Shri Agrasen Kanya P.G. College

(An Autonomous Institution)

Affiliated with Mahatma Gandhi Kashi Vidyapeeth

Two-year M.sc. Degree course in

CHEMISTRY

CHOICE BASED CREDIT SYSTEM SYLLABUS

PROLEGOMENA OF SYLLABUS

Master of Science (M.Sc.) in Chemistry is a post-graduation course of Shri Agrasen Kanya P.G. College (An autonomous Institution), Varanasi affiliated with Mahatma Gandhi Kashi Vidyapeeth Varanasi.
The aim of this programme is to impart in depth knowledge and skill to meet the current needs of industry, educational and R&D institutions. The revised curriculum is based on Choice based credit system and is developed with a viewpoint to keep pace with quality and quantity of knowledge of modern chemical science. In formulating these courses care has been taken to keep in mind the regional and national priorities maintain national and international educational standards.

The term credit is used to describe the quantum of syllabus for various programs in terms and hours of study. It indicates differential weightage given according to the contents and duration of the courses in the Curriculum design. Credit based system is flexible curriculum pattern with many merits. It is devoid of many limitations associated with the conventional rigid pattern of curriculum. Each course is assigned a weight (credit) depending upon its relative importance to the programme of definite total credit rating. In addition, several elective papers (choices) have been included in order to suit for the career of the students.

The curriculum to be implemented with this system would allow students to migrate between different institutions due to their own compulsions without losing their precious time. This system also has a benefit for students to develop a strong footing in the fundamentals with flexibility in selecting courses of specialization in the discipline of his/her liking and abilities

INTRODUCTION

- Master's degree course in chemistry would be of 100 credits, where one credit course of theory will be of one clock hour per week running for 15 weeks and one credit of practical course will consist of two clock hour per week running for 15 weeks.

- Every student shall complete 100 credits in four semesters. All semesters will have 24 credits each.

- Every student must clear 4 credits minor paper of other faculty/department in any semester organized by college.

- In each semester, there will be 4 theory papers of 4credits each. Thus, there will be 16 credits for theory papers in each semester. In each semester, practical course will be of 4 credits. 4 credits will be for project in each semester. The evaluation of 8 credits project will takes place by external examiner and internal faculty members in even semester (II and IV).

- Academic calendar showing dates of commencement and end of teaching and term end examination will be prepared and duly notified before commencement of each semester every year.

SEMESTER-1

PAPER – 1(THEORY)

COURSE TITLE: TRANSITION METAL CHEMISTRY

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: FIRST
PAPER-1		SUBJECT: CHEMISTRY
COURSE CODE: BO2O701T	COURSE TITLE: Transition metal chemistry	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Reaction Mechanism of Transition** Energy profile of a reaction, reactivity of metal complexes, inert and labile Complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis. factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reaction in square planner complexes, the trans-effect, mechanism of the substitution reaction, electron transfer reactions. Metal Complexes	
2.	**Metal to Metal Bonds and Metal Atom Clusters** Introduction, metal carbonyl clusters, Wades Rule, Higher, osmium carbonyl clusters, cluster compounds in catalysis	
3.	Higher boranes, carboranes, metalloboranes and mettalocarboranes.	
4.	Isopoly & heteropoly acid and salts	

5.	**Alkyls and Aryls of Transition metals:** Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further Suggestions:	

SEMESTER-1

PAPER – 2(THEORY)

COURSE TITLE: REACTION MECHANISM

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: FIRST
PAPER-2		SUBJECT: CHEMISTRY
COURSE CODE: B020702T		COURSE TITLE: Reaction Mechanism
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Carbocyclic compound –** Aromatically in benzenoid and non-benzenoid compounds, alterat and non-alternat hydrocarbons, Huckel's rule, energy level of Tt-molecular orbitals, annulenes, anti-aromaticity. aromaticity, homo-aromaticity, PO approach. Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity.	
2.	**Stereochemistry:** Elements of symmetry, chirality, molecules with more than one chrial center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chrial carbon(biphenyls, allenes and spiranes).	
3.	**Reaction Mechanism**: carbenes and nitrenes. Effect of structure on reactivity - resonance and field effects, steric, quantitative treatment, The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.	

4.	**Aliphatic Nucleophilic Substitution:** The S2, Syl, mixed Sy2 and SET mechanisms. Syl' & SN?' The neighbouring group mechanism, neighbouring group participation by it and & bonds. anchimeric assistance. Classical and non-classical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. The Syi mechanism. Necleophilic substitution at an allylic, Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium.	
5.	**Aromatic Electrophilic substitution** – The arenium ion mechanism, orientation and reactivity, energy profile diagram, ortho-pora, ratio, ipso attack, orientation in other ring system. vilsmeier reaction Gattermann Koch reaction.	
6.	**Aromatic nucleophilic substitution** The SNAr, Syl, benzene and SRN, mechanisms, reactivity, effect of substrate structure, leaving group and attacking nucleophile, The Von-Richter, Sommelet-Hacser.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further Suggestions:	

SEMESTER-1

PAPER – *3*(THEORY)

COURSE TITLE: QUANTUM, THERMODYNAMICS & BIOPHYSICAL

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: FIRST
PAPER-*3*		SUBJECT: CHEMISTRY
COURSE CODE: BO2O7O3T		COURSE TITLE: Quantum, Thermodynamic& biophysical
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**. 1. Quantum Chemistry** **1. Quantum Chemistry** (a) Introduction to Exact Quantum Mechanical Results: The Schrodinger equation and the postulates of quantum mechanics. Discussion of solution of the Schrodinger equation to some model systems viz... particle in a three-dimension box, one dimensional harmonic oscillator, the rigid rotor, the hydrogen atom. (b) Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to the Helium atom.	
	II. Thermodynamics: **(a) Classical** Thermodynamics: Partial molar properties; partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity. Application of phase rule to three component systems, second order phase transition. **(b) Solutions:** Thermodynamics properties of solution, chemical potential of pure substance, Chemical potential of real gases & fugacity, Chemical potential of ideal gas mixture, Thermodynamic functions of mixing, properties of liquid solutions, chemical potential of non-ideal solution, Excess functions of non-ideal solutions, Gibbs-Duhem-Margules equation.	

	(c) Non-Equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the → generalized fluxes and forces, non-equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity reactions.	
	III. Cell Membrane & Transport of ions: Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport, Nerve conduction.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further Suggestions:	

SEMESTER-1

PAPER – 4(THEORY)

COURSE TITLE: Analytical chemistry

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: FIRST
PAPER-4		SUBJECT: CHEMISTRY
COURSE CODE: B020704T	COURSE TITLE: Analytical chemistry	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**1. Errors and Evaluation -** Definition of terms in means & median, Precision Standard deviation, relative standard deviation, Accuracy - Absolute error, relative error. Types of error in experiment data determinate (systematic) in determinate (or random) & gross, Sources of errors & the effects upon the analytical data, statistical evaluation of data indeterminate errors, The uses of statistics.	

