FACULTY OF CHEMICAL SCIENCES

SYLLABUS

FOR

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

(Under Choice based Credit System)

Examinations: 2019 Onwards

Department of Chemical Sciences 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 Chemical Sciences

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										
Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks D	istribution	Marks			
						Internal	External				
1.	BHCL101-19	Inorganic Chemistry-I	45	3-1-0	4	40	60	100			
2.	BHCL102-19	Organic Chemistry-I	45	3-1-0	4	40	60	100			
3.	UC-BSHP-112- 19	Electricity and Magnetism	45	3-1-0	4	40	60	100			
4.	UC-BSHM- 104-19	Maths-I (Calculus-I)	45	3-1-0	4	40	60	100			
5.	BHHL105-19	Communicative English-I	30	2-0-0	2	20	30	50			
6.	BHHL106A-19 BHHL106B-19	Punjabi Compulsory-I OR Mudhli Punjabi-I	30	2-0-0	2	20	30	50			
7.	BHCP107-19	Inorganic Chemistry Lab-I	40	0-0-4	2	30	20	50			
8.	BHCP108-19	Organic Chemistry Lab-I	40	0-0-4	2	30	20	50			
9	UC-BSHP-113- 19	Physics Lab-I	40	0-0-4	2	30	20	50			
		Total		16-4- 12	26			650			

	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	Waves and Vibrations	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	Physics Lab-II	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 D	Marks Distribution			
						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	Physics-III (Elements of Modern Physics)	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	Physics Lab-III (Elements of modern physics lab)	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 (Matrices & Ordinary differential equations)	45	3-1-0	4	40	60	100		
5.	BHCL216-19	Basic Analytical Chemistry	30	2-0-0	2	20	30	50		
6.	ВНСР217-19	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.	ВНСР219-19	Basic Analytical Chemistry Lab	40	0-0-4	2	30	20	50		
		Total		14-4- 12	24			600		

Disc	Discipline Specific Elective-I								
Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Di	stribution	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	

	Semester-V									
Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks D	Marks Distribution			
						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		

Disc	Discipline Specific Elective-II								
Sr. No	Code	Theory Papers	Hours	L-T-P	Credits	Marks Di	stribution	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	

	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		

Disc	ipline Specific Elec	tive-III & IV						
Sr. No	Code	Theory Papers	Hours	L-T-P	Credi ts	Marks Di	stribution	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	Molecular Modelling and Drug Design	45	3-1-0	4	40	60	100

EXAMINATION AND EVALUATION

THEC	DRY				
S.No.			Weightage		Remarks
			in Ma	rks	
1	Internal	Mid-Semester	30	10	MSTs, Quizzes,
	Evaluation	Examination			assignments, attendance,
2		Attendance	5	5	etc. Constitute internal evaluation. Best of two
3		Assignments	5	5	mid-semester exams will
					be considered for
					evaluation
4	External	End-Semester	60	30	Conduct and checking of
	Evaluation	Examination			the answer sheets will be at
					the university level.
	Total		100	50	
PRAC	TICAL				
1	Internal	Daily evaluation of	1	5	
	Evaluation	practical			
		performance/ record/			
		viva voce			
2		Attendance	4	5	
3		Internal Practical	1	0	
		Examination			
4	External	Final Practical	2	0]
	Evaluation	Examination			
		Total	5	0]

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						
	DE	PAR	<u>l'MEN</u>	NT OF CHEMICAL SCIENCES		
Course Name	B.Se	B.Sc. (Honours) Chemistry				
Subject Code:	BHC	BHCL101-19				
Subject Title:	INO	RGAN	IC CH	HEMISTRY-I		
Contact Hours:	L:3	T:1	P:0	Credits:4		
Examination	3	3				
Duration (hours)	Duration (hours)					
Objective(s):	To t	To teach the fundamental concepts of Inorganic Chemistry and their				
	appli	cation	IS.			

Details of the Course (Atomic Structure and Chemical Bonding)

Unit	Contents	Contact
T	Atomia Stanoturo	10
1	Robr's theory its limitations and atomic spectrum of hydrogen atom	10
	Wave mechanics: de Broglie equation Heisenberg's Uncertainty Principle	
	and its significance. Schrödinger's wave equation, significance of w and	
	w^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.	
II	Periodicity of Elements:	11
	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 waais)	
	(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.	
III	Chemical Bonding I:	12
	(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	

	 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	Concepts & Models of	Oxford, 1970
	Daniel, D.H.	Inorganic Chemistry	
3	Atkins, P.W. & Paula	J. Physical Chemistry	Oxford Press, 2006
4	Day, M.C. and Selbin,	Theoretical Inorganic	ACS Publications 1962
	J.	Chemistry	

At the end of the course, the student will be able to								
CO1.	Understa	Understand the fundamental concepts and postulates of various theories						
	regarding	g the structur	re of atom					
CO2.	Learn the	e periodicity	of the s & p	block element	nts			
CO3.	Understa	and the varie	ous types of	bonding pr	esent in the	different	inorganic	
	compour	nds.	• •				-	
CO4 .	Learn ab	out the vario	ous theories p	ertaining to	the different	types of bo	onding	
	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							
	DE	PAR'	IME	NT OF CHEMICAL SCIENCES			
Course Name	B.S	c. (H	onou	rs) Chemistry			
Subject Code:	BHO	CL102	-19				
Subject Title:	OR	ORGANIC CHEMISTRY-I					
Contact Hours:	L:3	T:1	P:0	Credits:4			
Examination	3						
Duration (hours)							
Objective(s):	1. 7	1. To teach the basic principles, reaction mechanisms and					
	S	stereochemistry of organic compounds.					
	2. 7	To im	part k	nowledge regarding physical properties and chemical			
	reactions of alkanes, alkenes, dienes, alkynes, arenes, alkyl and aryl						
	halides etc.						
	3. 7	3. To predict and account for the most commonly encountered reaction					
	r	nechai	nisms	(substitution, addition and elimination) in organic			
	c	hemis	try.				

Unit	Contents	Contact
		Hours
Ι	Structure and Bonding	12
	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.	

Π	Stereochemistry of Organic Compounds II 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.	13
	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 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. <i>Cycloalkenes</i> Methods of formation, conformation and Chemical reactions of cycloalkenes. <i>Dienes</i> 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. <i>Alkynes</i> 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.	10
IV	Alkyl and Aryl Halides 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.	10

Polyhalogen compounds: chloroform, carbon tetrachloride.	
Methods of formation of arvl 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 PHC	
A non og om d A nom of i site	
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	
Activation and deactivating substituents, orientation and orthologram	
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.	Organic Chemistry, 5 th	Allyn and Bacon Inc.,	
	S. Boyd	Edition	Boston, 1992	
2	S. M. Mukerji, S. P.	Organic Chemistry Vol. I/II	Wiley Eastern Ltd., New	
	Singh and R. P. Kapoor		Delhi, 1985	
3	F. A. Carey	Organic Chemistry	McGraw-Hill, Inc, 2003	
4	G. Solomons	Fundamentals of Organic	John Wiley, 2002	
		Chemistry		
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	Carbenes, Nitrenes and	Thomas Nelson and Sons	
	C.W. Rees	Arynes	Ltd., London	

At the end of	f 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								
		DEPARTN	MENT OF C	HEMICAL	SCIENCES			
Course Na	me	B.Sc. (Hono	ours) Chemis	try				
Subject Co	ode:	UC-BSHP-112-19						
Subject Ti	tle:	ELECTRIC	CITY AND M	IAGNETIS	M			
Contact H	ours:	L:3 T:1	P:0 Credits	:4				
Examination 3								
Duration (hours)								
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.								

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
Π	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.

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.	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY							
	DEPARTMENT OF CHEMICAL SCIENCES							
Course Name	B.S	с. (Н	onou	rs) Chemistry				
Subject Code:	UC-	BSHN	1-104	-19				
Subject Title:	CAI	CUL	US-I					
Contact Hours:	L:3	T:1	P:0	Credits:4				
Examination	3							
Duration (hours)								
Objective(s):	1. The fundamental concepts of differential and integral calculus.							
	2. 7	2. The geometrical meaning of functions, limits, continuity, derivatives,						
	r	mean value theorems.						
	3. Applications of derivatives and integrals.							
	4. Limit, Continuity, partial derivatives and their applications in finding							
	e	extrem	e valu	es.				
	5. 7	The uti	lity of	f double and triple integrals in finding area and volume				
	b	ounde	d by s	surfaces.				

Unit	Contents
Ι	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)
Π	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

- 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 CHEMICAL 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	2						
Duration (hours)							
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 professiona						
	communication.						

Unit	Contents							
		Hours						
Ι	(A) The Poetic Palette (Orient Black Swan, Second Edition,	10						
	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							
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							
III	Reading and Understanding	04						
	Close Reading; Comprehension							
IV	Mechanics of Writing & Speaking Skills	10						
	Essay Writing (Descriptive/Narrative/Argumentative); Business							
	letters; Précis Writing; Self Introductions; Group Discussion							

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.S	c. (H	onou	rs) Chemistry			
Subject Code:	BHH	IL106	A-19	· · · ·			
Subject Title:	PUN	JABI	COM	IPULSORY-I (ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ-I)			
Contact Hours:	L:2	T:0	P:0	Credits:2			
Examination	2						
Duration (hours)							
Objective(s):	1.	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					
		sub	jects.				

Unit	Contents	Contact Hours
Ι	ਕਵਿਤਾ ਭਾਗ:	8
	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	
Π	ਕਹਾਣੀ ਭਾਗ: ਸੰਤ ਸਿੰਘ ਸੇਖੋਂ : ਪੇਮੀ ਦੇ ਨਿਆਣੇ ਸੁਜਾਨ ਸਿੰਘ : ਕੁਲਫੀ 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 ਪ੍ਰਕਾਸ਼ਨ,

	ਅੰਮ੍ਰਿਤਸਰ,2016.
C	

At the end of the course, the student will be able to											
CO1.	Translate	Translate and transfer/broadcast the western scientific knowledge in the local									
	language	language.									
CO2.	Translate	e and tran	sfer the in	digenous/tra	ditional sci	entific kı	nowledge				
	available	in local kno	wledge into 2	English and o	other global l	languages.					
CO3.	Understa	nd the societ	ty through Pu	injabi langua	ge, literature	and cultur	e.				
CO4 .	Learning	science and	in developin	g science lite	eracy.						
CO5.	Improve	the internal of	communicati	on.							
	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.S	с. (Н	onou	rs) Chemistry			
Subject Code:	BHH	IL106	B-19				
Subject Title:	MU	MUDHLI PUNJABI-I (ਮੁਢਲੀ ਪੰਜਾਬੀ)					
Contact Hours:	L:2	L:2 T:0 P:0 Credits:2					
Examination	2	2					
Duration (hours)							
Objective(s):	1. To enhance the language ability of students.						
	2	2. To enhance the ability of Learning science and developing					
		scie	ence 1	iteracy through local language teaching with science			
		sub	jects.				

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

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							
Course Name		PAK		Chomistary			
Course Name	D.50	. (по	liours	/ Chemistry			
Subject Code:	BHC	CP107	-19				
Subject Title:	INO	RGA	NIC C	CHEMISTRY LAB-I			
Contact Hours:	L:0	T:0	P:4	Credits:2			
Examination	3						
Duration (hours)							
Objective(s):	The	objec	tive o	of this course is to provide practical knowledge and			
	illust	illustrative experiments about various types of inorganic titrations and					
	prepa	aration	n of si	mple inorganic compounds.			

Unit	Contents
Ι	(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
	(1) Estimation of Fe (II) and oxalic acid using standardized KMnO ₄ solution.
	(11) Estimation of oxalic acid and sodium oxalate in a given mixture.
	(11) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine,
	and ranne 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 ₂ Cl ₂
	(ii) Preparation of Manganese (III) phosphate, MnPO ₄ .H ₂ O
	(iii) Preparation of Aluminium potassium sulphate KAl(SO ₄) ₂ .12H ₂ O (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	ELBS
		Inorganic Analysis	

At the end	At the end of the course, the student will be able to									
CO1.	Understa	Understand to calibrate and run the instruments for analysis.								
CO2.	Learn to	the quantitat	ive analysis	of various me	etal ions/cation	ons and an	ions.			
CO3.	Understa	nd the varie	ous principle	es of differe	ent technique	es involve	d in the			
	quantitat	ive analysis.								
CO4.	Learn to	prepare vario	ous 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 CHEMICAL SCIENCES									
Course Name	B.Sc.	B.Sc. (Honours) Chemistry							
Subject Code:	BHCP	BHCP108-19							
Subject Title:	ORGA	ORGANIC CHEMISTRY LAB-I							
Contact Hours:	L:0	L:0 T:0 P:4 Credits:2							
Examination	3	3							
Duration (hours)									
Objective(s):	The ob	The objective of this course is to provide practical knowledge and							
	illustrat	illustrative experiments regarding qualitative analysis, isolation, and							
	purifica	ation of c	organic co	ompounds.					

Unit	Contents
Ι	 Determination of melting point Napthalene 80-82°, Benzoic acid 121.5-122°, Urea 132.5-133°, Succinic acid 184.5-185°, Cinnamic acid 132.5-133°, Salicylic acid 157.5-158°, Acetanilide 113.5-114°, m-Dinitrobenzene 90°, p-Dichlorobenzene 52°, Aspirin 135° Determination of boiling point Ethanol 78°, Cyclohexane 81.4°, Toluene 110.6°, Benzene 80°
II	DistillationSimple distillation of ethanol-water mixture using water condenserDistillation of nitrobenzene and aniline using air condenserCrystallizationConcept of induction of crystallizationPhthalic acid from hot water (using fluted filter paper and stemless funnel)Acetanilide from boiling waterNapthalene from ethanolBenzoic 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

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

At the end of the course, the students will be able										
CO1.	To chec	To check the purity of organic compounds by determining the melting or								
	boiling	points								
CO2.	To deve	lop preparat	tive skills fo	r purificatio	n of organic	compounds	by			
	crystalli	zation meth	od.							
CO3.	To deter	mine the ele	ement or fund	ctional group	os present in	organic com	pound by			
	organic	qualitative a	nalysis.							
CO4.	To prese	ent their wor	k with pract	ical skills and	d the awaren	ess of health	and safety			
	procedu	res.								
CO5.	To appl	y related exp	periments fo	r their resea	rch work					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7			
CO1	2	-	2	-	3	1	-			
CO2	2	2 - 3 - 3 -								
CO3	3	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 CHEMICAL SCIENCES							
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	3							
Duration (hours)								
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.							

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: At the end of the course, the student will be able to										
CO1		Able t	Able to verify the theoretical concepts/laws learnt in theory courses.							
CO2		Traine	ed in carrying	out precise m	easurements a	nd handling s	ensitive equ	ipment.		
CO3		Under uncer	rstand the me tainties and s	ethods used f systematic "e	for estimating rrors".	g and dealing	with expe	rimental		
CO4		Learn	to draw concl	usions from d	ata and develo	op skills in ex	perimental o	lesign.		
CO5		Docur clear a	Document a technical report which communicates scientific information in a clear and concise manner.							
	PSC)1	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		

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** L:3 | T:1 | P:0 | Credits:4 **Contact Hours:** Examination 3 **Duration (hours) Objective(s):** To teach the fundamental concepts of Inorganic Chemistry and their applications.

Details of the Course

Unit	Contents	Contact
		Hours
Ι	Chemistry of s & p block elements:	11
	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,	
	nydroxides, oxides, suffaces, nydrides, nandes, caroldes, structures of colorium carbide, structures of basic berullium costate Pe O(CH COO)	
	calcium carolide, structures of basic berymum acetate $Be_4O(CH_3COO)_6$, hervilium ovalate complexes $Be/Ovalate)$. Structure of chlorophyll a	
П	Chemistry of s & n block elements'	13
	Chemistry of s & p block chemients.	15
	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_2U_5 , oxo acids of nitrogen and phosphorous, phosphazenes and	
	cyclopnospnazenes.	

