FACULTY OF CHEMICAL SCIENCES

SYLLABUS

FOR

B.Sc. (Honours) CHEMISTRY
(SEMESTER: I-VI)

(Under Choice based Credit System)

Examinations: 2025 Onwards

Department of Chemistry
I K GUJRAL PUNJAB TECHNICAL UNIVERSITY
KAPURTHALA

Note:

(i) Subject to change in the syllabi at any time. Please visit the University website time to time.

IK Gujral Punjab Technical University

VISION

To be an institution of excellence in the domain of higher technical education that serves as the fountainhead for nurturing the future leaders of technology and techno- innovation responsible for the techno-economic, social, cultural and environmental prosperity of the people of the State of Punjab, the Nation and the World.

MISSION

To provide seamless education through the pioneering use of technology, in partnership with industry and society with a view to promote research, discovery and entrepreneurship and

To prepare its students to be responsible citizens of the world and the leaders of technology and techno-innovation of the 21st Century by developing in them the desirable knowledge, skill and attitudes base for the world of work and by instilling in them a culture for seamlessness in all facets of life.

OBJECTIVES

- To offer globally-relevant, industry-linked, research-focused, technology- enabled seamless education at the graduate, postgraduate and research levels in various areas of engineering & technology and applied sciences keeping in mind that the manpower so spawned is excellent in quality, is relevant to the global technological needs, is motivated to give its best and is committed to the growth of the Nation;

- To foster the creation of new and relevant technologies and to transfer them to industry for effective utilization;

- To participate in the planning and solving of engineering and managerial problems of relevance to global industry and to society at large by conducting basic and applied research in the areas of technologies. To develop and conduct continuing education programmes for practicing engineers and managers with a view to update their fundamental knowledge base and problem-solving capabilities in the various areas of core competence of the University;

- To develop strong collaborative and cooperative links with private and public sector industries and government user departments through various avenues such as undertaking

of consultancy projects, conducting of collaborative applied research projects, manpower development programmes in cutting-edge areas of technology, etc;

- To develop comprehensive linkages with premier academic and research institutions within the country and abroad for mutual benefit;
- To provide leadership in laboratory planning and in the development of instructional resource material in the conventional as well as in the audio- visual, the video and computer-based modes;
- To develop programmes for faculty growth and development both for its own faculty as well as for the faculty of other engineering and technology institutions;
- To anticipate the global technological needs and to plan and prepare to cater to them;
- To interact and participate with the community/society at large with a view to inculcate in them a feel for scientific and technological thought and endeavour; and
- To actively participate in the technological development of the State of Punjab through the undertaking of community development programmes including training and education programmes catering to the needs of the unorganized sector as well as that of the economically and socially weaker sections of society.

ACADEMIC PHILOSOPHY

The philosophy of the education to be imparted at the University is to awaken the **"deepest potential"** of its students as holistic human beings by nurturing qualities of self-confidence, courage, integrity, maturity, versatility of mind as well as a capacity to face the challenges of tomorrow so as to enable them to serve humanity and its highest values in the best possible way.

Department of Chemistry

VISION

The Chemical Sciences at IKGPTU campus will address the challenging and important questions in the physical and life sciences of current era using its multi-disciplinary vision, its culture of synergistic collaboration and translational science, and its excellence in the physical, medical and engineering sciences. Chemical Sciences Department continues to explore the new fields and frontiers and, with them, fundamentally new and innovative ways to address the increasingly complex scientific, health, energy and environmental problems of our time.

MISSION

- Inspiring and educating undergraduate students in chemistry and molecular-driven sciences in the core concepts of chemistry and the scientific methodology.

- To explore the new frontier area of organometallic catalysis in synthetic chemistry.

- Developing more-economic and greener strategies for chemical synthesis and production

- Understanding how molecules and materials behave, interact and transform at macroscopic, molecular, atomic and electronic levels, and exploring the contribution of geometric and electronic structure to function.

- Informing the public about the excitement of science, its impact on everyday life, and the crucial role it plays in human health, energy and environmental stewardship

- Building centralized, state-of-the-science facilities designed to promote collaborative synergies among faculty, staff and students and across disciplinary boundaries.

- Sharing the excitement of new chemical knowledge across IKGPTU and to other institutions, educators, and the global community through scientific communications and outreach.

TITLE OF THE PROGRAM: B.Sc. (Honours) CHEMISTRY

YEAR OF IMPLIMENTATION: New Syllabus will be implemented from June 2019 onwards.

DURATION: The course shall be three years, with semester system (6 semesters, with two semesters in a year). The Choice based credit system will be applicable to all the semesters.

ELGIBILITY FOR ADMISSION: Candidates with 50% marks (5% relaxation for SC/ST) in aggregate in 10+2 in any science subject or any other examination recognized equivalent thereto.

INTAKE CAPACITY: 45 (Forty five)

MEDIUM OF INSTRUCTION: English.

PROGRAM EDUCATIONAL OBJECTIVES:
The Program Educational Objectives (PEOs) of the B.Sc. (Honours) Chemistry Program indicate expectations from our graduates a few years after graduation

PEO1	Apply scientific knowledge of chemical sciences and its allied sciences and maturity of experience to lead in the solution of complex problems in chemical Sciences
PEO2	Become a technically qualified chemist to address complex problems and be able to apply learned skills in chemical world.
PEO3	Maintain and enhance professional competence by acquiring new knowledge and refining skills
PEO4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PEO5	Apply reasoning using scientific knowledge to assess health, safety, legal and cultural issues of society.
PEO6	Fulfill the needs of society in solving technical problems using chemistry techniques, principles, tools and practices, in an ethical and responsible manner.

PROGRAM OUTCOMES: At the end of the program, the student will be able to:

PO1	Describe and apply the basic principles of chemistry and to carry out practical techniques important in chemical analysis.
PO2	Create and evaluate hypotheses, theories, methods and evidence within their proper contexts. Solve complex problems by critical understanding, analysis and synthesis
PO3	Develop proficiency in the analysis of complex chemistry problems and the use of allied fields or other appropriate techniques to solve them.

PO4	Be familiarised with the emerging areas of Chemistry and their applications in various spheres of Chemical sciences and to apprise the students of its relevance in future studies.
PO5	Engage in lifelong learning and adapt to changing professional and societal needs.
PO6	Communicate effectively scientific information both in written and oral formats.

PROGRAM SPECIFIC OUTCOMES:

At the end of the program,

PSO1	Students will have an ability to identify, formulate, and solve complex chemical problems by applying principles of chemistry, science, and mathematics
PSO2	The students will acquire in-depth knowledge to understand the role of chemistry in society and critically interpret the chemical literature.
PSO3	Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to problems related to chemical sciences.
PSO4	Students will be able to address social, economic, and environmental issues.
PSO5	Students will be able to learn and analyze the various principles using various scientific experiments.
PSO6	Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
PSO7	Students will have an ability to communicate effectively with a range of audiences in writing and orally.

SCHEME OF THE PROGRAM:

Semester-I								

<table>
<tr><td colspan="9" align="center">Semester-I</td></tr>
<tr><td>Sr. No</td><td>Code</td><td>Theory Papers</td><td>Hours</td><td>L-T-P</td><td>Credits</td><td colspan="2">Marks Distribution</td><td>Marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Internal</td><td>External</td><td></td></tr>
<tr><td>1.</td><td>BHCL101-19</td><td>Inorganic Chemistry-I</td><td>45</td><td>3-1-0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>2.</td><td>BHCL102-19</td><td>Organic Chemistry-I</td><td>45</td><td>3-1-0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>3.</td><td>UC-BSHP-112-19
Or
UGSEC2501</td><td>Electricity and Magnetism

Or
Computer I
(Problem Solving Techniques)</td><td>45</td><td>3-1-0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>4.</td><td>UC-BSHM-104-19</td><td>Calculus-I</td><td>45</td><td>3-1-0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>5.</td><td>BHHL105-19</td><td>Communicative English-I</td><td>30</td><td>2-0-0</td><td>2</td><td>20</td><td>30</td><td>50</td></tr>
<tr><td>6.</td><td>BHHL106A-19

BHHL106B-19</td><td>Punjabi Compulsory-I
OR
Mudhli Punjabi-I</td><td>30</td><td>2-0-0</td><td>2</td><td>20</td><td>30</td><td>50</td></tr>
<tr><td>7.</td><td>BHCP107-19</td><td>Inorganic Chemistry Lab-I</td><td>40</td><td>0-0-4</td><td>2</td><td>30</td><td>20</td><td>50</td></tr>
<tr><td>8.</td><td>BHCP108-19</td><td>Organic Chemistry Lab-I</td><td>40</td><td>0-0-4</td><td>2</td><td>30</td><td>20</td><td>50</td></tr>
<tr><td>9</td><td>UC-BSHP-113-19
Or
UGSEC2502</td><td>Physics Lab-I

Or
Computer Lab I
(Problem Solving Techniques Laboratory)</td><td>40</td><td>0-0-4</td><td>2</td><td>30</td><td>20</td><td>50</td></tr>
<tr><td></td><td></td><td>Total</td><td></td><td>16-4-12</td><td>26</td><td></td><td></td><td>650</td></tr>
</table>

Semester-II

Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
						Internal	External	
1.	BHCL111-19	Inorganic Chemistry-II	45	3-1-0	4	40	60	100
2.	BHCL112-19	Physical Chemistry-I	45	3-1-0	4	40	60	100
3.	UC-BSHP-124-19 Or UGCA1909	Waves and Vibrations Or Computer II (Object Oriented Programming using C++)	45	3-1-0	4	40	60	100
4.	UC-BSHM-204-19	Vector Algebra & Vector Analysis	45	3-1-0	4	40	60	100
5.	BHHL115-19	Communicative English-II	30	2-0-0	2	20	30	50
6.	BHHL116A-19 BHHL116B-19	Punjabi Compulsory-II OR Mudhli Punjabi-II	30	2-0-0	2	20	30	50
7.	BHCP117-19	Inorganic Chemistry Lab-II	40	0-0-4	2	30	20	50
8.	BHCP118-19	Physical Chemistry Lab-I	40	0-0-4	2	30	20	50
9	UC-BSHP-125--19 Or UGCA 1910	Physics Lab-II Or Computer Lab II (Object Oriented Programming using C++ Laboratory)	40	0-0-4	2	30	20	50
		Total		16-4-10	26			650