2.	**Thermal Analysis -** Theory, Methodology, Instrumentation & application of Thermometric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) & Thermometric titration.	
3.	**Modern Voltammetric Methods -** Theory & Instrumentation of polarography, Quantitative applications. Sampled Polarography, pulse polarography, Fast Linear Sweep Polarography, Cyclic Voltammetry, AC Polarography & Stripping voltammetry	
4.	**. 4. Acid-Base equilibria & Buffer Solution -** General concept of acid-base equilibria in water. Determination of pH & pH calculation for aqueous solutions of weak acid weak base, salt of	

	weak acid & weak base, Protolysis curve, buffer & buffer capacity.	
5.	**5. Separation Techniques** - Principles of Analytical separation analysis, Resolution gas chromatography (HPL-C), Ion exchange chromatography, general treatment of equilibria redox, complexion & precipitation titrations.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-1

CHEMISTRY PRACTICAL

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: FIRST
PRACTICAL-1		SUBJECT: CHEMISTRY
COURSE CODE: B020705P	COURSE TITLE:	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Qualitative and Quantitative Analysis** - Less common metal ions- TI, Mo, W, TI, Zr, Th, V, U (two metal ions in cationic/anionic forms) - Insoluble oxides, sulphates and halides	
2.	. **Organic Chemistry** **Qualitative Analysis** - Separation, purification and identification of compounds of binary mixture (one liquid and one solid) using tic and column chromatography, chemical tests. IR spectra to be used for functional group identification." - Estimation of amines/phenols using bromate bromide solution/or acetylation method - Determination of iodine and Saponification values of an oil sample.	
3.	**Adsorption** - To study surface tension - concentration relationship for solutions (Gibbs equation) **Phase Equilibria**	

	- Determination of congruent composition and temperature of a binary system (e.g. Diphenylamine-benzophenone system) - Determination of glass transition temperature of a given salt (e.g., $CaCl_2$) conductometrically. - To construct the phase diagram for three component system (e.g., chloroform-acetic-acid-water). **A. Conductometry** - Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically. - Determination of solubility and solubility product of sparingly soluble salts (e.g., PbSO.. $BaSO_4$) conductometrically. - Determination of the strength of strong and weak acids in a given mixture conductometrically. - To study the effect of solvent on the conductance of $AgNO_3$/acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO, DMF, dioxane, acetone, water) and to test the validity of Debye-Hückel- Onsager theory. - Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Hückel's limiting law.	

This course can be opted as an elective by the students of following subjects: Chemistry in B.Sc. (Bachelor of Science)	
Suggested Continuous Evaluation Methods:	
Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-1

CHEMISTRY PROJECT

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- FIRST	SEMESTER: FIRST
SUBJECT: CHEMISTRY		
COURSE CODE: B020706R	**COURSE TITLE**: PROJECT/ INDUSTRIAL TRAINING / INTERNSHIP	

The main objective of the exposure of students towards project/dissertation is to elevate their understanding into the practical and experimental aspects of some targeted areas of chemistry. This course will develop their analytical ability and will provide them an apt exposure to work in any research group and will motivate them to execute research in the area of their interest in chemical sciences.

Course Outcome: 1. students will be able to plan and strategize a scientific problem, and implement it within a reasonable time frame.
2. It is expected that after completing this project dissertation, students will learn to work
independently and how to keep accurate/readable record of assigned project.
3. In addition, students will be able to know the library search and handle the data in a
meaningful way
4. Also, students will be able to interpret the spectral data independently. 5. Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills and power point presentation.

Credits:		**Core compulsory**

For project work and dissertation, the area of the work would be to be decided by the advisor/mentor. On completion of the project work, students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty members and external expert in semester II .

SEMESTER-*2*

PAPER – 1(THEORY)

COURSE TITLE: SOME PROPERTIES OF COORDINATION COMPLEXES

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: Second
PAPER-1		SUBJECT: CHEMISTRY
COURSE CODE: B020801T	**COURSE TITLE**: SOME PROPERTIES OF COORDINATION COMPLEXES	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Basics –** Symmetry elements and symmetry operations, Point symmetry group, Classification of molecules in point groups.	
2.	**Electronic spectra of coordination complexes** origin of colour, Lambert-Beer's Law, Deviations from Lambert-Beart Law, Cause of Deviations, emission spectrum, Absorption spectrum, electronic spectra of transition metal complexes, selections rule their breakdown of miles.	
3.	**Charge Transfer spectrum** Origin of spectrum, types of C-T spectrum, LMCT, MLCT, MMCT, effect of solvent polarity. C-T spectrum on	
4.	**Optical Isomerism:** Optical isomerism in oh complexes Isomerisin from ligand distribution & unsymmetrical ligands for oh comple and biobentate with monodentated ligands, isomerism from ligand conformetin &	

	chirality, optical is mensm in Td complexes & square planer Complexes, Stereochemical notations for Fat complexes, absolute Configuration of Complexes; dal system, R&S system, X & A system Δ At resolution of enantiomers, spectroscopic methods for determination of absolute configuration of Complexes; ORD & CD, assignment of absolute Configuration using ORD&CD.	
5.	**Magnetic Properties in Complexes**: Anomalous magnetic 27 moment in Oh Ne^2; F2+ ,co2+Complex Td & Square planner complexes, factors responsible for anomely's quititrium between two spin states; magnetically hon-equivalent sites in unit cell's Solute-Solvent interaction; solute-Solute interaction; Configurations equilibrium.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-2

PAPER – 2(THEORY)

COURSE TITLE: (Reaction Mechanism-II and Organometallics)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: Second
PAPER-2		SUBJECT: CHEMISTRY
COURSE CODE: B020802T		COURSE TITLE: (Reaction Mechanism-II and Organometallics)
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Addition to Carbon Multiple Bonds:** Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction, Sharpless asymmetric epoxidation.	

2.	**Addition to Carbon-Hetero Multiple Bonds**: Mechanism of metal hydride of saturated carbonyl compounds, acids, esters and nitriles,	
3.	**Elimination Reactions:** The E2, El and ElcB mechanisms and their spectrum. Orientation of the double bond Reactivity effects of substrate structures, attacking base, the leaving group and the medium.	

4.	**Pericyclic Reactions:** Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffman correlation diagrams. FMO and PMO approach. Electrocyclic reaction-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements - superfacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.	
5.	**Organometallic reagents** Principle, properties and application of the following inorganic synthesis with mechanistic details. Transition metals - Fe, Co, Rh, compound:	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*2*

PAPER – *3*(THEORY)

COURSE TITLE: (Dynamics, Surface, Electro)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: Second
PAPER-*3*		SUBJECT: CHEMISTRY
COURSE CODE: B020803T		COURSE TITLE: (Dynamics, Surface, Electro)
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Chemical Dynamics:** Method of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, arrhenius equation and the activated complex theory, tonic reactions, kinetic salt effects, steady state kinetics. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and oscillatory reactions (Belousov-Zhabotinsky reaction).	
2.	**Surface Chemistry:** **(a) Adsorption:** Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimetion of surfaces (By BET Equation only) surface films on liquids (Electro-kinetic phenomenon). **(b) Micelles:** Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter	

	ion binding to micelles, thermodynamics of micellization phase separation and mass action models, solubilization, micro emulsion, reverse micelles.	
3.	**Electrochemistry** Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. of electrified interface. Guoy-Champman, Stern-theories of electrified surfaces. Electrocatalysis influence of various parameters, Hydrogen electrode. Polarography theory, Ilkovic reaction; half wave potential and its significance, introduction to corrosion, homogenous theory, forms of corrsion, corrosion monitoring and prevention methods.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-2