III	Chemistry of s & p block elements:	11
	 Group VI (Oxygen Group): Structure and allotropy of the elements. Oxides of sulfur (structure of SO₂ and SO₃) oxoacids of sulfur halides of sulfur, selenium and tellurium, compounds of Sulfur and nitrogen (S₄N₄). Group VII: Oxides of halogens (OF₂, O₂F₂, Cl₂O, ClO₂, Cl₂O₆, BrO₂, I₂O₅) (structures), Preparation, reaction and structure interhalogen compounds. (ClF₃, BrF₃, I₂, Cl₅, IF₅, IF₇) 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). 	
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.	Advanced Inorganic Chemistry	Wiley, VCH,	
	Wilinson		1999	
4	N.N. Greenwood and	Chemistry of Elements	Butterworth	
	A. Earnshaw		Heinemann 1997	
5	G. L. Miessler & A.	Inorganic Chemistry 4th Ed.,	Pearson, 2010	
	Tarr. Donald			
6	B.E. Douglas, D.H. Mc	Concepts & Models of Inorganic	John Wiley Sons,	
	Daniel, & J.J.	Chemistry 3rd Ed.	N.Y. 1994.	
	Alexander			

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.

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	

CO5. Learn about the terms and theories of the coordination compounds.
B.Sc (Honours) Chemistry, Choice Based Credit System, Batch 2019 and onwards

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

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES							
Course Name	Course Name B.Sc. (Honours) Chemistry						
Subject Code:	BHCL112-19						
Subject Title:	PHYSICAL CHEMISTRY-I						
Contact Hours:	L:3 T:1 P:0 Credits:4						
Examination	3						
Duration (hours)							
Objective(s):	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						

Unit	Contents	Contact Hours
Ι	Gaseous state	12
_	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 benaviour,	
	continuity of states, critical state, relation between critical constants and	
II	Liquid state'	10
	Qualitative treatment of the structure of the liquid state: physical	10
	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.	
III	Solid State	11
	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,	

	CsCl and KCl. Defects in crystals. Glasses and liquid crystals.	
IV	Ionic equilibria	12
	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.	

S.No.	Author(s)	Title of the Book	Publisher/Year
1	P.W. Atkins & J. de	Atkin's Physical Chemistry	Oxford University Press
	Paula		(2006)
2	S.H. Maron & C.F.	Principles of Physical	Oxford and IBH (1958)
	Prutton	Chemistry, 1 st edition	
3	G.W. Castellan	Physical Chemistry, 4 th	Narosa (2004)
		edition	
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.	Understa	Understand the basic principles and theories pertaining to various states of									
	matter	matter									
CO2.	Solve var	Solve various problems related to real gases and pH concept.									
CO3.	Define th	e various ty	pes of crystal	l systems and	l defects in so	olids.					
CO4 .	Familiari	se with the	concept of	acids and b	bases and di	fferentiate	between				
	them										
CO5.	Rationali	se bulk prop	perties and p	rocesses gov	erning gaseo	us, 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.	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	3						
Duration (hours)							
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.						

Unit	Contents	Contact
T		Hours
	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	11
	slit experiment, Lloyd's single mirror and Fresnel's Biprism, Interference in Thin Films, Newton's Rings and Michelson Interferometer.	
Π	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, CO2 laser, applications of laser: Holography, Principle of Holography.	11

- 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.

At the end of the course, the student will be										
CO1	Able to un	Able to understand the theoretical concepts learned in the theory course.								
CO2	Trained in	carrying out	precise meas	surements an	d handling e	quipment.				
CO3	Learn to dr	aw conclusion	ons from data	a and develop	p skills in exp	perimental	design.			
CO4	Able to u experiment	Able to understand the principles of error analysis and develop skills in experimental design.								
CO5	Able to do in a clear a	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.	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	3							
Duration (hours)								
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.							

Unit	Contents
Ι	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

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 kr and orthogor	nowledge of nality.	dot product a	and cross pro	duct in findi	ng projecti	ons, area		
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 spherical pol	knowledge o lar coordinat	of the concep es, Gauss, G	t of relation l reen and Stol	between carte kes Theorem	esian, cylir	ndrical and		
	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.	GUJI	RAL	PUN	JAB TECHNICAL UNIVERSITY	
	DE	PAR	IMEN	NT OF CHEMICAL SCIENCES	
Course Name	B.Sc	. (Ho i	nours) Chemistry	
Subject Code:	BHH	IL115	-19		
Subject Title:	CON	MMU	NICA	TIVE ENGLISH-II	
Contact Hours:	L:2	T:0	P:0	Credits:2	
Examination	2				
Duration (hours)					
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				
		comn	nunica	tion.	
	4.	.To h	elp th	e students become the independent users of English	
		langu	age.		

Unit	Contents							
		Hours						
Ι	(Literature)	10						
	(A) <i>The Poetic Palette</i> (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 Mansheld							
П	C. DUSK. H.H. MUNIFOE (Saki)	06						
11	Vocabulary.	00						
	(Homophonos/Homopyms)							
	(noniophones/nonionylis)							
	sentences: Transformation of Sentences: Importance of proper							
	punctuation							
III	Reading and Understanding:	04						
	Summary Paraphrasing: Analysis and Interpretation: Translation	01						
	(from Hindi/Puniabi to English and vice-versa)							
	Close Reading: Comprehension:							
	,,,							

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

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	Communication Skills	Oxford University Press.
	Pushp Lata.		2011
6	Liz Hamp-Lyons and	Study Writing	Cambridge University
	Ben Heasly		Press. 2006.

At the end of the course,								
CO1.	Students	Students will acquire basic proficiency in LSRW skills- listening, speaking,						
	reading,	reading, and writing.						
CO2.	To devel	op their voc	cabulary so t	hat they can	understand	spoken an	d written	
	English l	anguage, pa	rticularly the	language of	their chosen	technical f	ïeld	
CO3.	To intro	duce student	ts to the skil	lls and strate	egies of read	ing and w	riting by	
	identifyi	ng organiza	ational patte	erns, spottin	ng classifica	tion syste	ems and	
	understa	nding associa	ations betwee	en ideas thro	ugh study of	literary tex	xts.	
CO4 .	They wi	ll be able to	o converse fl	uently and p	produce on t	heir own o	clear and	
	coherent	texts.						
CO5.	To impr	ove the en	nployability	of students	and make	them prof	ficient in	
	professio	nal commu	nication thro	ugh understa	inding of car	eer docum	ents; 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	
	1		1					

I.K.	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY						
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	2						
Duration (hours)							
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.						

Unit	Contents	Contact
Ι	ਡਾ.ਹਰਿਭਜਨ ਸਿੰਘ: ਅਪ੍ਰਮਾਣਿਕ, ਤੇਰੇ ਹਜ਼ੂਰ ਮੇਰੀ ਹਾਜ਼ਰੀ ਦੀ ਦਾਸਤਾਨ	8
	ਸ਼ਿਵ ਕੁਮਾਰ ਬਟਾਲਵੀ: ਕੰਡਿਆਲੀ ਥੋਰ੍ਹ, ਧਰਮੀ ਬਾਬਲ ਪਾਪ ਕਮਾਇਆ, ਰੁੱਖ	
	ਪਾਸ਼: ਇਨਕਾਰ,ਸਭ ਤੋਂ ਖਤਰਨਾਕ,ਦਹਿਕਦੇ ਅੰਗਿਆਰਾਂ 'ਤੇ	
	ਸੁਰਜੀਤ ਪਾਤਰ: ਹੁਣ ਘਰਾਂ ਨੂੰ ਪਰਤਣਾ, ਕੁਝ ਕਿਹਾ ਤਾਂ, ਪੁਲ	
II	ਕਹਾਣੀ ਭਾਗ:	8
	ਸੰਤੋਖ ਸਿੰਘ ਧੀਰ: ਕੋਈ ਇਕ ਸਵਾਰ	
	ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼: ਲੱਛਮੀ	
	ਮੋਹਨ ਭੰਡਾਰੀ : ਘੋਟਣਾ	
	ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ : ਆਪਣਾ ਆਪਣਾ ਹਿੱਸਾ	
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,
			ਅਮ੍ਰਿਤਸਰ,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.	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES					
Course Name	B.S	с. (Н	onou	rs) Chemistry		
Subject Code:	BHH	IL116	B-19			
Subject Title:	MU	DHLI	PUN.	JABI-II (ਮੁਢਲੀ ਪੰਜਾਬੀ-॥)		
Contact Hours:	L:2	T:0	P:0	Credits:2		
Examination	2					
Duration (hours)						
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				
		sub	jects.			

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

Course Outcomes and Mapping

At the end of	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						
	DE	PAR	INE	I OF CHEIVIICAL SCIENCES		
Course Name	B.Se	c. (H	onou	rs) Chemistry		
Subject Code:	BHC	BHCP117-19				
Subject Title:	INO	INORGANIC CHEMISTRY LAB-II				
Contact Hours:	L:0	T:0	P:4	Credits:2		
Examination	3					
Duration (hours)						
Objective(s):	The	object	ive of	this course is to provide practical knowledge regarding		
	salt a	inalysi	is.			

Unit	Contents						
Ι	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						
	(a) Special resis for whiture of Amons						
	(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).						

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

At the end	At the end of the course, the student will be able to						
CO1.	Understa	nd the conce	pt of qualitat	tive analysis.			
CO2.	Learn to	Learn to identify present cations and anions through qualitative analysis of					
	various n	netal ions/ca	tions and ani	ons.			
CO3.	Understa	nd the vari	ious techniq	ues/principle	es involved	in the q	ualitative
	analysis	of mixtures i	n presence o	r absence of	interfering ic	ons.	
CO4 .	Learn to	separate and	identify less	familiar ion	s through qua	alitative an	alysis.
	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.(B.Sc.(Honours) Chemistry			
Subject Code:	BHCP	BHCP118-19			
Subject Title:	PHYSICAL CHEMISTRY LAB-I				
Contact Hours:	L:0	T:0	P:4	Credits:2	
Examination	3				
Duration (hours)					
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 pr	oblem so	olving an	d analytical skills.	

Unit	Contents
Ι	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

At the end	At the end of the course, the students will be able to							
CO1.	Underst	Understand the basic procedures for carrying out a physical chemistry practical						
	like prej	paration and	standardisat	ion of solutio	ons, handling	g the equipm	ents and	
	measuri	ng with prec	sision.					
CO2.	Correla	te the theore	tical and pra	actical aspec	ts and know	about the li	mits of the	
	experin	nental error.						
CO3.	Determi	ine the vario	us physical p	arameters fo	or the various	s problems u	nder study.	
CO4.	Verify v	various laws	studied in t	he theory pa	rt.			
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	1	1	3	-	3	2	1	
CO2	2	2 2 3 - 3 2 2				2		
CO3	2	3	3	-	2	1	1	
CO4	2	3	3	-	3	2	1	

I.I	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:0 T:0 P:0 Credits:2				
Examination	3				
Duration (hours)					
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.				

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

At the end of the course, the student will be							
CO1	Able to uno	derstand the	theoretical co	oncepts learn	ed in the the	ory course	
CO2	Trained in	carrying out	precise meas	surements an	d handling e	quipment.	
CO3	Learn to dr	aw conclusio	ons from data	a and develop	o skills in exp	perimental	design.
CO4	Able to u experiment	nderstand that design.	he principle	s of error	analysis and	l develop	skills in
CO5	Able to doo in a clear a	cument a tech nd concise m	hnical report hanner.	which comn	nunicates sci	entific info	rmation
	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	-

SEMESTER-III

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY							
	DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.S	с. (Н	onou	rs) Chemistry			
Subject Code:	BHC	CL201	-19				
Subject Title:	ORO	GANI	C CH	EMISTRY-II (CHEMISTRY OF FUNCTIONAL			
	GRO	GROUPS-II)					
Contact Hours:	L:3	T:1	P:0	Credits:4			
Examination	3						
Duration (hours)							
Objective(s):	4. 7 r	Fo pree nechai chemis	dict ar nisms try .	ad account for the most commonly encountered reaction (substitution, addition and elimination) in organic			
	5. 7 r g	5. To impart knowledge regarding physical properties and chemical reactions of oxygen, nitrogen and sulphur containing functional groups.					
	6. 1 c	Fo stu carboh	dy th ydrate	e classifications and properties of biomolecules like s, amino acids, proteins, peptides and nucleic acids.			

Unit	Unit Contents				
		Hours			
Ι	Alcohols	10			
	Classification and nomenclature. Monohydric alcohol - nomenclature,				
	methods of formation by reduction of aldehydes, ketones, carboxylic				
	acids and esters. Hydrogen bonding, Acidic nature. Reactions of				
	alcohols. Dihydric alcohols - nomenclature, methods of formation,				
	chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc) ₄				
	and HIO ₄] and pinacol-pinacolone rearrangement. Trihydirc alcohols -				
	nomenclature and methods of formation, chemical reactions of				
	glycerol.				
	Phenols				
	Nomenclature, structure and bonding. Physical properties, Acidity				
	of phenols and substituent effects, Comparative acidic strengths of				
	alcohols and phenols, Resonance stabilization of phenoxide ion.				
	Preparation and reactions of phenols - electrophilic aromatic				
	substitution, acylation and carboxylation, Kolb-Schmitt reaction.				
	Preparation of aryl ethers, Cleavage of aryl ethers by hydrogen				
	halides, Claisen rearrangement of allyl aryl ethers, Oxidation of				
	phenols. Gatterman synthesis, Hauben-Hoesch reaction, Laderer-				
	Manasse reaction and Reimen-Tiemann reaction.				
	Ethers and Epoxides				
	Nomenclature of ethers, epoxides and sulphides. Structure and bonding				
	in ethers and epoxides. Physical properties of ethers, Preparation of				

	ethers. The Williamson ether synthesis, Acid catalyzed cleavage of ethers. Preparation of epoxides, Conversion of vicinal halohydrins to epoxides, Reactions of epoxides: Nucleophilic ring opening, acid-catalyzed ring opening.	
II	Aldehydes and Ketones Nomenclature and structure of the carbonyl groups. Physical properties, Sources of aldehydes and/or ketones from alkenes, alkynes, carboxylic acids, acid chlorides, nitriles and alcohols. Reaction of aldehydes with Grignard reagent to produce ketones. Hydroformylation, Synthesis of aldehydes and ketones: Clemmensen, Wolff-Kishner, LiAlH ₄ , and NaBH ₄ reductions. Addition of Grignard reagents and organolithium reagents to aldehydes and ketones. Principles of nucleophilic addition: hydration of aldehydes and ketones, cyanohydrin formation, acetal formation. Benzoin, aldol, Perkin and Knoevenagel condensations. Use of acetals as protecting groups. Reactions of aldehydes and ketones with ammonia, primary amines and secondary amines. Enamines and Wittig reaction, Stereoselective addition to carbonyl groups. Oxidation of aldehydes. Mannich reaction. BaeyerVilliger oxidation of ketones, Cannizzaro reaction. Meerwein-Ponndorf-Verley reaction, Halogenation of enolizable ketone. An introduction to α,β- unsaturated aldehydes and ketones. Sulphur containing compounds Preparation and reactions of thiols, thioethers and sulphonic acids. Amines Amine nomenclature, Structure and bonding, physical properties. Basicity of amines. Structural features effecting basicity of amines. tetraalkylammonium salts as Phase Transfer Catalysts. Preparation of primary, secondary and tertiary amines: Nucleophilic substitution by azide ion on alkyl halides, nitration of arenes, nucleophilic ring opening of epoxides by ammonia, nucleophilic addition of amines to aldehydes and ketones, nucleophilic substitution by ammonia on α- halo acids. Nucleophilic acyl substitution. Preparation of amines to alkylation of ammonia, The Gabriel synthesis of primary alkylation of ammonia, The Gabriel synthesis of primary alkylation of ammonia, the Hofmann elimination. Electrophilic aromatic substitution in arylamines, nitrosation of alkylamines and arylamines. Synthetic transformations of aryl diazonium salts, azo counling.	12
III	Carboxylic Acids Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength . Dicarboxylic acids. Methods of formation and effect of heat and dehydrating agents. Preparation of carboxylic acids: carboxylation of Grignard reagents, oxidation of alkylbenzenes, oxidation of primary alcohols, aldehydes. Preparation and hydrolysis of nitriles. Reactions	12
	alcohols, aldehydes. Preparation and hydrolysis of nitriles. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid	

