SYLLABUS

Choice-Based Credit System (CBCS)

Maharaja Ganga Singh University

Bachelor of Science (B.Sc.) Chemistry

(Semester) 2023-24

Semester III

Department of Chemistry

Undergraduate Programme

(Effective from Academic Year 2023-24)

SCHEME OF EXAMINATION AND

COURSES OF STUDY

FACULTY OF SCIENCE

B.Sc. Examination, 2024

CHEMISTRY

Semester III Chemistry

Total 6 credits ; 150 marks

Type of Course	**Course Code**	**Title**	**Credit**	**Marks (External + Internal**	**Hours in a week**
Paper I Core course (DCC) (Theory) **[CHY-T-3]**	**CHY-T-3-** 5.0DCC**T**33	**CHEMISTRY - III**	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) **[CHY-L-3]**	**CHY-L-3-** 5.0DCC**P**33	**EXPERIMENTS ON CHROMATOGRAPHY, KINETICS AND THERMODYNAMICS**	2	50 (40 + 10)	4
	Total		**6**	**150 (120 + 30)**	**10**

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination and both the examiners will be appointed at Institute level.

For semester I, III and V no external examiner will be appointed by University. Instead, the examiners will be appointed by the Head of the institute / Principal of the college and both marks, term end practical and internal examination will be submitted to the university.

Course Code	**CHY-T-3-**5.0DCC**T**33
Type of the course	Core course (DCC) (Theory) course I of Semester III
Title of the Course	**CHEMISTRY - III**
Level of the Course	NHEQF5.0
Credit of the Course	**4**
Delivery sub-type of the course	Theory 6h Lecture per week
Pre-requisites and requisites of the course	Student enrolled and registered in UG Programme third semester.
Course Objectives	➢ To develop a basic understanding about the aromatic compounds ➢ To develop a basic understanding about the thermodynamics
Course Outcome	➢ After completion of course student will able to understand basic laws of thermodynamics and its application ➢ student will able to understand bonding in complex inorganic compounds ➢ student will able to understand basics of cyclo/aromatic compounds

Semester III

90 Hours (6 Hour/ week)

Unit-I

Thermodynamics-I: Definition of thermodynamics terms: system, surroundings etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics: statement, definition and internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law-joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU&dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry : Standard state, standard enthaply of formation-Hess's'Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutrilization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy, Kirchhoffs equation.

Unit-II

Thermodynamics –II : Second law of Thermodynamics, Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature. Concept of entropy: Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third Law of Thermodynamics : Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Variation of G with A and P, V and T.

Theories of chemical kinetics: Effect of temperature on rate of reaction, Arhenius concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis, characteristics of catalyzed reactions, classification of catalysis, miscellaneous examples.

Unit-III

Chemistry of f-block Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation of lanthanide compounds. General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds. Isomerism in coordination compounds, Valence bond theory of transition metal complexes.

Organometallic Chemistry: Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and Aryls of Al, Zn, Hg and Ti a brief account of metal- ethylene complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Unit-IV

Carboxylic Acid & their derivatives : Nomenclature, structure and bonding, physical properties, of Carboxylic acids and their derivatives. Eeffect of substituents on acid strength. Preparation, properties and uses of carboxylic acids, acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Methods of formation and chemical reactions of halo acids, hydroxy acids: malic, tartaric, citric acids, unsaturated monocarboxylic acids and Dicarboxylicacids.

Cycloalkanes & Cycloalkenes - Nomenclature, methods of formation, chemical reactions. Baeyer's strain theory and its limitations, ring strains in small rings (cyclopropane and cyclobutane), Theory of strainless rings, the case of cyclopropane ring: banana bonds. Methods of formation, confirmation and chemical reactions of Cycloalkenes.

Unit-V

Arenes and Aromaticity-Nomenclature of Benzene derivatives. The aryl group. Aromatic nucleus and side chain structure and properties of fused and bicyclic aromatic compounds like naphthalene, anthracene, phenanthrene, di benzene etc.

Aromatic electrophilic substitution- General pattern of the mechanism, role of sigma(σ) and pie(π) complexes. Mechanism of nitration, halogenation sulphonation, mercuration and Friedal- Craft's reactions, energy profile diagrams. Activating & deactivating substituents, orientation and ortho / para ratio, side chain reactions of benzene derivatives. Birch reduction. Methods of formation and chemical reactions of alkyl benzenes, alkynyl benzenes and biphenyl.

इकाई–1

ऊष्मागतिकी पदों की परिभाषाएं : तंत्र परिपार्श्व, आदि। तंत्र के प्रकार, सीमित–मात्रा एवं स्वतंत्र–मात्रा गुणधर्म, अवस्था एवं पथ फलन एवं उनके अवकलन। उष्मागतिक प्रक्रम, उष्मा एवं कार्य संकल्पना।

ऊष्मागतिकी का प्रथम नियम :– प्रक्कथन, आन्तरिक ऊर्जा एवं पूर्ण ऊष्मा (एन्थैल्पी) की परिभाषा, ऊष्मा–धारिता, स्थिर आयतन एवं दाब पर ऊष्मा–धारिताएं एवं उनके मध्य सम्बन्ध। जल का नियम, जूल–थामसन गुणांक, व्युत्क्रम ताप। उत्क्रमणीय प्रक्रमों के लिये समतापीय एवं रूद्वोष्म प्रक्रम अवस्था में आदर्श गैस प्रसार के लिये **w,q,dU** एवं **dH** की गणनाएं।