PAPER – 4(THEORY)

COURSE TITLE: (Chemical Kinetics)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR-FIRST	SEMESTER: Second
PAPER-4		SUBJECT: CHEMISTRY
COURSE CODE: B020804T	**COURSE TITLE:** (Chemical Kinetics)	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	Transition State Theory: Application of statistical mechanics to transition state theory with experimental results. Theories of unimolecular reactions-treatment of Lindmann, Hinshelwood, RiceRampsperger-Kassel (RRK) and Rice-Rampsperger Kassel-Marcus (RRKM).	
2.	**Reaction in solution:** Reaction between ions; effect of solvent (single and double sphere models), interpretation of frequency factor and entropy of activation, influence of ionic strength, salt effect and reaction mechanism, reaction involving dipoles, influences of pressure on reaction rates in solution, significance of volume of activation, influence of substitutent on reaction rates, electronic theories of organic reactivity, linear free energy relationship, the Hammett equation, significance of the Taft equation	

3.	**Kinetics of polymerization reaction**: Condensation, addition and ring opening polymerization, mechanism of polymerization (molecular free radical, cationic, and anionic mechanism), degree of polymerization and kinetics, chain length, kinetics of co polymerization.	
4.	Experimental Techniques for Fast Reaction: flow techniques, relaxation method, flash photolysis	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	

SEMESTER-2

CHEMISTRY PRACTICAL

<table>
<tr><td>PROGRAMME/CLASS:
MASTER OF SCIENCE</td><td>YEAR-FIRST</td><td>SEMESTER:
second</td></tr>
<tr><td colspan="2">PRACTICAL-1</td><td>SUBJECT: CHEMISTRY</td></tr>
<tr><td colspan="2">COURSE CODE: B020805P</td><td>COURSE TITLE:</td></tr>
<tr><td>Credits:</td><td></td><td>Core compulsory</td></tr>
<tr><td>Max. marks:</td><td colspan="2">Min passing marks:</td></tr>
<tr><td colspan="3">Total no. of Lectures=</td></tr>
<tr><td>Unit</td><td>Topic</td><td>No. of lectures</td></tr>
<tr><td>1.</td><td>Separation and determination of two motal lons Cu Ni, Ni-Zn C-Fc clc. involving volumetric and gravimetric methods

Preparations

Preparation of selected inorganic compounds and their studies by I.R. electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture

sensitive compounds

(1) VO (acac)2

(2) TIO(CHaNO)22H2O

(3) cis-K[Cr(C2O4)2(H2O)2]

(4) Na[Cr(NH3)2(SCN)4]

(5) Mn(acac)3

(6) Ks[Fe(C2O4)3]

(7) Prussian Blue, Turnbull's Blue.</td><td></td></tr>
</table>

	(8) Co(NH3)][Co(NO2)] (9) cis-[Co(trien) (NO2)2]CI.H2O (10) Hg[Co(SCN)4] (11) [Co(Py)2Clal (12) [Ni(NH3)]Cla (13) Ni(dmg)2 (14) [Cu(NH3)]SO, H2O	
2.	**Organic Synthesis** Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol Grignard reaction: Synthesis of triphenylmethanol from benzoic acid Aldol condensation: Dibenzal acetone from benzaldehyde Sandmeyer reaction: p-Chlorotoluene from p-toluidine Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation. Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate Friedel Crafts Reaction: B-Benzoyl propionic acid from succinic anhydride and benzene **Aromatic** electrophilic sustitutions: Synthesis of p-nitroaniline and p-bromoaniline The Products may be Characterized by Spectral Techniques	
3.	**Chemical Kinetics** i. Determination of the effect of (a) Change of temperature 1b) change ascertif reactants and catalyst and (c) lonic strep of the red on the co hydrolysis of an esterionic reactions ii. Determination of the velocity constant of hydrolysis of an este raden si mocis media.	

iii. Determination of the rate constant for the oxidation of iodide so by forego parood studying the kinetics as an iodine clock reaction

iv. Flowing clock reactions (Ref: Experiments in Physical Chemistry by Showmaker)

v. Determination of the primary salt effect on the kinetics of ionic reaction and testing of the Bronsted relationship (iodide ion is oxidised by persulphate ion)

vi. Oscillatory reaction.

Solutions

i. Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.

ii. Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

B. Potentiometry/pH metry

i. Determination of strengths of halides in a mixture potentiometrically.

ii. Determination of the valency of mercurous ions potentiometrically.

iii. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.

iv. Determination of temperature dependence of EMF of a cell.

v. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.

vi. Acid-base titration in a non-aqueous media using a pH meter.

	vii. Determination of activity and activity coefficient of electrolytes. viii. Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH. ix. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method. x. Determination of thermodynamic constants, AG, AS and AH for the reaction by e.m.f. method. $Zn + H_2SO \rightarrow ZnSO_4 + 2H_2$, **Polarimetry** i. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter. **ii.** Enzyme kinetics -inversion of sucrose	

This course can be opted as an elective by the students of following subjects: Chemistry in B.Sc. (Bachelor of Science)	
Suggested Continuous Evaluation Methods:	
Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-2

CHEMISTRY PROJECT

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- FIRST	SEMESTER: SECOND
SUBJECT: CHEMISTRY		
COURSE CODE: B020806R	**COURSE TITLE**: PROJECT/INDUSTRIAL TRAINING / INTERNSHIP	

Semester I & II of Masters the main objective of the exposure of students towards project/dissertation is to elevate their understanding into the practical and experimental aspects of some targeted areas of chemistry. This course will develop their analytical ability and will provide them an apt exposure to work in any research group and will motivate them to execute research in the area of their interest in chemical sciences.

Course Outcome: 1. students will be able to plan and strategize a scientific problem, and implement it within a reasonable time frame.
2. It is expected that after completing this project dissertation, students will learn to work
independently and how to keep accurate/readable record of assigned project.
3. In addition, students will be able to know the library search and handle the data in a
meaningful way
4. Also, students will be able to interpret the spectral data independently. 5. Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills and power point presentation.

Credits:		**Core compulsory**

For project work and dissertation, the area of the work would be to be decided by the advisor/mentor. On completion of the project work, students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty members and external expert in semester II .

SEMESTER-*3*

PAPER – 1(THEORY)

COURSE TITLE: SPECTROSCOPY- I

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-1		SUBJECT: CHEMISTRY
COURSE CODE: B020901T	COURSE TITLE: Spectroscopy- I	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Unifying Principles** Electromagnetic radiations, interaction of electromagnetic radiation with matter absorption, emission, Uncertainity relation and natural line width and natural line broadening, transition probability, transition moment, selection rules, intensity of spectral lines, Born Oppenheimer approximation, rotational, vibrational and electronic energy levels.	
2.	**Microwave Spectroscopy:** Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensitities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field, Applications.	
3.	**Vibrational Spectroscopy:** Infrared Spectroscopy: Vibrational energies of diatomic molecules, zero-point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-	

	rotation spectroscopy, vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, factors affecting the band positions and intensities, far IR region. Characteristic vibrational requencies of alkane, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FTIR. IR of gaseous, solids and polymeric materials.	
4.	**Ultraviolet and Visible Spectroscopy:** Various electronic transitions (185-800 nm). Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.	
5.	**Raman Spectroscopy:** Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman spectroscopy.	
6.	**X-ray Diffraction:** Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase	

	problem. Description of the procedure foran X-ray structure analysis, absolute configuration of molecules, Ramachandran diagram.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*3*

PAPER – *2*(THEORY)

COURSE TITLE: (Organic Synthesis-1 and Photochemistry)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-*2*		SUBJECT: CHEMISTRY
COURSE CODE: B020902T	COURSE TITLE: (Organic Synthesis-1 and Photochemistry)	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Oxidation:** Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) nitrate	

2.	**Reduction:** Introduction, Different reductive processes. Hydrocarbons-alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds aldehydes, ketones, acids and their derivatives. Epoxides, Nitro, nitroso, azo and oxime groups. Hydrogenolysis.	

