

K.K. UNIVERSITY

NALANDA, BIHAR - 803115



SCHOOL OF APPLIED SCIENCES

MASTER OF SCIENCE (M.Sc.)

CHEMISTRY

(Two Year Full Programme)

2022-2023

PROGRAMME STRUCTURE & SYLLABUS



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Berauti, Nepura, Bihar Sharif
Nalanda - 803115 (Bihar)

Year	Semester	Course Code	Course Title	L	T	P	C	
1	1	MSCH 1101	Physical Chemistry-I	4	1	0	5	
		MSCH 1102	Inorganic Chemistry-I	4	1	0	5	
		MSCH1103	Organic Chemistry-I	4	1	0	5	
		MSCH 1104-P	PRACTICAL-I	0	0	10	5	
	Total			12	3	10	20	
	2	2	MSCH 1201	Physical Chemistry-II	4	1	0	5
			MSCH 1202	Inorganic Chemistry-II	4	1	0	5
			MSCH 1203	Organic Chemistry-II	4	1	0	5
			MSCH 1204-P	PRACTICAL-II	0	0	10	5
		Total			12	3	10	20
2	3	MSCH 2101	Spectroscopy-II	4	1	0	5	
		MSCH 2102	Environmental and Analytical Chemistry	4	1	0	5	
		MSCH 2103	Bio-organic and Bio-inorganic Chemistry	4	1	0	5	
		MSCH 2104-P	PRACTICAL-III	0	0	10	5	
	Total			12	3	10	20	
	4	4	MSCH 2201	Medicinal Chemistry(Organic)	4	1	0	5
			MSCH 2202	Natural Products(Organic)	4	1	0	5
			MSCH 2203	Heterocyclic Chemistry(Organic)	4	1	0	5
			MSCH 2204-P	PROJECT AND DISSERTATION	0	0	10	5
		Total			12	3	10	20

Course of Dissertation: -

- ✓ Environmental and Analytical chemistry
- ✓ Bio-inorganic Chemistry



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MSCH 1101: Physical Chemistry-I

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Chemical thermodynamics: Partial molar properties in ideal gas mixture, Chemical Potential, its determination and variation with temperature and pressure, Gibbs Duhem equation. Fugacity and activity its variation with 'T' and 'P', Fugacity of a gas mixture.	10
II	Statistical Thermodynamics: Partition function and its significance, Relationship with thermodynamic functions, Translational, Rotational, Vibrational and Electronic partition function. Its applications in the case of monoatomic and diatomic molecules.	10
III	Surface Chemistry: Surface Tension and Surface free energy on liquids, Vapour pressure of droplets (Kelvin equation), Gibbs adsorption Isotherm, Estimation of surface area. (B.E.T equation), Unimolecular and bimolecular surface reactions	10
IV	Chemical Kinetics: Mechanism and Kinetics of consecutive and opposing reactions, Activated complex theory of Uni-molecular reaction, Mechanism and Kinetics of Photolysis of acetaldehyde Polymerization and Auto oxidation reaction, Homogeneous Catalysis, Kinetic of Enzyme catalysis	10



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V	Electro Chemistry: Electrode potential in terms of Chemical Potential and activity. Debye Huckle theory of conductance of electrolytic solution	10
VI	Macro molecules: Types of Polymers, Kinetics and mechanisms of Polymerization, Molecular mass—number and mass average molecular mass	10

REFERENCE BOOKS :		
1.	R.C MUKHERJEE	Modern Approach to Physical Chemistry
2.	S.GLASSSTONE	Electrochemistry, Thermodynamics, Chemical Kinetics
3.	GURDEEP & Dr. HARISH	Physical Chemistry
4.	V.K GUPTA & R.G SHARMA	Physical Chemistry



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MSCH 1102: Inorganic Chemistry-I

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Stereochemistry and Bonding: M.O. diagram for hetero-nuclear di-and triatomic molecules. d π -p π bonds, Bent Rule	10
II	Magnetochemistry: e-e interaction, Term Symbols, spin orbit coupling, Quenching of orbital contribution in metal complexes.	10
III	Metal-Ligand Equilibrium in Solution Stepwise and overall formation constants and their interaction, Factors affecting the Stability of metal complexes with reference to the nature of metal ion and ligand, Chelate effect	10
IV	Metal ligand Bonding Limitation of crystal field theory (CFT), MOT with σ - & π -bonding.	10
V	Reaction Mechanism of Transition metal complexes Inert and labile complexes Acid hydrolysis, base hydrolysis, CB mechanism, The trans-effect' Electron transfer reactions- inner and outer sphere mechanism.	10