	chlorides, esters and amides. Reduction of carboxylic acids.	
	Mechanism of decarboxylation. Intramolecular ester formation.	
	Hydroxy acids: malic, tartaric and citric acids. Methods of formation	
	and chemical reactions of unstaturated monocarboxylic acids.	
	Carboxylic Acid Derivatives	
	Nomenclature and structure of acid chlorides, esters, amides, acid	
	anhydrides and nitriles. Relative stability of acyl derivatives. Physical	
	properties, interconversion of acid derivatives by nucleophilic acyl	
	substitution in acyl chlorides and acid anhydrides. Sources and	
	physical properties of esters. Acid as well as base catalyzed ester	
	hydrolysis. Reactions of esters with ammonia, amines, Grignard	
	reagents and lithium aluminium hydride. Amides: hydrolysis of	
	amides. Lactams. Preparation of nitriles hydrolysis addition of	
	Grignard reagents to nitriles.	
IV	Carbohydrates	11
1.4	Classification of carbohydrates Fischer projections and D- I-	11
	notations of glyceraldehyde aldotetroses aldopentoses and	
	aldohevoses Cyclic forms of carbohydrates' Europoses and	
	Pentoses Mutarotation and mechanism Introduction to ketoses deoxy	
	sugars, amino sugars and branched, chain carbohydrates, Glycosides'	
	The Fischer alvosidation mechanism examples of disaccharides	
	and polysaccharides Reactions of carbohydrates' Reduction of	
	and polysaccharides. Reactions of carbonydrates. Reduction of	
	ring size of monoscepherides. Cyconohydrin formation and chain	
	ring size of monosacchandes. Cyanonydrin formation and chain	
	extension. Kinani-Fischer synthesis. Epimerization, isomerization and	
	A substian and alludation of same hudrants hudrawal anoun	
	Acylation and alkylation of carbonydrate hydroxyl group.	
	mechanism of osazone formation, An introduction to disaccharides	
	(mailose, sucrose and factose) and polysaccharides (starch and	
	A mine A side Destides Destains and Masleis A side	
	Amino Acids, Peptides, Proteins and Nucleic Acids	
	Classification, structure and stereochemistry of amino acids. Acid-	
	base benaviour, isoelectric point and electrophoresis. Preparation	
	and reactions of α -amino acids. Structure and nomenclature of	
	peptides and proteins. Classification of proteins. Peptide structure	
	determination, end group analysis, selective hydrolysis of peptides.	
	Classical peptide synthesis, the Edman degradation. The strategy of	
	peptide synthesis: amino and carboxyl group protection, peptide bond	
	iormation. Solid-phase peptide synthesis: The Merrifield method.	
	Secondary structures of peptides and proteins. Introduction to tertiary	
	and quaternary structures of proteins. Protein	
	denaturation/renaturation. Nucleosides and nucleotides. secondary	
	structure of DNA: The double helix. Tertiary structure of DNA:	
	supercoils. Nucleic acids: Introduction. Constitutents of nucleic	
	acids. Ribonucleosides and ribonucleotides. The double helical	
	structure of DNA.	

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

1	F.A. Carey	Organic Chemistry, 8 th edition	McGraw Hill, Inc.
2	Morrison and Boyd	Organic Chemistry	Prentice Hall
3	G. Solomons	Fundamentals of Organic	John Wiley, 2002
		Chemistry	
4	S.M. Mukherji, S.P.	Organic Chemistry Vol. I, II	Wiley
	Singh and R.P. Kapoor	& III	Eastern Ltd (New Age
			International).
5	Jerry March	Organic Reaction Mechanism	John Wiley Ed. 5, 2002
6	L. G. Jr. Wade	Organic Chemistry	Prentice-Hall,1990
7	Stritwieser, Heathcock	Introduction to organic	Macmilan
	and Kosover	chemistry	

Course Outcomes and Mapping

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

- **CO1.** Learn the range of organic compounds containing various types of functional groups like oxygen, nitrogen and sulphur.
- **CO2.** gain in-depth understanding of carbohydrates, amino acids, proteins and nucleotides and their roles in biological system.
- **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	4	3	-	3	4	2
CO2	4	2	3	1	2	2	-
CO3	4	2	1	-	4	4	-
CO4	4	4	4	-	4	3	-
CO5	4	3	4	-	4	-	-

I.K.	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY						
	DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.Sc. (Honours) Chemistry						
Subject Code:	BHCL202-19						
Subject Title:	PHYSICAL CHEMISTRY-II (CHEMICAL						
	THERMODYNAMICS)						
Contact Hours:	L:3 T:1 P:0 Credits:4						
Examination	3						
Duration (hours)							
Objective(s):	This course will equip students with the necessary knowledge						
	concerning the fundamentals in thermodynamics of chemical processes.						
	The problem solving skills of students are expected to be enhanced						
	through due weightage given to numerical problems in each unit.						

Unit	Contents	Contact
т	Chamical Thermodynamical	12
1	Chemical Inermodynamics:	12
	Intensive and extensive variables; state and path functions; isolated,	
	closed and open systems; zeroth law of thermodynamics.	
	First law. Concept of heat, q , work, w , internal energy, U , and	
	statement of first law; enthalpy, H, relation between heat capacities,	
	calculations of q , w , U and H for reversible, irreversible and free	
	expansion of gases (ideal and van der Waals) under isothermal and	
	adiabatic conditions.	
	Thermochemistry: Heats of reactions: standard states; enthalpy of	
	formation of molecules and ions and enthalpy of combustion and its	
	applications; calculation of bond energy from thermochemical data,	
	effect of temperature (Kirchhoff's equations) and pressure on enthalpy	
	of reactions.	
II	Chemical Thermodynamics:	10
	Second Law: Concept of entropy; thermodynamic scale of temperature,	
	statement of the second law of thermodynamics; molecular and	
	statistical interpretation of entropy. Calculation of entropy change for	
	reversible and irreversible processes.	
	Third Law: Statement of third law, concept of residual entropy.	
	Free Energy Functions: Gibbs and Helmholtz energy; variation of S,	
	G, A with T, V, P; Free energy change and spontaneity. Relation	
	between Joule-Thomson coefficient and other thermodynamic	
	parameters; inversion temperature; Gibbs-Helmholtz equation.	
III	Chemical Equilibrium:	11
	Criteria of thermodynamic equilibrium, degree of advancement of	
	reaction, chemical equilibria in ideal gases, concept of fugacity.	
	Thermodynamic derivation of relation between Gibbs free energy of	
	reaction and reaction quotient. Equilibrium constants and their	
	quantitative dependence on temperature, pressure and concentration.	

	Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p , K_c and K_x . Le Chatelier's principle; equilibrium between ideal gases and a pure condensed phase.	
IV	Solutions and Colligative Properties: Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.	12

S.N	Author(s)	Title of the Book	Publisher/Year
0.			
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	Oxford and IBH (1958)
2		Chemistry, 1 st edition	
3	G.W. Castellan	Physical Chemistry, 4 th	Narosa (2004)
5		edition	
4	I.N. Levine	Physical Chemistry 6 th Ed.,	Tata Mc Graw Hill (2010)
5	T. Engel & P. Reid	Physical Chemistry 3 rd Ed.	Prentice-Hall (2012)
6	D. A. McQuarrie, & J. D.	Molecular Thermodynamics	Viva Books Pvt. Ltd.: New
0	Simon		Delhi (2004)
	M. J. Assael, A. R. H.	Commonly Asked Questions	CRC Press: NY (2011)
7	Goodwin, M. Stamatoudis,	in Thermodynamics	
	W. A. Wakeham, & S. Will		

Course Outcomes and Mapping

At the end of the course, the student will be able to									
CO1.	Understa	Understand the basic principles and theories pertaining to thermodynamics							
CO2.	Solve va	Solve various problems related to thermodynamics of different chemical							
	processes	processes							
CO3.	Define th	Define the various laws of thermodynamics.							
CO4.	Familiarise with the different colligative properties of solutions and the								
	concept of abnormal molecular mass								
CO5.	CO5. Understand thermodynamics of processes at equilibrium								
	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
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I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES									
Course Name	Course Name B.Sc. (Honours) Chemistry								
Subject Code:	BH	BHCL203-19							
Subject Title:	SPE	CTRO)SCO	PY					
Contact Hours:	L:3	T:1	P:0	Credits:4					
Examination	3								
Duration (hours)									
Objective(s):	То	teach	the	fundamental	concepts	of	Spectroscopy	and	their
	appl	ication	s.						

Unit	Contents	Contact Hours
Ι	 Introduction, interaction of electromagnetic radiation with molecules; various types of spectroscopy; absorption and emission spectroscopy; Born-Oppenheimer approximation. Vibrational and IR spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, Fundamental and non-fundamental molecular vibrations; concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. 	12
Π	 IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. 	11
III	Electronic spectroscopy and UV spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation,	10

	calculation of electronic transitions of polyenes using free electron model. λ_{max} , Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ_{max} for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.	
IV	 Nuclear Magnetic Resonance (NMR) spectroscopy: General principle of NMR spectroscopy and Proton Magnetic Resonance Spectroscopy, Larmor precession, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant, different scales, low resolution spectra, high resolution spectra, anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpetation of NMR spectra of simple compounds. Applications of IR, UV and NMR for identification of simple organic molecules. 	12

S.No.	Author(s)	Title of the Book	Publisher/Year
1	Banwell, C. N. &	Fundamentals of Molecular	Tata McGraw-Hill: New
	McCash, E. M.	Spectroscopy 4 th Ed.	Delhi (2006).
2	Kakkar, R.	Atomic & Molecular	Cambridge University
		Spectroscopy	Press (2015)
3	Kemp, W.	Organic Spectroscopy	Palgrave
4	Pavia, Lampman, Kriz,	Spectroscopy	Cengage Learning
	Vyvyan		

At the end of	f the course, the student will be able to
CO1.	Understand the fundamental principles and theories of various spectroscopic techniques
CO2.	Learn the interaction of various electromagnetic radiations with matter
CO3.	Learn about the behaviour of different types of compounds towards different electromagnetic radiations
CO4.	Understand the applications of interaction of light in their characterization
CO5.	Learn about the role of different techniques in the characterization of different compounds

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

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY								
DEPARTMENT OF CHEMICAL SCIENCES								
Course Name	B.Sc. (H	onou	rs) Chemistry					
Subject Code:	UC-BSHI	-214-	19					
Subject Title:	PHYSICS	-III ()	ELEMENTS OF MODERN PHYSICS)					
Contact Hours:	L:3 T:1	P:0	Credits:4					
Examination	3							
Duration (hours)								
Objective(s):	The object	ive of	f the course is to develop basic understanding concepts					
	of modern	h phys	sics, namely to special relativity and to the quantum					
	nature of	light	and energy, emphasizing whenever possible, how					
	classical	assical concepts have shown up to be inadequate in explaining						
	experimen	ts, wh	ich will act as a strong background if he/she chooses to					
	pursue sci	ence a	s a career.					

Unit	Content	Hours						
Ι	Dual Nature of Waves and Particles: Black body radiation, Planck's	10						
	quantum, Planck's constant and light as a collection of photons; Photo							
	Electric effect and Compton scattering. De Broglie wavelength and matter							
	waves; Davisson-Germer experiment, Problems with Rutherford model-							
	instability of atoms and observation of discrete atomic spectra; Bohr's							
	quantization rule and atomic stability; Wave-particle duality, Heisenberg							
	uncertainty principle- impossibility of a particle following a trajectory;							
	Estimating minimum energy of a confined particle using uncertainty							
	principle; Energy-time uncertainty principle.							
II	Quantum Mechanics: Two slit interference experiment with photons,	10						
	atoms & particles; linear superposition principle as a consequence; Matter							
	waves and wave amplitude; Schrodinger equation for non-relativistic							
	particles; Momentum and Energy operators; stationary states; physical							
	interpretation of wavefunction, probabilities and normalization;							
	Probability and probability current densities in one dimension. One							
	dimensional infinitely rigid box- energy eigenvalues and eigenfunctions,							
	normalization; Quantum dot as an example.							
III	Atomic structure: The nuclear atom, Electron orbits, Atomic spectra,	10						
	The Bohr Model, Energy level and spectra, Correspondence principle,							
	Nuclear motion, Atomic excitation, Many electron atoms, Exclusion							
	Principle, electron spin, spin orbit coupling, X-ray spectra. Zeeman effect,							
157	Stern-Garlach experiment.	10						
IV	Special Theory of Relativity: Michelson-Moriey Experiment and its	10						
	Transformations Simultaneity and order of quents Lorentz contraction							
	Time dilation. Polativistic transformation of valuatity fragmany and wave							
	number Delativistic addition of velocities. Variation of mass with							
	number. Relativistic addition of velocities. variation of mass with							
	velocity. Massiess Particles. Mass-energy Equivalence. Relativistic							
	Doppier effect. Relativistic Kinematics. Iransformation of Energy and							
	Momentum. Energy- Momentum Four Vector.							

Recommended Books:

- 1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
- 2. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2009, PHI Learning
- 3. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
- 4. Quantum Physics, Berkeley Physics, Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
- 5. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning

At the end o	of the course,	the student v	will be able to	C						
CO1	gained a deep understanding on the motivations that have led in the past century to the relativistic and quantum revolution in physics									
CO2	demonstrat physics pro	e ability to a blems.	pply wave-pa	article duality	and uncertain	nty principle	to solve			
CO3	demonstrate ability to solve quantum mechanical eigenvalue equations for various operators and obtain expectation values of the corresponding observables.									
CO4	demonstrate ability to solve 1-D quantum problems including the quantum particle in a box, a well, the simple harmonic oscillator, and the transmission and reflection of waves.									
CO5	solve problems involving the quantization of mass, charge, light, and energy including Avogadro's number, black-body radiation, photoelectric effect, and other related issues.									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7			
CO1	2	1	2	1	-	1	2			
CO2	2	2	1	2	1	1	1			
CO3	3	2	2	2	1	1	2			
CO4	2	2	2	2	1	1	2			
CO5	2	2	2	2	1	1	2			

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES								
Course Name	B.Sc. (Honours) Chemistry							
Subject Code:	BHCL205-19							
Subject Title:	ENVIRONMENTAL SCIENCE							
Contact Hours:	L:2 T:0 P:0 Credits:2							
Examination	3							
Duration (hours)								
Objective(s):	This course will equip students with the necessary knowledge and make							
	them aware about the environmental issues.							

Unit	Contents	Contact
		Hours
1	Introduction to Environmental Studies	1
	Multidisciplinary nature of Environmental Studies: Scope &	
	Importance, Need for Public Awareness	
	Ecosystems	
	Concept of an Ecosystem: Structure & functions of an ecosystem	
	(Producers, Consumers & Decomposers) Energy Flow in an	
	ecosystem: Food Chain, Food web and Ecological Pyramids,	
	Characteristic features, structure & functions of following Ecosystems:	
	Forest Ecosystem, Aquatic Ecosystem (Ponds, Lakes, River & Ocean)	
II	Natural Resources	8
	Renewable & Non-renewable resources, Forest Resources: Their uses,	
	functions & values (Biodiversity conservation, role in climate change,	
	medicines) & threats (Overexploitation Deforestation Timber	
	extraction Agriculture Pressure) Forest Conservation Act	
	Water Resources' Their uses (Agriculture Domestic & Industrial)	
	functions & values Overexploitation and Pollution of Ground &	
	Surface water resources (Case study of Puniab) Water Conservation	
	Rainwater Harvesting	
	Land Pasources' Land as a resource: Land degradation soil erosion	
	and desertification	
	Energy Descurred Penewship & nen renewship energy recourses use	
	Energy Resources. Renewable & non-renewable energy resources, use	
	of alternate energy resources (Solar, wind, Biomass, Thermal), Urban	
	problems related to Energy	7
111	Biodiversity & its conservation	
	Types of Biodiversity: Species, Genetic & Ecosystem	
	India as a mega biodiversity nation, Biodiversity hot spots and	
	biogeographic regions of India	
	Examples of Endangered & Endemic species of India, Red data book	
IV	Environmental Pollution & Social Issues	8
	Types, Causes, Effects & Control of Air, Water, Soil & Noise	
	Pollution, Nuclear hazards and accidents & Health risks, Global	

Climate Change: Global warming, Ozone depletion, Acid rain, Melting	
of Glaciers & Ice caps, Rising sea levels.	
Environmental disasters: Earthquakes, Floods, Cyclones, Landslides	
Field Work	
Visit to a National Park, Biosphere Reserve, Wildlife Sanctuary	
Documentation & preparation of a Biodiversity (flora & fauna) register	
of campus/river/forest	
Visit to a local polluted site : Urban/Rural/Industrial/Agricultural	
Identification & Photography of resident or migratory birds, insects	
(butterflies)	
Public hearing on environmental issues in a village	

- 1. Bharucha, E. Text Book for Environmental Studies. University Grants Commission, New Delhi.
- 2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad - 380 013, India, Email:mapin@icenet.net (R)
- 4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
- 5. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
- 6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
- 7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
- 8. Down to Earth, Centre for Science and Environment (R)
- 9. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
- 10. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
- 11. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
- 12. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
- 13. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
- 14. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB).
- 15. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
- 16. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
- 17. Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
- 18. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
- 19. Survey of the Environment, The Hindu (M)
- 20. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science.