3.	**Rearrangements:** General mechanistic considerations - nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangments. Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Amdt-Eistert synthesis, Neber, Beckmann, Hoffinan, Curtius, Schmidt, Baeyer- Villiger, Shapiro reaction.	
4.	**Photochemistry -** (a) Photochemical Reactions: Intraction of electromagnetic radiation with matter, types of excitations, fate of excited molecules, quantum yield, transfer of excitation energy. (b) Photochemistry of Alkenes: Intramolecular reactions of the olefinic bond - geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5- diene. (c) Photochemistry of Carbonyl compounds: Intramolecular reactions of carbonyl compounds - Saturated, cyclic and acyclic,- unsaturated and, unsaturated compounds, cyclohexadienones. (d) Photochemistry of Aromatic compounds: Isomerisations, additions and substitutions. (e) Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides, Photo-Fries rearrangement, Barton reaction, Singlet molecular oxygen reactions**.**	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*3*

PAPER – *3*(A)(THEORY)

COURSE TITLE- CORRDINATION CHEMISTRY

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-*3*(A)		SUBJECT: CHEMISTRY
COURSE CODE: B020903T(A)		COURSE TITLE: CORRDINATION CHEMISTRY
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**. Electronic configuration in multi electron system:** Quantum numbers and vectors, coupling of orbital angular momenta, coupling of spin angular momenta, Spin-orbit coupling, L-S coupling scheme, i- coupling scheme, relation bet\vcen electron configurations and terms, hole formation, Hunds rules, inter electron repulsion parameters, spin-orbit coupling parameters.	
2.	**Molecular orbital theory:** Symmetry consideration for formation of a and it molecular orbitals in Oh, Td, D4h complexes, molecular orbital energy level diagrams of Oh, Td, D4h complexes	
3.	**Term Diagrams:** Effect of weak crystal fields on free ion terms in octahedral, square planer and tetrahedral symmetries, Orgel diagrams, mixing of terms. Transition from weak to strong field and correlations for only d case. Non-crossing rule, Tanabe-Sugano diagrams, ligand field theory, spectrochemical and Nephlauxetic series.	

4.	**spectra of complexes:** Selection rules, band intensities, factors influencing band width, effect of temperature, interpretation of spectra of aqueous solution of M (H spectra of spin free and spin paired MA Jahn Teller distortion and its effect on electronic spectra.	
5.	**Magnetic properties** Magnetic susceptibility - Pole strength, magnetic induction, intensity of magnetization, magnetic moment, diamagnetism, paramagnetism ferromagnetism and nilti ferromagnetism. Sources of paramagnetism (orbital and spin magnetic moment), thermal energy and magnetic property, magnetic moment for multiplet width large as compared to KT, small as compared to KT and to KT, magnetic properties of Oh, Td, D complexes based on crystal field model, spin cross over, quenching of orbital magnetic moment by crystal held, spin pairing in Oh and non-Oh complexes, spin cross over by inter electronic repulsion, b9 substitution in ligands, effect of pressure, elucidation of structure of complexes by magnetic nature in tetrahalocobolt(II) ions, isothiocyanatobis (p-toluidine) cobalt (U). Td & Oh complexes ofNi(II), square planar complexes.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*3*

PAPER – *3*(B)(THEORY)

COURSE TITLE: (Medicinal Chemistry)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-3(A)		SUBJECT: CHEMISTRY
COURSE CODE: B020903(B)	COURSE TITLE: (Medicinal Chemistry)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Drug Design:** Introduction, Concept of lead compound, concept of pro drugs, structure activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bioisosterism, spatial consideration, theories of drug activity occupancy theory, rate theory, induce fit theory.	
2.	**ANTIBIOTICS:** Cell wall biosynthesis inhibitors, B-Lactam ring, Antibiotics inhibiting bio synthesis of Protein. Synthesis of Penicillin G, Penicillin V, Chloramphenicol.	
3.	**Antimalarials:** Chemotherapy of malaria: SAR, synthesis of Primaquine, Chloroquine and Dapsone**.**	
4.	**Antineoplastic Drugs:** Cancer chemotherapy, role of alkylating agents and antimetabolites in the treatment of cancer. Synthesis of Cyclophosphamide, Uracil,	

	Mustards and 6 mercaptopurine. Introduction to hormone and natural products in cancer therapy**.**	
5.	**A general study of following classes of drugs:** (Structure and mode of action only). • Antifungal Drugs • Antiviral Drugs • General anaesthetics • Hypnotics and Sedatives	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*3*

PAPER – *3*(C)(THEORY)

COURSE TITLE: (Solid State Chemistry)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-*3*(C)		SUBJECT: CHEMISTRY
COURSE CODE: B020903T(C)	COURSE TITLE: (Solid State Chemistry)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Imperfection in Crystals: -** Points defects: Schottky ans Frenkel defects. Colour centers line defects: Edge and screw Dislocations. Burgers vector, dislocation densities. dislocation multiplicity and slip dislocation and crystal growth. Surface imperfection: grain boundaries.	
2.	**Band theory of Solids:** Metals, insulators, semiconductor, electronic structure of solids - Band theory, Band structure of metals, insulators and semiconductors, intrinsic-Extrinsic semiconductor: p-n junction. Hall effects Seebeck coefficient. p-n junction. Organic semiconductors.	
3.	**Superconductivity:** Zero resistance and the transition temperature. Super conductivity and periodic table. Magnetic properties. Theory of superconductivity (BCS theory). Type I and Type II superconductors. Hard superconductors. Surface energy, superconducting magnets. Preparation of superconducting materials. Preparation of 1-2-3 & 2-1-4 materials.	

