SYLLABUS

Choice-Based Credit System (CBCS)

Maharaja Ganga Singh University

Bachelor of Science (B.Sc.) Chemistry

(Semester) 2023-24

Semester I

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

Background

Considering the curricular reforms as instrumental for desired learning outcomes, all the academic Department of Maharaja Ganga Singh University made a rigorous attempt to revise the curriculum of postgraduate programmes in alignment with National Education Policy-2020 and UGC Quality Mandate for Higher Education Institutions-2021. The process of revising the curriculum could be prompted with the adoption of "Comprehensive Roadmap for Implementation of NEP". The roadmap identified the key features of the Policy and elucidated the Action Plan with well-defined responsibilities and indicative timeline for major academic reforms.

The process of revamping the curriculum started with the series of webinars and discussions conducted by the University to orient the teachers about the key features of the Policy, enabling them to revise the curriculum in sync with the Policy. Few research has also been carried out by the faculty members about the assessment, evaluation and significance of the NEP 2020. Proper orientation of the faculty about the vision and provisions of NEP-2020 made it easier for them to appreciate and incorporate the vital aspects of the Policy in the revised curriculum focusing on creating holistic, thoughtful, creative and well-rounded individuals equipped with the key 21st century skills 'for the development of an enlightened, socially conscious, knowledgeable, and skilled nation'.

With NEP-2020 in background, the revised curricula articulate the spirit of the Policy by emphasising upon- integrated approach to learning; innovative pedagogies and assessment strategies; multidisciplinary and cross-disciplinary education; creative and critical thinking; ethical and Constitutional values through value-based courses; 21st century capabilities across the range of disciplines through life skills, entrepreneurial and professional skills; community and constructive public engagement; social, moral and environmental awareness; Organic Living and Global Citizenship Education (GCED); holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning; exposure to Indian knowledge system, cultural traditions and classical literature through relevant courses offering 'Knowledge of India'; fine blend of modern pedagogies with indigenous and traditional ways of learning; flexibility in course choices; student-centric participatory learning; imaginative and flexible curricular structures to enable creative combination of disciplines for study; offering multiple entry and exit points, alignment of Vocational courses with the International Standard Classification of Occupations maintained by the International Labour Organization; breaking the silos of disciplines; integration of extra-curricular and

curricular aspects; exploring internships with local industry, businesses, artists and crafts persons; closer collaborations between industry and higher education institutions for technical, vocational and science progammes; and formative assessment tools to be aligned with the learning outcomes, capabilities, and dispositions as specified for each course. The University has also developed consensus on adoption of Blended Learning with 10% component of online teaching and 90% face to face classes for each programme.

Choice Based Credit System (CBCS)

The Choice Based Credit System (CBCS), a part of academic reform process to enhance quality of education and facilitate transferability of students from one University/institution to another at the national and international level, provides substantive autonomy to teachers to formulate their own curricula and enable them to introduce innovations in teaching and learning process and upgrade overall quality of higher education. The CBCS provides scope for Comprehensive and Continuous Evaluation (CCE) of students and encourages them to learn. The CBCS provides a cafeteria type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

The grading system is widely regarded as an improvement over the traditional marks system, which is why leading institutions in India and abroad have adopted it. Thus, there's a strong rationale for establishing a consistent grading system. This would facilitate seamless student mobility among institutions within the country and abroad, while also allowing prospective employers to accurately assess students' performances. To achieve the desired standardization in the grading system and the method for calculating the Cumulative Grade Point Average (CGPA) based on students' examination results, the UGC has devised these comprehensive guidelines.

Outline of Choice Based Credit System

(https://www.ugc.gov.in/pdfnews/8023719_guidelines-for-cbcs.pdf)

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course: Elective** courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii. English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

3.2 Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

4. Research Component in Under-Graduate Courses

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analysing /exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Semester I 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-1]**	**CHY-T-1-**4.5DCC**T**13	ATOMICS AND STRUCTURAL CHEMISTRY	2	50 (40 + 10)	3
Paper II Core course (DCC) (Theory) **[CHY-T-2]**	**CHY-T-2-**4.5DCC**T**13	REACTIONS & ISOMERISM IN CHEMISTRY	2	50 (40 + 10)	3
Paper III Core course (DCC) (Lab) **[CHY-L-1]**	**CHY-L-1-**4.5DCC**P**13	LABORATORY TECHNIQUES & SAFETY IN LABORATORY	2	50 (40 + 10)	4
	Total	**6**	**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.)

Course Code	**CHY-T-1-**4.5DCC**T**13
Type of the course	Core course (DCC) (Theory) course I of Semester I
Title of the Course	ATOMICS AND STRUCTURAL CHEMISTRY
Level of the Course	NHEQF4.5
Credit of the Course	**2**
Delivery sub-type of the course	Theory 3h Lecture per week
Pre-requisites and requisites of the course	Student enrolled and registered in UG Programme first semester. He/she should have biology background.
Course Objectives	➢ To develop a basic understanding about the structure of atoms and compounds among students ➢ To develop mathematical concept which are useful for chemical understanding
Course Outcome	➢ After completion of course student will able to apply the principles of atomic structure on different atoms of periodic table. ➢ Students will able to understand and explain the structure and properties of various molecules and different states viz solid, liquid and gas.