ऊष्मा – रसायन :–

मनक अवस्था, मानक सम्भवन एन्थैल्पी, ऊष्मा संकलन का हेस का नियम व उसके अनुप्रयोग। स्थिरप दाब व स्थिर आपतन पर अभिक्रिया ऊष्मा। उदासीनीकरण की एन्थैल्पी। बन्ध–वियोजन ऊर्जा एवं उसकी ऊष्मा–रसायनिक आकड़ों से गणना, एन्थैल्पी की ताप पर निर्भरता। कर्चोफ समीकरण।

ईकाई–**II** ऊष्मागतिकी–**II** :–

ऊष्मागतिकी का द्वितीय नियम :–

नियम की आवश्यकता नियम के विभिन्न कथन, कार्नोट चक्र एवं उसकी दक्षता। कार्नोट प्रमेय।

ताप का ऊष्मागतिकीय पैमाना, एन्ट्रॉपी की अवधारणा

रासायनिक बलगतिकी के सिद्धान्त :–

अभिक्रिया की दर पर ताप का प्रभाव, आर्हेनिअस समीकरण अवस्था सिद्धान्त (साम्य संकल्पना) गतिज| स्थिरांक आधारित साम्य स्थिरांक एवं ऊष्मागतिकी अवधारणाओं के व्यंजक। उत्प्रेरक, उत्प्रेरित अभिक्रियाओं के अभिलक्षणों, उत्प्रेरको के वर्गीकरण विभिन्न उदाहरण। साम्यावस्था निर्धारण में एन्ट्रापी की भूमिका। आदर्श गैसों एवं गैसों के मिश्रण में एन्ट्रॉपी परिवर्तन।

ऊष्मागतिकी का तृतीय नियम :– नेन्स्ट ऊष्मा सद्धान्त, अवशेष एन्ट्रॉपी कथन एवं धारणा, ऊष्माधारिता आकड़ों से निरपेक्ष एन्ट्रॉपी की गणना। गिब्ज एवं हेल्महोल्ट्ज फलन, ऊष्मागतिकी राशियों के रूप में गिब्स फलन (G) व हेल्महोल्ट्ज फलन (A)। ऊष्मागतिकी साम्य एवं स्वतः प्रक्रम परिवर्तन में A व G की भूमिकायें व एन्ट्रॉपी की तुलना में उसके लाभ। P, V एवं T के साथ G व A में परिवर्तन।

यूनिट III

F ब्लॉक तत्व के रसायन, इलेक्ट्रॉनिक विन्यास ऑक्सीकरण अवस्थायें, आयनिक त्रिज्या एवं लैन्थेनाईड संकुचन, संकुल निर्माण, लैन्थेनाईड तत्वों की उपस्थिति एवं निष्कर्षण, एक्टिनाइड तत्वों के सामान्य गुण, U से NP, Pu एवं Am के पृथ्क्करण का रसायन लैन्थेनाईड एवं ऐक्टिनाईड के बाद के तत्वों में समानतायें।

उपसहसंयोजन यौगिक : वर्नर सिद्धान्त, वर्नर सिद्धान्त का प्रायोगिक सत्यापन, प्रभावी परमाणु क्रमांक की अवधारणा, कीलेट, उपसहसंयोजक यौगिकों का नामकरण, उपसहसंयोजक यौगिकों में समावयक्ता, संक्रमण धातु संकुलो का संयोजकता बन्ध सिद्धान्त।

कार्बधात्विक रसायन : परिभाषा कार्बधात्विक यौगिको का नामकरण एवं वर्गीकरण में विरचन, गुण AL, Zn, Hg, Ti के ऐल्किल एवं ऐरिल के बन्धन एवं अनुप्रयोग 1 धातु ऐथिल संकुलों का संक्षिप्त विवरण, समांगी हाइड्रोजेनीकरण मोनानाभिकीय कार्बोनिल एवं धातु कार्बोनिलों के प्रकृति व बन्धन।

यूनिट **IV**

कार्बोक्सिलक अम्ल एवं उनके व्युत्पन्न : नामकरण, संरचना व बन्धन, कार्बोक्सिलिक अम्ल एवं व्युत्पन्न के भौतिक गुण, अम्नलीय सार्मथ्य पर प्रतिस्थापियों का प्रभाव, कार्बोक्सिलिक अम्ल, अम्ल ऐनाहाइड्राठड, ऐमाइड (यूरिया) ऐस्टर, ऐरिड क्लोराइड के विरचन, गुण एवं अनुप्रयोग, ऐसिल व्युत्पनों का आपेक्षिक स्थायित्व, भौतिक गुण, नाभिक स्नेही ऐसिल प्रतिस्थापन द्वारा अम्ल व्युत्पन्नों का अन्तपरिवर्तन, हैलो अम्ल हाइड्राक्सी अम्ल, टॉटकरिक अम्ल, सिट्रिक अम्ल के विरचन एवं असंतृप्त मोनो कार्बोक्सालिक अम्ल, द्विक्षारकी अम्ल के विरचन की विधि एवं रसायनिक अभिक्रियाएं।

अभिक्रियाएं बेयर का विकृतिवाद सिद्धान्त एवं इनकी सीमायें, छोटे वलयो में वलय तनाव (साइक्लोप्रोपेन एवं साइक्लो ब्यूटेन), विकृतिहीन वलयों का सिद्धान्त, साइक्लो प्रोपेन वलय केला बन्ध। साइक्लो ऐलकीन के बनाने की विधियों, संरूपण, एवं रसायनिक अभिक्रियाऐं।

यूनिट **V**

ऐरीन एवं ऐरोमैटिकता : बेंजीन व्युत्पन्न के नामकरण, ऐरिल समूह, संलयन और द्विचक्रीय ऐरोमैटिक यौगिक जैसे नफ्थलीन, ऐथ्रासीन, फेनान्थ्रीन एवं डाई बेजीन आदि के ऐरोमैटिक नाभिक व पाश्व श्रृंखला की संरचना एवं गुण।