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REFERENCE BOOKS :		
1.	COOPER H.LANGFORD,D.F SHRIVER,PETER ATKINS	Inorganic Chemistry
2.	J.D LEE	(Latest Edition)-Concise Inorganic Chemistry
3.	A.SINGH	Text book of Inorganic Chemistry
4.	GURDEEP R.CHHATWAL	Advanced Inorganic Chemistry(Part-I,Part-II)
5.	R.K PRASAD	Quantum Chemistry
6.	K.SOMA SEKHAR RAO,K.N.K VANI (KALYANI PUBLISHERS)	Text Book of Co-ordination Chemistry

MSCH 1103: Organic Chemistry-I

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Nature of Bonding in Organic molecules: Delocalized Chemical Bonding — Conjugation, cross conjugation, resonance, hyper-conjugation.	10
II	Aromaticity in Benzenoid and non-Benzenoid compounds: Alternante and non alternant hydrocarbons,Antiaromaticity, homo-aromaticity,Huckle rule.	10
III	Stereo chemistry: Elements of symmetry, chirality-molecules with more than one chiral center, Enantiotropic and dia-sterotopic synthesis, Optical activity in the absence of chiral carbon atom such as biphenyls, allenes, spiranes and helical phenanthrene.	10



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IV	<p>Reaction mechanism:</p> <p>Types of reactions. Hammond's postulate, Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbene, Effect of structure on reactivity, resonance and field effect and steric effect, The Hammett equation and linear free energy relationship substituent and reaction constants.</p>	10
V	<p>Aromatic Electrophilic Substitution:</p> <p>Orientation and reactivity in mono substituted benzene ring, o/p ratio, orientation in other ring systems, ipso substitution</p>	10
VI	<p>Addition to C=O:</p> <p>Wittig Reaction, Aldol Condensation, Perkin reaction and Benzoin condensation.</p> <p>Elimination reactions</p> <p>E1, E2, and E1CB mechanism.</p> <p>Free radical reactions</p> <p>Free radical substitution mechanism at an aromatic substrate, Allylic halogenations, Oxidation of aldehyde to carboxylic acid, Sandmeyer reaction, Hunsdiecker reaction.</p>	10
VII	<p>Conservation of Orbital symmetry in Pericyclic reactions:</p> <p>Woodward-Hoffmann rules, Cycloaddition [2+2], [4+2] and electrocyclic reactions Prototropic and Sigmatropic rearrangements.</p>	10

REFERENCE BOOKS :		
1.	BHAL & TULI	Text Book of Advanced Organic Chemistry
2.	WILLIAM KEMP	Organic Spectroscopy
3.	NORMAN & COXON	Principles of Organic Synthesis
4.	PETER SYKES	Mechanism in Organic Chemistry
5.	P.S KALSI	Stereochemistry: Conformation and Mechanism
6.	CAREY & SUNDBERG	Advanced Organic Chemistry
7.	O.P AGARWAL	Reaction Mechanism
8.	O.P AGARWAL	(Part-I, Part-II)-Natural products(Organic Chemistry)



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MSCH 1104-P: PRACTICAL-I

L	T	P	Cr
0	0	16	8

PRACTICAL	
1	Studies with Water equivalent of calorimeter and determination of heat of neutralization of strong acid and strong base.
2	Studies with saponification of ethyl acetate by sodium hydroxide and determination of rate constant.
3	Studies with Dissociation constant of acetic acid.
4	Studies pH of a given solution using hydrogen electrode Acid-base titration.
5	Qualitative analysis of inorganic mixture containing six radicals including interfering radicals
6	Quantitative analysis of two constituents ions of the following. Cu, Zn , Fe, Ni The cations Mg, Ca can be estimated using EDTA.



