Cd and As), chelating agents in medicine. Iron and its application in biosystems, Hemoglobin.		10h

Sessional Internal Assessment (SIA) Full Marks – 15 Marks

A – Internal written Examination – 10 Marks (1 Hr.)

B – Over All Performance including Regularity – 05 Marks

Books Recommended:

- Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.
- Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
- Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
- Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry Wiley-VCH, 1999
- Basolo, F, and Pearson, R.C. Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
- Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, Butterworth-Heinemann, 1997.

Semester-IV
PAPER Title: Major Paper- 7 (MJ-7)
Credits - 03

Learning objective:

- Nitrogen containing functional groups and their reactions.
- Familiarization with Polynuclear hydrocarbons and their reactions.
- Alkaloids and Terpenes

Organic Chemistry - 3

Unit	Content	Time 3hrs	Hours
1	Nitrogen Containing Functional Groups Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3°. Diazonium salts: Preparation and synthetic applications.		10h
2	Heterocyclic Compounds: Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction Derivatives of furan: Furfural and furoic acid.		15h
3	Polynuclear Hydrocarbons: Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.		10h
4	Alkaloids Natural occurrence, General structural features, Isolation and their physiological action, Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.		05h
5	Terpenoids Occurrence, classification, isoprene rule. Elucidation of structure and synthesis of Citral, Neral and α -terpineol.		05h

Sessional Internal Assessment (SIA) Full Marks – 15 Marks

A – Internal written Examination – 10 Marks (1 Hr.)

B – Over All Performance including Regularity – 05 Marks

Books Recommended:

- (i) Morrison, R. T., Boyd, R. N., Bhatlerjee, S.K., Organic Chemistry, 7th Edn., Pearson.
- (ii) Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds. John Welly & Sons (1976).
- (iii) Solomons, T.W., Fryhle Craig, Organic Chemistry, John Wiley & Sons, Inc (2009).
- (iv) McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- (v) Kalsi, P. S. Organic reactions and their mechanisms, New Age Science (2010).
- (vi) Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press Inc., New York (2001).
- (vii) Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, PrajatiParakashan (2010).
- (viii) Bansal R. K. Heterocyclic Chemistry: Syntheses, Reactions and Mechanisms, New Age, Third Edition (1999).
- (ix) Clayden J., Greeves N., Warren S., Organic Chemistry, (2nd Ed), (2012), Oxford University Press.

Semester-IV
PAPER Title: Major Paper-8 (MJ-8)
Credits- 03

Learning objective:

- Understanding the application of thermodynamics: Joule Thompson effects, partial molar quantities.
- Understanding the concept of heat of reactions and use of equations in calculations of bond energy, enthalpy, etc.
- Dilute solution and its properties.

Physical Chemistry - 2

Unit	Content	Time 3hrs Hours
1	Introduction to thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law of thermodynamics: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.	10h
2	Thermo chemistry: Heats of reactions: standard states; enthalpy of formation and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermo chemical data, effect of temperature (Kirchhoff's equations). pressure on enthalpy of reactions.	05h
3	Second Law of thermodynamics: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes.	05h
4	Third law of thermodynamics: Third Law of thermodynamics, calculation of absolute entropy of molecules.	03h
5	Free Energy Functions: Gibbs and Helmholtz energy: variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.	08h
6	Partial molar quantities: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs- Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.	05h
7	Dilute solutions: Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four Colligative properties: [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal dissociated and associated solutes in solution.	09h

Sessional Internal Assessment (SIA) Full Marks – 15 Marks

A – Internal written Examination – 10 Marks (1 Hr.)

B – Over All Performance including Regularity – 05 Marks

Books Recommended:

- (i) Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).
- (ii) Ball, D. W. Physical Chemistry Thomson Press, India (2007).
- (iii) Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
- (iv) Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
- (v) G. M. Barrow, Tata McGraw Hill (Fifth Edition) (2007).
- (vi) Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- (vii) Levine, I. N. *Physical Chemistry* 6th Ed., Tata McGraw Hill, 2010.
- (viii) Metz, C.R. *2000 solved problems in chemistry*. Schaum Series, 2006.
- (ix) Khosla, B. D.; Garg, V. C. and Gulati, A. *Senior Practical Physical Chemistry*, R. Chand New Delhi, 2011.