Semester-III

Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
						Internal	External	
1.	BHCL201-19	Organic Chemistry-II (Chemistry of Functional Groups-II)	45	3-1-0	4	40	60	100
2.	BHCL202-19	Physical Chemistry-II (Chemical Thermodynamics)	45	3-1-0	4	40	60	100
3.	BHCL203-19	Spectroscopy	45	3-1-0	4	40	60	100
4.	UC-BSHP-214-19 **Or** UGSEC2507	Physics-III (Elements of Modern Physics) **Or** Computer III (Python Programming)	45	3-1-0	4	40	60	100
5.	BHCL205-19	Environmental Science	30	2-0-0	2	20	30	50
6.	BHCP206-19	Organic Chemistry Lab-II (Functional group Transformations and their Identifications)	40	0-0-4	2	30	20	50
7.	BHCP207-19	Physical Chemistry Lab-II	40	0-0-4	2	30	20	50
8.	UC-BSHP-215-19 **Or** UGSEC2508	Physics Lab-III **Or** Computer Lab III (Python Programming Laboratory	40	0-0-4	2	30	20	50
		Total		14-4-12	**24**			**600**

Semester-IV

Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
						Internal	External	
1.	BHCL211-19	Inorganic Chemistry-III (Crystal field theory and transition elements)	45	3-1-0	4	40	60	100
2.	BHCL212-19	Physical Chemistry-III (Phase Equilibria and Chemical Kinetics)	45	3-1-0	4	40	60	100
3.	BHCL2XX-19	Discipline Specific Elective -I	45	3-1-0	4	40	60	100
4.	UC-BSHM-408-19	Maths-III	45	3-1-0	4	40	60	100
5.	BHCL216-19	Basic Analytical Chemistry	30	2-0-0	2	20	30	50
6.	BHCP217-19	Inorganic Chemistry Lab-III	40	0-0-4	2	30	20	50
7.	BHCP218-19	Physical Chemistry Lab-III	40	0-0-4	2	30	20	50
8.	BHCP219-19	Basic Analytical Chemistry Lab	40	0-0-2	2	30	20	50
		Total		**14-4-10**	**24**			**600**

Discipline Specific Elective-I								
Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
						Internal	External	
1	BHCL213-19	Green Chemistry	45	3-1-0	4	40	60	100
2	BHCL214-19	Polymer Chemistry	45	3-1-0	4	40	60	100
3	UGCC2521	Computer IV (Artificial Intelligence)	45	3-1-0	4	40	60	100

Semester-V

Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
						Internal	External	
1.	BHCL301-19	Inorganic Chemistry-IV (Organometallic Chemistry)	45	3-1-0	4	40	60	100
2.	BHCL302-19	Organic Chemistry-III (Heterocyclic Chemistry)	45	3-1-0	4	40	60	100
3.	BHCL303-19	Quantum Chemistry	45	3-1-0	4	40	60	100
4.	BHCL3XX-19	Discipline Specific Elective-II	45	3-1-0	4	40	60	100
5.	BHCL306-19	Ligand Field Theory	45	3-1-0	4	40	60	100
6.	BHCP307-19	Inorganic Chemistry Lab-IV	40	0-0-4	2	30	20	50
7.	BHCP308-19	Organic Chemistry Lab-III	40	0-0-4	2	30	20	50
		Total		**15-5-8**	**24**			**600**

		Discipline Specific Elective-II						
Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
						Internal	External	
1	BHCL304-19	Analytical Clinical Biochemistry	45	3-1-0	4	40	60	100
2	BHCL305-19	Industrial Chemicals and Environment	45	3-1-0	4	40	60	100
3		**Computer V**	45	3-1-0	4	40	60	100

Semester-VI

Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
						Internal	External	
1.	BHCL311-19	Organic Chemistry-IV (Natural Products and Biochemistry)	45	3-1-0	4	40	60	100
2.	BHCL312-19	Physical Chemistry-IV (Electrochemistry)	45	3-1-0	4	40	60	100
3.	BHCL3XX-19	Discipline Specific Elective-III	45	3-1-0	4	40	60	100
4.	BHCL3XX-19	Discipline Specific Elective-IV	45	3-1-0	4	40	60	100
5.	BHCP318-19	Organic Chemistry Lab-IV	40	0-0-4	2	30	20	50
6.	BHCP319-19	Physical Chemistry Lab-IV	40	0-0-4	2	30	20	50
		Total		**12-4-8**	**20**			**500**

Discipline Specific Elective-III & IV								
Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Distribution		Marks
						Internal	External	
1	BHCL313-19	Catalysis	45	3-1-0	4	40	60	100
2	BHCL314-19	Analytical Methods in Chemistry	45	3-1-0	4	40	60	100
3	BHCL315-19	Nanochemistry	45	3-1-0	4	40	60	100
4	BHCL316-19	**Computer VI** (Molecular Modelling and Drug Design)	45	3-1-0	4	40	60	100

EXAMINATION AND EVALUATION

			Weightage in Marks		Remarks
THEORY					
S.No.					
1	Internal Evaluation	Mid-Semester Examination	30	10	MSTs, Quizzes, assignments, attendance, etc. Constitute internal evaluation. Best of two mid-semester exams will be considered for evaluation
2		Attendance	5	5	
3		Assignments	5	5	
4	External Evaluation	End-Semester Examination	60	30	Conduct and checking of the answer sheets will be at the university level.
	Total		**100**	**50**	
PRACTICAL					
1	Internal Evaluation	Daily evaluation of practical performance/ record/ viva voce	15		
2		Attendance	5		
3		Internal Practical Examination	10		
4	External Evaluation	Final Practical Examination	20		
		Total	**50**		

PATTERN OF END-SEMESTER EXAMINATION

I.   **Part A** will be One Compulsory question consisting of short answer type questions [Q No. 1(a-h)] covering whole syllabus. There will be no choice in this question. It will be of 16 marks comprising of **8 questions of 2 marks each**.

II.   **Part B** will be comprising of eight questions [2-9]. Student will have to attempt any six questions from this part. It will be of 24 marks with **6 questions of 4 marks each**.

III. **Part C** will be comprising of two compulsory questions with internal choice in both these questions [10-11]. It will be of 20 marks with **2 questions of 10 marks each**.

SYLLABUS OF THE PROGRAM
The syllabus has been upgraded as per provision of the UGC module and demand of the academic environment. The contents of the syllabus have been duly arranged unit wise and included in such a manner so that due importance is given to requisite intellectual and laboratory skills. The application part of the respective contents has been appropriately emphasized.

SEMESTER-I

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY	
DEPARTMENT OF CHEMISTY	
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**BHCL101-19**
Subject Title:	**INORGANIC CHEMISTRY-I**
Contact Hours:	**L:3** **T:1** **P:0** **Credits:4**
Examination Duration (hours)	**3**
Objective(s):	To teach the fundamental concepts of Inorganic Chemistry and their applications.

Details of the Course (Atomic Structure and Chemical Bonding)

Unit	Contents	Contact Hours
I	**Atomic Structure:** Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.	10
II	**Periodicity of Elements:** s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-block. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.	11
III	**Chemical Bonding I:** (a) Properties of ionic substances, Occurrence of ionic bonding, The radius ratio rules, Efficiency of packing, Hexagonal close packing, Cubic close packing, Structures of different crystal lattices, Sodium chloride, Cesium chloride, Wurtzite, Zinc blende, Fluorite, Rutile, Cristobalite, Nickel arsenide, Pervoskite, Rhenium oxide, Calcium carbide, The calcite	12

		and aragonite structures. (b) Lattice energy, Born-Haber cycle, The calculations of the lattice energy on the basis of Born- Lande equation, The predictive power of thermochemical calculations on ionic compounds, Covalent character in predominantly ionic compounds, Imperfections of crystals, Conductivity in ionic solids, Band theory, Intrinsic and photoexcited semiconductors, Transistors, High temperature superconductors.	
IV	**Chemical Bonding II:** The Lewis theory, Valence bond theory - A mathematical approach, Resonance, Valence Shell Electron Pair Repulsion Model (VSEPR theory), Prediction of structures and variation of bond angles on the basis of VSEPR theory, Shortcomings of VSEPR theory, Concept of hybridization, Rules for obtaining hybrid orbitals, Extent of d-orbital participation in molecular bonding (SO_2, PCl_5, SO_3), Molecular orbital theory (LCAO method), Symmetry of molecular orbitals, Applications of MOT to homo- and hetero-nuclear diatomic molecules, Molecular orbital energy level diagrams (Be_2, N_2, O_2, F_2, LiH, NO, CO, HCl, NO_2, BeH_2, NO_2^-).	12

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	Lee, J.D.	Concise Inorganic Chemistry	ELBS, 1991.
2	Douglas, B.E. and Mc Daniel, D.H.	Concepts & Models of Inorganic Chemistry	Oxford, 1970
3	Atkins, P.W. & Paula	J. Physical Chemistry	Oxford Press, 2006
4	Day, M.C. and Selbin, J.	Theoretical Inorganic Chemistry	ACS Publications 1962

Course Outcomes and Mapping

At the end of the course, the student will be able to

CO1. Understand the fundamental concepts and postulates of various theories regarding the structure of atom

CO2. Learn the periodicity of the s & p block elements

CO3. Understand the various types of bonding present in the different inorganic compounds.

CO4. Learn about the various theories pertaining to the different types of bonding

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	2	3	3	2	3
CO2	2	1	2	3	2	3	3
CO3	1	2	2	2	3	3	2
CO4	0	2	1	3	2	2	2

	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY			
	DEPARTMENT OF CHEMISTY			
Course Name	B.Sc. (Honours) Chemistry			
Subject Code:	BHCL102-19			
Subject Title:	ORGANIC CHEMISTRY-I			
Contact Hours:	L:3	T:1	P:0	Credits:4
Examination Duration (hours)	3			
Objective(s):	1. To teach the basic principles, reaction mechanisms and stereochemistry of organic compounds. 2. To impart knowledge regarding physical properties and chemical reactions of alkanes, alkenes, dienes, alkynes, arenes, alkyl and aryl halides etc. 3. To predict and account for the most commonly encountered reaction mechanisms (substitution, addition and elimination) in organic chemistry.			