4.	**Nucleation and crystal growth: -** Homogenous and heterogenous nucleation. Equilibrium condition for a curved interface. Critical nuclei. Theory of nucleation rate. Crystallisation of lamellar eutectics. Dendritic growth and peritectic solidification. Preparation of single crystals from vapour, melt and solution.	
5.	**Solid State Reaction:** Classification, Nature of solid-state reactions. Reaction involving single solid phase, solid-gas reaction, solid-solid reaction, solid-liquid reaction, intercalation chemistry. Reaction of organic solids, factors affecting solid state reactivity.	
6.	Magnetic, dielectric and optical properties of solids. Behaviour of substances in a magnetic field, effect of temp. Curie and Curie-Weiss Laws, Selected examples of magnetic materials (TM and alloys, TM oxides Spinelle) their structure and properties. Dielectric constant and dictectric materials-Luminescence, Phosphors, Lasers-ruby lasers & Nd Lasers.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*3*

PAPER – 4(A)(THEORY)

COURSE TITLE: (STRUCTURAL INORGANIC CHEMISTRY)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-4(A)		SUBJECT: CHEMISTRY
COURSE CODE: B020904T(A)	COURSE TITLE: STRUCTURAL INORGANIC CHEMISTRY	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Nuclear Magnetic spectroscopy: -** The contact & pseudo Contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclides with emphasis on ^ 195 Pt and 119 Sn NMR.	
2.	**Electron resonance spectroscopy-** Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as PH4, F2 and [BH3]-	
3.	Mossbauer spectroscopy: - Basic Principles, spectral parameters and spectrum display Application of the technique to studies of (1) bonding and structures of fe2+ and fe+3F * e ^ 3 compounds including those of intermediate spin, (2) Sn+2 and Sn +^ 4 compounds - natures of M-L Bond, coordination number, structure and (3) Detection of oxidation state and inequivalent MB atoms.	

4.	Vibrational Spectroscopy: Symmetry and shapes of ABZ, AB3, AB4. AB, and AB6 mode of bonding of ambidentate ligands, ethylenediamine and diketones complexes.	
5.	Molecular Spectroscopy: Energy levels, molecular orbitals, vibrionic transitions, vibrational progressions and geometry of the excited states, internal conversion, charge-transfer spectra. Franck-Condon Principle, Spectra of Transition metal Complexes.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*3*

PAPER – 4(B)(THEORY)

COURSE TITLE: (CHEMISTRY OF NATURAL PRODUCTS)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-4 (B)		SUBJECT: CHEMISTRY
COURSE CODE: B020904T(B)	COURSE TITLE: (CHEMISTRY OF NATURAL PRODUCTS)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Terpenoids and Carotenoids:** Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry and synthesis of the following representative molecules: Citral, Menthol and -Carotene.	
2.	**Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic role of alkaloids in plants. Structure, stereochemistry, synthesis of the following: Nicotine, Quinine	

3.	**Steroids:** Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemisry, Isolation, structure determination and synthesis of Cholesterol, Testosterone, Progestrone, Aldosterone.	
4.	**Plant Pigments:** Occurrence, nomenclature and general methods of structure determination, Isolation and synthesis of Quercetin, Cyanidin, Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.	
5.	**Porphyrins:** Structure and synthesis of Haemoglobin and Chlorophyll.	
6.	**Prostaglandins:** Occurrence, nomenclature, classification and physiological effects. Synthesis of PGE2 and PGF20	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*3*

PAPER – 4(C)(THEORY)

COURSE TITLE: (ELECTROCHEMISTRY)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-4(C)		SUBJECT: CHEMISTRY
COURSE CODE: B020904T(C)	COURSE TITLE: (ELECTROCHEMISTRY)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Activity Coefficient and Ionic Migration in electrolytic solution:** Quantitative treatment of Debye-Huckle theory of ion-ion interaction and activity coefficient, applicability and limitation of Debye-Huckle limiting law, its modification for finite sized ions, effect of ion solvent interaction on activity coefficient. Pair wise association of ions (Bjerrums Fuoss treatments). Modification of D-H-O theory to account for ion pair formati01. Determination of association constant from conductance.	
2.	**Electrical Double Layer at Metal/semiconductors-electrode interface:** Thermodynamics of double layer, electrocapillarity equation Determination of surface excess and other chemical parameter electrocapillarity, excess charge, capacitance and surface excesses. Metal Water interaction contact adsorption, its influence on capacity of interface, complete capacity - potential curve, Semiconductor/electrolyte interface, capacity of space charge region.	

3.	**Electrode Kinetics:** Butler - Volmer equation under equilibrium (exchange current density) and non-equilibrium. conditions, low and high field approximations. Polarizable and non-polarizable interfaces, multistep reactions a near equilibrium relation between current density and over potential, concept of rate determining step, determination of reaction order,	
4.	**Electrocatalysis**: comparision of electrocatalytic activity, importance of oxygen reduction and hydrogen evolution reaction and their mechanisms	
5.	**Concentration cells:** Cells with &without transference, concentration cells involving mixing of electrolyte. Amalgam cell liquid junction potential, Membrane potential.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-3

PAPER – 4(D)(THEORY)

COURSE TITLE: Bioinorganic Chemistry

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PAPER-4 (D)		SUBJECT: CHEMISTRY
COURSE CODE: B020904T(D)	COURSE TITLE: Bioinorganic Chemistry	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	Bioenergetics and ATP Cycle DNA polymerization, glucose storage, metal complexes in transmission of energy chlorophylls, photosystem I and photosystem II in cleavage of water. Model system.	
2.	Transport and Storage of Dioxygen I-Icnie proteins and oxygen uptake, structure and functioin of haemoglobin, nyoglohin, haemocyanins hemerythrin, model synthetic complexes of ion, cobalt and copper.	
3.	**Nitrogenase** **Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidences, other nitrogenases model system.**	
4.	**Metalloenzymes** **Zinc enzyme-carboxypetidase and carbonic anhydrase. Iron enzymes-catalase, peroxidase and cytochrome P-450. Copper enzyme-superoxide dismutase.** **Molyhdcnum oxatransferase en oxidase.Co enzyme vitamin B12**	

5.	**Electron Transfer in Biology** **Structure and function of metallo proteins in electron transport processes-cytochromes and ion-sulphur proteins, synthetic models**	
6.	**Metals in Medicines:** **Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anti-cancer drugs.**	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-3

CHEMISTRY PRACTICAL

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
PRACTICAL-ORGANIC		SUBJECT: CHEMISTRY
COURSE CODE: B020905P		COURSE TITLE: ORGANIC PRACTICAL
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Qualitative Analysis** Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid), using tic for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.	
2.	**Paper Chromatography** Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.	
3.	**Spectroscopy** Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR & MS)	

4.	**Spectrophotometric (UV/VIS) Estimations** • Amino acids • Proteins • Carbohydrates • Cholesterol • Ascorbic acid • Aspirin • Caffeine	
5.	**Quantitative Analysis** • Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method • Determination of DO, COD and BOD of water sample	
6.	**Estimation of three component mixture of cations like** Cu, Ni, Zn or Cu, Ni, My or Ag, Cu, Ni or Cu, Ag, In or Ag, Ni, Zn or Ag, Ni, Me or Fo, Ni, Zupor analysis of solder and type metal (Pb, sb,$n), analysis of silver coin for (Ag Cu, Ni) etc. involving volumetric and gravemetic method	
7.	**Spectrophotometric Determinations** (a) Manganese/Chromium/Vanadium in steel sample (b) Nickel/molybdenum/tungsten/vanadium/uranium by extractive spectrophotometric method. (c) Fluoride/nitrite/phosphate (d) Iron-phenanthroline complex: Job's Method of continuous variations. (e) Zirconium-Alizarin Red-S complex: Mole-ratio method. (f) Copper-Ethylene diamine complex: Slope-ratio method.	