Semester I

PAPER-I – ATOMICS AND STRUCTURAL CHEMISTRY

45 Hours (3 Hour/ week)

Unit-I

Atomic Structure: Idea of De-Broglie matter/waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of psi(ψ) and psi*(ψ*), quantum numbers, radial and angular wave function and probability distribution curves, shapes of s, p,d, f orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge.

Unit-II

Periodic Properties: Atomic and ionic radii, ionization energy, electron affinity and electronegativity, different, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behavior.

Unit-III

Structure and Bonding: Hybridization, bond lengths and bond angles. Bond energy, localized and delocalized chemical bond, vanderwaals interactions, inclusion compounds, clatherates, charge transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding, Valence bond theory and its limitations, Valence shell electron pair repulsion (VESPR)

theory to NH_3, H_3O^+, SF_4, ClF_3, $ICl_2^-$and H_2O etc. **MO theory**-Homonuclear and heteronuclear (CO and NO) diatomic molecules,

Unit-IV

Structure of Ionic Solids - Ionic Structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber Cycle, solvation energy and solubility of ionic solids, polarizaing power and polarizability of ions. Fajan's rule.

Gaseous States : Postulates of kinetic theory of gases, deviation from ideal behaviour, Vander-waals equation of state, PV isotherms of real gases, continuity of states, the isotherms of Vander-waals equation, relationship between critical constants and Vander-waals constants, the law of corresponding states, reduced equation of state. Qualitative discussions of the Maxwell's distribution of molecular velocities, Liquification of gases (based on Joule - Thomson effect).

Unit-V

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid Crystals : Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholestric phases. Thermography and seven-segment cell.

Mathematical Concepts: Logarithmic relations, curve, sketching linear graphs and calculations of slopes, differentiation of functions like K_x, e^x, X^n, sin x, log x; maxima and minima, partial differentiation and reciprocity relations. Integrations of some useful/relevant functions; permutations and combinations, Factorials. Probability.

Reference Books:

- J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.17
- James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles ofStructure and Reactivity*, Pearson Publication.
- Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
- Atkins, Overton, Rourke, Weller, Armstrong, Shriver and Atkins *Inorganic Chemistry*, Oxford
- G. M. Barrow: *Physical Chemistry* Tata McGraw Hill (2007).
- G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
- J. C. Kotz, P. M. Treichel & J. R. Townsend: *General Chemistry* Cengage Lening India Pvt. Ltd.,New Delhi (2009).
- B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
- R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

प्रथम प्रश्न पत्र – परमाणु एवं संरचनात्मक रसायन

इकाई – I

परमाणु संरचना : डी ब्रॉग्ली द्रव्य/तरंगों विचार हाइजेनबर्ग का अनिश्चितता का सिद्धान्त, परमाण्वींय कक्षक, श्रोडिंगर तरंग समीकरण, तरंगफलन व उसके वर्ग (व) की सार्थकता, क्वांटम संख्याए, त्रिज्य एवं कोणीय तरंग फलन, प्रायिकता वितरण वक्र, S, P, D, F कक्षाकों की आकृति, ऑफबौ एवं पाउली अपवर्जन सिद्धान्त, हुंड का अधिकतम बहुकता का नियम, तत्वों के इलेक्ट्रॉन विन्यास, प्रभावी नाभिकीय आवेश।

इकाई – II

आवर्ती गुण : परमाणु व आयनिक त्रिज्या, आयनन ऊर्जा, विद्युतऋणता एवं इलेक्टॉन बंधुता की परिभाषा एवं निर्धारण की विधियां, आवर्त सारणी में प्रवृत्ति, रासायनिक व्यवहार की व्याख्या एवं अनुमान लगाने मे अनुप्रयोग।

इकाई – III

संरचना और बन्धनः संकरण, बन्ध लम्बाई, बन्ध कोण, बन्ध ऊर्जा, स्थानीकृत एवं विस्थानीकृत रसायन बन्ध, वाण्डरवाल्स अन्योन्यक्रया, समावेश यौगिक, क्लैथ्रेट्स कोश इलेक्ट्रॉन युग्म प्रतिकर्षण सिद्धान्त (VESRP) NH_3, H_3O^+, SF_4, ClF_3 ICl_2^- , H_2O आधि के लिए, अणुकक्षक, सिद्धान्त समनाभिकीय एवं विषमनाभिकीय (CO व NO) द्विपरमाणुक अणु।

इकाई - IV

आयनिक ठोस की संरचा : आयनिक संरचनाएं, त्रिज्या अनुपात प्रभाव व उपसहसंयोजन संख्या, त्रिज्या अनुपात नियम की सीमाएं, जालक दोष, अर्धचालक, जालक ऊर्जा एवं बॉर्न हेबर चक्र, विलायकन ऊर्जा एवं आयनिक ठोसों की विलेयता, ध्रुवण शक्ति एवं आयनों का ध्रुवण फायान्स के नियम।