ऐरोमैटिक यौगकों में इलेक्ट्रान स्नेही प्रतिस्थापन : सामान्य क्रियाविधि एवं त्र संकुलो का कार्य, नाईट्रीकरण एवं फ्रीडल क्रफ्ट्स अभिक्रियाओं की क्रियाविधि, ऊर्जा अवस्था चित्र, सक्रिय कारक एवं निष्क्रियकारक प्रतिस्थापन, अभिविन्यास एवं आर्थे/पैरा अनुपात, बेन्जीन व्युपन्नों की पार्श्व श्रृंखला, अभिक्रिमायें बर्च अपचयन। ऐल्किल बेन्जीन ऐल्काईनिल बेन्जीन एवं वाइफेनिल के विरचन की विधियां तथा रासायनिक अभिक्रियाएं।

Course Code	**CHY-L-3-**5.0DCC**P**33
Type of the course	Core course (DCC) (Practical)
Title of the Course	**Experiments on Chromatography, Kinetics and Thermodynamics**
Level of the Course	NHEQF5.0
Credit of the Course	**2**
Delivery sub-type of the course	**Practical 4h Laboratory per week**
Course Objectives	➢ To develop a basic understanding about the chromatographic analysis ➢ To develop an understanding towards the experimental importance of Kinetics and Thermodynamics.
Course Outcome	➢ After completion of lab student will able to understand and apply basic separation procedures. ➢ Students will able to apply basic thermodynamic and kinetic principles on simple commercial samples.

Chemistry Lab 3

Experiments on Chromatography, Kinetics and Thermodynamics

PRACTICAL

60 hours (4 h per week)

A Qualitative Analysis & Chromatography

Analysis of given organic mixture containing two solid components Using water , $NaHCO_3$ or NaOH for separation and preparation of suitable derivatives. **Chromatography: Determination of R_f values and identification of organic compounds.**

(i) Preparation and separation of 2, 4-dinitrophenylhydrozone of acetone, 2-butanone, hexan-2- and 3-one using toluene and light petroleum (40 :60). (Thin layer chromatography)

(ii) Separation of a mixture of dyes using cyclohexane and ethyl acetate(8.5 : 1.5). (Thin layer chromatography)

(iii) Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid. Leucine and glutamic acid. Spray reagent-ninhydrin.

(Paper chromatography : Ascending and Circular),

(iv) Separation of a mixture of D, L-alanine, glycine and L-Leucine using n-butanol: acetic acid : water (4:1:5), spray reagent-ninhydrin.

(Paper chromatography : Ascending and Circular).

(v) Separation of monosachharides-a mixture of D-galactose and D-frutose using n-butanol: acetone: water (4:5:1) spray reagent-aniline hydrogen phthalate.

(Paper chromatography: Ascending and Circular).

B C**hemical Kinetics**

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of ethyl acetate.
4. To study kinetically the reaction of decomposition of iodide by H_2O_2.

C Thermodynamics

1. Determination of the transition temperature of the given substance by thermometric/dialometric method (e.g. $MnCl_2.2H_2O/SrBr_2 2H_2O$.)
2. To study the effect of a solute (e.g. NaCI, suecinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol water system.
3. To construct the phase diagram of two component (e.g. diphenylamine-benzophenone) system by cooling curve method.
4. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
5. To determine the enthalpy of neutralisation of weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
6. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.

Note : Similar exercise may be set in question paper as per availability

PRACTICAL-SCHEME OF EXAMINATION

Max. Marks: 50 (including 10 marks of internal) **Min. Marks: 18** **Time: 5 Hours**

Exercise

Experiment	Marks
Qualitative Analysis & Chromatography	**10**
C**hemical Kinetics**	**10**
Thermodynamics	**10**
Viva	**5**
Record	**5**

Note :-

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination and both the examiners will be appointed at Institute level.

For semester I, III and V no external examiner will be appointed by University. Instead, the examiners will be appointed by the Head of the institute / Principal of the college and both marks, term end practical and internal examination will be submitted to the university.

Theory (term end paper)-SCHEME OF EXAMINATION

Max. Marks: 100 (including 20 marks of internal) **Min. Marks: 36** **Time: 3 Hours**

Pattern for Questions for term end semester exam Total marks per paper 80

Types	Marks
Part A (total 10 questions, 2 questions from each unit; answer all questions, each question carry 1.5 mark, word limit for answer is 50 words)	**15**
Part B (total 10 questions, 2 questions from each unit with internal choice; answer 5 questions selecting 1 question from set, each question carry 7 mark, word limit for answer is 200 words)	**35**
Part C (total 5 questions, 1 questions from each unit;, Attempt any three questions; each question carry 10 mark, word limit for answer is 500 words)	**30**

Note :-

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination and both the examiners will be appointed at Institute level.

For semester I, III and V no external examiner will be appointed by University. Instead, the examiners will be appointed by the Head of the institute / Principal of the college and both marks, term end practical and internal examination will be submitted to the university.