8.	**Flame Photometric Determinations** (a) Sodium and potassium when present together (b) Lithium/calcium/barium/strontium (c) Cadmium and magnesium in tap water.	
9.	**Nephelometric determinations** (a) Sulphate (b) Phosphate (c) Silver	

This course can be opted as an elective by the students of following subjects: Chemistry in B.Sc. (Bachelor of Science)	
Suggested Continuous Evaluation Methods:	
Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-*3*

CHEMISTRY PROJECT

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: THIRD
SUBJECT: CHEMISTRY		
COURSE CODE: B020906R	**COURSE TITLE:** PROJECT/ INDUSTRIAL TRAINING / INTERNSHIP	

Semester III & IV of Masters the main objective of the exposure of students towards project/dissertation is to elevate their understanding into the practical and experimental aspects of some targeted areas of chemistry. This course will develop their analytical ability and will provide them an apt exposure to work in any research group and will motivate them to execute research in the area of their interest in chemical sciences.

Course Outcome: 1. students will be able to plan and strategize a scientific problem, and implement it within a reasonable time frame.
2. It is expected that after completing this project dissertation, students will learn to work independently and how to keep accurate/readable record of assigned project.
3. In addition, students will be able to know the library search and handle the data in a meaningful way
4. Also, students will be able to interpret the spectral data independently. 5. Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills and power point presentation.

Credits:		**Core compulsory**

For project work and dissertation, the area of the work would be to be decided by the advisor/mentor. On completion of the project work, students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty members and external expert in semester IV

SEMESTER-4

PAPER – 1(THEORY)

COURSE TITLE: SPECTROSCOPY-II

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-1		SUBJECT: CHEMISTRY
COURSE CODE: B020001T	COURSE TITLE: SPECTROSCOPY-II	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Magnetic Resonance Spectroscopy**: **Nuclear Magnetic Resonance Spectroscopy** Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, clinical shift and its measurements, factors influencing chemical shift deshielding, spin-spin interactions, factors influencing coupling constant J. Classification (ABX, AMX, ABC, A,B, etc.) spin decoupling FT NMR, advantages of FT NMR. Chemical excliange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Simplification of complex spectra- magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique, nuclear Overhauser effect (NOE). Stereochemistry Lindered rotation, Karplus curve-variation of coupling constant with Dihedral angle.	
2.	**Carbon-13 NMR Spectroscopy:** General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, lictcroaroinatic and carbonyl carbon), coupling constants.	

3.	**Mass Spectrometry:** Introduction, ion production - El, Cl, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance, Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometery. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.	
4.	**Electron Spin Resonance Spectroscopy:** Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the value, isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications	
5.	**Photo Electron Spectroscopy:** Basic principle, photo electric effect, ionization process, Koopman's theorem, Photoelectron Spectra of simple molecule, ESCA, Chemical information from ESCA Auger electron spectroscopy-basic idea..	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 2(THEORY)

COURSE TITLE: Organo Transition Metal chemistry

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-2		SUBJECT:CHEMISTRY
COURSE CODE: B020002T	COURSE TITLE: Organo Transition Metal chemistry	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	Fluxional Organometallic compounds: Fluxionality and dynamic equilibria in compounds such as es-ally and all dienyl compexes. -allyl and • 32^2= olefin	
2.	**Metal carbonyl and nitrosyl compounds**: Structural aspects of metal carbonyls, vibrational spectra for the structural diagnosis, Force constants and bonding, Preparations, Properties and structure of some metal nitrosyls, Substitution reaction using donor, donor and acceptors, hydrocarbonyls and metal carbides...	
3.	**Homogeneous catalytic reactions**: Coordinative unsaturation, Acid-Base behaviour of metal atoms in complexes. Insertion reaction, Reactions of co-ordinated ligands, catalytic reactions of alkenes, Hydrogenation of alkenes, hydrofonylation of alkenes. Alkene polymerization & oligomerization, Fischer- Tropsch process. Reactions involving molecular oxygen. Fluxional isomerism, Redistribution reactions, Wacker process (Smidt oxopalladation reaction, activation of C-H bond.	

4.	**Complexes with T-bonding ligands:** **(a)** arene complexes of the transition metals, origin of bis-arene concept bis-arene complexes of Cr & Fe, mixed arene & arene metal carbonyl compounds. **(b)** Compounds of Transition metals and Carbon-Multiple bonds: Alkylidenes, alkylidynes, low valent Carbenes and Carbynes-Synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reaction on the ligand. **(c)** Cyclopentadienyl metal compounds of Fe. Structure & bonding of cyclopentadienyl metal compounds.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 3(A)(THEORY)

COURSE TITLE: (Photo inorganic Chemistry)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-3(A)		SUBJECT:CHEMISTRY
COURSE CODE: B020003T(A)	COURSE TITLE: (Photo inorganic Chemistry)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Basics of Photochemistry:** Absorption, excitation, photochemical laws, quantum yield, electronically excited states, life times-measurements of the times. Flash photolysis, stopped flow techniques. Energy dissipation by radiative and non-radiative processes absorption spectra, Franck-Condon principle, photochemical stages-primary and secondary processes	
2.	**Properties of Excited States**: Structure dipole moment, acid base strengths, reactivity. Photo chemical kinetics-calculation of rates of radiative process. Bi molecular deactivation-quenching.	
3.	**Excited States of Metal complexes:** Excited States of Metal complexes: - Comparison with organic compounds electronically excited states of Metal complexes, charge transfer spectra, charge transfer excitations, methods for obtaining charge transfer spectra.	

4.	**Ligand Field Photochemistry:** Photo substitution, photo oxidation, lability and selectivity, Zero vibrational levels of ground states and excited states, energy content of excited state, Zero-zero spectroscopic energy, development of equation for redox potentials of the excited states	
5.	**Redox Reactions by Excited Metal Complexes:** Energy transfer under conditions of weak interaction and strong interactions-exciplex formation, conditions of the excited states to be useful as redox reactants, exited electron transfer metal complexes as attractive candidates (2,2-bi pyridine and 1,10phenonthroline complexes). illustration of reducing and oxidizing character of Ruthenium2+ (bipyridil complex, comparison with Fetbipy); role of spin-orbit coupling-life time of these complexes. Application of redox processes of electronically excited states for catalytic purposes, transformations of low energy reactants into high energy products, chemical energy into light.	
6.	**Metal Complex sensitizers**: Metal Complex sensitizers, electron relay, metal colloid systems, semi-conductors Supported metal oxide systems, water photolysis, nitrogen fixation and CO, reduction.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 3(B)(THEORY)

COURSE TITLE: (Organic Synthesis-II)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-3(B) SUBJECT:CHEMISTRY		
COURSE CODE: B020003T(B)	COURSE TITLE: (Organic Synthesis-II)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Disconnection Approach**: An introduction to synthons, Disconnection Approach, functional group inter conversions and one group C-X and two group C-X Disconnections.	
2.	**Protecting Groups:** Principle of protection of alcohol, amine, carbonyl and carboxyl groups.	
3.	**One group C-C Disconnections:** Alcohol and carbonyl compounds, alkene synthesis.	