Course Outcomes and Mapping

At the end of the course, the student will be able to CO1. Understand environmental problems at local and national level through

literature and general awareness.								
CO2.	Gain practical knowledge by visiting wildlife areas, environmental institutes							
	and var	ious person	alities who	have done	e practical	work on	various	
	environm	environmental Issues.						
CO3.	Apply in	Apply interdisciplinary approach to understand key environmental issues and						
	critically	critically analyze them to explore the possibilities to mitigate these problems.						
CO4.	Reflect c	Reflect critically about their roles and identities as citizens, consumers and						
	environn	environmental actors in a complex, interconnected world.						
CO5.	Become aware of the local, regional and global environmental problems.							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	3	2	3	2	3	2	2	
CO2	2	3	3	3	2	3	3	
CO3	3	3	3	2	2	2	3	
CO4	3	3	3	2	2	2	3	
CO5	3	1	2	3	2	2	3	

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES							
Course Name	B.Sc. (Honours) Chemistry						
Subject Code:	BHCP206-19						
Subject Title:	ORGANIC CHEMISTRY LAB-II: (FUNCTIONAL GROUP						
	TRANSFORMATIONS AND THEIR IDENTIFICATIONS)						
Contact Hours:	L:0	T:0	P:4	Credits:2			
Examination	3						
Duration (hours)							
Objective(s):	The objective of this course is to provide practical knowledge and						
	illustrative experiments regarding synthesis, separation and purification						
	of organic compounds.						

Unit	Contents								
Ι	Functional group detection using spectroscopy techniques								
	Application of IR and UV spectroscopy in functional groups characterization of								
	various compounds containing different functional groups (20 compounds).								
II	One step synthesis								
	1. Acetylation of the following compounds using conventional method or using								
	green approach								
	(a) amines (aniline, o-, p-toluidines)								
	(b) phenols (β -naphthol, 2-amino phenol, salicylic acid)								
	2. Benzolyation of the following compounds								
	(a) amines (aniline, o-, p- toluidines)								
	(b) phenols (β -naphthol, resorcinol) by Schotten-Baumann reaction.								
	3. Oxidation of ethanol/ isopropanol (Iodoform reaction).								
	4. Bromination of any one of the following:								
	(a) Acetanilide by conventional methods								
	(b) Acetanilide using green approach (Bromate-bromide method)								
	5. Nitration of any one of the following:								
	(a) Acetanilide/nitrobenzene by conventional method								
	(b) Salicylic acid by green approach (using ceric ammonium nitrate).								
	The above derivatives should be prepared using 0.5-1.0 g of the organic								
	compound. The solid samples must be collected and may be used for								
-----	------------------------------------------------------------------------------------------------------------------								
	recrystallization, melting point and TLC.								
III	Chromatography								
	a. Separation of a mixture of two amino acids by ascending and horizontal paper								
	chromatography								
	b. Separation of a mixture of two sugars by ascending paper chromatography								
	c. Separation of a mixture of <i>o</i> -and <i>p</i> -nitrophenol or <i>o</i> -and <i>p</i> -aminophenol by thin								
	layer chromatography (TLC)								

S.No.	Author(s)	Title of the Book	Publisher
1	Furniss, B.S., Hannaford,	Practical Organic Chemistry,	Pearson (2012)
	A.J., Smith, P.W.G. &	5th Ed.	
	Tatchell, A.R.		
2	F.G. Mann and B.C.	Practical Organic Chemistry	Longman, New York
	Saunders		
3	Ahluwalia, V.K. &	Comprehensive Practical	University Press
	Aggarwal, R.	Organic Chemistry:	(2000)
		Preparation and Quantitative	
		Analysis,	
4	Ahluwalia, V.K. & Dhingra,	Comprehensive Practical	University Press
	S.	Organic Chemistry:	(2000)
		Qualitative Analysis	

At the end of the course, the students will be able										
CO1.	To synt	To synthesise organic compounds by conventional and greener approach.								
CO2.	To deve crystalli	lop preparatization meth	tive skills fo .od.	r purificatio	n of organic	compounds	by			
CO3.	To sepa	rate the orga	nic compour	nd by thin lay	yer chromato	graphy tech	nique.			
CO4.	To prese	ent their wor	k with practi	ical skills and	d the awaren	ess of health	and safety			
	procedures.									
CO5.	To appl	y related exp	periments fo	or their resea	rch work					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7			
CO1	3	1	2	-	3	2	-			
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. G	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY						
Course Name	B.Sc.(Honou	rs) Che	emistry			
Subject Code:	BHCP	207-19					
Subject Title:	PHYSI	CAL CI	HEMIST	TRY LAB-II			
Contact Hours:	L:0	T:0	P:4	Credits:2			
Examination	4	4					
Duration (hours)	Duration (hours)						
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 pr	oblem so	olving an	d analytical skills.			

	Contents
1.	Determination of heat capacity of a calorimeter for different volumes using change of
	enthalpy data of a known system (method of back calculation of heat capacity of
	calorimeter from known enthalpy of solution or enthalpy of neutralization).
2.	Determination of heat capacity of the calorimeter and enthalpy of neutralization of
	hydrochloric acid with sodium hydroxide.
3.	Calculation of the enthalpy of ionization of ethanoic acid.
4.	Determination of heat capacity of the calorimeter and integral enthalpy (endothermic
	and exothermic) solution of salts.
5.	Determination of basicity/proticity of a polyprotic acid by the thermochemical method
	in terms of the changes of temperatures observed in the graph of temperature versus
	time for different additions of a base. Also calculate the enthalpy of neutralization of
	the first step.
6.	Determination of enthalpy of hydration of copper sulphate.

- 7. Study of the solubility of benzoic acid in water and determination of ΔH .
- 8. To Determine the Molecular Weight of given compound by Freezing Point Depression Method

Any other experiment related to thermochemistry carried out in the class.

Reference Books

S.No.	Author(s)	Title of the Book	Publisher
1	J.B. Yadav	Practical Physical Chemistry	Krishna
2	B. D. Khosla, V. C. Garg,	Senior Practical Physical	R. Chand & Co.
	& A. Gulati,	Chemistry	New Delhi (2011)
3	V. D. Athawale, & P.	Experimental Physical	New Age
	Mathur,	Chemistry	International: New
			Delhi (2001)

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	3	3	3	3	3	3
CO2	2	2	3	3	3	2	2
CO3	2	3	3	2	2	3	3
CO4	2	3	3	1	2	2	3

I.K. (I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.Sc. (Honours) Chemistry						
Subject Code:	UC-BSHP-215-19						
Subject Title:	PHYSICS LAB-III (ELEMENTS OF MODERN PHYSICS LAB)						
Contact Hours:	L:0 T:0 P:4 Credits:2						
Examination	3						
Duration (hours)							
Objective(s):	The aim and objective of the Physics Lab course is to introduce the						
	students of B. Sc. (Hons.) Physics to the formal structure of wave and						
	vibrations and mechanics so that they can use these as per their						
	requirement.						

Contents

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

- 1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
- 2. To show the tunneling effect in tunnel diode using I-V characteristics.
- 3. To determine work function of material of filament of directly heated vacuum diode
- 4. To determine value of Planck's constant using LEDs of at least 4 different colors.
- 5. Measurement of Planck's constant using black body radiation and photo-detector.
- 6. To determine work function of material of filament of directly heated vacuum diode.
- 7. To determine the ionization potential of mercury.
- 8. To determine the wavelength of H-alpha emission line of Hydrogen atom.
- 9. To determine the absorption lines in the rotational spectrum of Iodine vapour.
- 10. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source Na light.
- 11. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
- 12. To determine the value of e/m by magnetic focusing.
- 13. To experimentally demonstrate the concept of quantization of energy levels according to Bohr's model of atom using Franck-Hertz Apparatus.
- 14. To determine the wavelength of laser source using diffraction of single slit.
- 15. To determine the wavelength of laser source using diffraction of double slits.
- 16. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.

Recommended Books:

- 1. Experimental Physics M.A. Hippargi.
- 2. Experimental Physics Gadad & Hiregoudar.
- 3. Practical Physics C. L. Arora.
- 4. Advanced Practical Physics Worsnop and Flint.
- I.K. Gujral Punjab Technical University, Kapurthala

- 5. Practical Physics Gupta & Kumar Vol I, Vol II
- 6. <u>http://vlab.amrita.edu/?sub=1&brch=195</u>

Course Outcomes and Mapping

At the end of the course, the student will be

CO1	Able to une	Able to understand the theoretical concepts learned in the theory course.								
CO2	Trained in	carrying out p	precise measu	rements and h	andling equip	oment.				
CO3	Learn to dr	aw conclusion	ns from data a	and develop s	kills in experi	mental design				
CO4	Able to un	nderstand the	principles of	f error analys	sis and devel	op skills in e	experimental			
	design.									
CO5	Able to document a technical report which communicates scientific information in a clear									
	and concise	e manner.								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7			
CO1	3	3	2	2	2	1	2			
CO2	3	3	3	3	2	2	1			
CO3	3	3	2	-	2	1	2			
CO4	3	2	2	2	-	2	2			
CO5	2	2	2	2	-	2	2			

SEMESTER-IV

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY							
	DE	PAR	IMEN	NT OF CHEMICAL SCIENCES			
Course Name	B.S	с. (Н	onou	rs) Chemistry			
Subject Code:	BHC	CL211	-19				
Subject Title:	INO	INORGANIC CHEMISTRY-III (Crystal field theory and transition					
	elem	ents)					
Contact Hours:	L:3	T:1	P:0	Credits:4			
Examination	3						
Duration (hours)							
Objective(s):	To t	To teach the fundamental concepts of Inorganic Chemistry and their					
	appli	cation	is.				

Unit	Contents	Contact
		Hours
Ι	Coordination Chemistry-II:	13
	Valence bond theory (inner and outer orbital complexes),	
	electroneutrality principle and back bonding. Crystal field theory,	
	measurement of 10 Dq (Δo), CFSE in weak and strong fields,	
	pairing energies, factors affecting the magnitude of 10 Dq (Δo , Δt).	
	Octahedral vs. tetrahedral coordination, tetragonal distortions from	
	octahedral geometry Jahn-Teller theorem, square planar geometry.	
	Qualitative aspect of Ligand field and MO Theory.	
II	Transition Elements-I:	10
	General group trends with special reference to electronic	
	configuration, colour, variable valency, magnetic and catalytic	
	properties, ability to form complexes. Stability of various oxidation	
	states and e.m.f. (Latimer & Bsworth diagrams). Difference	
	between the first, second and third transition series.	
III	Transition Elements-II:	10
	Chemistry of Ti V Cr Mn Fe and Co in various oxidation states	
	(excluding their metallurgy)	
	(excluding then meanargy).	
	Lanthanoids and Actinoids:	
	Electronic configuration, oxidation states, colour, spectral and	
	magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only)	
	anthanides (1011-exchange method only).	

IV	Bioinorganic Chemistry:	12
	Metal ions present in biological systems, classification of elements	
	according to their action in biological system. Geochemical effect	
	on the distribution of metals. Sodium / K-pump, carbonic anhydrase	
	and carboxypeptidase. Excess and deficiency of some trace metals.	
	Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity,	
	Use of chelating agents in medicine.	
	Iron and its application in bio-systems, Haemoglobin; Storage and	
	transfer of iron.	

S.No.	Author(s)	Title of the Book	Publisher/Year
1	Purcell, K.F & Kotz,	Inorganic Chemistry	W.B. Saunders Co, 1977.
	J.C.		
2	Huheey, J.E.	Inorganic Chemistry	Prentice Hall, 1993
3	Lippard, S.J. & Berg,	Principles of Bioinorganic	Panima Publishing
	J.M.	Chemistry	Company 1994
4	Cotton, F.A. &	Advanced Inorganic	Wiley-VCH, 1999
	Wilkinson, G	Chemistry	
5	Basolo, F, and Pearson,	Mechanisms of Inorganic	John Wiley & Sons, NY,
	R.C.	Chemistry	1967
6	Greenwood, N.N. &	Chemistry of the Elements	Butterworth-
	Earnshaw A.		Heinemann,1997

Course Outcomes and Mapping

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

CO1.	Understand	the	fundamental	concepts	of	various	theories	of	coordination
	compounds								

- **CO2.** Learn the periodicity of the transition elements
- **CO3.** Understand the chemistry involved in the different transition elements.
- CO4. Learn about the role of metal ions in the biological systems.CO5. Understand the effect of trace metals on the biological systems

003.	Understand the effect of trace metals on the biological systems						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	3	3	2	1
CO2	2	3	2	3	1	3	2
CO3	2	2	3	2	2	2	3
CO4	1	2	2	2	2	1	2
CO5	2	1	2	2	1	3	2

I.K. G	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY				
	DEPARTMENT OF CHEMICAL SCIENCES				
Course Name	B.Sc. (Honours) Chemistry				
Subject Code:	BHCL212-19				
Subject Title:	PHYSICAL CHEMISTRY-III (Phase Equilibrium & Chemical				
	Kinetics)				
Contact Hours:	L:3 T:1 P:0 Credits:4				
Examination	3				
Duration (hours)					
Objective(s):	This course will equip students with the necessary knowledge				
	concerning the fundamentals in physical chemistry concerning phase				
	equilibria, chemical kinetics, catalysis and adsorption. The problem				
	solving skills of students are expected to be enhanced through due				
	weightage given to numerical problems in each unit.				

Unit	Contents	Contact
		Hours
Ι	Phase Equilibria: Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius- Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions. <i>Binary solutions:</i> Gibbs-Duhem-Margules equation, azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.	15
Π	Chemical Kinetics Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy, Numericals. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.	14
III	Catalysis: Types of catalyst, specificity and selectivity, mechanisms of catalyzed	8

	reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts, surface catalyzed unimolecular and bimolecular reactions. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.	
IV	Adsorption:	8
	Physical adsorption, chemisorption, adsorption isotherms. nature of adsorbed state, derivation of Langmuir, Freundlich, and BET adsorption isotherms, estimation of surface area by BET equation, Types of Adsorption Isotherms, Gibb's Adsorption isotherm.	

- 1. Peter Atkins & Julio De Paula, *Physical Chemistry* 9th Ed., Oxford University Press (2010).
- 2. Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
- 3. McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics*, Viva Books Pvt. Ltd.: New Delhi (2004).
- 4. Engel, T. & Reid, P. *Physical Chemistry* 3rd Ed., Prentice-Hall (2012).
- 5. Zundhal, S.S. Chemistry concepts and applications Cengage India (2011).
- 6. Ball, D. W. *Physical Chemistry* Cengage India (2012).
- 7. Mortimer, R. G. *Physical Chemistry* 3rd Ed., Elsevier: NOIDA, UP (2009).
- 8. Levine, I. N. *Physical Chemistry* 6th Ed., Tata McGraw-Hill (2011).
- 9. Metz, C. R. *Physical Chemistry* 2nd Ed., Tata McGraw-Hill (2009).

Course Outcomes and Mapping

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

CO1.	Describe variou	s terms	associated	with	phase	equilibria,	chemical	kinetics,
cataly	sis and adsorption							
CO2.	Analyse and dra	w phase	diagrams f	or sing	gle and	two compo	onent syste	ems

- **CO3.** Define the various terms associated with catalysis.
- **CO4.** Familiarise with the phenomenon of adsorption and its related theories.

CO5. Understand the factors affecting the kinetics of chemical processes.