Details of the Course

Unit	Contents	Contact Hours
I	**Structure and Bonding** Hybridization, bond lengths, bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding. **Mechanism 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, Types of organic reactions, Energy considerations, Reactive intermediates (carbocations, carbanions, free radicals, carbenes, arynes and nitrenes), Assigning formal charges on intermediates and other ionic species. **Stereochemistry of Organic Compounds I** Isomerism and its types, Optical isomerism-elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeric centers, diastereomers, threo and erythro, diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.	12

II	**Stereochemistry of Organic Compounds II**	13
	Geometric isomerism-determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds, Conformational isomerism-conformational analysis of ethane and n-butane, conformational analysis of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivative, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation.	
	Alkanes	
	Introduction, IUPAC nomenclature, Isomerism and classification of carbon atoms of alkanes, Sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), Physical properties and chemical reactions of alkanes, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.	
	Cycloalkanes	
	Cycloalkanes-nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring; banana bonds	
III	**Alkenes, Cycloalkenes, Dienes and Alkynes**	10
	Alkenes Nomenclature, methods of synthesis (mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. Saytzeff rule, Hofmann elimination), physical properties and relative stabilities of alkenes. Chemical reactions of alkenes - mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikiff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.	
	Cycloalkenes Methods of formation, conformation and Chemical reactions of cycloalkenes.	
	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 addition, Diels-Alder reaction.	
	Alkynes Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration oxidation, metal-ammonia reductions, oxidation and polymerization.	
IV	**Alkyl and Aryl Halides**	10
	Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nuclephilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams.	

| | Polyhalogen compounds: chloroform, carbon tetrachloride. Methods of formation of aryl halides, nuclear and side chain reactions. The addition elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.
Arenes and Aromaticity
Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain.
Structure of benzene: Molecular formula and Kekule structure. Stability and carbon-carbonbond lengths of benzene, resonance structure, MO picture.
Aromaticity: The Huckel rule, aromatic ions, Aromatic electrophilic substitution -general pattern of mechanism, role of sigma and pi complexes. Machansim of nitration, halogenation, sulponation, mercuration and Friedel-Crafts reaction. Energy profie diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivations. Birch reduction. Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl. | |

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	R. T. Morrison and P. S. Boyd	Organic Chemistry, 5th Edition	Allyn and Bacon Inc., Boston, 1992
2	S. M. Mukerji, S. P. Singh and R. P. Kapoor	Organic Chemistry Vol. I/II	Wiley Eastern Ltd., New Delhi, 1985
3	F. A. Carey	Organic Chemistry	McGraw-Hill, Inc, 2003
4	G. Solomons	Fundamentals of Organic Chemistry	John Wiley, 2002
5	Jerry March	Organic Reaction Mechanism	John Wiley Ed. 5, 2002
6	L. G. Jr. Wade	Organic Chemistry	Prentice-Hall,1990
7	T. L. Gilchrist and C.W. Rees	Carbenes, Nitrenes and Arynes	Thomas Nelson and Sons Ltd., London

Course Outcomes and Mapping

At the end of the course, the student will be able to
CO1. Understand the fundamental concepts of organic chemistry i.e structure, bonding and various effects in organic compounds.
CO2. To learn the stereochemistry viz. optical isomerism, stereoisomerism and conformational isomerism of organic compounds.
CO3. To study the various known reactive intermediate in organic synthesis
CO4. To learn the fundamental and advanced concepts of reaction mechanisms along with the study of reaction mechanisms in various types of substitution addition and elimination reactions.
CO5. To predict the relationships between organic chemical structures and their reactivity.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	4	3	3	-	3	1	2
CO2	3	-	3	1	3	2	1
CO3	4	2	1	-	4	4	-
CO4	4	4	4	-	4	3	-
CO5	4	3	4	-	4	-	-

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY **DEPARTMENT OF CHEMISTY**			
Course Name	**B.Sc. (Honours) Chemistry**		
Subject Code:	**UC-BSHP-112-19**		
Subject Title:	**ELECTRICITY AND MAGNETISM**		
Contact Hours:	**L:3** | **T:1** | **P:0** | **Credits:4**		
Examination Duration (hours)	**3**		
Objective(s):	The objective of the course is to expose the students to the formal structure of electricity and magnetism so that they can use these as per their requirement.		

Details of the Course

Unit	Contents	Contact Hours
I	**Review of Vector Analysis:** Vector algebra, scalar and vector product; Concept of Fields; scalar and vector field; gradient, divergence and curl and their physical significance; Conservative field, Line, surface and volume integral of a vector field, Gauss-divergence theorem and Stoke's theorem.	10
II	**Electrostatics:** Electrostatic field; electric flux; Gauss's law in differential and integral form; Applications of Gauss law-Electric filed due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charge sheet; Electric potential as line integral of electric field, potential due to point charge and electric dipole; calculation of electric field from potential; Poisson's equation and Laplace's equation(Cartesian coordinate); Capacitance; capacitance of a spherical conductor and cylindrical capacitor, Energy per unit volume in electrostatic field, Dielectric medium, dielectric polarization and its types, Displacement vector, Boundary conditions.	13
III	**Magnetostatics:** Magnetic flux; magnetic flux density; Faraday's law; magnetomotive force; Biot-Savart's law and its applications-straight conductor, circular coil, divergence and curl of magnetic field; Ampere's Circuital law in differential and integral form; Magnetic vector potential; ampere's force law; magnetic vector potential; Energy stored in a magnetic field, boundary conditions on magnetic fields.	12
IV	**Maxwell's Equations and Electromagnetic Waves:** Equation of	11

	continuity for time varying fields; Inconsistency of ampere's law; concept of sinusoidal time variations (Phasor notation); Maxwell's equations in differential and integral form, physical significance; Maxwell equations in free space, static field and in Phasor notation; Difference between displacement current and conduction current; Wave equation in free space and in homogenous medium, Concept of Poynting vector; Poynting Theorem.	

Reference Books

1. David Griffiths, Introduction to Electrodynamics, Pearson Education India Learning Private Limited; 4th Edition.
2. E.C. Jordan and K.G. Balmain, Electromagnetic waves and radiating systems, Prentice Hall.
3. Kraus John D, Electromagnetics, McGraw-Hill Publisher
4. W. Saslow, Electricity, magnetism and light, Academic Press
5. A Textbook of Electricity and Magnetism, S K Sharma, Shalini Sharma, S Dinesh & Co.
6. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.

Course Outcomes and Mapping

At the end of the course, the student will be able to	
CO1	Understand and describe the different concepts of electromagnetism
CO2	To obtain the electric and magnetic fields for simple configurations under static conditions.
CO3	To analyse time varying electric and magnetic fields.
CO4	To understand Maxwell's equation in different forms and different media.
CO5	have a solid foundation in fundamentals required to solve problems and also to pursue higher studies.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	2	2	1	2
CO2	3	2	1	-	2	2	1
CO3	3	2	3	-	2	1	2
CO4	3	2	3	2	-	2	2
CO5	2	2	3	2	-	2	2

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMISTRY	
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**UC-BSHM-104-19**
Subject Title:	**CALCULUS-I**
Contact Hours:	**L:3** **T:1** **P:0** **Credits:4**
Examination Duration (hours)	**3**
Objective(s):	1. The fundamental concepts of differential and integral calculus. 2. The geometrical meaning of functions, limits, continuity, derivatives, mean value theorems. 3. Applications of derivatives and integrals. 4. Limit, Continuity, partial derivatives and their applications in finding extreme values. 5. The utility of double and triple integrals in finding area and volume bounded by surfaces.

Details of the Course

Unit	Contents
I	Functions of single variable, Simple examples of limit, continuity, differentiability, Derivative of elementary functions (t-ratios, logarithmic functions, exponential functions), Higher order derivatives, Statement of Mean value theorems and simple applications, Applications of derivative: increasing decreasing functions, extreme values of functions. **(Ref. 1)**
II	Integration as an inverse process of differentiation, Finding integrals by partial fractions, by parts, Statement of fundamental theorem of calculus, Finding definite integrals by method of substitution, Applications of definite integral in finding length of an arc, area under simple curves, area enclosed between two curves. **(Ref. 1)**
III	Introduction of Limit, continuity of functions of two variables with simple examples, partial derivatives, Total derivatives, Homogeneous functions, Statement of Euler's theorem, Simple examples of maxima-minima of functions of several variables, Lagrange's method of multipliers.
IV	Double integrals, Change of order of integration, Jacobian, Double integral in polar coordinates, Triple integrals, Simple applications in finding area and volumes.

Reference Books

1. Mathematics, A Text book for Class XII (Parts I & II), New Delhi: NCERT, 2003. **(**Unit I & II**)**
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Pub., 4th Edition, 2015.
3. James Stewart, Calculus, 5th Edition, Brooks/Cole (Thomson), 2003.

Course Outcomes and Mapping

At the end of the course, the student will be
- **CO1.** Understand the basic concepts of Differential and Integral Calculus.
- **CO2.** Visualize all concepts geometrically.
- **CO3.** Apply the knowledge of derivatives in finding extreme values of the function and definite integrals to find area under the curve.
- **CO4.** Explain the concept of Limit, Continuity, partial derivatives of functions of severable variables and their applications.
- **CO5.** Utilize the concept of multiple integrals in finding areas and volumes of different geometrical shapes.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	3	2	3	2	-
CO2	3	1	3	2	-	-	-
CO3	1	1	3	1	2	1	-
CO4	3	3	3	1	2	1	-
CO5	3	3	3	1	2	1	-

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY
DEPARTMENT OF CHEMISTRY SCIENCES

Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**BHHL105-19**
Subject Title:	**COMMUNICATIVE ENGLISH-I**
Contact Hours:	**L:2** | **T:0** | **P:0** | **Credits:2**
Examination Duration (hours)	**2**
Objective(s):	1. To help the students become proficient in LSRW-Listening, Speaking, Reading & Writing skills. 2. To help the students become the independent users of English language. 3. To develop in them vital communication skills, integral to their personal, social and professional interactions. 4. To teach them the appropriate language of professional communication.

Details of the Course

Unit	Contents	Contact Hours

I	**(A)** *The Poetic Palette* **(Orient Black Swan, Second Edition, 2016)** The following poems from this anthology are prescribed:
	     1. Pippa's Song: Robert Browning
	     2. Apparently With No Surprise: Emily Dickinson
	     3. Fool and Flea: Jeet Thayil
	 (B) *Prose Parables* **(Orient Black Swan, 2013)**
	     The following stories from the above volume are prescribed:
	         a. The Kabuliwallah : Rabindranath Tagore
	         b. The Eyes Are Not Here: Ruskin Bond
	         c. Grief: Anton Chekov
		10

II	**Vocabulary: Word Formation Processes;** Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives; Synonyms, antonyms **Grammar:** Subject-verb agreement; Noun-pronoun agreement; Misplaced modifiers; Articles; Determiners; Modals; Prepositions	06
III	**Reading and Understanding** Close Reading; Comprehension	04
IV	**Mechanics of Writing & Speaking Skills** Essay Writing (Descriptive/Narrative/Argumentative); Business letters; Précis Writing; Self Introductions; Group Discussion	10

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year

1	John Eastwood	Oxford Practice Grammar	Oxford University Press,

			2014
2	Michael Swan	Practical English Usage.	OUP. 1995.
3	F.T. Wood	Remedial English Grammar	Macmillan.2007
4	William Zinsser	On Writing Well	Harper Resource Book. 2001
5	Sanjay Kumar and Pushp Lata	Communication Skills	Oxford University Press. 2011
6	Liz Hamp-Lyons and Ben Heasly	Study Writing	Cambridge University Press. 2006.