गेसीय अवस्था : गैसों के अणुगति सिद्धान्त के अभिधारणाएं, आदर्श व्यवहार से विचलन, वाण्डर वाल्स की अवस्था समीकरण, वास्तविक गैसों के PV समतापी वक्र, अवस्था का सातत्य, वाण्डर वास्ल समीकरण के समपाती, क्रान्तिक स्थिरांकों एवं वाण्डर वाल्स स्थिरांकों में सम्बन्ध, संगत अवस्था का नियम, अवस्था की समानीत समीकरण, मैक्सवेल का आण्विक वेग वितरण का गुणात्मक चर्चा, गैसों का द्रवण (जूल थोमसन प्रभाव पर आधारित)

इकाई - V

द्रव अवस्था : अन्तराण्विक बल, द्रवों की संरचना (एक गुणात्मक वर्णन) ठोस, द्रव एवं गैसों में संरचनात्मक भेद। द्रव क्रिस्टल : द्रव क्रिस्टल, ठोस एवं द्रव मे अन्तर। वर्गीकरण, निमैटिक तथा कोलेस्टीरिक प्रावस्थाओं की संरचना गणितीय अवधारणाएं : लघुगणकीय सम्बन्ध, वक्र खींचना, रेखीय ग्राफ एवं ढाल की गणना जैसे फलनों का अवकलन, उच्चिष्ठ व निम्निष्ठ, आंशिक अवकलन एवं परस्परिक सम्बन्ध, कुछ उपयोगी/संगत फलनों का समाकलन, क्रमचय एवं संवय, क्रमगुणित, प्रायिकता।

Course Code	**CHY-T-2-**4.5DCC**T**13
Type of the course	Core course (DCC) (Theory)
Title of the Course	**REACTIONS & ISOMERISM IN CHEMISTRY**
Level of the Course	NHEQF4.5
Credit of the Course	**2**
Delivery sub-type of the course	**Theory 3h Lecture per week**
Course Objectives	➢ To develop a basic understanding about the mechanisms of organic reactions ➢ To develop stereo chemical understanding of small molecules
Course Outcome	➢ After completion of course student will able to understand the reactions related with aliphatic hydrocarbons. ➢ Students will able to understand and explain the geometrical and optical isomerism in simple molecules

Semester I

PAPER-II – REACTIONS & ISOMERISM IN CHEMISTRY

45 Hours (3 Hour/ week)

Unit-I

Mechanisms of Organic Reactions : Curved arrow notation, drawing electron movements with arrows, half headed and double headed arrows, homolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles. Type of organic reactions, energy considerations.

Reactive intermediates- carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples) Assigning, formal charges on intermediates and other ionic species.

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects. Kinetic and stereochemical studies).

Unit-II

Stereochemistry of Organic Compounds-Concept of isomerism, types of isomerism. Optical isomerism- elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres, diastereomers, threo and erythrodiastereomers, meso compounds, resolution of enantiomers, inversion, retention and recemization.

Relative and absolute, configuration, sequence rules, D & L and R & S systems of nomenclature.

Unit-III

Geometric isomerism- Determination of configuration of geometricisomers E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism- conformational analysis of ethane and n-butane. Conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and sawhorse formulae, Fischer and flying wedge formulae.

Difference between configuration and conformation.

Unit-IV

Alkanes: *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: *Preparation:* Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) andtrans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration - demercuration, Hydroboration-oxidation.

Unit-V

Alkynes: *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides and acidity of alkynes, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$. Hydration to form carbonyl compounds.

Dienes: Nomenclature and classification of Dienes- Isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions- 1,2 and 1,4 additions, Diels- Alder reaction.

Reference Books:

- T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons*.
- E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
- I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
- Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

द्वितीय प्रश्न पत्र – रसायन में अभिक्रियाएं एवं समावयवता

इकाई – I

रासायनिक अभिक्रियाओं की क्रियाविधि : धुमावदार तीर संकेतन, कार्बनिक रासायनिक अभिक्रियाओं के क्रियाविधि प्रदर्शन में तीरों का महत्व, समांश एवं विषमाश बन्ध विदलन, नाभिकस्नेही एवं इलेक्टॉनस्नेही अभिकर्मक, कार्बनिक अभिक्रियाओं के प्रकार, ऊर्जा का चिन्तन, क्रियाशील मध्यवर्ती कार्बोकेटाउन, कार्बऋणायन, मुक्त मूलक, कार्बिन्स, एराईन्स तथा नाइट्रिन्स (उदाहरण सहित), मध्यवर्ती एवं अन्य आयनिक स्पीशीज पर औपचारिक आवेश दर्शाना, अभिक्रियाओं की क्रियाविधि ज्ञात करने की विधियां, गतिज एवं स्टीरियोकेमिकल अध्ययन।