	0		s united ing i		energy h	••••••••	
	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 DEPARTMENT OF CHEMICAL SCIENCES										
Course Name	Course Name B.Sc. (Honours) Chemistry									
Subject Code:	BHCL213-19									
Subject Title:	GREE	N CH	EN	AISTRY						
Contact Hours:	L:3 T	::1 P): 0	Credits:4						
Examination	3									
Duration (hours)										
Objective(s):	To tea	ch th	e i	fundamental	concepts	of	Green	Chemistry	and	its
	applica	tions.								

Details of the Course (Atomic Structure and Chemical Bonding)

Unit	Contents	Contact Hours
Ι	Introduction to Green Chemistry	12
	What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.	
	Principles of Green Chemistry and Designing a Chemical synthesis	
	Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions - use of microwaves, ultrasonic energy; selection of starting materials; avoidance of unnecessary derivatization – careful use of	
II	Principles of Green Chemistry and Designing a Chemical	12
	 synthesis Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products; prevention of chemical accidents; strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. Examples of Green Synthesis/ Reactions Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, citral, ibuprofen, paracetamol. Microwave assisted reactions in water: Hofmann Elimination, Oxidation of toluene 	
	Microwave assisted reactions in organic solvents: Esterification,	10

III	Fries rearrangement, Diels-Alder Reaction.	
	 Microwave assisted solid state reactions: Deacetylation, Deprotection. Saponification of esters, Alkylation of reactive methylene compounds, synthesis of nitriles from aldehydes. 3. Ultrasound assisted reactions: Esterification, saponification, substitution reactions, Alkylations, oxidation, reduction, coupling reaction, Cannizaro reaction. 	
IV	4. Selective methylation of active methylene group using dimethylcarbonate, Free Radical Bromination; Biocatalysis in	11
	organic syntheses.	
	Future Trends in Green Chemistry	
	Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development	

S.No.	Author(s)	Title of the Book	Publisher/Year
1	V.K. Ahluwalia &	New Trends in Green	Anamalaya Publishers
	M.R. Kidwai	Chemistry	(2005)
2	P.T. Anastas & J.K.	Oxford Green	University Press (1998)
	Warner	Chemistry- Theory and	
		Practical	
3	A.S. Matlack	Introduction to Green	Marcel Dekker (2001)
		Chemistry	
4	M.C. Cann & M.E.	Real-World cases in	American Chemical Society,
	Connely	Green Chemistry	Washington (2000)
5	M.A. Ryan & M.	Introduction to Green	American Chemical Society,
	Tinnesand	Chemistry	Washington (2002)

At the end of the course, the student will be able to								
CO1.	Understa	Understand the fundamental concepts of green chemistry						
CO2.	Learn the	e use of thes	e fundamen	tal principle	s for the desi	gning of va	rious	
	chemical	reactions						
CO3.	Understa	and the varie	ous techniqu	es available	and their p	resent appli	cations in	
	different	green reacti	ons		Ĩ			
CO4 .	Learn ab	out the vari	ous applicati	ons of the g	reen chemist	ry		
CO5.	Understa	and the vario	ous expected	future trend	ls of the gree	n chemistry		
	r i i i i i i i i i i i i i i i i i i i							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	2	2 3 2 2 1 2						
CO2	2	3	2	1	3	2	1	

CO3	1	2	3	1	2	2	1
CO4	1	2	1	3	2	2	0
CO5	2	3	2	2	1	2	2

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY					
	DEP	ART	MEN	T OF CHEMICAL SCIENCES	
Course Name	B.S	с. (Н	onou	rs) Chemistry	
Subject Code:	BHC	L214	-19		
Subject Title:	POL	YME	R CH	IEMISTRY	
Contact Hours:	L:3	T:1	P:0	Credits:4	
Examination	3				
Duration (hours)					
Objective(s):	This	cours	e will	l equip students with the knowledge concerning the	
	funda	ament	als in	the basic areas of Polymer Chemistry.	

Unit	Contents	Contact
		Hours
Ι	 Introduction and history of polymeric materials: Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. Functionality and its importance: Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems. 	10
Π	 Kinetics of Polymerization: Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. Crystallization and crystallinity: Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. Nature and structure of polymers-Structure Property relationships. 	12
III	Determination of molecular weight of polymers (M_n , M_w , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Glass transition temperature (T _g) and determination of T _g Free volume theory, WLF equation, Factors affecting glass transition temperature (T _g). Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.	11
IV	Properties of Polymers (Physical, thermal, Flow & Mechanical	12

Properties).	
Brief introduction to preparation, structure, properties and	
application of the following polymers: polyolefins, polystyrene and	
styrene copolymers, poly(vinyl chloride) and related polymers,	
poly(vinyl acetate) and related polymers, acrylic polymers, fluoro	
polymers, polyamides and related polymers. Phenol formaldehyde	
resins (Bakelite, Novalac), polyurethanes, silicone polymers,	
polydienes, Polycarbonates, Conducting Polymers, [polyacetylene,]	
polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].	

S.No.	Author(s)	Title of the Book	Publisher/Year
1	G. Odian	Principles of Polymerization	John Wiley
2	F.W. Billmeyer	Text Book of Polymer	John Wiley
		Science	
3	P. Ghosh	Polymer Science &	Tata Mcgraw-Hill
		Technology	
4	R.W. Lenz:	Organic Chemistry of	-
		Synthetic High Polymers	

At the end of the course, the student will be able to								
CO1.	Study the	Study the nomenclature, classifications and bonding in polymers						
CO2.	Learn th	Learn the criteria for the synthesis of polymers and mechanism involved in						
CO3.	Understa	and the morp	hology, kine	tics and their	structure pro	operty relat	ionship	
CO4.	Learn th polymer	e various te	chniques us ls	ed for detern	nining the n	nolecular v	veight of	
CO5.	Study the	e physical, th	nermal, Flow	and Mechan	ical Properti	es of Polyr	ners	
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	4	4	3	-	3	4	2	
CO2	4	2	3	1	2	2	-	
CO3	4	2	1	-	4	4	-	
CO4	4	4	4	-	4	3	-	
CO5	4	3	4	-	4	-	-	

I.K. G	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY					
	DEPARTMENT OF CHEMICAL SCIENCES					
Course Name	B.Sc. (Honours) Chemistry					
Subject Code:	UC-BSHM-408-19					
Subject Title:	Maths-III (MATRICES & ORDINARY DIFFERENTIAL					
	EQUATIONS)					
Contact Hours:	L:3 T:1 P:0 Credits:4					
Examination	3					
Duration (hours)						
Objective (s):	The objective of the course on Matrices & Ordinary Differential					
	Equations is to equip the B.Sc. (Hons) students with the theoretical					
	aspects of matrices. Their applications in system of equations and real-					
	life engineering problems. Furthermore, students will be introduced to					
	Ordinary Differential Equations.					

Unit	Contents	Contact
Ι	Matrices: Introduction to matrix, Different kinds of matrices, Addition, Multiplication, Symmetric and Skew symmetric matrix, Transpose of matrix, trace of a matrix. Determinants: Determinant of matrix, Properties of determinant, Singular and non-singular matrices, Adjoint and inverse of a matrix, Rank of a matrix.	<u>12</u>
Π	System of Equations: Introduction to system of linear equations, Condition of Consistency of system of linear equations, Homogenous and Nonhomogenous system of equations, Echelon form. Solving Linear system of Equations: Matrix inversion method, Gauss-Jordon method and Gauss Elimination method.	12
III	ODE : Introduction of differential coefficient, Ordinary differential equation, Order and degree of differential equation, Formation of differential equation, Difference between linear and non-linear differential equations.	10
IV	Solving Ordinary Differential Equations: Solution of Separable differential equations, linear differential equations of the first order, Exact differential equations, Solution of homogeneous differential equations, Bernoulli's equation and Riccati equation, The chemical application of these first order differential equations.	11

Reference Books

- 1. Mathematics 10+2, NCERT, New Delhi.
- 2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition. Wiley Publications, 2005.

- 3. O'Neil, P.V., Advanced Engineering Mathematics 7th Edition. Cengage Learning Custom Publishing, 2011.
- 4. Jain, R.K. and Iyengar, S.K., Advanced Engineering Mathematics 5th Edition. New Delhi: Narosa Publication, 2011.

Course Outcomes and Mapping

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

- **CO1.** Learn the basic concepts of Matrices.
- **CO2.** Understand about operations on matrices, such as, addition, subtraction and multiplication. And, the concept of determinants.
- **CO3.** Use matrices in solving system of equations using Gauss Elimination method, Gauss-Jordon method, Matrix inversion method etc.
- **CO4.** Be acquainted with knowledge of ordinary differential equations and Linear differential equations.
- **CO5.** Apply the learnt techniques in solving various problems related to differential equations.

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

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY						
	DEP	PART	MEN	T OF CHEMICAL SCIENCES		
Course Name	Course Name B.Sc. (Honours) Chemistry					
Subject Code:	BHC	BHCL216-19				
Subject Title:	BAS	BASIC ANALYTICAL CHEMISTRY				
Contact Hours:	L:2	T:0	P:0	Credits:2		
Examination	3					
Duration (hours)						
Objective(s):	This	is ski	ll enh	ancement course to equip students with the necessary		
	know	vledge	about	t basic techniques applied in analytical chemistry.		

Unit	Contents	Contact Hours				
Ι	Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.	6				
Π	Analysis of soil: Composition of soil, humus and clay, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification					
III	Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc. Ion-exchange: Column, ion-exchange chromatography etc.	7				
IV	Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.Analysis of cosmetics: Major and minor constituents and their function	7				

Reference Books

- 1. Willard, H. H. Instrumental Methods of Analysis, CBS Publishers.
- 2. Skoog & Lerry. *Instrumental Methods of Analysis*, Saunders College Publications, New York.
- 3. Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry* 6th *Ed.*, Saunders College Publishing, Fort Worth (1992).
- 4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
- 5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
- 6. Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
- 7. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- 8. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977).
- 9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.

I.K. Gujral Punjab Technical University, Kapurthala

10. Vogel, A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Prentice Hall.
11. Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.*, Marcel Dekker, Inc., New York.

At the end of the course, the student will be able to								
CO1.	Understand the basics of analytical chemistry.							
CO2.	Know ab	out soil and	water, their s	sampling, and	alysis & puri	fication me	ethods.	
CO3.	Familaris	se with the p	rinciples and	techniques of	of chromatog	raphy.		
CO4 .	Aware o	f the nutriti	onal value o	of various fo	ood items ar	nd concept	of food	
	processing and adulteration.							
CO5.	Understa	nd the function	ions of vario	us constituen	ts present in	cosmetics.		
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	3	2	1	-	3	-	-	
CO2	3	2	1	2	2	2	1	
CO3	3	2	1	1	2	2	1	
CO4	3	3	1	2	-	2	1	
CO5	3	3	1	2	-	2	-	

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY								
	DEPART	MEN	T OF CHEMICAL SCIENCES					
Course Name	B.Sc. (H	onou	rs) Chemistry					
Subject Code:	BHCP217	-19						
Subject Title:	INORGAN	INORGANIC CHEMISTRY LAB-III						
Contact Hours:	L:0 T:0	P:6	Credits:3					
Examination	3							
Duration (hours)								
Objective (s):	To unders	stand	the various concepts involved in the quantitative					
•	analysis c	analysis of the metal ions through gravimetric analysis; learn to						
	prepare th	ne inc	organic complexes and chromatographic separation					
	techniques	for th	e separation of different metal ions.					

Unit	Contents							
	Gravimetric Analysis:							
	 i. Estimation of nickel (II) using Dimethylglyoxime (DMG). ii. Estimation of copper as CuSCN iii. Estimation of iron as Fe₂O₃ by precipitating iron as Fe(OH)₃. iv. Estimation of Al (III) by precipitating with oxine and weighing as Al(oxine)₃ (aluminium oxinate). 							
	Inorganic Preparations:							
	 i. Tetraamminecopper (II) sulphate, [Cu(NH₃)₄]SO₄.H₂O ii. <i>Cis</i> and <i>trans</i> K[Cr(C₂O₄)₂. (H₂O)₂] Potassium dioxalatodiaquachromate (III) 							
	iii. Tetraamminecarbonatocobalt (III) ion							
	iv. Potassium tris(oxalate)ferrate(III)							
	Chromatography of metal ions							
	Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:							
	i. Ni (II) and Co (II)ii. Fe (III) and Al (III)							

Reference Books

S.No.	Author(s)	Title of the Book	Publisher/Year
1	Vogel, A.I.	Vogel's book on Quantitative	ELBS, 1986
		Analysis	

At the end of the course, the student will be able to									
CO1.	Understa	Understand the concept of qualntitative analysis.							
CO2.	Understa	Understand the various techniques/principles involved in the quantitative							
ana	lysis for pres	ent metal io	ns.						
CO3.	Learn to	synthesize v	various inorg	anic compou	inds				
CO4 .	Understa	and the princ	iples involve	ed in chroma	tographic sep	parations			
CO5.	Learn to	estimate the	cations pres	ent, through	quantitative	analysis			
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7		
CO1	3	2	1	2	2	1	2		
CO2	1	2	2	2	1	0	1		
CO3	2	1	1	2	2	1	2		
CO4	2	3	3	2	2	2	1		
CO5	1	2	2	2	3	1	2		

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.Sc.(B.Sc.(Honours) Chemistry				
Subject Code:	BHCP	BHCP218-19				
Subject Title:	PHYS	PHYSICAL CHEMISTRY LAB-III				
Contact Hours:	L:0	T:0	P:4	Credits:2		
Examination	4					
Duration (hours)						
Objective (s):	To pro	To provide students practical knowledge and skills about various				
	topics t	topics taught in theory class of physical chemistry, which in turn will enhance their problem solving and analytical skills.				

Unit	Contents
	1. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it
	 Determination of distribution coefficient of succinic acid between ether and water.
	3. Distribution of benzoic acid between water and benzene and show that benzoic acid dimerises in benzene.
	4. Determination of equilibrium constant of the reaction; $KI + I_2 \leftrightarrow KI_3$ by the distribution method.
	5. Determination of formula of complex formed between the cupric ion and ammonia by distribution method.
	6. Determination of rate constant of hydrolysis of methyl acetate catalyzed by acid and also the energy of activation.
	7. Compare the relative strengths of the acids by studying kinetics of hydrolysis of methyl acetate.
	8. Study the hydrolysis of methyl acetate catalyzed by HCl and equimolar urea hydrochloride, and hence the degree of hydrolysis of the salt.
	9. Study the kinetics of the saponification of ethyl acetate.
	10. Investigate the reaction between hydrogen peroxide and hydrogen iodide.
	11. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Reference Books

S.No.	Author(s)	Title of the Book	Publisher
1	J.B. Yadav	Practical Physical	Krishna
		Chemistry	
2	B. D. Khosla, V. C. Garg,	Senior Practical Physical	R. Chand & Co. New
	& A. Gulati,	Chemistry	Delhi (2011)
3	V. D. Athawale, & P.	Experimental Physical	New Age International:
	Mathur,	Chemistry	New Delhi (2001)

At the end of the course, the students will be able to									
CO1.	Underst	Understand the basic procedures for carrying out a physical chemistry practical							
	like prep	paration and	standardisat	ion of solution	ons, handling	g the equipm	ents and		
	measuri	ng with prec	ision.						
CO2.	Correlat	te the theore	tical and pra	ctical aspec	ts and know	about the li	mits of the		
	experim	ental error.							
CO3.	Determi	ne the vario	us physical p	arameters fo	or the various	s problems u	nder study.		
CO4.	Verify v	various laws	studied in t	he theory pa	rt.				
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7		
CO1	1	3	3	3	3	3	3		
CO2	2	2	3	3	3	2	2		
CO3	2	2 3 3 2 2 3				3			
CO4	2	3	3	1	2	2	3		

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.Sc.(B.Sc.(Honours) Chemistry				
Subject Code:	BHCP	BHCP219-19				
Subject Title:	BASIC	BASIC ANALYTICAL CHEMISTRY LAB-III				
Contact Hours:	L:0	T:0	P:4	Credits:2		
Examination	3					
Duration (hours)						
Objective (s):	To pro	To provide students practical knowledge and skills about various				
	topics t	topics taught in theory class of basic analytical chemistry, which in				
	turn wi	ll enhand	e their p	roblem solving and analytical skills.		