Course Outcomes and Mapping

At the end of the course,

CO1. Students will acquire basic proficiency in reading &listening, writing and speaking skills.

CO2. Students will be able to understand spoken and written English language, particularly the language of their chosen technical field.

CO3. They will be able to converse fluently and produce on their own clear and coherent texts.

CO4. Students will become proficient in professional communication such as interviews, group discussions, office environments, important reading skills as well as writing skills

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	3	2	2	2
CO2	3	3	2	3	2	3	3
CO3	2	3	3	2	2	3	3
CO4	2	2	3	3	3	2	3
CO5	2	1	1	3	1	1	3

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY
DEPARTMENT OF CHEMICAL SCIENCES

Course Name	B.Sc. (Honours) Chemistry
Subject Code:	BHHL106A-19
Subject Title:	PUNJABI COMPULSORY-I (ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ-I)
Contact Hours:	L:2 | T:0 | P:0 | Credits:2
Examination Duration (hours)	2
Objective(s):	1. To enhance the language ability of students. 2. To enhance the ability of Learning science and developing science literacy through local language teaching with science subjects.

Details of the Course

Unit	Contents	Contact Hours
I	**ਕਵਿਤਾ ਭਾਗ:** ਭਾਈ ਵੀਰ ਸਿੰਘ: ਸਮਾਂ, ਚਸ਼ਮਾ ਪ੍ਰੋ. ਪੂਰਨ ਸਿੰਘ : ਪੰਜਾਬ ਨੂੰ ਕੂਕਾਂ ਮੈਂ, ਹੱਲ ਵਾਹੁਣ ਵਾਲੇ ਪ੍ਰੋ.ਮੋਹਨ ਸਿੰਘ : ਮਾਂ, ਕੋਈ ਆਇਆ ਸਾਡੇ ਵਿਹੜੇ, ਪਿਆਰ ਪੰਧ ਅੰਮ੍ਰਿਤਾ ਪ੍ਰੀਤਮ: ਆਖਾਂ ਵਾਰਿਸ ਸ਼ਾਹ ਨੂੰ, ਅੰਨਦਾਤਾ	8
II	**ਕਹਾਣੀ ਭਾਗ:** ਸੰਤ ਸਿੰਘ ਸੇਖੋਂ : ਪੇਮੀ ਦੇ ਨਿਆਣੇ ਸੁਜਾਨ ਸਿੰਘ : ਕੁਲਫ਼ੀ ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ : ਤੂੜੀ ਦੀ ਪੰਡ ਗੁਰਦਿਆਲ ਸਿੰਘ : ਸਾਂਝ	8
III	ਭਾਸ਼ਾ ਦਾ ਟਕਸਾਲੀ ਰੂਪ, ਭਾਸ਼ਾ ਤੇ ਉਪ-ਭਾਸ਼ਾ ਵਿਚ ਅੰਤਰ, ਪੰਜਾਬੀ ਦੀਆਂ ਉਪ-ਭਾਸ਼ਾਵਾਂ,ਪੰਜਾਬੀ ਭਾਸ਼ਾ:ਨਿਕਾਸ ਤੇ ਵਿਕਾਸ। ਭਾਸ਼ਾ ਤੇ ਲਿਪੀ, ਗੁਰਮੁਖੀ ਲਿਪੀ ਦੀਆਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ, ਗੁਰਮੁਖੀ ਲਿਪੀ: ਨਿਕਾਸ ਤੇ ਵਿਕਾਸ।	8
IV	ਸੰਖੇਪ ਰਚਨਾ (ਪ੍ਰੈਸੀ) ਪੈਰ੍ਹਾ ਰਚਨਾ ਸਰਲ ਅੰਗਰੇਜ਼ੀ ਪੈਰ੍ਹੇ ਦਾ ਪੰਜਾਬੀ ਅਨੁਵਾਦ	6

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	ਸੰਪ.ਡਾ.ਮਹਿਲ ਸਿੰਘ	ਸਾਹਿਤ ਦੇ ਰੰਗ	ਰਵੀ ਸਾਹਿਤ ਪਕਾਸ਼ਨ.
			ਅੰਮ੍ਰਿਤਸਰ,2016.

Course Outcomes and Mapping

At the end of the course, the student will be able to

CO1. Translate and transfer/broadcast the western scientific knowledge in the local language.

CO2. Translate and transfer the indigenous/traditional scientific knowledge available in local knowledge into English and other global languages.

CO3. Understand the society through Punjabi language, literature and culture.

CO4. Learning science and in developing science literacy.

CO5. Improve the internal communication.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	1	1	2	2	2
CO2	2	2	2	2	1	2	3
CO3	2	1	2	3	1	1	3
CO4	1	2	1	2	2	2	1
CO5	2	1	1	2	2	2	3

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY
DEPARTMENT OF CHEMICAL SCIENCES

Course Name	B.Sc. (Honours) Chemistry			
Subject Code:	BHHL106B-19			
Subject Title:	MUDHLI PUNJABI-I (ਮੁਢਲੀ ਪੰਜਾਬੀ)			
Contact Hours:	L:2	T:0	P:0	Credits:2
Examination Duration (hours)	2			
Objective(s):	1. To enhance the language ability of students. 2. To enhance the ability of Learning science and developing science literacy through local language teaching with science subjects.			

Details of the Course

Unit	Contents	Contact Hours
I	ਪੈਂਤੀ ਅੱਖਰੀ (ਵਰਣਮਾਲਾ), ਅੱਖਰ ਕ੍ਰਮ ਮਾਤਰਾਵਾਂ : ਮੁਢਲੀ ਜਾਣ-ਪਛਾਣ ਲਗਾਖਰ :ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ	8
II	ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ: ਮੁਢਲੀ ਜਾਣ-ਪਛਾਣ ਮੂਲ ਸ਼ਬਦ , ਅਗੇਤਰ, ਪਿਛੇਤਰ ਸਮਾਨਾਰਥਕ ਸ਼ਬਦ, ਵਿਰੋਧਾਰਥਕ ਸ਼ਬਦ ਸ਼ੁੱਧ- ਅਸ਼ੁੱਧ: ਦਿੱਤੇ ਪੈਰ੍ਹੇ ਵਿੱਚੋਂ ਅਸ਼ੁੱਧ ਸ਼ਬਦ ਨੂੰ ਸ਼ੁੱਧ ਕਰਨਾ	8
III	ਹਫਤੇ ਦੇ ਸੱਤ ਦਿਨਾਂ ਦੇ ਨਾਂ ਬਾਰ੍ਹਾਂ ਮਹੀਨਿਆਂ ਦੇ ਨਾਂ ਰੁੱਤਾਂ ਦੇ ਨਾਂ ਇਕ ਸੌ ਤੱਕ ਗਿਣਤੀ ਸ਼ਬਦਾਂ ਵਿਚ	6
IV	ਸਧਾਰਣ ਸ਼ਬਦਾਂ ਦਾ ਅੰਗਰੇਜ਼ੀ ਤੋਂ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ਸਧਾਰਣ ਸ਼ਬਦਾਂ ਦਾ ਪੰਜਾਬੀ ਤੋਂ ਅੰਗਰੇਜ਼ੀ ਅਨੁਵਾਦ	8

Course Outcomes and Mapping

At the end of the course, the student will be able to
- **CO1.** Translate and transfer/broadcast the western scientific knowledge in the local language.
- **CO2.** Translate and transfer the indigenous/traditional scientific knowledge available in local knowledge into English and other global languages.
- **CO3.** Understand the society through Punjabi language, literature and culture.
- **CO4.** Learning science and in developing science literacy.

CO5.	Improve the internal communication.						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	1	1	2	2	2
CO2	2	2	2	2	1	2	3
CO3	2	1	2	3	1	1	3
CO4	1	2	1	2	2	2	1
CO5	2	1	1	2	2	2	3

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY
DEPARTMENT OF CHEMISTRY

Course Name	B.Sc. (Honours) Chemistry			
Subject Code:	BHCP107-19			
Subject Title:	INORGANIC CHEMISTRY LAB-I			
Contact Hours:	L:0	T:0	P:4	Credits:2
Examination Duration (hours)	3			
Objective(s):	The objective of this course is to provide practical knowledge and illustrative experiments about various types of inorganic titrations and preparation of simple inorganic compounds.			

Details of the Course

Unit	Contents
I	**(A) Titrimetric Analysis** (i) Calibration and use of apparatus (ii) Preparation of solutions of different Molarity/Normality of titrants **(B) Acid-Base Titrations** (i) Estimation of carbonate and hydroxide present together in mixture. (ii) Estimation of carbonate and bicarbonate present together in a mixture. (iii) Estimation of free alkali present in different soaps/detergents **(C) Oxidation-Reduction Titrimetry** (i) Estimation of Fe (II) and oxalic acid using standardized $KMnO_4$ solution. (ii) Estimation of oxalic acid and sodium oxalate in a given mixture. (iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator. **(D) Iodo / Iodimetric Titrations** (i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically). (ii) Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically (iii) Estimation of available chlorine in bleaching powder iodometrically. **(E) Inorganic preparations** (i) Cuprous Chloride, Cu_2Cl_2 (ii) Preparation of Manganese (III) phosphate, $MnPO_4.H_2O$ (iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	Vogel, A.I.	A Textbook of Quantitative Inorganic Analysis	ELBS

Course Outcomes and Mapping

At the end of the course, the student will be able to
  CO1. Understand to calibrate and run the instruments for analysis.
  CO2. Learn to the quantitative analysis of various metal ions/cations and anions.
  CO3. Understand the various principles of different techniques involved in the quantitative analysis.
  CO4. Learn to prepare various inorganic compounds.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	2	3	3	2	2
CO2	2	1	2	2	1	2	3
CO3	1	2	2	2	2	3	2
CO4	2	2	1	2	3	2	1
CO5	1	1	2	2	1	1	3

	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMISTRY
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**BHCP108-19**
Subject Title:	**ORGANIC CHEMISTRY LAB-I**
Contact Hours:	**L:0** **T:0** **P:4** **Credits:2**
Examination Duration (hours)	**3**
Objective(s):	The objective of this course is to provide practical knowledge and illustrative experiments regarding qualitative analysis, isolation, and purification of organic compounds.