इकाई - II

कार्बनिक यौगिकों का त्रिविम रसायन विज्ञान : समावयवता की अवधारणा, समावयता के प्रकार, प्रकाशित समावयवता, सममिति के तत्व, आण्बिक किरैलता, प्रतिबिम्बरूप, स्टीरियोजेनिक केन्द्र, ध्रुवण धूर्णकता, प्रतिबिम्बरूपों के गुण, दो स्टीरियोजेनिक केन्द्र युक्त किरैल व अकिरैल अणु, विवरिम समावयवी, थ्रियों व एरिथ्रो विवरिम समावयवी, मीसो यौगिक, प्रतिबिम्बरूपों का वियोजन, प्रतीपन, अप्रतीपन तथा रेसमकरण, आपेक्षिक व निरपेक्ष विन्यास, अनुक्रम नियम, नामकरण की D व L तथा R व S पद्वति।

इकाई - III

ज्यामितीय समावयवताः ज्यामितीय समावयवों के विन्यासों का निर्धारण, नामकरण की E व Z पद्धति, ऑक्सिमों तथा एलिसाइक्लिक यौगिकों को ज्यामितीय समावयवता, संरूपीय समावयवता, ऐथेन व n-ब्यूटेन का संरूपीय विश्लेषण साइक्लोहेक्सेन के संरूपण, अक्षीय एवं भूमध्यीय बन्ध, एकल प्रतिस्थापी साइक्लोहेक्सेन व्युत्पन्नों के संरूपण, न्यूमान प्रक्षेपण एवं सॉहॉर्स सूत्र, फिशर एवं फ्लाइंग वेज सूत्र, संरूपण तथा विन्यास में अन्तर।

इकाई - IV

ऐल्केन : बनाने की विधियां,– उत्प्रेरकीय हाइड्रोजनीकरण, वुर्ट्ज संश्लेषण, कोल्बे संश्लेषण, ग्रिन्यार अभिकर्मक अभिक्रिया, मुक्त मूलक प्रतिस्थापनः हैलोजेनीकरण।

ऐल्कीन : विरचन की विधियां, विलोपन अभिक्रियाएं, ऐल्कोहॉल का निर्जलीकरण, एल्किल हैलाइडों के विहाइड्रो हैलोजनीकरण (सैटफेज का नियम), सिस ऐल्कीन (आंशिक उत्प्रेरकीय हाइड्रॉजेनीकरण) तथा ट्रान्स ऐल्कीन (बिर्च अपचयन) अभिक्रियाएंः सिस– योगात्मक (क्षारीय $KMnO_4$) तथा ट्रान्स योगात्मक (ब्रोमीन), का HX योग (मार्कोनीकॉफ एवं एंटी मार्कोनीकॉफ का नियम, जलयोजन, ओजोनीकरण, आक्सीमर्क्यूरीकरण – विमर्क्यूरीकरण, हाइड्रॉबोरीकरण– आक्सीकरण।

इकाई - V

ऐल्काइन : विरचन की विधियां – CaC_2 से ऐसीटाइलीन तथा उच्च ऐल्काइन मे परिवर्तन टेट्रा हैलाइडों का विहैलोजेनीकरण तथा समीवपर्ती हाइहैलाइडों का विहाइड्रोहैलोजेनीकरण, अभिक्रियाएं – धातु ऐसीटाइलाइडस का बनना, एल्काइनों का अम्लता, ब्रोमीन एवं क्षारीय $KMnO_4$ का योग, ओजोनीकरण, गर्म क्षारीय $KMnO_4$ के साथ आक्सीकरण, कार्बोनिल यौगिकों का जलयोजन से बनना।

डाईन : वर्गीकरण एवं नामकरण– विलगित, संयुग्मित तथा संचयी डाईन, ऐलीन की संरचना, ब्यूटाडाईन की संरचना, बनाने की विधियां, बहुलकीकरण, रासायनिक अभिक्रियाएं– 1,2 तथा 1,4 योग, डील्स–ऐल्डर अभिक्रियाएं।

Course Code	**CHY-L-1-**4.5DCC**P**13
Type of the course	Core course (DCC) (Practical)
Title of the Course	**LABORATORY TECHNIQUES & SAFETY IN LABORATORY**
Level of the Course	NHEQF4.5
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 laboratory techniques ➢ To develop safety sense and behavior in the laboratory work among students.
Course Outcome	➢ After completion of lab student will able to understand and apply basic laboratory techniques. ➢ Students will able to understand the laboratory behaviors, safety parameters and safe handling in the lab

Chemistry Lab 1

Laboratory Techniques & Safety in Laboratory

PRACTICAL

60 hours (4 h per week)

A. Laboratory techniques:

(i) Determination of melting point & boiling point of simple organic and inorganic molecule

(ii) Mixed melting point determination

Urea-cinnamic acid mixture of various compositions(1:4,1:1,4:1)

(iii) Distillation – Various types of distillations

Simple distillation of ethanol-water using water condenser,

Distillation of nitrobenzene and aniline using air condenser

(iv)Green Chemistry - Identification of Safety Symbols

(v) Laboratory behaviors, safety rules and general ethics in the laboratory

(vi) Demonstration of general laboratory techniques, instruments and glasswares

(vii) Types of molecular models including R/S; E/Z

B. Purification Methods

(i).**Crystallization**

(ii) **Decolorisation & Crystallization using charcoal and or other adsorbing materials –** examples of jiggery, sugar, simple salts etc.