Semester-IV
PAPER Title: Chemistry Practical - MJ-4 LAB
Credits- 03

FM - 75

Pass Marks- 30

Content

(A) INORGANIC

- Gravimetric estimation of Ag^+ , Ba^{2+} , Ni^{2+} , Cu^{2+} , Cl^- , SO_4^{2-} .
- Synthesis of ammine complexes of Ni (II) and its Ligand exchange reactions (e.g. bidentate Ligand like acetyl acetone, DMG, glycine) by substitution method.

(B) PHYSICAL

1. Study the kinetics of the following reactions.
 - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
 - b. Saponification of ethyl acetate.
2. To find the partition Coefficient of Solution Between the two Immiscible Liquid
 - a. Carbon Tetrachloride and water
 - b. Benzoic acid and water

(C) ORGANIC

1. Qualitative analysis of unknown organic compounds containing monofunctional groups.
2. Preparation of methyl orange.
3. Extraction of caffeine from tea leaves.

1.

Experiments – 45 Marks

Viva-Voice – 15 Marks

Notebook – 15 Marks

Semester-IV
PAPER Title: Minor Paper-2B (MN-2B)
Credits - 03

Learning objective:

- Expresses the role of analytical chemistry in science.
- Compare qualitative and quantitative analyses.
- Expresses the quantitative analysis methods.
- Expresses the qualitative analysis methods.

Analytical Chemistry		Time 3hrs
Unit	Content	Hours
	FM-60 Marks	3
1	Qualitative analysis of Inorganic salts: Principle involved in the separation of cations. Application of solubility product and common ion effect. Detection and removal interfering radicals (eg. PO_3^- , BO_3^-). Special tests for the mixture of acid radicals – Carbonate in presence of sulphite, Nitrate in presence of Nitrite. Nitrate in presence of bromide and iodide. Chloride, Bromide and Iodide in presence of each other.	10h
2	Principles involved in volumetric analysis – Acidimetry and alkalimetry. Principles involved in the red-ox titrations: uses of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$, Iodometry and Jodimetry.	07h
3	Detection of elements and functional groups in the organic compounds. Elements: N, P, S and halogens. Functional groups: Hydroxyl, -OH (alcoholic), Nitro, $-\text{NO}_2$, Amide – CONH_2 , Ketonic $\text{C}=\text{O}$, Aldehydic – CHO, Carboxylic – COOH, Phenolic – OH Amino – NH_2	08h
4	Spectroscopy: Ultraviolet and visible spectra (electronic spectra). Uses of UV and visible spectra. Infra-red (IR), Nuclear magnetic resonance (NMR) uses of IR and NMR spectra.	10h
5	Organic reagents in inorganic analysis: (i) Dimethyl glyoxime (ii) α-Furyl dioxime (iii) 8-hydroxy quinoline (iv) α-nitroso-β-naphthol (v) Cupron (vi) Cupferron (vii) αα-Dipyridyl (viii) Salicylaldehyde (ix) Nitron (xii) Dithiazone	10h

Sessional Internal Assessment (SIA) Full Marks – 15 Marks

A – Internal written Examination – 10 Marks (1 Hr)

B – Over All Performance including Regularity – 05 Marks

Books Recommended:

1. General Chemistry by Sanyal & Sanyal
2. General Chemistry by F. M. Miller
3. Industrial Chemistry by B.K. Sharma
4. Inorganic Practical Chemistry by P.K. Banerjee
5. Organic Practical Chemistry by Banerjee & Mukhopadhyaya

Semester-IV
PAPER Title: Chemistry Practical - MN-2B LAB
Credits - 01

FM-25 Marks

Pass Marks - 10

Content

- Gravimetric estimation of Ag^+ , Ba^{2+} , Cl^- and SO_4^{2-}
- Preparation of potash alum.
- Preparation of chrome alum.

Experiments – 15 Marks

Viva-Voice – 05 Marks

Notebook – 05 Marks