Unit	Contents
	1. Importance of significant figures and standard deviations
	2. Determination of pH of soil samples.
	3. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.
	4. Determination of pH, acidity and alkalinity of a water sample.
	5. Determination of dissolved oxygen (DO) of a water sample.
	6. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
	7. Analysis of preservatives and colouring matter.
	8. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).
	9. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
	10. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
	11. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

Reference Books

- 1. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
- 2. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.

Course Outcomes and Mapping

At the end of the course, the students will be able to									
CO1.	Identify	Identify the adulterants in common food items.							
CO2.	Analys	e samples o	f soil (pH) a	und water (p	H, acidity, a	lkalinity etc	:)		
CO3.	Learn t	Learn the paper chromatographic technique for separation of metal ions.							
CO4.	Learn t	Learn the spectrophotometric determination of compounds in commercial							
	produc	ts.			-				
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7		
CO1	1	3	3	3	3	3	3		
CO2	2	2 2 3 3 2 2							
CO3	2	1	2	2	2	1	1		
CO4	2	3	3	1	2	2	3		

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Semester V

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY							
	DE	PAR	IMEN	NT OF CHEMICAL SCIENCES			
Course Name	B.Se	c. (H	onou	rs) Chemistry			
Subject Code:	BHC	BHCL301-19					
Subject Title:	Inor	ganic	Chen	nistry-IV (Organometallic Chemistry)			
Contact Hours:	L:3	L:3 T:1 P:0 Credits:4					
Examination	3						
Duration (hours)							
Objective (s):	To t	Fo teach the fundamental concepts of Inorganic Chemistry and their					
	appli	catior	IS.				

Unit	Contents	Contact
		Hours
Ι	Organometallic Compounds: Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π -acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding	10
Π	Organometallic Compounds: Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.	12
III	Metallocenes and sandwich complexes, Structure of the metallocenes, Redox properties of the sandwich metallocenes, Metallocene synthesis, Chemical properties of Metallocenes, Triple- and multiple-decker sandwich complexes, Non-sandwich metallocenes derivatives, Metal- bis-arene sandwich complexes, Cylopentadienyl-metal-arene complexes. Preparations of Metal-carbene complexes, Metal-carbyne complexes, structures and reactions.	11
IV	Reaction Kinetics and Mechanism: Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Transeffect, theories of trans effect, Mechanism of nucleophilic substitution	12

in square planar complexes, Thermodynamic and Kinetic stability,	
Kinetics of octahedral substitution, Ligand field effects and reaction	
rates, Mechanism of substitution in octahedral complexes.	

- 1. Vogel, A.I. Qualitative Inorganic Analysis, Longman, 1972.
- 2. Svehla, G. Vogel's Qualitative Inorganic Analysis, 7th Edition, Prentice Hall, 1996-03-07.
- 3. Cotton, F.A. G.; Wilkinson & Gaus, P.L. Basic Inorganic Chemistry 3rd Ed.; Wiley India.
- 4. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.
- 5. Sharpe, A.G. Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005
- 6. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry3rd Ed., John Wiley and Sons, NY, 1994.
- 7. Greenwood, N.N. & Earnshaw, A. Chemistry of the Elements, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
- 8. Lee, J.D. Concise Inorganic Chemistry 5th Ed., John Wiley and sons 2008.
- 9. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.
- 10. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
- 11. Basolo, F. & Person, R. Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed., John Wiley & Sons Inc; NY.
- 12. Purcell, K.F. & Kotz, J.C., Inorganic Chemistry, W.B. Saunders Co. 1977
- 13. Miessler, G. L. & Donald, A. Tarr, Inorganic Chemistry 4th Ed., Pearson, 2010.
- 14. Collman, James P. et al. Principles and Applications of Organotransition Metal Chemistry. Mill Valley, CA: University Science Books, 1987.
- 15. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. j New York, NY: John Wiley, 2000.
- 16. Spessard, Gary O., &Gary L. Miessler. Organometallic Chemistry. Upper Saddle River, NJ: Prentice-Hall, 1996.

Course Outcomes and Mapping

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

- CO1. Understand the fundamental concepts of various concepts involved in organometallic compounds
- CO2. Learn different methods of preparations and various chemical reactions of organometallic compounds
- CO3. Understand the kinetics involved in the different reactions.
- CO4. Learn about the catalytic applications of organometallic compounds.

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

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY								
	DE	PAR	IMEN	NT OF CHEMICAL SCIENCES				
Course Name	B.Sc	:. (H	onou	rs) Chemistry				
Subject Code:	BHC	L302	-19					
Subject Title:	Orga	nic C	hemi	stry-III (Heterocyclic Chemistry)				
Contact Hours:	L:3	T:1	P:0	Credits:4				
Examination	3	3						
Duration (hours)								
Objective (s):	The	The objective of this course is to develop basic understanding of						
	heter	heterocyclic chemistry. Emphasis is given on the most important						
	heter	ocycl	ic sys	tems particularly five and six-membered heterocyclic				
	syste	ms, si	nall ri	ng heterocycles as well as fused heterocyclic systems.				

Unit	Contents	Contact
		Hours
Ι	Heterocyclic Nomenclature Systematic (Hantzsch-Widman System), trivial and replacement nomenclature system for monocyclic, fused, spiro and bridged heterocycles	12
	Aromatic Heterocycles Aromaticity in heterocycles: relationship with carbocyclic aromatic compounds and structural criteria, structure of six-membered and five membered rings with one heteroatom. Structures of bicyclic heteroaromatic compounds and tautomerism in aromatic heterocycles. Synthesis and mechanism of substitution reactions of furan, pyrrole (Paal-Knorr, Knorr pyrrole and Hantzch synthesis), thiophene, pyridine (Hantzch synthesis), Pyrimidine, structure elucidation of indole, Fisher indole synthesis and Madelung synthesis. Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones. Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.	
Π	Six-Membered Heterocycles with Two or More Heteroatoms Synthesis and reactions of diazines, triazines, oxadiazoles and thiadiazoles Purines: Synthesis and Reactions Approaches for the construction of purine ring, reactions of purines with electrophilic reagents, with nucleophilic reagents, reactions with bases, reactions of C-metallated purines Non-aromatic Heterocycles Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction. Stereo-electronic effect-anomeric and related effects. Attractive interactions-hydrogen bonding and intermolecular nucleophilic-	13

	electrophilic interactions	
III	Heterocyclic Synthesis Introduction, types of reactions and heterocyclic synthesis involving cyclization and cycloaddition reactions Small Ring Heterocycles Synthesis and reactions of three-membered heterocycles (aziridine, oxirane, thiirane) and four membered heterocycles (azetidine, oxetane and thietane)	10
IV	Benzo-Fused Five-Membered HeterocyclesSynthesis and reactions (electrophilic, nucleophilic, oxidation, reduction and cycloaddition) of benzopyrroles, benzofurans and benzothiophenesMeso-ionic HeterocyclesGeneral classification, chemistry of meso-ionic heterocycles of type-A (1,3-oxazolium-4-olates, 1,3-oxazolium-5-olates, 1,3- oxathioliwn-4-olates, 1,3-oxathiolium-5-olates) and type-B (1,2- Diazoliwn-4-aminides, 1,2-Dithiolium-4-olates) and their applications.	10

S.No.	Author(s)	Title of the Book	Publisher/Year
1	J. A. Joule, K. Mills and	Heterocyclic Chemistry, 3 rd &	A John Wiley & Sons, Ltd.,
	G. F. Smith	5 th edition	Publication
2	T. L. Gilchrist	Heterocyclic Chemistry	Longman Scientific
			Technical
3	T. Eicher, S.	The chemistry of Heterocyclic	Wiley-VCH
	Hauptmann, and A.	Chemistry	
	Speicher		
4	G. R. Newkome and	Contemporary Heterocyclic	Wiley-Inter
	W.W. Paudler,	Chemistry	Science
5	R. M. Acheson	An Introduction to	John Wiley
		Heterocyclic Compounds	
6	A. Paquett	Heterocyclic Chemistry	-

Course Outcomes and Mapping

At the end of the course, the student will be able to CO1. Know about the most important heterocyclic ring systems containing heteroatom and their systems of nomenclature and numbering. CO2. Understand and discuss the reactivity and stability of hetero aromatic compounds. CO3. Study the important synthetic routes and reactivity for five and six member hetero aromatic compounds. CO4. Understand the important chemical properties of five and six member hetero aromatic compounds. CO5. Learn the synthesis and chemical reactions of small ring and Benzo-fused heterocycles. PSO1 PSO₂ PSO3 PSO4 PSO5 PSO6 PSO7

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CO1	4	1	3	-	1	3	1
CO2	4	1	3	-	2	3	-
CO3	3	3	2	-	3	2	1
CO4	3	3	2	-	3	2	1
CO5	2	3	3	-	2	3	-

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY					
	DEPARTMENT OF CHEMICAL SCIENCES				
Course Name	B.Sc. (Honours) Chemistry				
Subject Code:	BHCL303-19				
Subject Title:	QUANTUM CHEMISTRY				
Contact Hours:	L:3 T:1 P:0 Credits:4				
Examination	3				
Duration (hours)					
Objective(s):	This course will equip students with the necessary knowledge				
	concerning the quantum mechanical concepts in chemistry. The problem				
	solving skills of students are expected to be enhanced through due				
	weightage given to numerical problems in each unit.				

Unit	Contents	Contact
Ι	Classical Mechanics vs quantum mechanics, Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and particle-in-a-box, quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic	<u>13</u>
	molecules and zero-point energy.	
Π	Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression) Radial and angular parts of the hydrogen atomic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. Significance of Quantum numbers.	10
III	Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H2. Bonding and antibonding orbitals. Qualitative extension to H2 ⁺ . Qualitative description of LCAO-MO treatment of diatomic molecules: Term symbols and Molecular orbital for homonuclear and heteronuclear (CO, HF, LiH) molecules. Comparison of LCAO-MO and VB treatments of H2 (only wavefunctions, detailed solution not required) and their limitations.	10

IV	Photochemistry	12
	Characteristics of electromagnetic radiation, Lambert-Beer's law and	
	its limitations, physical significance of absorption coefficients. Laws,	
	of photochemistry, quantum yield, actinometry, examples of low and	
	high quantum yields, photochemical equilibrium and the differential	
	rate of photochemical reactions, photosensitised reactions, quenching.	
	Role of photochemical reactions in biochemical processes,	
	photostationary states, chemiluminescence.	

S.N	Author(s)	Title of the Book	Publisher/Year
0.			
1	G.M. Barrow	Physical Chemistry	Tata McGraw-Hill: New Delhi (2007)
2	A. K. Chandra	Introductory Quantum Chemistry	Tata McGraw-Hill (2001).
3	J. E. House	Fundamentals of Quantum Chemistry 2 nd Ed.	Elsevier: USA (2004).
4	J. P. Lowe & K.Peterson,	Quantum Chemistry	Academic Press (2005).
5	G.W. Castellan	Physical Chemistry 4 th Ed	Narosa (2004)

At the end of the course, the student will be able to								
CO1.	be able to explain how quantum mechanical systems differ from classical							
	systems.							
CO2.	interpret	interpret the physical significance of the wave functions and energy levels						
	derived b	y solving th	e time-indep	endent Schrö	dinger equat	ion.		
CO3.	understar	nd and be ab	le to explain	the origin of	quantized er	nergy level	s.	
CO4.	relate th	e energy l	evels obtain	ned as solu	tions to the	e time-ind	ependent	
	Schrödin	ger equation	for different	systems wit	h spectrosco	pic techniq	ues.	
CO5.	Understa	nd the orig	in of theori	es used to	describe the	e covalent	bonding	
	especiall	y for diatom	ic molecules.					
CO6.	learn the	various lav	vs of photoc	hemistry and	d explain the	e various j	processes	
	behind pl	hotochemica	l reactions.	I	ſ			
	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	

CO6	2	2	1	-	2	1	1
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I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.Sc. (Honours) Chemistry					
Subject Code:	BHCL304-19					
Subject Title:	ANALYTICAL CLINICAL BIOCHEMISTRY					
Contact Hours:	L:3 T:1 P:0 Credits:4					
Examination Duration (hours)	3					
Objective (s):	Basic understanding of the structures, properties and functions of carbohydrates, lipids and proteins and the analysis of biochemistry of diseases using Blood and Urine.					

Unit	Contents	Contact Hours
I	Carbohydrates: Classification, Types and Biological importance of Monosaccharides, Disaccharides, Polysaccharides and Glycosaminoglycans. Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle. Isolation and characterization of polysachharides.	10
Π	 Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins- α-helix and β- pleated sheets, Isolation, characterization and denaturation of proteins. Enzymes: Nomenclature, classification, Characteristics (mention of Ribozymes), Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, effect of pH, temperature on enzyme activity, enzyme inhibition. Biocatalysis. 	11
III	 Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications. Lipoproteins: Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones. Nucleic Acids: Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy. 	11

IV	 Biochemistry of disease: A diagnostic approach by blood/ urine analysis. Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin. Normal constituents of blood and their estimation and variation in pathological conditions - urea, uric acid, creatinine, glucose, bilirubin, total protein, 	13
	 constituents of blood and their estimation and variation in pathological conditions - urea, uric acid, creatinine, glucose, bilirubin, total protein, albumin/globulin ratio. Lipid profile – cholesterol, triglycerides, lipoproteins - HDL and LDL. Urine: Collection and preservation of samples. Normal composition of urine – volume, pH, colour, specific gravity. Constituents-urea, uric acid, creatinine, pigment. Abnormal constituents – glucose, albumin, ketone bodies, variations in urea, creatinine, pigments and their clinical 	
	significance in brief. Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance.	

- 1. Lippincott's illustrated biochemistry Champe and Harvey; 6th edition 2007.
- 2. D.Voet and J.G. Voet: Fundamentals of Biochemistry, John Wiley & Sons, USA 2004.
- 3. Albert L. Lehninger Principles of Biochemistry CBS Publishers & Distributors, New Delhi.
- 4. Nelson, D. L. & Cox, M. M. :Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
- 5. Berg, J. M., Tymoczko, J. L. & Stryer, L. Biochemistry 7th Ed., W. H. Freeman.
- 6. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Methods.
- 7. M.N.Chatterjea and Ranashinde: Text book of Medical biochemistry. Jaypee Brothers Medical Publisher (P) Ltd.

Course Outcomes and Mapping

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

- CO1. Understand the structure & functions of Biomolecules.
- CO2. An advanced understanding and applied knowledge of the theory of clinical biochemistry.
- CO3. A critical understanding of how biochemical investigations are employed to develop a clinical diagnosis.
- CO4. To gain knowledge and understanding of clinical disorders.
- CO5. To gain knowledge of biological samples and their collection procedures.

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

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES							
Course Name	B.Se	c. (H	onou	rs) Chemistry			
Subject Code:	BHC	CL305	-19				
Subject Title:	IND	USTF	RIAL	CHEMICALS AND ENVIRONMENT			
Contact Hours:	L:3	T:1	P:0	Credits:4			
Examination	3						
Duration (hours)							
Objective(s):	The conc and Inorg semi for A Envi	objec epts o hazaro ganic condu Air an ronme	tive of f diffe ls; Ma Che cting nd Wa ent.	of this course is to make students aware about the erent gases and their industrial production, uses, storage anufacturing, applications, analysis and hazards of the emicals, Preparation of Ultra-Pure metals for technology, Air and Water pollution, control measures ater Pollutants, Catalyst and Biocatalyst, Energy and			

Unit	Contents						
		Hours					
Ι	Industrial Gases and Inorganic Chemicals						
	<i>Industrial Gases:</i> Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.						
	<i>Inorganic Chemicals:</i> Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.						
	<i>Industrial Metallurgy</i> : Preparation of ultrapure metals for semiconductor technology.						
II	Environment and its segments	11					
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	Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. <i>Air Pollution:</i> Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry., Major sources of air pollution and Pollution by SO ₂ , CO ₂ , CO, NO _x , and H ₂ S gases. Methods of estimation of CO, NO _x , SO _x and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal.						
III	Water Pollution	10					
	 Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water. 						
IV	Energy & Environment	12					
	Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.						
	Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management. E-waste and its Management						
	Biocatalysis						
	Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry.						