(iii) **Sublimation (Simple and Vacuum)**

C. Viscosity & Surface Tension

1. To determine the percentage composition of given mixture (non interacting system) by viscosity method.

2. To determine the viscosity of any mixture (e.g. amyl alcohol in water) at different concentrations and calculate the viscosity of these compositions.
3. To determine the percentage composition of a given binary mixture by surface tension method (e.g. acetone & ethyl- ketone)
4. Determination of surface tension and viscosity of edible / non ediable oils

D. Spotting

Spotting will include Safety symbols, laboratory instruments, techniques etc. During examination in spotting there should be 6 spots related with instruments, techniques, safety etc. from the syllabus ; time of spotting is 20 minutes and a separate copy shall be used for the purpose.

Reference Books:

- A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
- F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960.
- B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.

प्रायोगिक पाठ्यक्रम

प्रयोगशाला 1

A. प्रयोगशाला तकनीके–

(i) सरल अकार्बनिक एवं कार्बनिक अणुओं का गलनांक तथा क्वथनांक मापन

(ii) मिश्र गलनाक मापन

यूरिया (सिरेमिक अम्ल के अलग–अलग संघटन के मिश्रण (1:4ए 1:1, 4:1)

(iii) आसवन

एथेनॉल का सरल आसवन – जल संधनित्र द्वारा जल का उपयोग वायुसधनित्र के द्वारा नाइट्रो बेन्जी एवं एनिलीन मिश्रण का आवसन

(iv) ग्रीन कैमिस्ट्री – सुरक्षा चिन्हों की पहचान

(v) प्रयोगशाला व्यवहार, सुरक्षा नियम, प्रयोगशाला में सामान्य नैतिकता

(vi) सामान्य प्रयोगशाला तकनीके, उपकरण, कांच के बने पदार्थ का प्रदर्शन

(vii) आण्विक मॉडल के प्रकार R/S, E/Z सहित

B. शुद्धिकरण तकनीकें

(i) क्रिस्टलीकरण

(ii) चारकोल के उपयोग द्वारा विरंजन एवं क्रिस्टलीकरण और अथवा दूसरे अधिशोषित पदार्थ – गुड़, शक्कर, सरल लवण आदि

(iii) ऊर्ध्वपातन (सरल एवं निर्वात)

C. विस्कॉसिता एवं पृष्ठ तनाव

(i) श्यानता मापन विधि द्वारा, अक्रियाशील तंत्रद्ध मिश्रणों के प्रतिशत संघटन का मापन

(ii) एमिल एल्कोहॉल की जल मे विभिन्न सांद्रताओं वाले मिश्रणों की श्यानताओं का मापन एवं इन विलयनों की श्यानताओं की गणना

(iii) (एसीटोन एवं एथिल–कटोन) द्वि अंगी मिश्रण के प्रतिशत संगठन की पृष्ठ तनाव विधि से मापन

(iv) खाद्य एवं गैर खाद्य तेलों का श्यानता एवं पृष्ठ तनाव

D. Spotting – 6 Spots

(सुरक्षा, चिन्ह, प्रयोगशाला तकनीके, उपकरण, आदि)

Spotting के लिए 20 मिनट का समय एवं अलग उत्तर पुस्तिका का उपयोग।

PRACTICAL-SCHEME OF EXAMINATION

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

Exercise

Experiment	Marks
Laboratory techniques (any one)	**8**
Purification Methods (any one)	**8**
Viscosity & Surface Tension (any one)	**8**
Spotting (Six spots)	**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 examiner (Two members one external and one internal) will conduct the examination.

Theory (term end paper)-SCHEME OF EXAMINATION

Max. Marks: 50 (including 10 marks of internal) **Min. Marks: 18** **Time: 3 Hours**

Pattern for Questions for term end semester exam Total marks per paper 40

Types	Marks
Part A (total 10 questions, 2 questions from each unit; answer all questions, each question carry 0.5 mark, word limit for answer is 50 words)	**05**
Part B (total 10 questions, 2 questions from each unit with internal choice; answer 5 questions selecting 1 question from set, each question carry 2.5 mark, word limit for answer is 200 words)	**12.5**
Part C (total 5 questions, 1 questions from each unit;, each question carry 7.5 mark, word limit for answer is 500 words)	**22.5**

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 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 II

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 II 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-**4.5DCC**T**13	CHEMISTRY OF BLOCK ELEMENTS	2	50 (40 + 10)	3
Paper II Core course (DCC) (Theory) **[CHY-T-4]**	**CHY-T-4-**4.5DCC**T**13	CHEMISTRY ORGANIC COMPOUNDS	2	50 (40 + 10)	3
Paper III Core course (DCC) (Lab) **[CHY-L-2]**	**CHY-L-2-**4.5DCC**P**13	BASIC CHEMICAL ANALYSIS PROCEDURES	2	50 (40 + 10)	4
	Total	**6**	**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.)