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Choice-Based Credit System (CBCS)

Maharaja Ganga Singh University

Bachelor of Science (B.Sc.) Chemistry

(Semester) 2023-24

Semester IV

Department of Chemistry

Undergraduate Programme

(Effective from Academic Year 2023-24)

SCHEME OF EXAMINATION AND

COURSES OF STUDY

FACULTY OF SCIENCE

B.Sc. Examination, 2024

CHEMISTRY

Semester IV Chemistry

Total 6 credits ; 150 marks

Type of Course	**Course Code**	**Title**	**Credit**	**Marks (External + Internal**	**Hours in a week**
Paper I Core course (DCC) (Theory) **[CHY-T-4]**	**CHY-T-4-**5.0DCC**T**43	**Chemistry- IV**	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) **[CHY-L-4]**	**CHY-L-4-**5.0DCC**P**43	**EXPERIMENTS ON SYNTHESIS, ANALYSIS AND ELECTROCHEMISTRY**	2	50 (40 + 10)	4
	Total		**6**	**150 (120 + 30)**	**10**

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination.

Course Code	**CHY-T-4-**5.0DCC**T**43
Type of the course	Core course (DCC) (Theory) course I of Semester IV
Title of the Course	**CHEMISTRY - IV**
Level of the Course	NHEQF5.0
Credit of the Course	**4**
Delivery sub-type of the course	Theory 6h Lecture per week
Pre-requisites and requisites of the course	Student enrolled and registered in UG Programme fourth semester. He/she should have biology background.
Course Objectives	➢ To develop a basic understanding about coordination compounds, complexes and aromatic reactions ➢ To develop a basic understanding about the electrochemistry
Course Outcome	➢ After completion of course student will able to understand basic laws of electrochemistry and its application ➢ student will able to understand metal – ligand bonding inorganic compounds ➢ student will able to understand basics of aromatic nucleophilic reactions

Semester IV

PAPER-I

90 Hours (6 Hour/ week)

Unit-I

Metal-ligand Bonding in Transition Metal Complexes: Limitation of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors. affecting the crystal Field Parameters

Thermodynamic and Kinetic Aspect of Metal Complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

Unit-II

Magnetic Properties of Transition Metal Complexes: Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of $\square_s$and $\square$eff values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

Electron Spectra of **Transition Metal Complexes:** Types of electronic transition, selection rules of d-d transitions, spectroscopic ground state, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6J^{3+}$ complex ion.

Unit-III

Electrochemistry: Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, meas+urement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrahusch law, Arrehenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only).

Transport number- Definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements : Determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Electrolytic and Galvanic cells-reversible and irreversible cells, EMF of a cell and its measurements. Computation of cell EMF. Concentration cell with and without transport, liquid junction potential, application of concentration cells.

Corrosion-Types, theories and methods of combating it.

Unit-IV

Aryl halides: Nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophillic aromatic substitution reactions. Synthesis and uses of D.D.T. and B.H.C.

Phenols: Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis; Hauben-Hooesch reaction, Lederer-Manasse reaction and Reimeer-Tiemann reaction.

Unit-V

Aromatic nucleophilic substitution: Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.

Halonitroarenes: Reactivity; Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity, of amines. Amines salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic andketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reaction of amines, electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid. Synthesis, transformation of aryl diazonium salts, azo coupling.

यूनिट I

संक्रमण धातु संकुलों में धातु–लिगक्ड बन्धन।

संयोजकता बन्ध सिद्धान्त की सीमाएं, क्रिस्टल क्षेत्र सिद्धान्त का प्रारम्भिक अभिप्राय, ऊष्टफलकीय, चतुफलकीय तथा वर्ग समतलीय संकुलो में क्रिस्टल क्षेत्र विभाजन, क्रिस्टल क्षेत्र पैरामीटर को प्रभावित करने वाले कारक।

धातु संकलो के ऊषगतिकीय एवं गतिकीय पहलू :– धातु संकलो के ऊष्मागतिकीय स्थायित्व की संक्षिप्त रूपरेखा और स्थायित्व को प्रभावित करने वाले कारक, वर्ग समतल संकुलो की प्रतिस्थापन अभिक्रियाएं।

इकाई II

संक्रमण धातु संकुलो के चुम्बकीय गुण :– चुम्बकीय व्यवहार के प्रकार, चुम्बकीय प्रवृति के

निर्धारण की विधियां, चक्रण मात्र सूत्र, L-S युग्मन, u, तथा Mv मानो में अन्तसम्बन्ध, चुम्बकीय आपूर्ण में कक्षकीय योगदान, उन संकुलो केलिये चुम्बकीय आपूर्ण आंकड़ो के अनुप्रयोग। संक्रमण धातु संकुलो के इलेक्ट्रान स्पेक्ट्रा। इलेक्ट्रानिक संक्रमण के प्रकार, वन्व संक्रमण के लिये चयन के नियम, स्पेक्ट्रोस्कोपक निम्नतम अवस्था, स्पेब्ट्रोरासायनिक श्रेणी, वे एवं तं अवस्थाओं के लिये आर्गल ऊर्जा अवस्था आरेख [II)H2O)6]3+ संकुल, आयन के इलेक्ट्रॉनिक स्पेक्ट्र की व्याख्या।

इकाई III

विद्युत रसायन :– विद्युत का अभिगमन, धातुओं एवं विद्युत वलयनों में चालकता, विशिष्ट चालकता एवं तुल्यांकी चालकता तुल्यांकी चालकता का मापन, तनुता के साथ तुल्याकी चालकता एवं विशिष्ट चालकता का परिवर्तन, आयनों का अभिगमकन एवं कोलराऊश का नियम, विद्युत वियोजन का आर्हीनियस सिद्धान्त एवं उसकी सीमाएं, दुर्बल एवं प्रबल विद्युत अपघट्य, ओस्टवाल्ड का तनुता नियम, उसके उपयोग एवं सीमाएं, प्रबल विद्युत अपघट्यो के लिये डिकाई हवल ऑन्सेगर सीमाकरण (लेवल प्रारम्भिक उपचार) ।