1. Manahan, S.E. (2017), Environmental Chemistry, CRC Press.

- 2. Buchel, K.H.; Moretto, H.H.; Woditsch, P.(2003), Industrial Inorganic Chemistry, Wiley-VCH.
- 3. De, A.K.(2012), Environmental Chemistry, New Age International Pvt., Ltd.
- 4. Khopkar, S.M. (2010), Environmental Pollution Analysis, New Age International Publisher.
- 5. Rai, G.D., Non-Conventinal Energy Resources, Khanna Publications.

Course Outcomes and Mapping

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

- **CO1.** different toxic gases and their toxicity hazards, Safe design systems for large scale production of Industrial gases.
- **CO2.** manufacturing processes, handling and storage of inorganic chemicals and knowledge of Hazardous effects of the inorganic chemicals on human beings and vegetation.
- CO3. the requirement of ultra-pure metals for the semiconducting technologies.
- **CO4.** different sources, effects and control measures of air, water pollutants, water quality parameters, different methods of Treatment of effluents from different sources.
- **CO5.** different sources of energy, source of nuclear waste and its disposal. Use of biocatalyst in chemical industries.

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

I.K.	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES					
Course Name	B.Sc. (Honours) Chemistry					
Subject Code:	BHCL306-19					
Subject Title:	LIGAND FIELD THEORY					
Contact Hours:	L:3 T:1 P:0 Credits:4					
Examination	3					
Duration (hours)						
Objective(s):	To teach the concepts of ligand field theory and their applications.					

Unit	Contents	Contact Hours
Ι	Symmetry: Symmetry elements, symmetry operations, point group determination, determination of reducible and irreducible representations, character tables, use of symmetry in obtaining symmetry of orbitals in molecules, use of character table to determine which metal orbitals are used in σ and π bond formation in octahedral, tetrahedral and square planar transition metal complexes, qualitative splitting of s, p, d, f orbitals in octahedral, tetrahedral and square planar fields using character tables and without the use of character tables. Orbital Wave Functions: Wave function and shapes of imaginary and real s, p, d and f orbital (cubic and general set in case of f orbitals), Z – component of orbital angular momentum, vector, imaginary and real d orbitals.	11
Π	Crystal Field Theory: Evaluation of $V_{(x, y, z)}$, $V_{oct.}$, V_{sq} , $pl.$ and $V_{tetragonal}$, evaluation of $V_{oct.}$ in cartesian co- ordinates, effect of V_{oct} on d-orbital wave functions. Interelectronic Repulsions: Spin-spin, orbital-orbital and spin orbital coupling, L.S. and jj coupling schemes, determination of all the spectroscopic terms of p^n , d^n ions, determination of the ground state terms for p^n , d^n , f^n ions using L.S. scheme, determination of total degeneracy of terms, order of interelectronic repulsions and crystal field strength in various fields, two type of electron repulsion parameters, term wave functions, Bra and Ket notation, derivations of single electron wave functions of all spectroscopic terms of d^n system, spin orbit coupling parameters (λ) energy separation between different j states.	13
III	Free Ions in Weak Crystal Field: The effect of V_{oct} on S, P, D and F terms (with help of the character table and qualitatively), splitting patterns of and G, H and I terms. Free Ions in Medium and Strong Crystal Fields : Strong field configurations, transition from weak to strong crystal fields, evaluation of strong crystal field terms of d^2 and d^3 cases in octahedral and	11

	tetrahedral crystal fields (using group theory), construction of the correlation energy level diagrams of d^2 and d^3 configurations in octrahedral and tetrahedral fields, study of energy level diagrams for higher configurations, selection rules of electronic transitions in transition metal complexes, their proof using group theory, relaxation of the selection rule in centrosymmetric and non centrosymmetric molecules, Orgel diagrams, Tanabe Sugano diagrams, interaction of T_{1g} (P) and T_{1g} (F) terms.	
IV	Electronic Spectra of Transition Metal Complexes : Variation of the Racah parameter, central field covalency, symmetry restricted covalency, differential radial expansion, intermediate coupling, nephlauxetic effect, spectrochemical series, band intensities, factors influencing band widths, variation of 10Dq, vibrational structure, spin orbit coupling, low symmetry components, Jahn-Teller effect, discussion of electronic spectra of octahedral and tetrahedral d ¹ – d ⁹ metal ions, calculation of 10Dq and B with and without the use of Tanabe Sugano diagrams, low spin complexes of Mn^{3+} , Mn^{2+} , Fe^{3+} , Co^{3+} , Fe^{2+} , comment on the spectra of second and third transition series, spectra of K ₃ MoCl ₆ and [Rh(NH ₃) ₆] ³⁺ , spectra of cis and trans[Co(en) ₂ X ₂] ⁺ , [Mn(H ₂ O) ₆] ²⁺ , CuSO ₄ .5H ₂ O and anhydrous complex, comparison of d – d band with f – f bands.	10

- 1. B.N. Figgis, Introduction to Ligand Field, Wiley Eastern.
- 2. A.B.P. Lever, Inorganic Electronic Spectroscopy, Elsevier.
- 3. A. Earnshaw, Introduction to Magnetochemistry, Academic Press.
- 4. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Inter-Science.
- 5. R.S. Drago, Physical Method in Chemistry, W.B. Saunders Company.
- 6. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Interscience.
- 7. F.A. Cotton, Chemical Application of Group Theory, Wiley Eastern.

Course Outcomes and Mapping

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

CO1. Understand the fundamental concepts of various aspects of Ligand Field Theory

- CO2. Learn the different aspects of crystal field theory
- CO3. Understand the effect of weak, medium and strong crystal field on free ions

CO4. Learn about the electronic spectra of transition metal complexes

CO5. Understand the factors affecting the electronic spectra of the complexes								
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	2	2	2	2	3	3	2	
CO2	2	3	3	3	2	3	3	

CO3	2	3	2	2	1	2	3
CO4	2	3	3	2	2	2	2
CO5	3	2	2	3	3	2	3

I.K.	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.Sc	c. (H	onou	rs) Chemistry			
Subject Code:	BHC	BHCP307-19					
Subject Title:	Inor	ganic	Chen	nistry Lab-IV			
Contact Hours:	L:0	L:0 T:0 P:4 Credits:2					
Examination	3	3					
Duration (hours)							
Objective (s):	To u	To understand the various concepts involved in the quantitative analysis					
	of the	e meta	ıl ions	through different types of titrations.			

Unit	Contents	Contact
		Hours
1	Oxidation-Reduction Titrations-II	
	Ceric Sulphate Litrations:	
	(1) Standardisation with Mohr's salt.	
	(ii) Determination of Cu(II)	
	(iii) Determination of oxalates.	
	KIO ₃ Titrations:	
	(i) Determination of copper.	
	(ii) Determination of hydrazine.	
	Precipitation Titrations	
	(i) AgNO3 – standardisation by Mohr's method / by using absorption indicator.	
	(ii) Determination of chloride.	
	(iii)Volhard's method for chloride determination.	
	Complexometric Titrations (EDTA)	
	(i) Standardisation of EDTA with $Pb(NO_3)_2 / ZnSO_4.7H_2O$	
	(ii) Determination of Mg_{2}^{2+}	
	(iii) Determination of Ca^{2+} (by substitution method).	
	(iv) Determination of total hardness of water (permanent and	
	temporary	
	(v) Determination of Cu^{2+} and Ni^{2+} by using masking reagent.	

Reference Books

1. Vogel, A.I. Quantitative Inorganic Analysis.

Course Outcomes and Mapping

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

CO1. Understand the concept of quantitative analysis.

CO2. Learn to estimate the present cations through quantitative analysis

CO3. Understand the various techniques/principles involved in the quantitative analysis present metal ions.

CO4. Learn to perform the volumence analysis using different methods.								
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	2	2	3	2	3	2	2	
CO2	2	2	3	3	3	3	2	
CO3	3	3	3	2	2	2	2	
CO4	2	3	1	3	2	2	3	

CO4. Learn to perform the volumetric analysis using different methods.

I.K. (I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY						
Come Nore	DEPA		1 OF C				
Course Name	B.SC.	Honou	irs) Cne	emistry			
Subject Code:	BHCP	808-19					
Subject Title:	ORGANIC CHEMISTRY LAB-III: (Synthesis of organic						
	compounds and their identifications)						
Contact Hours:	L:0	T:0	P:4	Credits:2			
Examination	3						
Duration (hours)							
Objective(s):	The objective of this course is to provide practical knowledge and						
	illustrative experiments regarding synthesis, separation, purification and						
	characte	erization	of organ	ic compounds.			

Contents

Organic Preparations

- **1.** Selective reduction of 1,3-dinitrobenzene to *m*-nitroaniline.
- 2. Reduction of *p*-nitrobenzaldehyde by sodium borohydride.
- **3.** Hydrolysis of amides and esters.
- **4.** Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
- **5.** S-Benzylisothiouronium salt of one each of water-soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
- **6.** Aldol condensation using either conventional or green method.
- 7. Benzil-Benzilic acid rearrangement.
- 8. Solvent-free Cannizzaro reaction of benzaldehyde.
- 9. Preparation of fluorescein from resorcinol and phthalic anhydride.
- **10.** Synthesis of 2-phenylindole using Fischer Indole synthesis reaction.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point determination. All reactions in the following experiments are to be monitored by thin layer chromatography (TLC) and characteristic data (UV-visible/fluorescence, IR, NMR, MS) is to be explained.

Reference Books

S.No.	Author(s)	Title of the Book	Publisher
1	Furniss, B. S., Hannaford,	Vogel's Textbook of Practical	Pearson (1989)
	A. J., Smith, P. W. G. &	Organic Chemistry, 5th Ed.	

	Tatchell, A. R.				
2	F. G. Mann and B. C.	Practical Organic	Longman, New York		
	Saunders				
3	Ahluwalia, V. K. &	Comprehensive	Practical	University	Press
	Aggarwal, R.	Organic	Chemistry:	(2000)	
		Preparation and	Quantitative		
		Analysis,			
4	Ahluwalia, V. K. &	Comprehensive	Practical	University	Press
	Dhingra, S.	Organic	Chemistry:	(2000)	
		Qualitative Analy	sis		

Course Outcomes and Mapping

At the end of the course, the students will be able										
CO6.	To synt	To synthesise organic compounds by various approach.								
CO7.	To deve crystalli	To develop preparative skills for purification of organic compounds by crystallization method.								
CO8.	To sepa	To separate the organic compound by thin layer chromatography technique.								
CO9.	To prese	ent their wor	k with practi	cal skills and	d the awaren	ess of health	and safety			
	procedu	res.								
CO10.	To appl	y related exp	periments fo	r their resea	rch work					
			-							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7			
CO1	3	1	2	-	3	2	-			
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			

Semester VI

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY					
	DE	PAR	IMEN	NT OF CHEMICAL SCIENCES	
Course Name	B.Sc	c. (H	onou	rs) Chemistry	
Subject Code:	BHC	CL311	-19		
Subject Title:	Orga	anic C	Chemi	stry-IV (Natural Products and Biochemistry)	
Contact Hours:	L:3	T:1	P:0	Credits:4	
Examination	3				
Duration (hours)					
Objective(s):	The o	object	ive of	this course is to	
	1	. imp	oart kr	nowledge of types, synthesis, isolation and physiological	
		fun	ctions	of alkaloids and terpenes	
	2. study the properties of lipids and enzymes and their importance				
	in biological systems				
	3	. unc	lerstar	nd the importance of high-energy compounds, electron	
		trai	nsport	chain and metabolic processes.	

Unit	Contents	Contact						
		Hours						
Ι	Alkaloids	12						
	Natural occurrence, General structural features, Isolation and their							
	physiological action, Hoffmann's exhaustive methylation, Emde's							
	modification, Structure elucidation and synthesis of Hygrine and							
	Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine,							
	Morphine, Cocaine, and Reserpine							
II	Terpenes	12						
	Occurrence, classification, isoprene rule; Elucidation of structure							
	and synthesis of Citral, Neral and α -terpineol.							
	Lipids							
	Introduction to oils and fats; common fatty acids present in oils and							
	fats, Hydrogenation of fats and oils, Saponification value, acid value,							
	iodine number. Reversion and rancidity							
III	Enzymes	11						
	Introduction, classification and characteristics of enzymes, Salient							
	features of active site of enzymes, Mechanism of enzyme action							
	(taking trypsin as example), factors affecting enzyme action,							
	coenzymes and cofactors and their role in biological reactions,							
	specificity of enzyme action (including stereo specificity), enzyme							
	inhibitors and their importance, phenomenon of inhibition							
	(competitive, uncompetitive and non-competitive inhibition							
	including allosteric inhibition).							
IV	Concept of Energy in Biosystems	10						
	Cells obtain energy by the oxidation of foodstuff (organic molecules).							
	Introduction to metabolism (catabolism, anabolism).							

ATP: The universal currency of cellular energy, ATP hydrolysis	
and free energy change.	
Agents for transfer of electrons in biological redox systems: NAD ⁺ ,	
FAD.	
Conversion of food to energy: Outline of catabolic pathways of	
carbohydrate- glycolysis, fermentation, Krebs cycle.	
Overview of catabolic pathways of fat and protein.	
Interrelationship in the metabolic pathways of protein, fat and	
carbohydrate. Caloric value of food, standard caloric content of food	
types.	

S.No.	Author(s)	Title of the Book	Publisher/Year
1	Finar, I. L.	Organic Chemistry (Volume	Dorling Kindersley
		2)	(India) Pvt. Ltd. (Pearson
			Education).
2	Singh, J.; Ali, S. M. &	Natural Product Chemistry,	Prajati Parakashan
	Singh, J.	2010	
3	Agarwal O. P.	Natural Product (Volume 1)	Krishna Parakashan
			Publication
4	Berg, J. M., Tymoczko,	Biochemistry, VI th edition,	W. H. Freeman and Co.
	J. L. and Stryer, L.	2006	
5	Nelson, D. L., Cox, M.	Principles of Biochemistry,	W. H. Freeman and Co.
	M. and Lehninger, A. L.	IV th edition, 2009	
6	Murray, R. K., Granner,	Harper's Illustrated	Lange Medical Books/
	D. K., Mayes, P. A.	Biochemistry, XXVIII	McGraw-Hill.
	and Rodwell, V. W.	edition, 2009	

Course Outcomes and Mapping

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

- **CO6.** Learn the different types of alkaloids and terpenes and their chemistry and medicinal importance
- **CO7.** Understand the importance of natural compounds as lead molecules for new drug discovery.
- **CO8.** Elaborate general methods of structural elucidation of compounds of natural origin.
- **CO9.** Understand the fundamentals of lipids and enzyme structure and function.

CO10. learn the metabolism of carbohydrates through various anabolic and catabolic pathways like glycolysis, Kreb's cycle, Glycogen metabolism etc.

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

I.K.	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY						
	DE	PAR	TMEN	NT OF CHEMICAL SCIENCES			
Course Name	B.S	c. (H	onou	rs) Chemistry			
Subject Code:	BHC	CL312	-19				
Subject Title:	PHY	SICA	L CH	IEMISTRY-IV (ELECTROCHEMISTRY)			
Contact Hours:	L:3	T:1	P:0	Credits:4			
Examination	3						
Duration (hours)							
Objective (s):	This	This course will equip students with the necessary knowledge					
	concerning the fundamentals of electrochemistry with regard to various						
	theories developed and their applicability for various systems under						
	consideration. The problem solving skills of students are expected to be						
	enha	enhanced through due weightage given to numerical problems in each					
	unit.						

Unit	Contents	Contact
		Hours
I	Conductance: Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions and its applications.	10
	Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations and (v) hydrolysis constants of salts. Numericals	
Π	Electrochemistry-I: Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells.	12
III	Electrochemistry-II: Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values. Latimer and Frost diagrams. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).	12

IV	Electrical & Magnetic Properties of Atoms and Molecules:	11
	Basic ideas of electrostatics, Electrostatics of dielectric media,	
	Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment	
	and molecular polarizabilities and their measurements. Diamagnetism,	
	paramagnetism, magnetic susceptibility and its measurement,	
	molecular interpretation.	