Details of the Course

Unit	Contents
I	**Determination of melting point** Napthalene 80-82º, Benzoic acid 121.5-122º, Urea 132.5-133º, Succinic acid 184.5-185º, Cinnamic acid 132.5-133º, Salicylic acid 157.5-158º, Acetanilide 113.5-114º, m-Dinitrobenzene 90º, p-Dichlorobenzene 52º, Aspirin 135º **Determination of boiling point** Ethanol 78º, Cyclohexane 81.4º, Toluene 110.6º, Benzene 80º
II	**Distillation** Simple distillation of ethanol-water mixture using water condenser Distillation of nitrobenzene and aniline using air condenser **Crystallization** Concept of induction of crystallization Phthalic acid from hot water (using fluted filter paper and stemless funnel) Acetanilide from boiling water Napthalene from ethanol Benzoic acid from water
III	**Qualitative Analysis** *Elemental analysis* nitrogen, sulphur, chlorine, bromine, iodine *Functional groups* -phenols, carboxylic acids -carbonyl compounds - ketones, aldehydes -carbohydrates -aromatic amines -amides, ureas and anilides -aromatic hydrocarbons and their halo- derivatives

Reference Books

S.No.	Author(s)	Title of the Book	Publisher
1	Brian S. Furniss, Antony J. Hannaford, Peter W.G. Smith and Austin R. Tatchell	Vogel's Textbook of Practical Organic Chemistry, 5th Edition	Longman, London
2	F.G. Mann and B. C. Saunders	Practical Organic Chemistry	Longman, New York
3	J.T. Sharp	Practical Organic Chemistry: A student handbook of techniques	Springer
4	Philippa B. Cranwell, Laurence M. Harwood and Cristopher J. Moody	Experimental Organic Chemistry, 3rd Edition	Wiley

Course Outcomes and Mapping

At the end of the course, the students will be able
- **CO1.** To check the purity of organic compounds by determining the melting or boiling points
- **CO2.** To develop preparative skills for purification of organic compounds by crystallization method.
- **CO3.** To determine the element or functional groups present in organic compound by organic qualitative analysis.
- **CO4.** To present their work with practical skills and the awareness of health and safety procedures.
- **CO5.** To apply related experiments for their research work

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	-	2	-	3	1	-
CO2	2	-	3	-	3	3	-
CO3	3	3	4	-	3	3	-
CO4	3	4	3	4	4	5	4
CO5	2	3	4	2	4	4	4

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMISTRY	
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**UC-BSHP-113-19**
Subject Title:	**PHYSICS LAB -I**
Contact Hours:	**L:0 | T:0 | P:4 | Credits:2**
Examination Duration (hours)	**3**
Objective(s):	The aim and objective of the lab course is to introduce the students to the formal structure of electromagnetism and phenomenon of wave optics so that they can use these as per their requirement.

Details of the Course:

Note: Students are expected to perform about 8-10 experiments from the following list, selecting minimum of 6-7 from the Physical Lab and 2-3 from the Virtual lab.

List of experiments:
1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the laser beam characteristics like; wave length, aperture, spot size, etc. using diffraction grating.
3. To study the diffraction using laser beam and thus to determine the grating element.
4. To study wavelength and laser interference using Michelson's Interferometer.
5. To find the refractive index of a material/glass using spectrometer.
6. To find the refractive index of a liquid using spectrometer.
7. To determine the resolving power of a prism.
8. To study the magnetic field of a circular coil carrying current using a Steward and Gees Tangent Galvanometer.
9. Determine the radius of circular coil using the Circular coil.
10. To study B-H curve using CRO.
11. To find out polarizability of a dielectric substance.
12. To find out the horizontal component of earth's magnetic field (Bh).

Reference Books

1. A Text -book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University
4. Press.Practical Physics, C L Arora. S. Chand & Company Ltd.
5. http://www.vlab.co.in

Course Outcomes and Mapping

Course Outcomes: At the end of the course, the student will be able to	
CO1	Able to verify the theoretical concepts/laws learnt in theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Document a technical report which communicates scientific information in a clear and concise manner.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	2	2	1	2
CO2	3	3	1	-	2	2	1
CO3	3	3	2	-	2	1	2
CO4	3	2	2	2	-	2	2
CO5	2	2	2	2	-	2	2

Computer I-Problem Solving Techniques

UGSEC2501	Problem Solving Techniques	3L:1T:0P	4 Credits

Course Objectives
 CO1: Express the logical flow used in Programming.
CO2: Design algorithms for solving various real life problems
CO3: Implement programs using C.
CO4: Choose the right data type and statements for programs.
CO5: Explain various concepts of C programming language.

Prerequisite: This is an introductory programming course and hence no prerequisites

Course Content:

UNIT I: (CO-1, CO-2)

Logic Development: Data Representation, Flowcharts, Problem Analysis, Decision Trees/Tables, Pseudo code and algorithms. Fundamentals: Character set, Identifiers and Key Words, Data types, Constants, Variables, Expressions, Statements, Symbolic Constants. [CO1]

Operations and Expressions: Arithmetic operators, Unary operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions. [CO2]

UNIT II: (CO-2, CO-3, CO-4)

Data Input and Output: formatted & unformatted input output.
Control Statements: While, Do–while and For statements, Nested loops, If–else, Switch, Break – Continue statements.

UNIT III: (CO-2, CO-3, CO-4)

Functions: Brief overview, defining, accessing functions, passing arguments to function, specifying argument data types, function prototypes, recursion. [CO4]
Arrays: Defining, processing arrays, passing arrays to a function, multi–dimensional arrays.

Strings: String declaration, string functions and string manipulation Program Structure Storage Class: Automatic, external and static variables. [CO3]

UNIT IV: (CO-2, CO-3, CO-4, CO-5)

Structures & Unions: Defining and processing a structure, user defined data types, structures and pointers, passing structures to functions, unions.

Pointers: Understanding Pointers, Accessing the Address of a Variable, Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Pointers and Arrays

File Handling: File Operations, Processing a Data File [CO5]

Text Books:
1.   Programming in ANSI C, E. Balagurusami, Fourth Edition, Tata McGraw Hill.
2.   Programming in C, Third Edition, Stephen G Kochan, Pearson.
3.   The C Programming Language, Kernighan & Richie, Second Edition, PHI Publication.

Reference Books:
1.   Object Oriented Programming, Lafore R, Third Edition, Galgotia Publications
2.   Let us C, Yashvant P Kanetkar, Seventh Edition, BPB Publications, New Delhi.
3.   Programming in C, Byron S. Gottfried, Second Edition, McGraw Hills.
4.   Problem Solving and Programming in C, R.S. Salaria, Second Edition
5.   Programming in C, Atul Kahate.

Computer Lab I-Problem Solving Techniques Laboratory

UGSEC2502	Problem Solving Techniques Laboratory	0L:0T:4P	2 Credits

Course Outcomes: After studying this course, students will be able to:
CO1: Select the right statement for the program.
CO2: Experiment with different input values.
CO3: Test the output with boundary conditions.
CO4: Distinguish between various control statements and data types.
CO5: Implement programs for various problems.

Instructions: Instructor can increase/decrease the experiments as per the requirement.
Assignments:
1. WRITE A PROGRAM to display your name. Write another program to print message with inputted name.
2. WRITE A PROGRAM to add two numbers.
3. WRITE A PROGRAM to find the square of a given number.
4. WRITE A PROGRAM to calculate the average of three real numbers.
5. Write a program to Find ASCII Value of a Character
6. WRITE A PROGRAM to Find the Size of int, float, double and char

7. WRITE A PROGRAM to Compute Quotient and Remainder
8. WRITE A PROGRAM to accept the values of two variables.
9. WRITE A PROGRAM to find the simple interest, inputs are amount, period in years and rate of interest.
10. Basic salary of an employee is input through the keyboard. The DA is 25% of the basic salary while the HRA is 15% of the basic salary. Provident Fund is deducted at the rate of 10% of the gross salary(BS+DA+HRA). WRITE A PROGRAM to calculate the net salary
11. WRITE A PROGRAM to find area of a circle using PI as constant
12. WRITE A PROGRAM to find volume of a cube using side as input from user
13. WRITE A PROGRAM using various unformatted Input Functions
14. WRITE A PROGRAM to find area of rectangle and print the result using unformatted output Functions

15. WRITE A PROGRAM to find the larger of two numbers.
16. WRITE A PROGRAM to find greater of three numbers using Nested If.
17. WRITE A PROGRAM to find whether the given number is even or odd.
18. WRITE A PROGRAM to Generate Multiplication Table Using for loop
19. WRITE A PROGRAM to Generate Multiplication Table Using while loop
20. WRITE A PROGRAM to Make a Simple Calculator Using switch...case
21. WRITE A PROGRAM to find whether the given number is a prime number.
22. WRITE A PROGRAM using function to find the largest of three numbers
23. WRITE A PROGRAM using function to print first 20 numbers and its squares.
24. WRITE A PROGRAM to find the factorial of a given number.
25. WRITE A PROGRAM to print the sum of two matrices
26. WRITE A PROGRAM to Find the Length of a String
27. WRITE A PROGRAM to Copy String using strcpy()
28. WRITE A PROGRAM to compare a string
29. WRITE A PROGRAM to reverse a string
30. WRITE A PROGRAM to reverse a string
31. WRITE A PROGRAM to multiply two numbers using pointers.
32. WRITE A PROGRAM to display address of variable using pointers
33. WRITE A PROGRAM to show the memory occupied by Structure and Union
34. WRITE A PROGRAM to create Student I-Card using a Structure
35. WRITE A PROGRAM to read data from a file from a file
36. WRITE A PROGRAM to save Employee details in a file using File Handling

SEMESTER-II

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES				
Course Name	**B.Sc. (Honours) Chemistry**			
Subject Code:	**BHCL111-19**			
Subject Title:	**INORGANIC CHEMISTRY-II**			
Contact Hours:	**L:3**	**T:1**	**P:0**	**Credits:4**
Examination Duration (hours)	**3**			
Objective(s):	To teach the fundamental concepts of Inorganic Chemistry and their applications.			