4.	**Two group C-C Disconnections:** Diels alder reaction, Micheal addition and Robinson annelation, 1, 3 difunctionalised and 1,5 difunctionalised compounds.	
5.	**Ring synthesis:** Saturated heterocycles (Piperidine, oxetanc, THF, only) aromaticheterocycles (3, 4, 5 and 6 membered rings) for example Aziridine, Pyrrole, Oxetene, Thiazole and Pyridine.	
6.	**Synthesis of some complex molecules:** Application of above in the synthesis of following. Camphor, Reserpine and Vitamin D.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 3(C)(THEORY)

COURSE TITLE: (Advanced Quantum Chemistry)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-3(B)		SUBJECT:CHEMISTRY
COURSE CODE: B020003T(C)	COURSE TITLE: (Advanced Quantum Chemistry)	
Credits:		OPTINAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Principles of Quantum Mechanics:** Review of the principles of quantum mechanics, Treatment of H-atom, harmonic oscillator, Rigid rotor. Born-Oppenheimer Approximation, Slater-Condon rules, Theory of angular momentum	
2.	**Ab initio and Semi-empirical SCE-MO Calculations for Closed Shell System:** Roothaan-Hartree-Fock method. Methods based on neglect of differential overlap.	
3.	**Molecular Orbital Theory:** MOT of H_2, MO treatment of HOMO and Heteronuclear diatomics, Shapes of triatomic molecules. Huckle theory of conjugated system, bond order and charge density calculations, Applications of ethylene, butadines, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel theory.	

4.	Time dependent pertutation theory-radiative transition, Einstein Coefficient. Introduction to the methods of self-consistent fields.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 4(A)(THEORY)

COURSE TITLE: (Analytical Chemistry-II)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-4(A)		SUBJECT:CHEMISTRY
COURSE CODE: B020004T(A)	COURSE TITLE: (Analytical Chemistry-II)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Food Analysis**: Moisture, ash, crude protein, fat, crude fiber, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food, contamination of food stuffs. Microscopic examination of foods for adulterants. Pesticide analysis in food products. Extration and purification of sample. HPLC. Gas chromatography for organophosphates. Thin-layer chromatography for identification of chlorinated pesticides in food products.	
2.	**Analysis of Water Pollution:** Objectives of analysis-parameter for analysis-colour, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen. General survey of instrumental technique for the analysis of heavy metals in aqueous systems. Pesticides as water pollutants and analysis. Water pollution Standards.	
3.	**Analysis of Soil, Fuel, Body Fluids and Drugs:** **soil: (a)** Analysis of solids; moisture, pH total nitrogen, phosphorus, silica, lime, magnesia, manganese, Sulphur and alkali salts.	

	(b) Fuel' analysis: solid, liquid and gas. Ultimate and proximate analysis-heating values grading of coal. Liquid fuels-flash point, aniline point, octane number and carbon residue. Gaseous fuels producer gas and water gas-calorific value. **(c)** Clinical chemistry: Composition of blood-collection and preservation of samples. Clinical analysis. Serum electrolytes, blood glucose, blood urea, nitrogen, uric acid, albumin, globulins, barbiturates, acid & alkaline phosphatases. Immunoassay principles of radio immunoassay (RIA) & applications. The blood gas analysis trace element in the body. **(d)** Drug analysis: Narcotics & dangerous drugs. Classification of drugs screening by gas and thin layer chromatography and spectrophotometric measurement.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 4(B)(THEORY)

COURSE TITLE: (Heterocyclic Chemistry)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-4(B)		SUBJECT:CHEMISTRY
COURSE CODE: B020004T(B)	COURSE TITLE: (Heterocyclic Chemistry)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Nomenclature of Heterocycles:** Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic fused and bridged heterocycles	
2.	**Heterocyclic Synthesis:** Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions	
3.	**Small Ring Heterocycles:** Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, azetidines, oxetanes.	
4.	**Benzo-Fused Five-Membered Heterocycles:** Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes.	

5.	**Six-Membered Heterocycles with one heteroatom:** One Heteroatom Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones. Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.	
6.	**Six-Membered Heterocycles with Two or More Heteroatoms**: Synthesis and reactions of diazines, triazines and thiazines.	
7.	**Mesoionic Heterocycles:** General classification, chemistry of some important mesoionic heterocycles of type A & typeB & their application	
8.	**Seven & Large Membered Heterocycles:** Synthesis and reaction of azepines, oxepines, Thiepines and diazepines.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 4(C)(THEORY)

COURSE TITLE: (Enzyme Chemistry)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-4(C)		SUBJECT:CHEMISTRY
COURSE CODE: B020004T(C)	COURSE TITLE: (Enzyme Chemistry)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	1. **Introduction:** Basic consideration, Proximity effects and molecular adaptation.	
2.	**Enzymes:** Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fil hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics. Michaelis-Menten and Lineweaver Burk plots, reversible and irreversible inhibition	
3.	**Mechanism of Enzyme Action**: Transition-state theory, orientation and steric effect, acid-bace catalysis, covalent catalysis, strain or distortion, Example of some typical enzyme mechanism for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.	

4.	**Kinds of Reactions Catalysed by Enzymes:** Nucleophilic displacement on phosphorus atom, multi displacement reactions and the coupling of ATP cleavage to endergonic processes. Addition and elimination reactions, enolic intermediates in isomerization reaction, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.	
5.	**Co-enzyme chemistry:** Cofactor as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme ANDA, NADP, FAD, vitamin B12 Mechanisms of reactions catalyzed by the above cofactors.	
6.	**Enzyme Model:** Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, crown ethers, cryptates. Cyclodextrins, cyclodextrin-based enzyme models, calixarenes, ionophores, micelles, synthetic enzymes or synzymes	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 4(D)(THEORY)

COURSE TITLE: (Statistical Thermodynamics)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-4(D)		SUBJECT: CHEMISTRY
COURSE CODE: B020004T(D)	COURSE TITLE: (Statistical Thermodynamics)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		
Unit	Topic	No. of lectures
1.	**Review of Basic Statistical Mechanics:** Phase Space, Ensembles, Equal a priori probability, Microcanonical ensemble, canonical ensemble & Grand Canonical ensembles, Probability and most probable distribution. Entropy & information. Stirling's approximation. Energy levels. Entropy & third law of thermodynamics	
2.	**Distribution law:** (1) Boltzmann distribution law: Molecular partition functions for non-interacting particles, relation of partition function to thermodynamic functions (H,U,G,S,A) & equilibrium constant. (ii) Fermi-Dirac statistics: Electrons in metals. (iii) Bose-Einstein statistics; Application to Helium.	

3.	**Determination (Evaluation) of partition function:** Localized & non-localised particles, seperation of partition function, Review of rotational, vibrational, translational & electronic partition functions. The Sackur-Tetrode equation. Derivation of thermodynamic properties of ideal gases from partition function.	
4.	**Statistics Mechanics of Crystals:** Heat capacity of Solids, The Einstein's theory, The Debye theory.	
5.	**Statistical of Non-equilibrium States:** Boltzmann transport equation. Electrical conductivity.	
6.	**Statistical mechanics to liquids:** Radial distribution functions. Distribution function for classical monoatomic fluids.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 4(E)(THEORY)

COURSE TITLE: (Chemistry of Materials)

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-4(E)		SUBJECT:CHEMISTRY
COURSE CODE: B020004T(E)	COURSE TITLE: (Chemistry of Materials)	
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Multiphase Materials:** Ferrous alloys; Fe-C phase transformations in ferrous alloys; stainless steels, non-ferrous alloys. properties of ferrous and non-ferrous alloys and their applications.	
2.	**Ceramics, Composites and Nanomaterials:** Ceramic structures, mechanical properties, clay product, Refractories characterization, properties and applications, Microscopic composites; dispersion-strengthened and particle-reinforced, fibre- reinforced Composites, macroscopic composites, Nanocrystalline phase, preparation procedures, special properties, applications.	
3.	**Thin Films and Langmuir-blodgett Films:** Preparation techniques; evaporation sputtering, chemical Processes, MOCVD, Langmuir- and blodgett (LB) Film, growth techniques, properties and applications of thin, LB film.	