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MSCH 1201: Physical Chemistry-II

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Solid state chemistry: Perfect and imperfect crystals, intrinsic and extrinsic defects, Vacancies-Schottky and Frenkel defect, Non-stoichiometric defects	10
II	Non-Equilibrium thermodynamics: Entropy production in irreversible process, Reverse osmosis and electrokinetic phenomena	10
III	Introduction of quantum mechanics: Particle in three dimensional box, Hermitian operators, Angular momentum operator, their Eigen function and Eigen values, Theorems of operators	10
IV	Exactly Soluble System: Linear Harmonic oscillator, Hermit differential equation and its solution through recursion relation, H-like atoms and Legendre polynomial equation and their solution.	10
V	Approximate Method: Linear application to Harmonic oscillator, First order perturbation Application to He-atom, Huckel theory of conjugated system, bond order and charge density-its calculation. Application to ethylene and butadiene	10

REFERENCE BOOKS :

1.	R.C MUKHERJEE	Modern Approach to Physical Chemistry
2.	S.GLASSSTONE	Electrochemistry, Thermodynamics, Chemical Kinetics
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MSCH 1202: Inorganic Chemistry-II

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Symmetry and Group Theory in chemistry: Symmetry elements and symmetry operations, Definition of groups, sub-group, conjugate and class. Multiplication table for C_{2v} , C_{3v} , Representation of group by matrices, Working out representation of C_{2v} , C_{3v} point groups	10
II	Electronic spectra and magnetic properties of transition metal complexes: Derivation of spectroscopic ground states, Basic idea & calculation of Dq , B and β parameters, Spectroscopic method for assignment of absolute configuration in optically active metal chelates	10
III	Metal clusters Structural aspects of Boranes	10

REFERENCE BOOKS :		
1.	COOPER H.LANGFORD,D.F SHRIVER,PETER ATKINS	Inorganic Chemistry
2.	J.D LEE	(Latest Edition)-Concise Inorganic Chemistry
3.	A.SINGH	Text book of Inorganic Chemistry
4.	GURDEEP R.CHHATWAL	Advanced Inorganic Chemistry(Part-I,Part-II)
5.	R.K PRASAD	Quantum Chemistry
6.	K.SOMA SEKHAR RAO,K.N.K VANI (KALYANI PUBLISHERS)	Text Book of Co-ordination Chemistry



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MSCH 1203: Organic Chemistry-II

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Carbohydrate: Conformation of monosaccharide's and important derivatives of monosaccharide-glycosides, Disaccharides - Structure determination and chemical synthesis of sucrose, maltose & lactose	10
II	Lipids: Lipid metabolism, β -oxidation of fatty acid	10
III	Amino acids, peptides and proteins: Chemical and enzymatic hydrolysis of proteins, Amino acid sequencing, Secondary structure of protein, Tertiary structure of proteins folding.	10
IV	Nucleotides and nucleic acids: Chemical properties of pyrimidine and Purine derivatives, Structure of RNA and DNA, Chemical and enzymatic hydrolysis of nucleic acid	10
V	Terpenoids: Introduction, classification, isoprene rule and special isoprene rule, Structural determination of citral, α -Terpeniol and camphor.	10
VI	Alkaloids: Introduction, classification general method of structure, Structure and synthesis of the following compounds- Nicotine, Atropine	10



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REFERENCE BOOKS :		
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2.	WILLIAM KEMP	Organic Spectroscopy
3.	NORMAN & COXON	Principles of Organic Synthesis
4.	PETER SYKES	Mechanism in Organic Chemistry
5.	P.S KALSI	Stereochemistry: Conformation and Mechanism
6.	CAREY & SUNDBERG	Advanced Organic Chemistry
7.	O.P AGARWAL	Reaction Mechanism
8.	O.P AGARWAL	(Part-I, Part-II)-Natural products(Organic Chemistry)

MSCH 1204-P: PRACTICAL-II

L	T	P	Cr
0	0	10	5

PRACTICALS	
1.	Estimation of hardness, Mg, Ca, alkalinity and chloride in water and soil.
2.	Estimation of DO, BOD, and COD.
3.	Detection and estimation of phosphates, nitrates, nitrites.
4.	Determination of pH of soil and water.
5.	Estimation of Glucose.