S.N	Author(s)	Title of the Book	Publisher/Year
0.			
1	P.W. Atkins & J. de Paula	Physical Chemistry 9 th ed	Oxford University Press (2011)
2	S.H. Maron & C.F. Prutton	Principles of Physical Chemistry, 1 st edition	Oxford and IBH (1958)
3	G.W. Castellan	Physical Chemistry, 4 th edition	Narosa (2004)
4	I.N. Levine	Physical Chemistry 6 th Ed.,	Tata Mc Graw Hill (2010)
5	T. Engel & P. Reid	Physical Chemistry 3 rd Ed.	Prentice-Hall (2012)
6	D.W. Rogers	Concise Physical Chemistry	Wiley (2010)
7	M. J. Assael, A. R. H. Goodwin, M. Stamatoudis, W. A. Wakeham, & S. Will	Commonly Asked Questions in Thermodynamics	CRC Press: NY (2011)

Course Outcomes and Mapping

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

- **CO1.** Understand and recognize the electrochemical processes
- **CO2.** discuss electrode potentials and relate it to cell thermodynamics
- **CO3.** explain potentiometric methods and explain the types of indicator electrodes
- **CO4.** evaluate conductivity measurements and titration curves to develop corelation with the practical part

CO3.	charitation the concept of upore moment, magnetic behaviour in molecules							
	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	

CO5. Understand the concept of dipole moment, magnetic behaviour in molecules

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.Sc. (Honours) Chemistry					
Subject Code:	BHCL313-19					
Subject Title:	CATALYSIS					
Contact Hours:	L:3 T:1 P:0 Credits:4					
Examination	3					
Duration (hours)						
Objective(s):	To teach the fundamental concepts of Catalysis and their applications.					

Unit	Contents	Contact Hours
Ι	Heterogeneous catalysis: - Introduction, Concepts of heterogeneous catalysis, Important Reaction Types, Oxidative Addition and Reductive Elimination, Insertion Reactions, b-Hydride Elimination, Nucleophilic Attack on a Coordinated Ligand Transformation of hydrocarbons, Metathesis of alkanes, alkenes and alkynes, Oxidation of hydrocarbons, Alkene hydrogenation (Wilkinsons Catalyst), Hydroformylation (Co salts), Wacker Process, Synthetic gasoline (Fischer Tropsch reaction).	12
II	Hydrogenation and hydroelementation of alkenes, Hydrogenation of olefins, Asymmetric hydrogenation, Hydroboration of olefins, Hydrocyanation of olefins, Hydroamination of olefins and alkynes Transformations of alkenes and alkynes : Ziegler-Natta-type olefin polymerization, Metathesis of alkenes, alkynes and cycloalkenes, Olefin dimerization and oligomerization, Olefin isomerization	10
III	Bio-catalysis Introduction, Introduction to enzymes and enzyme catalysed reactions. Classification and mechanism of reaction. Purification and characterization of enzymes. Applications of enzymes in diagnostics, analysis, biosensors and other industrial processes and bio- transformations, Enzyme immobilization and concept of enzyme engineering. Nanobiocatalysis, Bio-organometallic chemistry Cobalamin: co-enzyme vitamin B12, Biological redox mediators, Examples of oxido-reductase enzymes: the mono-oxygenases, Nitrogen fixation by nitrogenase enzyme	11
IV	Organometallic complexes in organic synthesis Examples of applications Protection and stabilization of unsaturated organic derivatives and fragments.Nucleophilic and electrophilic reactions on hydrocarbon ligands, General methods of C-C bond formation using the oxidative addition of an organic halide or a related	12

electrophile, Extension of palladium catalysis to the formation of C-O and C-N bonds, Oxidative coupling reactions of alkynes with other unsaturated fragments,for the formation of cyclic and heterocyclic compounds,Metal-carbene complexes in organic synthesis, Examples of asymmetric catalysis.

Reference Books

- 10. Cotton, F.A. G.; Wilkinson & Gaus, P.L. Basic Inorganic Chemistry 3rd Ed.; Wiley India.
- 11. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.
- 12. Sharpe, A.G. Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005
- 13. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry3rd Ed., John Wiley and Sons, NY, 1994.
- 14. Greenwood, N.N. & Earnshaw, A. Chemistry of the Elements, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
- 15. Lee, J.D. Concise Inorganic Chemistry 5th Ed., John Wiley and sons 2008.
- 16. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.
- 8. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
- 9. Basolo, F. & Person, R. Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed., John Wiley & Sons Inc; NY.
- 10. Purcell, K.F. & Kotz, J.C., Inorganic Chemistry, W.B. Saunders Co. 1977
- 11. Miessler, G. L. & Donald, A. Tarr, Inorganic Chemistry 4th Ed., Pearson, 2010.
- 12. Collman, James P. et al. Principles and Applications of Organotransition Metal Chemistry. Mill Valley, CA: University Science Books, 1987.
- 13. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. j New York, NY: John Wiley, 2000.
- 14. Spessard, Gary O., &Gary L. Miessler. Organometallic Chemistry. Upper Saddle River, NJ: Prentice-Hall, 1996.

Course Outcomes and Mapping

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

- CO1. Understand the Organometallic chemistry
- CO2. Understand the fundamental concepts of various concepts involved in catalysis.
- CO3. Learn different application of catalysis in the synthesis of organic compounds.

CO4. To Understand role of catalysis in biological model

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

I.K.	I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	B.Sc. (Honours) Chemistry						
Subject Code:	BHCL314-19						
Subject Title:	ANALYTICAL METHODS IN CHEMISTRY						
Contact Hours:	L:3 T:1 P:0 Credits:4						
Examination	3						
Duration (hours)							
Objective(s):	This course will equip students with the necessary knowledge						
	concerning various analytical techniques, their sampling and sources of						
	error etc.						

Unit	Contents						
		Hours					
Ι	 Qualitative and quantitative aspects of analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. Thermal methods of analysis: Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture. 	10					
Π	 Optical methods of Analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution. 	13					
III	Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background	10					

	correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.	
IV	Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation.Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.	12
	Chromatography: Classification, principle and efficiency of the technique.Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.	

 Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
 Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed.

Wardsworth Publishing Company, Belmont, California, USA, 1988.

3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.

5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.

7. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.

8. Ditts, R.V. Analytical Chemistry – Methods of separation.

Course Outcomes and Mapping

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

CO1. explain the fundamentals of analytical chemistry and steps of a characteristic analysis

CO2. estimate kinds of errors in chemical analysis.

CO3. identify quality of experimental measurements.

CO4. interpret the sources of random errors and effects of random errors on analytical results.

CO5. Familiarise with various analytical techniques and compare them.

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

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY							
	DE	PARI	IMEN	NT OF CHEMICAL SCIENCES			
Course Name	B.Sc	e. (He	onou	rs) Chemistry			
Subject Code:	BHC	L315	-19				
Subject Title:	NAN	OCH	EMIS	STRY			
Contact Hours:	L:3	L:3 T:1 P:0 Credits:4					
Examination	3	3					
Duration (hours)							
Objective (s):	• To	• To learn the basic concepts of Nanochemistry and changes of chemical and					
	physic	physical properties due size reduction.					
	• To	To familiarize about the different chemical methods of synthesis,					
	charae	cteriza	tion, a	nd different applications of nanomaterials			

Unit	Contents	Contact
Ι	Introduction to Nanomaterials: History-Feynman's hypothesis- scales of nanosystems- Moore's law, Classification of nanomaterials based on dimensions – one dimensional (1D), two dimensional (2D) and three dimensional (3D) nanomaterials, quantum dots, quantum wires, quantum core/shell structures, Different types of nanomaterials: Synthesis, properties and applications of fullerenes, carbon nanotubes and quantum dots, self-assembled monoayers, monolayer protected metal nanoparticles.	<u>10</u>
Π	 Chemical Routes for Synthesis of Nanomaterials: Chemical precipitation and co-precipitation; Sol-gel synthesis; Microemulsions or reverse micelles; Solvothermal synthesis; Thermolysis routes, Microwave heating synthesis; Sonochemical synthesis; Photochemical synthesis; Synthesis in supercritical fluids. Organic nanoparticles: Size and shape control of nanoparticles and their characterization; inorganic-organic hybrid nanoparticles; Nanopolymers: Preparation and characterization of diblock Copolymer based nanocomposites; Applications of Nanopolymers in Catalysis. 	13
III	Optical characterization: Absorption and photoluminescence (PL & PLE) spectroscopies, steady-state vs. fast spectroscopy, dynamic light scattering, Structural characterization: XRD, SEM, STEM, TEM, AFM, Deviations between bulk and near-surface crystal structures.	12
IV	Chemistry of small surfaces: Curvature and neighboring-charge effects on chemical reactivity and equilibria (pKa's, redox potentials), Applications in structural materials, lighting, energy conversion (Solar Cells) and catalysis applications, Environmental, safety, and ethical aspects of nanotechnology.	10

- C.N.R. Rao, H.C. Mult, A. Müller, A. K. Cheetham; The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley, 2004, ISBN:9783527306862.
- 2. G.B. Sergeev, K.J. Klabunde, Nanochemistry, Elsevier, 2013.
- 3. Robert Kelsall, Ian W. Hamley , Mark Geoghegan, Nanoscale Science and Technology, Wiley.
- 4. C Brechignac, P Houdy, M Lahmani, Nanomaterials and Nanochemistry, 2011, Wiley.

Course Outcomes and Mapping

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

- CO1. Understand the fundamental concepts of nanomaterials.
- CO2. Learn the different methods of chemical synthesis of nanoparticles.
- CO3. Understand the basic techniques about the organic nanoparticles.
- CO4. Learn about the various characterization techniques.

CO5. Understand the various applications of nanomaterials.

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

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY DEPARTMENT OF CHEMICAL SCIENCES						
Course Name	ame B.Sc. (Honours) Chemistry					
Subject Code:	BHC	BHCL316-19				
Subject Title:	MO	LECU	JLAR	MODELLING AND DRUG DESIGN		
Contact Hours:	L:3	T:1	P:0	Credits:4		
Examination	3					
Duration (hours)						
Objective (s):	• To	• To learn the basic concepts of molecular modelling and drug designing using				
	the di	the different energy minimization methods.				
	• To	unders	tand th	ne fundamentals of computer simulation.		

Unit	Contents	Contact
Ι	Introduction to Molecular Modelling: Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces. Computer Hardware and Software. The Molecular Modelling Literature.	13
	Force Fields: Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. Van-der Waals Interactions. Hydrogen bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.	
II	Energy Minimization and Computer Simulation: Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Computer simulation methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors.	10
III	Molecular Dynamics & Monte Carlo Simulation: Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of molecules. Models used in Monte Carlo simulations of polymers.	12
IV	Structure Prediction and Drug Design: Structure prediction - Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics – QSAR.	10

Reference Books

- 1. A.R. Leach, Molecular Modelling Principles and Application, Longman, 2001.
- 2. J.M. Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.
- 3. Satya Prakash Gupta, QSAR and Molecular Modeling, Springer Anamaya Publishers, 2008.

Course Outcomes and Mapping

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

- CO1. Understand the fundamental concepts of molecular modelling.
- CO2. Learn the different methods of energy minimization and computer simulation.
- CO3. Understand the basic concepts of molecular dyanamics.

CO4. Learn about the various concepts of drug designing and molecular moderning.							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	2	2	3	3	2
CO2	2	2	2	3	3	2	2
CO3	2	3	2	2	3	2	2
CO4	2	3	3	1	2	3	3

Learn about the various concents of drug designing and molecular modelling CO1

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

DEPARTMENT OF CHEMICAL SCIENCES							
Course Name	B.Sc.	(Honou	rs) Cho	emistry			
Subject Code:	BHCP3	818-19					
Subject Title:	ORGANIC CHEMISTRY LAB-IV						
Contact Hours:	L:0	T:0	P:4	Credits:2			
Examination	3						
Duration (hours)	hours)						
Objective(s):	The objective of this course is to provide practical knowledge and						
	illustrative experiments regarding study, estimation and isolation of						
	bioorga	nic comp	oounds.				

S. No.	Contents
1.	Estimation of glycine by Sorenson's formalin method.
2.	Study of the titration curve of glycine.
3.	Estimation of proteins by Lowry's method.
4.	Study of the action of salivary amylase on starch at optimum conditions.
5.	Effect of temperature on the action of salivary amylase.
6.	Saponification value of an oil or a fat.
7.	Determination of Iodine number of an oil/ fat.
8.	Isolation and characterization of DNA from onion/ cauliflower/peas.
	Synthesis of Nanoparticles and their applications
	(i) Green synthesis of silver nanoparticles using plant extract.
	(ii) Preparation of Chitosan Nanoparticles and characterization using FTIR.
	(iii) Synthesis of ZnO nanoparticles through non-aqueous route.
	(iv) Synthesis of copper nanoparticles.
	Application of synthesized nanoparticles in any two organic transformations /
	synthesis.

Reference Books

S.No.	Author(s)	Title of the Book	Publisher
1	Manual of Biochemistry Work	shop, 2012, Department of Chen	nistry, University of
	Delhi.		
2	Arthur, I. V. Quantitative Orga	anic Analysis, Pearson.	

Course Outcomes and Mapping

At the end of the course, the students will be able										
CO11.	To stud	To study about properties of amino acids/proteins/enzymes.								
CO12.	To estin	nate amino a	acids/protein	s by various	s methods.					
CO13.	To unde	erstand the is	olation and c	characterisati	ion of DNA.					
CO14.	To prese	ent their wor	k with practi	cal skills and	d the awaren	ess of health	and safety			
	procedu	res.								
CO15.	To appl	y related exp	periments fo	r their resea	rch work					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7			
CO1	4	1	2	-	3	2	-			
CO2	3	-	3	-	3	3	-			
CO3	3	3 4 - 3 3 -								
CO4	3	2 3 4 4 5 -								
CO5	2	3	4	2	4	4	-			

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY							
	DEPA	RIMEN	NT OF C	CHEMICAL SCIENCES			
Course Name	B.Sc. (Honou	rs) Che	emistry			
Subject Code:	BHCP	BHCP319-19					
Subject Title:	PHYSI	PHYSICAL CHEMISTRY LAB-IV					
Contact Hours:	L:0	T:0	P:4	Credits:2			
Examination	4						
Duration (hours)	ition (hours)						
Objective (s):	To provide students practical knowledge and skills about various topics						
	taught i	taught in theory class of physical chemistry, which in turn will enhance					
	their pr	oblem so	olving an	d analytical skills.			

Unit	Contents
	Conductometry
	I. Determination of cell constant
	 II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. III. Perform the following conductometric titrations: Strong acid vs. strong base Weak acid vs. strong base Mixture of strong acid and weak acid vs. strong base Strong acid vs. weak base
	Potentiometry
	Perform the following potentiometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Dibasic acid vs. strong base iv. Potassium dichromate vs. Mohr's salt
	Any other experiment related to electrochemistry carried out in the class.
	Introduction to Computational study / Molecular modeling
	1. To study the 3-dimensional structure of simple organic molecules such as alkanes, alkene and alkynes using physical as well as computer based modelling.
	 To study the relative stability of E and Z isomers of simple alkenes using molecular modelling. Determination of the molecular configuration of di (determine the interatomic distances) / triatomic (determine the interatomic distances and bond angles) / tetra atomic molecules (determine the interatomic distances and bond angles).

S.No.	Author(s)	Title of the Book	Publisher
1	J.B. Yadav	Practical Physical Chemistry	Krishna
2	B. D. Khosla, V. C. Garg,	Senior Practical Physical	R. Chand & Co. New
	& A. Gulati,	Chemistry	Delhi (2011)
3	V. D. Athawale, & P.	Experimental Physical	New Age
	Mathur,	Chemistry	International: New
			Delhi (2001)

Course Outcomes and Mapping

At the end of the course, the students will be able to										
CO5.	Underst	Understand the basic procedures for carrying out a physical chemistry practical								
	like prej	paration and	standardisat	ion of solution	ons, handling	g the equipm	ents and			
	measuri	ng with prec	ision.							
CO6.	Correla	te the theore	tical and pra	ctical aspec	ts and know	about the li	mits of the			
	experin	experimental error.								
CO7.	Determi	ine the vario	us physical p	parameters for	or the various	s problems u	nder study.			
CO6.	Verify v	various laws	studied in t	he theory pa	rt.					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7			
CO1	1	3	3	3	3	3	3			
CO2	2	2 2 3 3 2 2								
CO3	2	3 3 2 3 3								
CO4	2	3	3	1	2	2	3			