Details of the Course

Unit	Contents	Contact Hours
I	**Chemistry of s & p block elements:** **IA-VII A and Zero Groups:** General remarks about each group, trends in electronic configuration, structure of elements, atomic and ionic, Radii, ionization potential, electron affinity, electronegativity, oxidation states, Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements, Important classes of Compounds of s and p block elements. **Alkali Metals:** Oxides, hydroxides, peroxides and super oxides, halides, halides, hydrides, solutions of metals in liquid ammonia, complexes crowns and cryptands and podands. **Alkaline Earth Metals:** Solutions of the metals in liquid ammonia, hydroxides, oxides, sulfates, hydrides, halides, carbides, structures of calcium carbide, structures of basic beryllium acetate $Be_4O(CH_3COO)_6$, beryllium oxalate complexes $Be(Oxalate)_2$. Structure of chlorophyll `a'.	11
II	**Chemistry of s & p block elements:** **Group III (Boron Group**): Oxides, halides and hydrides of group III elements, boron sesquioxide and borates structure of borates, trihalides and lower halides of boron, preparation of boron hydrides reactions and structures of boranes. **Group IV (Carbon Group):** Structure and allotropy of the elements, types and structure of carbides, oxides of carbon and silicon, types and structures of silicates, Organo-silicon compounds and the silicones, halides of IV group elements. **Group V (Nitrogen Group):** Hydrides, properties and structure of ammonia, hydrazine, hydroxylamine, trihalides and Pentahalides of V groups elements, oxides of nitrogen, structure of N_2O, NO, N_2O_3, N_2O_4 and N_2O_5, oxo acids of nitrogen and phosphorous, phosphazenes and cyclophosphazenes.	13

III	**Chemistry of s & p block elements:** **Group VI (Oxygen Group):** Structure and allotropy of the elements. Oxides of sulfur (structure of SO_2 and SO_3) oxoacids of sulfur halides of sulfur, selenium and tellurium, compounds of Sulfur and nitrogen (S_4N_4). **Group VII:** Oxides of halogens (OF_2, O_2F_2, Cl_2O, ClO_2, Cl_2O_6, BrO_2, I_2O_5) (structures), Preparation, reaction and structure interhalogen compounds. (ClF_3, BrF_3, I_2, Cl_5, IF_5, IF_7) Polyhalides, basic properties of halogens. **Zero Group (Chemistry of noble gases):** Clatharate compounds, preparation, structure and bonding of noble gas compounds ($XeF2$, $XeF4$, $XeF6$, $XeO3$, $XeO2F2$, $XeO4$).	11
IV	**Coordination Chemsitry I:** Werner's theory, nomenclature of coordination complexes, isomerism in coordination complexes, chelating agents, metal chelates and chelate effects, names and abbreviations of important ligands, polydenate ligands, polypyarzolyborates, macrocylic ligands, macrocylic effect, ketoenolates, troplonates, tripod ligands, conformation of chelate rings, stereochemistry of coordination numbers 2-12, factors determining kinetic and thermodynamic stability.	10

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	J.D. Lee	Concise Inorganic Chemistry, 4th Ed.	ELBS, 1991
2	J.E. Huheey	Inorganic Chemistry	Harper & Row
3	F.A.Cotton and G. Wilinson	Advanced Inorganic Chemistry	Wiley, VCH, 1999
4	N.N. Greenwood and A. Earnshaw	Chemistry of Elements	Butterworth Heinemann 1997
5	G. L. Miessler & A. Tarr. Donald	Inorganic Chemistry 4th Ed.,	Pearson, 2010
6	B.E. Douglas, D.H. Mc Daniel, & J.J. Alexander	Concepts & Models of Inorganic Chemistry 3rd Ed.	John Wiley Sons, N.Y. 1994.

Course Outcomes and Mapping

At the end of the course, the student will be able to							
CO1. Understand the fundamental concepts and theories of s & p block elements							
CO2. Learn about the different compounds of s & p block elements, their structure, synthesis and stability of the coordination complexes.							
CO3. Understand the structure, formation and properties of various compounds of s & p block elements.							
CO4. Learn about various ligands and their effect on the formation of coordination compounds.							
CO5. Learn about the terms and theories of the coordination compounds.							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	3	2	2	3	2
CO2	2	1	2	3	3	2	2
CO3	1	2	2	3	2	2	1

| CO4 | 1 | 2 | 2 | 3 | 2 | 2 | 1 |
| CO5 | 0 | 1 | 2 | 2 | 1 | 2 | 1 |

<table>
<tr><td colspan="5" align="center">I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY
DEPARTMENT OF CHEMICAL SCIENCES</td></tr>
<tr><td>Course Name</td><td colspan="4">B.Sc. (Honours) Chemistry</td></tr>
<tr><td>Subject Code:</td><td colspan="4">BHCL112-19</td></tr>
<tr><td>Subject Title:</td><td colspan="4">PHYSICAL CHEMISTRY-I</td></tr>
<tr><td>Contact Hours:</td><td>L:3</td><td>T:1</td><td>P:0</td><td>Credits:4</td></tr>
<tr><td>Examination Duration (hours)</td><td colspan="4">3</td></tr>
<tr><td>Objective(s):</td><td colspan="4">This course will equip students with the necessary chemical knowledge concerning the fundamentals in the basic areas of physical chemistry viz. different states of matter and ionic equilibrium. The problem solving skills of students are expected to be enhanced through due weightage given to numerical problems in each unit.</td></tr>
</table>

Details of the Course

Unit	Contents	Contact Hours
I	**Gaseous state** Kinetic molecular theory of gases: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behavior. van der Waals equation of state, its derivation and application in explaining real gas behaviour, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states, Numericals.	12
II	**Liquid state:** Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.	10
III	**Solid State** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl,	11

	CsCl and KCl. Defects in crystals. Glasses and liquid crystals.	
IV	**Ionic equilibria** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid– base indicators; selection of indicators and their limitations.	12

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	P.W. Atkins & J. de Paula	Atkin's Physical Chemistry	Oxford University Press (2006)
2	S.H. Maron & C.F. Prutton	Principles of Physical Chemistry, 1st edition	Oxford and IBH (1958)
3	G.W. Castellan	Physical Chemistry, 4th edition	Narosa (2004)
4	D. W. Ball	Physical Chemistry	Thomson Press, India (2007)

Course Outcomes and Mapping

At the end of the course, the student will be able to
CO1. Understand the basic principles and theories pertaining to various states of matter
CO2. Solve various problems related to real gases and pH concept**.**
CO3. Define the various types of crystal systems and defects in solids**.**
CO4. Familiarise with the concept of acids and bases and differentiate between them
CO5. Rationalise bulk properties and processes governing gaseous, liquid and solid states**.**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	-	2	1	1
CO2	3	2	3	-	1	-	1
CO3	2	2	1	-	2	1	1
CO4	3	2	2	-	2	1	1
CO5	3	2	2	-	1	-	1

I.K. Gujral Punjab Technical University, Kapurthala

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES	
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**UC-BSHP-124-19**
Subject Title:	**WAVES AND VIBRATIONS**
Contact Hours:	**L:3** | **T:1** | **P:0** | **Credits:4**
Examination Duration (hours)	**3**
Objective(s):	The objective of the course is to develop basic understanding of Interference, Diffraction and Polarization among students. The Students also learn about the LASER and its applications. Students will be equipped with knowledge to measure wavelength, refractive index and other related parameters, which will act as a strong background if he/she chooses to pursue sciences as a career.

Details of the Course

Unit	Contents	Contact Hours
I	**Interference:** Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle, Temporal and Spatial Coherence, Division of amplitude and wavefront, Young's double slit experiment, Lloyd's single mirror and Fresnel's Biprism, Interference in Thin Films, Newton's Rings and Michelson Interferometer.	11
II	**Diffraction and Polarization:** Huygens Principle, Huygens-Fresnel Diffraction theory, Fraunhofer diffraction: Single slit. Circular aperture, Rayleigh criterion of resolution, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating; Polarization, Plane polarized light, Representation of Unpolarized and Polarized light, Polarization by Reflection, Brewster's law, Malus Law, Polarization by Selective absorption by Crystals, Polarization by Scattering, Polarization by Double Refraction.	11
III	**Simple Harmonic Motion:** Simple harmonic motion, Energy of a SHO, Simple, Compound and Torsional pendulum, Electrical Oscillations, damped oscillations, damped harmonic oscillator – heavy, critical, and light damping, Damping coefficients, energy decay in a damped harmonic oscillator, quality factor, forced mechanical oscillators, resonance.	12
IV	**Laser and Application:** Lasers, Spontaneous emission, Stimulated absorption, Stimulated emission, Einstein coefficients, Conditions for Laser actions, Population inversion, Different types of Laser, Pumping mechanism: Optical Pumping, Electric Discharge and Electrical pumping, Resonators, Two, Three, and Four level laser systems, Ruby laser, He-Ne gas Laser, Semiconductor laser, CO_2 laser, applications of laser: Holography, Principle of Holography.	11

Reference Books

1. Optics: A.K. Ghatak (Tata-McGraw Hill), 1992.
2. Fundamentals of Optics: F.A. Jenkins and H.E. White (McGraw Hill), 1981.
3. A Text Book of Optics: Subrahmaniyam N. & et al.(S. Chand Publishing) (2006).
4. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.

Course Outcomes and Mapping

At the end of the course, the student will be							
CO1	Able to understand the theoretical concepts learned in the theory course.						
CO2	Trained in carrying out precise measurements and handling equipment.						
CO3	Learn to draw conclusions from data and develop skills in experimental design**.**						
CO4	Able to understand the principles of error analysis and develop skills in experimental design**.**						
CO5	Able to document a technical report which communicates scientific information in a clear and concise manner.						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	2	2	1	2
CO2	3	3	1	-	2	2	1
CO3	3	3	2	-	2	1	2
CO4	3	2	2	2	-	2	2
CO5	2	2	2	2	-	2	2

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY **DEPARTMENT OF CHEMICAL SCIENCES**	
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**UC-BSHM- 204-19**
Subject Title:	**VECTOR ALGEBRA & VECTOR ANALYSIS**
Contact Hours:	**L:3** | **T:1** | **P:0** | **Credits:4**
Examination Duration (hours)	**3**
Objective(s):	The objectives of this course are to make the students understand the following**:** 1. The fundamental concepts of Scalars and Vector algebra**.** 2. The geometrical meaning of projections and orthogonality**.** 3. Applications of gradient, divergence and curl**.** 4. Geometric meaning of scalar and vector valued functions, gradient of scalar point function**.** 5. The utility of Gauss, Green and Stokes Theorem**.**

Details of the Course

Unit	Contents
I	Definitions of Scalars, vectors, position vector, unit vector, types of vectors, Addition of vectors, direction ratios, direction cosines, multiplication by a scalar, dot product, cross product of vectors, projection of vectors on a line.
II	Vector joining two points, section formula, angle between two vectors, Cauchy-Schwartz inequality, Solenoidal vectors, orthogonality, Area of triangle, area of parallelogram, Scalar and vector product of three vectors.
III	Scalar valued point functions, vector valued point functions, Derivative along a curve, directional derivatives, Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors, Gradient, divergence and curl Gradient of a scalar point function. Geometrical interpretation of gradient of a scalar point function (grad φ).
IV	Divergence and curl of a vector point function, Character of divergence and curl of a vector point function, relation between Cartesian and cylindrical or spherical coordinates, Statements of Theorems of Gauss, Green and Stokes **(**without proof**).**

Reference Books

1. Mathematics, A Text book for Class XII (Parts I & II), New Delhi: NCERT, 2003. (Unit I & II)
2. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
3. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd. 2002.
4. P.C. Matthew's, Vector Calculus, Springer Verlag London Limited, 1998.