4.	**Polymeric Materials:** Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, polymer types and their applications, conducting and ferro-electric polymers.	
5.	**Ionic Conductors:** Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); Vacancy mechanism, diffusion super ionic conductors.	
6.	**High Tc Materials:** Defects perovskites, high Tc superconductivity in cuprates, normal state properties; anisotropy, temperature dependence of electrical resistance.	

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others. Or	
Assessment and presentation of Assignment	(10 marks)
04 tests (Objective): Max marks of each test = 10 (average of all 04 tests)	(10 marks)
Overall performance throughout the semester. Discipline. participation in different activities)	(05 marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

PAPER – 4(F)(THEORY)

COURSE TITLE: Environmental Chemistry

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: fourth
PAPER-4(F)		SUBJECT:CHEMISTRY
COURSE CODE: B020004T(F)		COURSE TITLE: Environmental Chemistry
Credits:		OPTIONAL SUBJECT
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**ENVIRONMENT** Biogeochemical cycles of C, N, P, S and O. Hydrosphere: Aquatic pollution inorganic, organic, pesticides, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters dissolved oxygen, biochemical oxygen demand, solids, metals, content of chloride, sulphate, phosphate, nitrate and micro-organism. Water quality standards. Analytical methods of measuring BaD, DO, COD, F, Oils, Metals (As, Cd, Cr, Hg, Pb, Se etc.), residual chloride and chlorine demand. Purification & treatments of water.	
2.	**Soils:** Pollution fertilizers, pesticides, plastics and metals. Waste treatment.	

3.	**Atmosphere:** Chemical composition of atmosphere particles, ions. and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, and deir effect, pollution by chemicals, petroleum, minerals: chlorofluorohydrocarbons Greenhouse effect, acid rain, air pollution controls and their chemistry. Analytical methods 'for measuring air pollutants. Continuous monitoring instruments.	
4.	**Industrial Pollution:** Cement, Sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy. Polymers, drug etc. Radionuclide analysis. Disposal of wastes and their management.	
5.	**Environmental Toxicology:** Chemical solutions to environmental problems, biodegradability, principles of decomposition, better industrial processes. Bhopal gas tragedy, hemobyl, Three-mile island. Sewozo and Minamata disasters	

SEMESTER-4

CHEMISTRY PRACTICAL

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: FOURTH
Practical-2(ORGANIC)		SUBJECT:CHEMISTRY
COURSE CODE: B020005P	COURSE TITLE: PRACTICAL	
Credits:		Core compulsory
Max. marks:	Min passing marks:	
Total no. of Lectures=		

Unit	Topic	No. of lectures
1.	**Multi-step Synthesis of Organic Compounds** The exercises should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques Photochemical reaction Benzophenone → Benzpinacol →→Benzpinacolone Beckmann rearrangement: Benzanilide from benzene Benzene →→ Benzophenone → Benzophenone oxime →→ Benzanilide Benzilic acid rearrangement: Benzilic acid from benzoin Benzoin → Benzil →→ Benzilic acid Synthesis of heterocyclic compounds Skraup synthesis: Preparation of quinoline from aniline Fisher -Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine. Enzymatic synthesis Enzymatic reduction:. Reduction of ethyl acetoacetate using Bakers yeast to yield enantiomeric excess of S (+) ethyl-3-hydroxybutanoate and determine its optical purity. Biosynthesis of ethanol from sucrose Synthesis using microwaves	

	Alkylation of diethyl malonate with benzyl chloride. Synthesis using phase transfer catalyst Alkylation of diethyl malonate or ethyl acetoacetate with an alkyl halide	
2.	**Extraction of Organic Compounds from Natural Sources.** 1.Isolation of caffeine from tea leaves. 2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins). 3. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported). 4. Isolation of nicotine dipicrate from tobacco. 5. Isolation of cinchonine from cinchona bark. 6. Isolation of piperine from black pepper. 7. Isolation of lycopene from tomatoes. 8. Isolation of B-carotene from carrots. 9. Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid). 10. Isolation of eugenol from cloves. 11. Isolation of (+) limonine from citrus rinds	
3.	**Estimation** of three component mixture of cations like Cu, Ni, Zn or Cu, Ni, My or Ag, Cu, Ni or Cu, Ag, In or Ag, Ni, Zn or Ag, Ni, Me or Fo, Ni, Zupor analysis of solder and type metal (Pb, sb,$n), analysis of silver coin for (Ag Cu, Ni) etc. involving volumetric and gravemetic methods.	

4.	**Spectrophotometric Determinations** (a) Manganese/Chromium/Vanadium in steel sample (b)Nickel/molybdenum/tungston/vanadium/uraniumby extractive spectrophotometric method. spectrophotometric (c) Fluoride/nitrite/phosphate (d) Iron-phenanthroline complex: Job's Method of continuous variations. (e) Zirconium-Alizarin Red-S complex: Mole-ratio method. (f) Copper-Ethylene diamine complex: Slope-ratio method.	
5.	**Flame Photometric Determinations** (a) Sodium and potassium when present together (b) Lithium/calcium/barium/strontium (c) Cadmium and magnesium in tap water.	
6.	**Nephelometric determinations** (a) Sulphate (b) Phosphate (c) Silver	

This course can be opted as an elective by the students of following subjects: Chemistry in B.Sc. (Bachelor of Science)	
Suggested Continuous Evaluation Methods:	
Viva voce	(10 marks)
Mock test	(10 marks)
Overall performance	(05marks)
Course prerequisites: To study this course, a student must have had the chemistry in B.Sc. (Bachelor of Science)	
Suggested equivalent online courses:	
Further suggestion	

SEMESTER-4

CHEMISTRY PROJECT

PROGRAMME/CLASS: **MASTER OF SCIENCE**	YEAR- SECOND	SEMESTER: FOURTH
Project.		SUBJECT: CHEMISTRY
COURSE CODE: B020006R	COURSE TITLE: PROJECT	

Semester III & IV of Masters the main objective of the exposure of students towards project/dissertation is to elevate their understanding into the practical and experimental aspects of some targeted areas of chemistry. This course will develop their analytical ability and will provide them an apt exposure to work in any research group and will motivate them to execute research in the area of their interest in chemical sciences.

Course Outcome:

1. students will be able to plan and strategize a scientific problem, and implement it within a reasonable time frame.
2. It is expected that after completing this project dissertation, students will learn to work independently and how to keep accurate/readable record of assigned project.

3. In addition, students will be able to know the library search and handle the data in a meaningful way
4. Also, students will be able to interpret the spectral data independently.
5. Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills and power point presentation.

Credits:		**Core compulsory**

For project work and dissertation, the area of the work would be to be decided by the advisor/mentor. On completion of the project work, students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty members and external expert in semester IV.