Course Code	**CHY-T-3-**4.5DCC**T**13
Type of the course	Core course (DCC) (Theory) course I of Semester II
Title of the Course	**CHEMISTRY OF BLOCK ELEMENTS**
Level of the Course	NHEQF4.5
Credit of the Course	**2**
Delivery sub-type of the course	Theory 3h Lecture per week
Pre-requisites and requisites of the course	Student enrolled and registered in UG Programme second semester. He/she should have biology background.
Course Objectives	➢ To develop a basic understanding about the elemental framework of periodic table ➢ To develop understanding about chemical, physical properties of different elements of periodic table
Course Outcome	➢ After completion of course student will able to understand and apply the properties of block elements of periodic table. ➢ Students will able to understand and explain the uses of properties of block elements in different fields.

Semester II

PAPER-I – CHEMISTRY OF BLOCK ELEMENTS

45 Hours (3 Hour/ week)

Unit-I

s- Block Elements- Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems and introduction to alkyls and aryls.

Unit-II

p-Block elements-Comparative study (Including diagonal relationship) of groups13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-17.

Chemistry of Noble Gases-Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

Unit-III

Chemistry of Elements of First Transition Series: Characteristic properties of d-block elements. Properties of the elements of first transition series, their binary compounds and complexes, illustrating the relative stabilities of oxidation states, coordination number and geometry.

Unit-IV

Chemistry of Elements of Second and Third Transition Series: Chemistry of elements belonging to II and III transition series comparative study of post lanthanide transition metals with the members of 4d series with special emphasis on ionic radii, oxidation states, magnetic & spectral properties. Stereochemistry of their compounds.

Unit-V

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.

Reference Books:

- B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
- R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- J. D. Lee: *A New Concise Inorganic Chemistry,* E.L.B.S.
- F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry,* John Wiley.
- D. F. Shriver and P. W. Atkins: *Inorganic Chemistry*, Oxford University Press.
- Gary Wulfsberg: *Inorganic Chemistry,* Viva Books Pvt. Ltd.

प्रथम प्रश्नपत्र –ब्लॉकतत्वों का रसायन

इकाई–I

s-ब्लॉक तत्व : तुलनात्मक अध्ययन, विकर्णी सम्बन्ध हाइड्राइडों के प्रमुख लक्षण, जैविकतन्त्र में उनके कार्यों सहित विलायकन एवं संकुलन प्रवृत्तियां, ऐल्किल एवं ऐरिलों का परिचय।

इकाई–II

p-ब्लॉक तत्वः वर्ग 13–17 समूहों का तुलनात्मक अध्ययन (विकर्णी सम्बन्ध सहित) वर्ग 13–17 के तत्वों के हाइड्राइट, ऑक्साइड, ऑक्सीअम्ल एवंह`लाइड जैसे यौगिक। उत्कृष्ट गैसों का रसायनः उत्कृष्ट गैसों के रासायानिकगुण, जीनॉन का रसायन, जीनॉन यौगिकों की संरचना व बन्धन।

इकाई–III

प्रथम संक्रमण श्रेणी के तत्वों का रसायनः d ब्लॉक तत्वों के विशिष्ट गुण। प्रथम संक्रमण श्रेणी के तत्वों के गुण, उनके द्वि अंगी यौगिक एवं संकुल, आक्सीकरण अवस्था का आपेक्षिक स्थायित्व का चित्रण, ज्यामिति एवं समन्वय संख्या।

इकाई- IV

द्वितीय तथा तृतीय संक्रमण श्रेणी के तत्वों का रसायन : II व III संक्रमण श्रेणी में आने वाले तत्वों का रसायन, 4d श्रेणी । के तत्वों के साथ लैन्थेनाइडों के बाद आने वाले तत्वों की तुलना में आयनिक त्रिज्याएं आक्सीकरण अवस्था, चुम्बकीय एवं स्पेक्ट्रमी व्यवहार का अध्ययन, उनके यौगिकों का त्रिविम रसायन।

इकाई- V

f-ब्लॉकतत्वों का रसायन : इलेक्ट्रानिक विन्यास, आक्सीकरण अवस्थाएं, आयनिक त्रिज्याएं एवं लैन्थेलाइड संकुचन, संकुल निर्माण, लैन्थेनाइड यौगिकों की प्राप्ति एवंपृथक्करण। ऐक्टिनाइडों के सामान्य लक्षण एवं रसायन, यूरेनियम से Np, Pu एवं Am के पृथक्करण का रसायन, बाद आने वाले लैन्थेनाइड व बाद आन`वाले ऐक्टिनाइडों में समानता।

Course Code	**CHY-T-4-**4.5DCC**T**13
Type of the course	Core course (DCC) (Theory)
Title of the Course	**CHEMISTRY ORGANIC COMPOUNDS**
Level of the Course	NHEQF4.5
Credit of the Course	**2**
Delivery sub-type of the course	**Theory 3h Lecture per week**
Course Objectives	➢ To develop a basic understanding about the simple organic compounds ➢ To develop the understanding of chemical reactions of organic compounds
Course Outcome	➢ After completion of course student will able to understand the preparation, properties and uses of organic halides, alcohols, ethers, aldehyde ketones, carboxylic acids and their derivatives ➢ Students will able to understand and apply the reactions of organic halides, alcohols, ethers, aldehyde ketones, carboxylic acids and their derivatives for other synthesis.