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MSCH 2101: Spectroscopy -II

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Rotational spectra: Classification of molecules, Rigid rotator model, Non-rigid rotator, Quantization of rotational energy level, Bond Length calculation.	10
II	Vibrational rotational spectra: Quantization of vibrational energy level, vibrational energy of diatomic molecule, Anharmonicity, Group frequency, Finger print region, Factors influencing vibrational frequency.	10
III	NMR Spectroscopy Nuclear spin, nuclear resonance, shielding of magnetic nuclei, Factor influencing chemical deshielding and coupling constant	10
IV	Mass Spectroscopy: Ion production, ion analysis, factors affecting fragmentation, Mass spectral fragmentation of Organic compounds	10
V	Various electronic transitions, Beer Lambert Law, effect of solvent on electronic transition Fieser Woodward rules for calculating λ_{max} in conjugated dienes & α, β -unsaturated carbonyl compounds. H ₂ molecule, Ground & excited state terms derivation of H ₂ molecule. ¹³ C NMR, spin decoupling, Shift reagent	10

REFERENCE BOOKS :

1.	R.C MUKHERJEE	Modern Approach to Physical Chemistry
2.	S.GLASSSTONE	Electrochemistry, Thermodynamics, Chemical Kinetics
3.	GURDEEP & Dr. HARISH	Physical Chemistry
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MSCH 2102: Environmental Chemistry and Analytical Chemistry

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Environment & hydrosphere: Composition of atmosphere, Biogeochemical cycles of C, N, P, S and O, Chemical composition of water bodies, Hydrological cycle, Water quality parameters-dissolved oxygen, BOD, solids, metals, contents of chloride, sulfate, phosphate, nitrate and micro organisms, Analytical methods for measuring BOD, DO, COD, F, chloride and chlorine demand.	10
II	Soils and Industrial pollution: Composition of soils, micro and macro nutrients, Soil pollution- fertilizers, pesticides, Industrial pollution	10
III	Atmosphere: Particles, ions and radicals in atmosphere, their formation, Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, Green house effect, Acid rains.	10
IV	Analytical chemistry: Analytical methods for measuring air and water pollutants, Instrumental techniques for analysis of heavy metal in aqueous systems.	10
V	Thermal Analysis and Calorimetry: Basic principles of thermal analysis, TG, DTA, DSC, TM and microcalorimetry, Applications in polymer chemistry and solid state reactions	10
VI	Chromatography and colorimetry: Chromatography-Classification, chromatograph terminology, Colorimetry :- Beer Lambert law, Photoelectric colorimeter	10



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3.	A.SINGH	Text book of Inorganic Chemistry
4.	GURDEEP R.CHHATWAL	Advanced Inorganic Chemistry(Part-I,Part-II)
5.	R.K PRASAD	Quantum Chemistry
6.	K.SOMA SEKHAR RAO,K.N.K VANI (KALYANI PUBLISHERS)	Text Book of Co-ordination Chemistry

MSCH 2103: Bio-inorganic Chemistry and Bio-organic Chemistry

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Metals in biological systems: Trace elements and their significance. Na ⁺ /K ⁺ pump,Transport and storage proteins,Structure and functioning of myoglobin & hemoglobin, Metal complexes in transmission of energy, chlorophylls,Photo system-I and photo system-II in cleavage of water.	10
II	Electron transfer and Redox systems: Cytochromes and iron-sulfur proteins,Biological nitrogen fixation.nitrogenase.	10
III	Cell membrane: Ion transport through cell membrane.	10



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IV	Enzymes properties: Specify orientation and steric effects-coenzymes.Idea of prosthetic groups, thiamine, pyrophosphate, NADP, NADO, FMN& FAD.	10
V	Bioenergetics: Synthesis of ATP, Hydrolysis of ATP and entropy change in biological process	10
VI	Carbohydrate Metabolism: Calvin cycle, Kreb cycle, Glycolysis, gluconogenesis, glycogenolysis Biosynthesis of disaccharides	10
VII	Protein synthesis: Chemical basis of heredity, Replication of DNA,The effect of x-rays and y - rays on nucleic acid and protein structure.	10

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5.	R.K PRASAD	Quantum Chemistry
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MSCH 2104-P: PRACTICAL-III

L	T	P	Cr
0	0	10	5

PRACTICALS	
1.	Determination of the distribution coefficient of I ₂ , between CCl ₄ and water.
2.	Determination of the velocity constant of hydrolysis (or saponification) of ethyl acetate with NaOH.
3.	Determination of the order of reaction and the energy of activation of the reaction between H ₂ O, and HI.
4.	Determination of basicity of succinic acid conductometrically.
5.	Synthesis of Aspirin from Salicylic Acid