अभिगमनांक :– परिभाषा एवं हिटॉर्फ विधि एवं चल सीमा विधि द्वारा इसका मापन। चालकता मापन के अनुप्रयोग, वियोजन की मात्रा का निर्धारण, अम्लों के Ka का निर्धारण,

अभिगमनांक :– परिभाषा एवं हिटॉर्फ विधि एवं चल सीमा विधि द्वारा इसका मापन। चालकता मापन के अनुप्रयोग, वियोजन की मात्रा का निर्धारण, अम्लों के Ka का निर्धारण, अल्पविलयशील लवणों के विलेयता गुजन फल का निर्धारण, चालकता मूलक अनुमापन विद्युत अपघटनी एवं गैल्टोनिक सेल, उत्क्रमणीय या अनुत्क्रमणीय सेल का EMF एवं मापन, सेल EMF की गाना, अभिगमन रहित सान्द्रता सेल एवं अभिगमन युक्त सान्द्रता सेल, द्रव सन्धि विभव।

संक्षारण :– प्रकार, सिद्धान्त एवं संघर्ष विधियां।

इकाई IV

ऐरिल हैलाइड :– नाभिकीय एवं पार्श्व श्रृंखला अभिक्रियाएं नाभिक स्नेही ऐरोमेटिक प्रतिस्थापन के विलोपन – यौगात्मक, योगत्मक–विलीयन अभिक्रियाओं की क्रिया विधि, DDT एवं BHC के संश्लेषण एवं उपयोग।

फीनॉल :– ऐल्कोहौलो तथा फीनालो के अम्ल सामर्ध्य की तुलना, अनुवाद एवं फीनाक्साइड आयन का स्थायित्व, फीनाल की अभिक्रियाएं – इलेक्ट्रान स्नेही ऐरोमैटिव प्रतिस्थापन, ऐसिटिलीकरण, कार्बोक्सिलीकरण फाइज पुनर्विन्यास, ब्लेजन पुर्वान्यास, गॉटरमान संश्लेषण हाइबेन हॉश अभिक्रिया, लेडेरर – मनासे अभिक्रियेा एवं राइमन टाइमन अभिक्रियाओं की क्रिया विधि।

इकाई V

ऐरोमेटिक नाभिकीय स्नेही प्रतिस्थापन :– नाईट्रो ऐरिन में नभिक स्नेही प्रतिस्थापन की क्रियाविधि एवं अमनीय, क्षारीय एवं उदासीन माध्यम में अपचमन, पिक्रिक अम्ल। हेलोनाट्रोऐरीन – क्रियाशीलता, ऐमीन के भौतिक गुण संरचना एवं नामकरण ऐमीन की क्षिविम समावयवता, प्राथकि, द्वितीयक एवं तृतीयक ऐीन के मिश्रण का पृथक्करण, सेमीनो की क्षारकीय प्रकृति पर संरचना का प्रभाव, ऐमीन लवणों का प्रवस्था स्थानान्तरण उत्प्रेरक के रूप में उपयोग, ऐलिवल एवं ऐरिलऐमीन बनाने की विधियां (नाईट्रो एवं नाइट्रिल यौगिको का अपचयन), ऐल्डिहाइडी एवं कीटोनी यौगिको का अपचयनी ऐमीनीकरण, गेब्रियल थैलिमाइड अभिक्रिया, हॉफमैन ब्रोमऐमाइड अभिक्रिया, ऐमिन की अभिक्रियाएं, ऐरिल ऐमीन में इलेक्ट्रॉन स्नेही ऐरामेटिक प्रतिस्थापन, ऐमीन की नाइट्रस अम्ल से अभिक्रिया, ऐटिल डाइजोनियम लवण के सांश्लेषिक रूपान्तरण ऐजो युम्मन।

Course Code	**CHY-L-4-**5.0DCC**P**43
Type of the course	Core course (DCC) (Practical)
Title of the Course	**Experiments on Synthesis, Analysis and Electrochemistry**
Level of the Course	NHEQF5.0
Credit of the Course	**2**
Delivery sub-type of the course	**Practical 4h Laboratory per week**
Course Objectives	➢ To develop a basic understanding about the gravimetric analysis and inorganic synthesis ➢ To develop an understanding towards the experimental importance of electrochemistry and distribution laws.
Course Outcome	➢ After completion of lab student will able to understand and apply basic gravimetric and synthesis procedures. ➢ Students will able to apply basic electrochemical and distribution principles on simple commercial samples.

Chemistry Lab 4

Experiments on Synthesis, Analysis and Electrochemistry

PRACTICAL

60 hours (4 h per week)

A Gravimetric Analysis

Gravimetric estimation of Cu, Ba, Mg, Fe etc.

B Inorganic Synthesis

(a) Sodium trioxalato ferrate (III), Na_3 $[Fe(C_2O_4)_3]$

(b) Ni-DMG complex, $[Ni\ (DMG)_2]$

(c) Copper tetrammine complex $[Cu(NH_3)]_4\ SO_4$.

(d) Cis-and trans-bisoxalato diaqua chromate (III) ion.

C Electrochemical studies : pH metric studies, conductometric studies of simple solutions**.** Preparation of few simple cells and batteries.

D Colloids & Distribution Law

1. To study the distribution of iodine between water and CCl_4
2. To study the distribution of benzoic acid between benzene and water
3. **Preparation of few colloidal systems viz** arsenious sulphide sol and compare the precipitating power of mono- ,bi- and trivalent anions.