Course Outcomes and Mapping

I.K. Gujral Punjab Technical University, Kapurthala

	At the end of the course, the students will be able to						
CO1	Understand the basic concepts of Scalars and Vector algebra.						
CO2	Visualize all concepts geometrically.						
CO3	Apply the knowledge of dot product and cross product in finding projections, area and orthogonality.						
CO4	Utilize the concept of scalar and vector valued functions, gradient of scalar point function, divergence and curl of vector point functions, their geometrical interpretation.						
CO5	Acquire the knowledge of the concept of relation between cartesian, cylindrical and spherical polar coordinates, Gauss, Green and Stokes Theorem.						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	-	3	2	3	2	-
CO2	3	1	3	2	-	-	-
CO3	1	1	3	1	2	1	-
CO4	3	3	3	1	2	1	-
CO5	3	3	3	1	2	1	-

	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES			
Course Name	**B.Sc. (Honours) Chemistry**			
Subject Code:	**BHHL115-19**			
Subject Title:	**COMMUNICATIVE ENGLISH-II**			
Contact Hours:	**L:2**	**T:0**	**P:0**	**Credits:2**
Examination Duration (hours)	**2**			
Objective(s):	1. To help the students become proficient in LSRW-Listening, Speaking, Reading & Writing skills 2. To develop in them vital communication skills, integral to their personal, social and professional interactions 3. To teach them the appropriate language of professional communication. 4. To help the students become the independent users of English language.			

Details of the Course

Unit	Contents	Contact Hours
I	**(Literature)** **(A)** *The Poetic Palette* **(Orient BlackSwan, Second Edition, 2016)** The following poems from this anthology are prescribed: 4. The Soul's Prayer: Sarojini Naidu 5. I Sit and Look Out: Walt Whitman 6. Women's Rights: Annie Louise Walker **(B)** *Prose Parables* **(Orient Black Swan, 2013)** The following stories from the above volume are prescribed: a. The Doctor's Word: R.K. Narayan b. The Doll's House: Katherine Mansfield c. Dusk: H.H. Munroe (Saki)	10
II	**Vocabulary:** Standard abbreviations; One word substitution; Word Pairs (Homophones/Homonyms) **Grammar:** Sentence Structures; Use of phrases and clauses in sentences; Transformation of Sentences; Importance of proper punctuation	06
III	**Reading and Understanding:** Summary Paraphrasing; Analysis and Interpretation; Translation (from Hindi/Punjabi to English and vice-versa) Close Reading; Comprehension;	04

IV	**Mechanics of Writing & Speaking Skills:** Report writing; Career Documents- Job applications, Resume/CV writing, Common Everyday Situations: Conversations & Dialogues, Formal Presentations	10

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	John Eastwood	Oxford Practice Grammar	Oxford University Press,2014
2	Michael Swan.	Practical English Usage.	OUP. 1995.
3	F.T. Wood	Remedial English Grammar	Macmillan.2007
4	William Zinsser	On Writing Well	Harper Resource Book. 2001
5	Sanjay Kumar and Pushp Lata.	Communication Skills	Oxford University Press. 2011
6	Liz Hamp-Lyons and Ben Heasly	Study Writing	Cambridge University Press. 2006.

Course Outcomes and Mapping

At the end of the course,
   CO1. Students will acquire basic proficiency in LSRW skills- listening, speaking, reading, and writing.
   CO2. To develop their vocabulary so that they can understand spoken and written English language, particularly the language of their chosen technical field
   CO3. To introduce students to the skills and strategies of reading and writing by identifying organizational patterns, spotting classification systems and understanding associations between ideas through study of literary texts.
   CO4. They will be able to converse fluently and produce on their own clear and coherent texts.
   CO5. To improve the employability of students and make them proficient in professional communication through understanding of career documents; job interviews; group discussions; internal communication in office environments etc.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	3	2	2	2
CO2	3	2	2	3	2	3	3
CO3	2	3	3	2	2	3	3
CO4	2	2	3	3	3	2	3
CO5	2	1	1	3	1	1	3

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY				
DEPARTMENT OF CHEMICAL SCIENCES				
Course Name	**B.Sc. (Honours) Chemistry**			
Subject Code:	BHHL116A-19			
Subject Title:	PUNJABI COMPULSORY-II (ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ-II)			
Contact Hours:	L:2	T:0	P:0	Credits:2
Examination Duration (hours)	2			
Objective(s):	1. To enhance the language ability of students. 2. To enhance the ability of Learning science and developing science literacy through local language teaching with science subjects.			

Details of the Course

Unit	Contents	Contact Hours
I	ਡਾ.ਹਰਿਭਜਨ ਸਿੰਘ: ਅਪ੍ਰਮਾਣਿਕ, ਤੇਰੇ ਹਜ਼ੂਰ ਮੇਰੀ ਹਾਜ਼ਰੀ ਦੀ ਦਾਸਤਾਨ ਸ਼ਿਵ ਕੁਮਾਰ ਬਟਾਲਵੀ: ਕੰਢਿਆਲੀ ਥੋਰ੍ਹ, ਧਰਮੀ ਬਾਬਲ ਪਾਪ ਕਮਾਇਆ, ਰੁੱਖ ਪਾਸ਼: ਇਨਕਾਰ,ਸਭ ਤੋਂ ਖਤਰਨਾਕ,ਦਹਿਕਦੇ ਅੰਗਿਆਰਾਂ 'ਤੇ ਸੁਰਜੀਤ ਪਾਤਰ: ਹੁਣ ਘਰਾਂ ਨੂੰ ਪਰਤਣਾ, ਕੁਝ ਕਿਹਾ ਤਾਂ..., ਪੁਲ	8
II	**ਕਹਾਣੀ ਭਾਗ:** ਸੰਤੋਖ ਸਿੰਘ ਧੀਰ: ਕੋਈ ਇਕ ਸਵਾਰ ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼: ਲੱਛਮੀ ਮੋਹਨ ਭੰਡਾਰੀ : ਘੋਟਣਾ ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ : ਆਪਣਾ ਆਪਣਾ ਹਿੱਸਾ	8
III	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੀਆਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਉਪਰ ਪਏ ਪ੍ਰਭਾਵ	6
IV	ਰਿਪੋਰਟਿੰਗ, ਸਮਾਚਾਰ ਲਿਖਣ ਦੀ ਵਿਧੀ ਤੇ ਤੱਤ ਪੰਜਾਬੀ ਪੈਰ੍ਹੇ ਦਾ ਸਰਲ ਅੰਗਰੇਜ਼ੀ ਅਨੁਵਾਦ ਦਫਤਰੀ ਚਿੱਠੀ ਪੱਤਰ	8

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	ਸੰਪ.ਡਾ.ਮਹਿਲ ਸਿੰਘ	ਸਾਹਿਤ ਦੇ ਰੰਗ	ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ,2016.

Course Outcomes and Mapping

At the end of the course, the student will be able to

CO1. Translate and transfer/broadcast the western scientific knowledge in the local language.

CO2. Translate and transfer the indigenous/traditional scientific knowledge available in local knowledge into English and other global languages.

CO3. Understand the society through Punjabi language, literature and culture.

CO4. Learning science and in developing science literacy.

CO5. Improve the internal communication.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	1	1	2	2	2
CO2	2	2	2	2	1	2	3
CO3	2	1	2	3	1	1	3
CO4	1	2	1	2	2	2	1
CO5	2	1	1	2	2	2	3

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY	
DEPARTMENT OF CHEMICAL SCIENCES	
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**BHHL116B-19**
Subject Title:	**MUDHLI PUNJABI-II (ਮੁਢਲੀ ਪੰਜਾਬੀ-II)**
Contact Hours:	**L:2** | **T:0** | **P:0** | **Credits:2**
Examination Duration (hours)	2
Objective(s):	1. To enhance the language ability of students. 2. To enhance the ability of Learning science and developing science literacy through local language teaching with science subjects.

Details of the Course

Unit	Contents	Contact Hours
I	ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ : ਪਛਾਣ ਤੇ ਵਰਤੋਂ- ਨਾਂਵ ਪੜਨਾਂਵ ਵਿਸ਼ੇਸ਼ਣ ਕਿਰਿਆ ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ	8
II	ਰੋਜ਼ਾਨਾ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ: ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਰਿਸ਼ਤੇ-ਨਾਤੇ ਤੇ ਕਿੱਤਿਆਂ ਸਬੰਧੀ।	6
III	ਪੰਜਾਬੀ ਵਾਕ ਬਣਤਰ : ਸਧਾਰਨ ਵਾਕ ਸੰਯੁਕਤ ਵਾਕ ਮਿਸ਼ਰਤ ਵਾਕ	8
IV	ਸਧਾਰਨ ਵਾਕਾਂ ਦਾ ਅੰਗਰੇਜ਼ੀ ਤੋਂ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ਸਧਾਰਨ ਵਾਕਾਂ ਦਾ ਪੰਜਾਬੀ ਤੋਂ ਅੰਗਰੇਜ਼ੀ ਅਨੁਵਾਦ	8

Course Outcomes and Mapping

At the end of the course, the student will be able to
CO1. Translate and transfer/broadcast the western scientific knowledge in the local language.
CO2. Translate and transfer the indigenous/traditional scientific knowledge available in local knowledge into English and other global languages.
CO3. Understand the society through Punjabi language, literature and culture.
CO4. Learning science and in developing science literacy.
CO5. Improve the internal communication.

I.K. Gujral Punjab Technical University, Kapurthala

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	1	1	2	2	2
CO2	2	2	2	2	1	2	3
CO3	2	1	2	3	1	1	3
CO4	1	2	1	2	2	2	1
CO5	2	1	1	2	2	2	3

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY **DEPARTMENT OF CHEMICAL SCIENCES**	
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**BHCP117-19**
Subject Title:	**INORGANIC CHEMISTRY LAB-II**
Contact Hours:	**L:0** **T:0** **P:4** **Credits:2**
Examination Duration (hours)	**3**
Objective(s):	The objective of this course is to provide practical knowledge regarding salt analysis.