MSCH 2201: Medicinal Chemistry (Organic Special)

L	T	P	Cr
4	1	0	5



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UNITS	CONTENTS	Contact Hrs.
I	Drug Design : (a) Introduction, classification, SAR factor affecting bio activity (b) Theories of drug activity	10
II	Antineoplastic agents: (a) Cancer chemotherapy (b) Synthesis of Uracil	10
III	Cardiovascular Drugs: (a) Cardiovascular disease (b) Synthesis of amyl nitrate, sorbitrate, juinidine, Methyldopa, atenolol and oxyprenolol.	10
IV	Anti-tubercular Drugs: (a) PAS, Isoniazid Antiparkinsonian Drugs: (a) Introduction, levodopa and some ther dopaminergic agents — Anticholingeric, Aminoalcohols (b) Ethers-A phenothiazine derivations. Drugs based on five membered heterocycles	10



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4.	PETER SYKES	Mechanism in Organic Chemistry
5.	P.S KALSI	Stereochemistry: Conformation and Mechanism
6.	CAREY & SUNDBERG	Advanced Organic Chemistry
7.	O.P AGARWAL	Reaction Mechanism
8.	O.P AGARWAL	(Part-I, Part-II)-Natural products(Organic Chemistry)

MSCH 2202: Natural Products (Organic Special)

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Terpenoids: Isolation, Structure determination, biosynthesis of the following compounds, linalolene, Santonin	10
II	Alkaloids: Occurrence, Isolation, structural determination, stereochemistry and synthesis, Ephedrine, Quinine, Morphine and Narcotine.	10
III	Steroids and Hormones : Introduction, structural determination and synthesis of cholesterol, Androsterone, Cortisone (only synthesis)	10



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IV	Vitamins : Occurrence, Classification, biological functions Structure determination and synthesis of vitamins Vit A, ,Vit B and Vit C.	10
V	Plant pigments: Occurrence, structural determination and thesis of flavones, Isoflavone, anthocyanins, jocyandines and coumarins.	10

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1.	BHAL & TULI	Text Book of Advanced Organic Chemistry
2.	WILLIAM KEMP	Organic Spectroscopy
3.	NORMAN & COXON	Principles of Organic Synthesis
4.	PETER SYKES	Mechanism in Organic Chemistry
5.	P.S KALSI	Stereochemistry: Conformation and Mechanism
6.	CAREY & SUNDBERG	Advanced Organic Chemistry
7.	O.P AGARWAL	Reaction Mechanism
8.	O.P AGARWAL	(Part-I, Part-II)-Natural products(Organic Chemistry)

MSCH 2203: Heterocyclic Chemistry (Organic Special)

L	T	P	Cr
4	1	0	5

UNITS	CONTENTS	Contact Hrs.
I	Biopolymers: Polysaccharides, starch, amino acids and polypeptides, Proteins	10



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II	Synthetic polymers: Polyester, polytetrafluoroethylene, polyurethanes, poly-amino acids, polycyanoacrylates.	10
III	Benzofused five membered heterocyclic compounds: Classification, nomenclature of aromatic heterocycles, synthesis and reaction of benzopyrrole, benzofuran and benzothiophenes	10
IV	Five and six membered Heterocycles with two or more heteroatoms: Synthesis and reaction of oxazole, isooxazole thiazole, diazine and tetrazines	10
V	Seven and large membered Heterocycles with two or more heteroatoms: Synthesis and reaction of azepines, oxepines, diazepines	10

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1.	BHAL & TULI	Text Book of Advanced Organic Chemistry
2.	WILLIAM KEMP	Organic Spectroscopy
3.	NORMAN & COXON	Principles of Organic Synthesis
4.	PETER SYKES	Mechanism in Organic Chemistry
5.	P.S KALSI	Stereochemistry: Conformation and Mechanism
6.	CAREY & SUNDBERG	Advanced Organic Chemistry
7.	O.P AGARWAL	Reaction Mechanism
8.	O.P AGARWAL	(Part-I, Part-II)-Natural products(Organic Chemistry)

MSCH 2204-P: PROJECT AND DISSERTATION

L	T	P	Cr
0	0	10	5



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