Note : Similar exercise may be set in question paper as per availability

PRACTICAL-SCHEME OF EXAMINATION

Max. Marks: 50 (including 10 marks of internal) **Min. Marks: 18** **Time: 5 Hours**

Exercise

Experiment	Marks
A Gravimetric Analysis	**8**
B Inorganic Synthesis	**8**
C Electrochemical studies	**8**
A Colloids & Distribution Law	**6**
Viva	**5**
Record	**5**

Note :-

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination.

Theory (term end paper)-SCHEME OF EXAMINATION

Max. Marks: 100 (including 20 marks of internal) **Min. Marks: 36** **Time: 3 Hours**

Pattern for Questions for term end semester exam Total marks per paper 80

Types	Marks
Part A (total 10 questions, 2 questions from each unit; answer all questions, each question carry 1.5 mark, word limit for answer is 50 words)	**15**
Part B (total 10 questions, 2 questions from each unit with internal choice; answer 5 questions selecting 1 question from set, each question carry 7 mark, word limit for answer is 200 words)	**35**
Part C (total 5 questions, 1 questions from each unit;, Attempt any three questions; each question carry 10 mark, word limit for answer is 500 words)	**30**

Note :-

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination.

SYLLABUS

Choice-Based Credit System (CBCS)

Maharaja Ganga Singh University

Bachelor of Science (B.Sc.) Chemistry

(Semester) 2023-24

Semester V

Department of Chemistry

Undergraduate Programme

(Effective from Academic Year 2023-24)

SCHEME OF EXAMINATION AND

COURSES OF STUDY

FACULTY OF SCIENCE

B.Sc. Examination, 2024

CHEMISTRY

Semester V Chemistry

Total 6 credits ; 150 marks

Type of Course	**Course Code**	**Title**	**Credit**	**Marks (External + Internal**	**Hours in a week**
Paper I Core course (DCC) (Theory) **[CHY-T-5]**	**CHY-T-5-A-** 5.5DCC**T**53	**Chemistry-V**	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) **[CHY-L-5]**	**CHY-L-5-** 5.5DCC**P**53	**Lab-5**	2	50 (40 + 10)	4
	Total		**6**	**150 (120 + 30)**	**10**

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Course Code	**CHY-T-5 -**5.5DCC**T**53
Type of the course	Core course (D CC) (Theory) course I of Semester V
Title of the Course	**CHEMISTRY – V**
Level of the Course	NHEQF5.5
Credit of the Course	**4**
Delivery sub-type of the course	Theory 6h Lecture per week
Pre-requisites and requisites of the course	Student enrolled and registered in UG Programme fifth semester.
Course Objectives	➢
Course Outcome	➢

Semester V

PAPER-I

Chemistry V - CHY-T-5 -5.5DCC**T**13

90 Hours (6 Hour/ week)

Unit-I

(a) Hard and Soft Acids and Bases (HSAB)

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and Softness. Lux-Flood concept of acid base and its limitation. Lewis concept and its limitation Usanovich concept. A generalized acid –base concept.

(b) Non-aquenous Solvents:

Physical properties of a solvent, types of solvent and their general characteristics reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

Unit-II

Heterocyclic Chemistry

Nomenclature , preparation and properties of compounds having one heteroatom with five and six member ring (Pyrrole, Thiophene, Furan and Pyridine)

Organic Synthesis Via Enolates

Acidity of □-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate:, the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes.Alkylation and acylation of enamines.

Unit-III

Polymers

General Classification of Natural and Synthetic Polymers. Concept of molecular weight of polymer. Chemical and Physical properties of polymers. Addition of chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegier-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol- formaldehyde resins, urea- formaldehyde resins, epoxy resins and polyurethanes.

Synthetic Dyes

Color and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolpthalein, Fluorescein, Alizarin and Indigo.

Unit-IV

Elementary Quantum Mechanics

Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect.

De Brogile hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiitonian operator, Schrodinger wave equation and its importance, physical interpretation of the **wave** function, postulates of quantum mechanics, particle in a one dimensional box. Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

Unit-V

Basic chemistry in everyday life: Structure of matter in Nature, molecule stability check by Born-Haber Cycle, solubility check by fajan's rule. Mg in chiorophyll and Li in lithium ion batteeries, Na-K pump in nervous system. Si and Ge in semiconductors. Ozone deplection by CFCs, free radicals in aging, medicine, cosmetics, various fuels and fabrics. isomers in human body through enzymatic reactions. 50% drugs as optical isomers. Cis platin as anticancer drug. LPG, CNG, Biogas as hydrocarbon, ethylene in fruits ripening, polythene bags, pvc, Acetylene in welding torch, fuel and plastic industry.

Chemistry Lab 5

PRACTICAL

60 hours (4 h per week)

Course Code	**CHY-L-5-** 5.5DCC**P**53
Type of the course	Core course (DCC) (Practical)
Title of the Course	**Chemistry Lab 5**
Level of the Course	NHEQF5.5
Credit of the Course	**2**
Delivery sub-type of the course	**Practical 4h Laboratory per week**
Course Objectives	➢
Course Outcome	➢

A. Synthesis & Analysis

(i)Inorganic Synthesis

(a) Sodium trioxalato ferrate (III), Na_3 $[Fe(C_2O_4)_3]$

(b) Ni-DMG complex, $[Ni\ (DMG)_2]$

(c) Copper tetrammine complex $[Cu(NH_3)]_4\ SO_4$.

(d) Cis-and trans-bisoxalato diaqua chromate (III) ion.

(ii) Analysis

Semi micro and Macro analysis , Separation and Identification of

Six radicals - three acidic and three basic from a mixture with one interfering radicals and/or combinations of radicals.