Details of the Course

Unit	Contents
I	Identification of cations and anions in a mixture which may contain combinations of acid ions. These must contain interferring acid anions and one, the insoluble. **(a) Special Tests for Mixture of Anions** (i) Carbonate in the presence of sulphate. (ii) Nitrate in the presence of nitrite (iii) Nitrate in the presence of bromide and iodide. (iv) Nitrate in the presence of chlorate. (v) Chloride in the presence of bromide and iodide. (vi) Chloride in the presence of bromide. (vii) Chloride in the presence of iodide. (viii) Bromide and iodide in the presence of each other and of chloride. (ix) Iodate and iodide in the presence of each other. (x) Phosphate, arsenate and arsenite in the presence of each other. (xi) Sulphide, sulphite, thiosulphate and sulphate in the presence of each other. (xii) Borate in the presence of copper and barium salts. (xiii) Oxalate in the presence of fluoride. (xiv) Oxalate, tartrate, acetate, citrate in the presence of each other. **(b) Separation and Identification of Cations in Mixtures** (i) Separation of cations in groups. (ii) Separation and identification of Group I, Group II (Group IIA and IIB), Group III, Group IV, Group V and Group VI cations. **(c) Identification of Cations Including Less Familiar Elements by Spot Tests Assisted by Group Analysis (3 cations).**

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	Vogel, A.I.	Vogel's book on Inorganic Qualitative Analysis	ELBS

Course Outcomes and Mapping

At the end of the course, the student will be able to
- **CO1.** Understand the concept of qualitative analysis.
- **CO2.** Learn to identify present cations and anions through qualitative analysis of various metal ions/cations and anions.
- **CO3.** Understand the various techniques/principles involved in the qualitative analysis of mixtures in presence or absence of interfering ions.
- **CO4.** Learn to separate and identify less familiar ions through qualitative analysis.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	2	3	2	2	1
CO2	2	2	1	1	0	2	2
CO3	1	2	0	2	2	2	3
CO4	2	3	2	2	2	3	2

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY				
DEPARTMENT OF CHEMICAL SCIENCES				
Course Name	**B.Sc.(Honours) Chemistry**			
Subject Code:	**BHCP118-19**			
Subject Title:	**PHYSICAL CHEMISTRY LAB-I**			
Contact Hours:	**L:0**	**T:0**	**P:4**	**Credits:2**
Examination Duration (hours)	**3**			
Objective(s):	To provide students practical knowledge and skills about various topics taught in theory class of physical chemistry, which in turn will enhance their problem solving and analytical skills.			

Details of the Course

Unit	Contents
I	**Surface tension measurements.** a) Determine the surface tension by (i) drop number (ii) drop weight method. b) Study the variation of surface tension of detergent solutions with concentration.
II	**Viscosity measurement using Ostwald's viscometer.** **a)** Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature. **b)** Study the variation of viscosity of sucrose solution with the concentration of solute.
III	Indexing of a given powder diffraction pattern of a cubic crystalline system**.**
IV	**pH metry** a) Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures. b) Preparation of buffer solutions of different pH; (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide c) pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base. d) Determination of dissociation constant of a weak acid.

Reference Books

S.No.	Author(s)	Title of the Book	Publisher
1	J.B. Yadav	Practical Physical Chemistry	Krishna
2	Findlay	Practical Physical Chemistry	Longman, New York

Course Outcomes and Mapping

At the end of the course, the students will be able to
- **CO1.** Understand the basic procedures for carrying out a physical chemistry practical like preparation and standardisation of solutions, handling the equipments and measuring with precision.
- **CO2.** Correlate the theoretical and practical aspects and know about the limits of the experimental error.
- **CO3.** Determine the various physical parameters for the various problems under study.
- **CO4.** Verify various laws studied in the theory part.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	1	3	-	3	2	1
CO2	2	2	3	-	3	2	2
CO3	2	3	3	-	2	1	1
CO4	2	3	3	-	3	2	1

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY **DEPARTMENT OF CHEMICAL SCIENCES**	
Course Name	**B.Sc. (Honours) Chemistry**
Subject Code:	**UC-BSHP-125-19**
Subject Title:	**PHYSICS LAB -II**
Contact Hours:	**L:4 | T:0 | P:0 | Credits:4**
Examination Duration (hours)	**3**
Objective(s):	The aim and objective of the Physics Lab course is to introduce the students of B. Sc. (Hons.) to the formal structure of wave and vibrations and mechanics so that they can use these as per their requirement.

Details of the Course:

Note: Students are expected to perform about 8-10 experiments from the following list, selecting minimum of 6-7 from the Physical Lab and 2-3 from the Virtual lab.

List of experiments:
1. Measurement of volume using travelling microscope. Use of Plumb line and Spirit level.
2. To determine the frequency of an electrically maintained tuning fork in a) Transverse mode of vibration b) Longitudinal mode of vibration.
3. To find out the frequency of AC mains using sonometer.
4. To study the characteristic of Ge-Si junction diode.
5. To analyze the suitability of a given Zener diode as a power regulator.
6. To determine the horizontal and vertical distance between two points using a Sextant.
7. To determine the height of an inaccessible object using a Sextant.
8. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g and (c) Modulus of rigidity.
9. To determine the time period of a simple pendulum for different length and acceleration due to gravity.
10. To study the variation of time period with distance between centre of suspension and centre of gravity for a compound pendulum and to determine: (i) Radius of gyration of the bar about an axis through its C.G. and perpendicular to its length. (ii) The value of g in the laboratory.
11. To find the moment of inertia of an irregular body about an axis through its C.G with the torsional pendulum.
12. To determine the angular acceleration α, torque τ, and Moment of Inertia of flywheel.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab

Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Practical Physics, C L Arora, S. Chand & Company Ltd.
7. http://www.vlab.co.in

Course Outcomes and Mapping

At the end of the course, the student will be	
CO1	Able to understand the theoretical concepts learned in the theory course.
CO2	Trained in carrying out precise measurements and handling equipment.
CO3	Learn to draw conclusions from data and develop skills in experimental design**.**
CO4	Able to understand the principles of error analysis and develop skills in experimental design**.**
CO5	Able to document a technical report which communicates scientific information in a clear and concise manner.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	3	3	2	3	3
CO2	2	2	3	2	2	3	-
CO3	2	-	3	2	2	3	1
CO4	2	2	3	1	1	2	2
CO5	2	2	2	1	2	2	-

Computer II- Object Oriented Programming using C++

UGCA1909	Object Oriented Programming using C++	3L:1T:0P	4 Credits

Course Outcomes:

CO#	Course outcomes
CO1	Outline the role of programming for solving real world problems.
CO2	Explain Object oriented approach for finding Solutions to various problems with the help of C++ language.
CO3	Implement computer based solutions to various real-world problems using C++
CO4	Select the right Object Oriented Concept for optimal solution.
CO5	Review different solutions for a common problem.

Detailed Contents	Contact hours
Unit-I **Principles of object oriented programming** Introduction to OOP and its basic features, Basic components of a C++, Program and program structure, Compiling and Executing C++ Program. Difference between Procedure Oriented Language(C) and Object Oriented Language [CO1]	12
Unit-II	10
Classes & Objects and Concept of Constructors Defining classes, Defining member functions, Declaration of objects to class, Access to member variables from objects, Different forms of member functions, Access specifiers (Private, public, protected), Array of objects. Introduction to constructors, Parameterized constructors, Copy Constructor, Multiple constructors in class, Dynamic initialization of objects, Destructors.[CO2]	

Unit-III **Inheritance and Operator overloading** Introduction to Inheritance, Types of inheritance: - Single inheritance, Multiple inheritance, Multilevel inheritance, Hierarchical inheritance, Hybrid inheritance, Defining operator overloading, Overloading of Unary and Binary operators, Rules for overloading operators [CO3]	12
Unit-IV **Polymorphism and File Handling** Early Binding, Late Binding, Virtual Functions, pure virtual functions, Abstract Classes. [CO5] Opening and Closing File, Reading and Writing a file.	10

Text Books:

1. Object Oriented Programming with C++, E. Balagurusami, Fourth Edition, Tata Mc-Graw Hill.
2. Object Oriented Programming in Turbo C++, Robert Lafore, Fourth Edition Galgotia Publications.
3. The C++ Programming Language, Bjarna Stroustrup, Third Edition, Addison-Wesley Publishing Company.
4. Object Oriented Programming Using C++, Salaria, R. S, Fourth Edition, Khanna Book Publishing.

UGCA1910	Object Oriented Programming using C++ Laboratory	0L:0T:4P	2 Credits

Course Outcomes:

CO#	Course outcomes
CO1	Design the classes.
CO2	Illustrate the concept of memory representation for objects
CO3	Implement programs using OOP concepts for various problems.
CO4	Implement file handling in C++
CO5	Select the right data types to represent class properties.

Instructions: Develop all program in C++
Assignments:

1.	Write a program to enter mark of 6 different subjects and find out the total mark (Using cin and cout statement)
2.	Write a function using reference variables as arguments to swap the values of pair of integers.
3.	Write a function to find largest of three numbers.
4.	Write a program to find the factorial of a number.
5.	Define a class to represent a bank account which includes the following members as Data members: a) Name of the depositor b) Account Number c) Withdrawal amount d) Balance amount in the account Member Functions: a) To assign initial values b)To deposit an amount c) To withdraw an amount after checking the balance d) To display name and balance.

6.	Write the above program for handling n number of account holders using array of objects.
7.	Write a C++ program to compute area of right angle triangle, equilateral triangle, isosceles triangle using function overloading concept.
8.	Consider a publishing company that markets both book and audio cassette version to its works. Create a class Publication that stores the title (a string) and price (type float) of a publication. Derive the following two classes from the above Publication class: Book which adds a page count (int) and Tape which adds a playing time in minutes(float). Each class should have get_data() function to get its data from the user at the keyboard. Write the main() function to test the Book and Tape classes by creating instances of them asking the user to fill in data with get_data() and then displaying it using put_data().
9.	Consider an example of declaring the examination result. Design three classes student, exam and result. The student has data members such as rollno, name. Create the lass exam by inheriting the student class. The exam class adds data members representing the marks scored in 5 subjects. Derive the result from exam-class and it has own data members like total, avg.
10.	Write a program for overloading of Unary ++ operator.
11.	Write a program for overloading of Binary + operator.
12.	Write a program of Virtual Functions.
13.	Write a program of Abstract Classes.
14.	Write a program to read and write from file.

Reference Books:

1. Object Oriented Programming with C++, E. Balagurusami, Fourth Edition, Tata Mc-Graw Hill.
2. Object Oriented Programming in Turbo C++, Robert Lafore, Fourth Edition Galgotia Publications.
3. The C++ Programming Language, Bjarna Stroustrup, Third Edition, Addison-Wesley Publishing Company.
4. Object Oriented Programming Using C++, Salaria, R. S, Fourth Edition, Khanna Book Publishing.