Semester II

PAPER-II – CHEMISTRY ORGANIC COMPOUNDS

45 Hours (3 Hour/ week)

Unit-I

Alkyl and Aryl Halides-Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms, nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams. Polyhalogencompounds : Chloroform, carbon tetrachloride. Relative reactivities of alkyl vsallyl, vinyl and aryl halides.

Unit-II

Alcohols: Classification and nomenclature.-Monohydric alcohols-nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols.

Dihydric alcohols-Nomenciature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement. Trihydric alcohols-Nomenclature and methods of formation, chemical reactions of glycerol.

Unit-III

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, physical properties.Chemical reactions-cleavage and autoxidation, Ziesels method.

Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

Unit-IV

Aldehydes and Ketones: Nomenclature and structure of carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1, 3-dithianes, synthesis of ketones from nitriles and from carboxylic acid. Physical properties.Mechanism of nucleophilic addition to carbonyl group with particular emphasis on benzoin, Aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Witting reaction. Mannichreaction.

Unit-V

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.

Reference Books:

- T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons*.
- E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
- I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
- Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

द्वितीय प्रश्नपत्र –साइक्लों एवं ऐरोमैटिक यौगिकों का रसायन

इकाई– I

ऐल्किन एवं ऐरिलहैलाइड : नामकरण एवं ऐल्किनहैलाइडों का वर्गीकरण, बनाने की विधियां, रासायनिकअभिक्रियाएं, एल्किल हैलाइडों के नाभिक स्नेही प्रतिस्थापन अभिक्रियाओं की क्रियाविधि?, ऊर्जा अवस्था चित्रों के साथ SN^2 एवं SN^1अभिक्रियाएं।

पॉलीहैलोजन यौगिक : क्लोरोफॉर्म, कार्बनटेट्राक्लाराइड। एल्किल हैलाइडों की ऐलिल, वाईनिल एवं ऐरिलहैलाइडों के सापेक्ष अभिक्रियाशीलता।

इकाई- II

ऐल्कोहॉल : वर्गीकरण तथा नामकरण–मोनोहाइड्रिक ऐल्कोहॉल नामकरण, विरचन की विधियां (ऐडिहाइड, कीटोन, कार्बोक्सिलिकअम्ल एवं एस्टरों के अपचयन द्वारा), हाइड्रोजनबन्धन, अम्लीय प्रकृति, ऐल्कोहॉलों की अभिक्रियाएं। हाइहाड्रिक ऐल्कोहॉल : नामरण, विरचन की विधियां समीपवर्ती ग्लाइकॉलों की रासायनिक अभिक्रियाएं, ऑक्सीकरण युक्तविखण्डन$[Pb(OAc)_4$तथाHIO_4 एवं पिनैकॉल–पिनैकॉलान पुनर्विन्यास।

ट्राइहाइड्रिक ऐल्कोहॉलः नामकरण, विरचन की विधियां, ग्लिसरॉल की रासायनिक अभिक्रियाएं

इकाई- III

ऐल्डिहाइड एवंकीटोन : नामकरण तथा कार्बोनिक समूह की संरचना, ऐल्डिहाइड व कीटोनों के बनाने की विधियां–विशेषतः ऐसिडक्लोराइड से ऐल्डिहाइडों का संश्लेषण, डइथायऐन के उपयोग से ऐल्डिहाइड व कीटोनों का संश्लेषण, नाइट्राइलों एवं कार्बोक्सिलिक अम्लों से कीटोनों का संश्लेषण, भौतिकगुण। कार्बोनिल समूह पर नाभिक स्नेही योग की क्रियाविधि विशेषतः निम्न अभिक्रियाओं का अध्ययन –बेन्जोइन, ऐल्डोल, पार्किन तथा नोवेनैजेल संघनन, अमोनिया तथा उसके व्युत्पन्नों का संघनन, विटिग अभिक्रिया।