B. Utilization of Laboratory Techniques

(i)Laboratory Techniques

(a) Steam Distillation

(b) Naphthalene from its suspension in water

(c) Clove Oil form Cloves

(d) Separation of o-and p-nitrophenols

(e) Column Chromatography

(f) Separation of fluorescene and methylene blue

(g) Separation of leaf pigments form spinach leaves

(h) Resolution of racemic mixture of (±) mandelic acid

(ii) Stereochemical Study of Organic Compounds via Models

(a) R and S configuration of optical isomers.

(b) E and Z configuration of geometrical isomers.

(c) Conformational analysis of cyclohexanes and substituted cyclohexanes.

C. Physical Chemistry Experiments

1. To determent the strength of the given acid conductometrically using standard alkali solution.
2. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
3. To study the saponification of ethyl acetate conductometrically.
4. To determint the ionisation constant of a weak acid conductometrically.
5. To tirate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4$ /$K_2Cr_2O_7$ /$CuSO_4$ as titrant calculate the redox potential of Fe++/Fe+++ system on the hydrogen scale.
6. To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.

Seminar and Project work

A seminar and Project work should be allotted to each student. Marks will be awarded by panel of examiners / experts (who will conduct seminars) constituted internally and panel will submit the marks in sealed envelope to HOD who will hand over it to external examiner during final University examination.

Books Suggested (Laboratory Courses)

1. Vogel's Qualitative Inorganic Analysis, revised, Svehta, Orient Longman.
2. Vogel's Textbook of quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney, G.H. Heffery and J Mendham, ELBS.
3. Standard Methods of Chemical Analysis, W.W. Scott, The Technical Press.
4. Experimental inorganic Chemistry, W.G. Palmer, Cambridge.
5. Handbook of Preparative Inorganic Chemistry, Vol, I & II Brauer, Academic Press.
6. Inorganic Synthesis, McGraw Hill.
7. Experimental Organic Chemistry Vol. l&ll, P.R.Singh, D.S.Gupta and K.S. Bajpai, Tata McGraw Hill.
8. Laboratory Mannual in Organic Chemistry, R.K. Babsal, Wiley Eastern.
9. Vogel's Textbook of Practical Organic Chemistry, B.S. Fumiss, A.J. Hannaforct, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
10. Experiments in General Chemistry, C.N.R; and U.C. Agarwal, East-West press.
11. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw hill.
12. Advanced Practical Physical Chemistry, Vol. I-Physical, J.B. Yadav, Goel Publishing House.
13. Advanced Experimental Chemistry, Vol. I-Physical, J.N. Gurju and R. Kapoor, S Chand & Co.
14. Selected Experiments in Physical Chemistry, N.G. Mukherjee. J.N. Ghose & Sons.
15. Experiments in Physical Chemistry, J.C. Ghosh, Bharati Bhavan.

PRACTICAL-SCHEME OF EXAMINATION

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Exercise

Experiment	Marks
A Instrumentation (any one)	**8**
B Applied Chemistry Experiments (any one)	**8**
C Physical Chemistry Experiments (any one)	**8**
Seminar and Project work	**6**
Viva	**5**
Record	**5**

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For semester I, III and V no external examiner will be appointed by University. Instead, the examiners will be appointed by the Head of the institute / Principal of the college and both marks, term end practical and internal examination will be submitted to the university.

SYLLABUS

Choice-Based Credit System (CBCS)

Maharaja Ganga Singh University

Bachelor of Science (B.Sc.) Chemistry

(Semester) 2023-24

Semester VI

Department of Chemistry

Undergraduate Programme

(Effective from Academic Year 2023-24)

SCHEME OF EXAMINATION AND

COURSES OF STUDY

FACULTY OF SCIENCE

B.Sc. Examination, 2024

CHEMISTRY

Semester VI Chemistry

Total 6 credits ; 150 marks

Type of Course	**Course Code**	**Title**	**Credit**	**Marks (External + Internal**	**Hours in a week**
Paper I Core course (DCC) (Theory) **[CHY-T-6]**	**CHY-T-6-**5.5DCC**T**63	**Chemistry-VI**	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) **[CHY-L-6]**	**CHY-L-6-**5.5DCC**P**63		2	50 (40 + 10)	4
	Total		**6**	**150 (120 + 30)**	**10**

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination.

Course Code	**CHY-T-6 -**5.5DCC**T**63
Type of the course	Core course (DCC) (Theory) course I of Semester V
Title of the Course	**CHEMISTRY – VI**
Level of the Course	NHEQF5.5
Credit of the Course	**4**
Delivery sub-type of the course	Theory 6h Lecture per week
Pre-requisites and requisites of the course	Student enrolled and registered in UG Programme fifth semester.
Course Objectives	➢
Course Outcome	➢

Semester VI

PAPER-I

Chemistry VI

90 Hours (6 Hour/ week)

Unit-I

Spectroscopy

Introduction: electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum

Diatomic molecules, Energy levels of a rigid rotator (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell- Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Vibrational spectrum

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of an harmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Raman Spectrum concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selction rules.

Unit-II

NMR Spectroscopy

Nucelear Magnetic resonance (NMR) spectroscopy. Paramagnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2,-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and NMR spectroscopic techniques.

Unit-III

Bioinorganic Chemistry

Essential and trace elements in biological processes, metallporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}, nitrogen fixation.

Amino Acids, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids. Acid base behavior, electrophoresis. Preparation and reactions of □-amino acids, structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure .determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis. solid-phase peptide synthesis. Structures of peptides and proteins, level of protein structure. Proteins denaturation/renaturation.