इकाई- IV

कार्बोक्सिलिकअम्ल एवं इनके व्युत्पन्न : नामकरण, संरचना एवंबन्धन, कार्बोक्सिलिकअम्ल एवं इनके व्युत्पन्न के भौतिकगुण, अम्ल सामर्थ्य पर प्रतिस्थापी का प्रभाव, कार्बोक्सिलिक अम्ल, ऐसिडक्लोराइड, एस्टर, ऐमाइड (यूरिया) एवं ऐसिड ऐनहाइड्राइड के विरचन की विधियां, गुण तथा उपयोगिता, ऐसिलव्युत्पन्नों का आपेक्षिक स्थायित्व, भौतिक गुण, नाभिकस्नेही ऐसिलप्रतिस्थापन द्वारा अम्ल व्युत्पन्नों का अन्तर्परिवर्तन। हैलोंअम्ल, हाइड्रॉक्सीअम्ल (मैलिक, टार्टरिक एवंसिट्रिक अम्ल), असंतृप्त मोनोकार्बोक्सिलिकअम्ल एवं डाइकार्बोक्सिलिकअम्लों के बनाने की विधियां तथा रासायनिक अभिक्रियाएं

Course Code	**CHY-L-2-**4.5DCC**P**13
Type of the course	Core course (DCC) (Practical)
Title of the Course	**BASIC CHEMICAL ANALYSIS PROCEDURES**
Level of the Course	NHEQF4.5
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 qualitative and quantitative analysis. ➢ To develop an understanding towards the protocols of chemical analysis.
Course Outcome	➢ After completion of lab student will able to understand and apply basic analysis procedures. ➢ Students will able to apply basic qualitative and quantitative analysis procedures on simple commercial samples.

Chemistry Lab 2

BASIC CHEMICAL ANALYSIS PROCEDURES

PRACTICAL

60 hours (4 h per week)

A Qualitative Inorganic analysis

Semi micro and Macro analysis , Separation and Identification of Four radicals - two acidic and two basic in a given mixture which may include any one interfering radical and/or combinations of radicals.

B Qualitative Organic analysis

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives

C Volumetric Analysis

(i) Determination of acetic acid in commercial vinegar using NaOH.

(ii) Determination of alkali content-antacid tablet using HCI.

(iii) Estimation of calcium content in chalk as calcium oxalate

(iv) Estimation, of hardness of water by EDTA.

(v) Estimation of ferrous and ferric by dichromate method,

(vi) Estimation of copper using thiosulphate.

D. Spotting

General analytical instruments / procedures / protocols related with water analysis, food analysis etc. should be demonstrated. Spotting will include Safety symbols, laboratory instruments, techniques etc.

During examination in spotting there should be 6 spots related with instruments, techniques, safety etc. from the syllabus ; time of spotting is 20 minutes and a separate copy shall be used for the purpose.

Reference Books:

- A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

प्रायोगिक पाठ्यक्रम

प्रयोगशाला 2

A. मात्रात्मक अकार्बनिक विश्लेषणः सूक्ष्म तथा स्थूल विश्लेषण–दा अम्लीय एवं दो क्षारकीय कूलचारमूलाकों का परीक्षण एवं पृथक्करण (बाधक मूलक एवं युग्मक मूलक दिये जाये।

B. मात्रात्मक कार्बनिक विश्लेषण : कार्बनिक यौगिकों की क्रियात्मक समूह विश्लेषण द्वारा पहचान, गलनांक का निर्धारण एवं यौगिकों के व्युत्पन्न का निर्माण।

C. आयतनी विश्लेषणः

(i) NaOHकी सहायता से व्यावसायिक सिरकेमें एसिटिक अम्ल की मात्रा ज्ञातकरना।

(ii) HCLकी सहायता से एण्टि एसिड टेबलेट में एल्कली की मात्रा का निर्धारण।

(iii) परमेंगनामिति द्वारा चॉक में कैल्सियम की मात्रा केल्स्यिम ऑक्सलेट के रूप में ज्ञात करना।

(iv) EDTA द्वारा जल की कठोरता ज्ञात करना।

(v)डाइक्रोमेटविधि द्वारा फेरस व फेरिक का आकलन।

(vi) थायोसल्फेट के उपयोग से कॉपर का आंकलन।

D. Spotting – 6 Spots

(सुरक्षा, चिन्ह, प्रयोगशाला तकनीके, उपकरण, आदि)

Spottingके लिए 20 मिनट का समय एवं अलग उत्तरपुस्तिका का उपयोग।

PRACTICAL-SCHEME OF EXAMINATION

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

Exercise

Experiment	Marks
Qualitative Inorganic analysis	**8**
Qualitative Organic analysis	**8**
Volumetric Analysis	**8**
Spotting (Six spots)	**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 examiner (Two members one external and one internal) will conduct the examination.

Theory (term end paper)-SCHEME OF EXAMINATION

Max. Marks: 50 (including 10 marks of internal) **Min. Marks: 18** **Time: 3 Hours**

Pattern for Questions for term end semester exam Total marks per paper 40

Types	Marks
Part A (total 10 questions, 2 questions from each unit; answer all questions, each question carry 0.5 mark, word limit for answer is 50 words)	**05**
Part B (total 10 questions, 2 questions from each unit with internal choice; answer 5 questions selecting 1 question from set, each question carry 2.5 mark, word limit for answer is 200 words)	**12.5**
Part C (total 5 questions, 1 questions from each unit;, each question carry 7.5 mark, word limit for answer is 500 words)	**22.5**

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 examiner (Two members one external and one internal) will conduct the examination.