Nucleic acids: Introduction, Constitution of nucleic acids-Ribnonucleosides and ribonucleotides. The double helical structure of DNA. '

Unit-IV

Carbohydrates

Classification and nomenclature. Monosaccharides. mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosacchariedes. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. Structrure or ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides e.g. starch and cellulose (without involving structure determination.)

Unit-V

Synthetic drugs: Introduction, medicinal value, precautions, pharmacology - mechanism of action, merits and demerits. Green Synthesis. Green Chemistry & Pharmacy, Drugs acting on brain and nervous system, psychoactive drugs. Depressants, Stimulants, hallucinogens – sources, effects, basic mechanism of action.

Scope of medicinal chemistry, indigenous medical system, Ayurveda, Siddha, Unani, Homeopathy, Tibetian & folklore system of medicine, need to preserve knowledge system. Green Extraction

Chemistry Lab 6

PRACTICAL

60 hours (4 h per week)

Course Code	**CHY-L-6-** 5.5DCC**P**63
Type of the course	Core course (DCC) (Practical)
Title of the Course	**Chemistry Lab 6**
Level of the Course	NHEQF5.5
Credit of the Course	**2**
Delivery sub-type of the course	**Practical 4h Laboratory per week**
Course Objectives	➢
Course Outcome	➢

Chemistry Lab 6

PRACTICAL

60 hours (4 h per week)

A. Instrumentation

(i) Colorimetry

(a)To determine Metal- Ligand ratio of complexes by Jobs method

(b) To determine Metal- Ligand ratio of complexes by Mole Ratio method

(c) Determination of adulteration in Food Stuffs.

(d) Effluent or waste water analysis.

(e) Ground Water Analysis.

(ii) Solvent Extraction: Separation and estimation of Mg(II) and Fe(II) ions.

(iii) Exchange Method: Separation and estimation Mg(II) and Zn(II) ions.

B. Applied Chemistry Experiments

(i) Determination of following parameters of oils & fats

(a) Saponification Value

(b)Iodine Value and /or

(c)R.M. Value

(ii) Green Chemistry Synthesis – Solventless synthesis of aldol derivative or any other compound

C. Physical Chemistry Experiments

1. To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.
2. To determine the specific rotation of a given optically active compound.

3. Determination of molecular weight of a non-violatile solute by Rast method/Backmann freezing point method.

4. Determination of the apparent degree of dissociation of an electolyte (e.g- Na Cl) in aqueous solution at different concentrations by ebullioscopy.

5. To verify Beer-Lambert law for $KMnO_4/K_2$, Cr_2, O_7 and determine the concentration of the given solution of the substance.

Seminar and Project work

A seminar and Project work should be allotted to each student. Marks will be awarded by panel of examiners / experts (who will conduct seminars) constituted internally and panel will submit the marks in sealed envelope to HOD who will hand over it to external examiner during final University examination.

Books Suggested (Laboratory Courses)

1. Vogel's Qualitative Inorganic Analysis, revised, Svehta, Orient Longman.
2. Vogel's Textbook of quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney, G.H. Heffery and J Mendham, ELBS.
3. Standard Methods of Chemical Analysis, W.W. Scott, The Technical Press.
4. Experimental inorganic Chemistry, W.G. Palmer, Cambridge.
5. Handbook of Preparative Inorganic Chemistry, Vol, I & II Brauer, Academic Press.
6. Inorganic Synthesis, McGraw Hill.
7. Experimental Organic Chemistry Vol. l&ll, P.R.Singh, D.S.Gupta and K.S. Bajpai, Tata McGraw Hill.
8. Laboratory Mannual in Organic Chemistry, R.K. Babsal, Wiley Eastern.
9. Vogel's Textbook of Practical Organic Chemistry, B.S. Fumiss, A.J. Hannaforct, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
10. Experiments in General Chemistry, C.N.R; and U.C. Agarwal, East-West press.
11. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw hill.
12. Advanced Practical Physical Chemistry, Vol. I-Physical, J.B. Yadav, Goel Publishing House.
13. Advanced Experimental Chemistry, Vol. I-Physical, J.N. Gurju and R. Kapoor, S Chand & Co.
14. Selected Experiments in Physical Chemistry, N.G. Mukherjee. J.N. Ghose & Sons.
15. Experiments in Physical Chemistry, J.C. Ghosh, Bharati Bhavan.

PRACTICAL-SCHEME OF EXAMINATION

Max. Marks: 50 (including 10 marks of internal) **Min. Marks: 18** **Time: 5 Hours**

Exercise

Experiment	Marks
A Instrumentation (any one)	**8**
B Applied Chemistry Experiments (any one)	**8**
C Physical Chemistry Experiments (any one)	**8**
Seminar and Project work	**6**
Viva	**5**
Record	**5**

Note :-

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination.

Theory (term end paper)-SCHEME OF EXAMINATION

Max. Marks: 100 (including 20 marks of internal) **Min. Marks: 36** **Time: 3 Hours**

Pattern for Questions for term end semester exam Total marks per paper 80

Types	Marks
Part A (total 10 questions, 2 questions from each unit; answer all questions, each question carry 1.5 mark, word limit for answer is 50 words)	**15**
Part B (total 10 questions, 2 questions from each unit with internal choice; answer 5 questions selecting 1 question from set, each question carry 7 mark, word limit for answer is 200 words)	**35**
Part C (total 5 questions, 1 questions from each unit;, Attempt any three questions; each question carry 10 mark, word limit for answer is 500 words)	**30**

Note :-

The marks of Internal Examination should be given on the basis of two term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminar, quizzes, artwork, model preparations, student fest, chemistry association / science club activities etc.)

For Term end practical examination board of examiner (Two members one external and one internal) will conduct the examination.