Indrashil University

Department of Chemistry
School of Science

B.Sc. Chemistry Semesters I-IV

Course Profile
Academic Year: 2023 – 2024

Course structure: Semester I

Semester-I	**Minimum Semester Credit Required: 22 Cumulative Semester Credit Required: 22**			
Course Type	**Course Code**	**Course Name**	**L-T-P**	**Credits**
Major Discipline Core **(MDC)**	**CH1 101**	**MDC-1:** Organic Chemistry-I	2-0-0	2
	CH1 102	**MDC-2:** Analytical Chemistry-I	2-0-0	2
	CH1 103	**MDC-3: Lab-1:** Organic Practicals-I	0-0-4	2
	CH1 104	**MDC-4: Lab-2:** Analytical Practicals-I	0-0-4	2
Minor Discipline Elective **(MDE)**	**CH1 105**	**MDE-1:** Chemistry in Daily Life	2-0-0	2
	CH1 106	**MDE-2: Lab-3:** Chemistry in Daily Life	0-0-4	2
Multi-Disciplinary **(MDS)**	**CH1 107**	**MDS-1:** Biology for Chemists	2-0-0	2
	CH1 108	**MDS-2: Lab-4:** Biology for Chemists	0-0-4	2
Ability Enhancement Course **(AEC)**	**CH1 109**	**AEC-1:** English Language-1	2-0-0	2
Skill Enhancement Course **(SEC) /Internship**	**CH1 110**	**SEC-1:** Computer Technology & IT Skills for Chemists	1-0-2	2
Value Added Course **(VAC)/** Indian Knowledge System **(IKS)**	**CH1 111**	**IKS-1:** (Indian Knowledge System course for Science students) **Traditional Yoga and its Modernization for Health Benefits**	1-0-2	2
Total			**12L+0T+20P = 32 hrs.**	**22**

Course structure: Semester II

Semester II	Minimum Semester Credit Required: 22 Cumulative Semester Credit Required: 44			
Course Type	**Course Code**	**Course Name**	**L-T-P (Hour)**	**Credits**
Major Discipline Core **(MDC)**	**CH1 201**	Inorganic Chemistry-I	2-0-0	2
	CH1 202	Physical Chemistry-I	2-0-0	2
	CH1 203	Inorganic Chemistry - I Laboratory	0-0-4	2
	CH1 204	Physical Chemistry – I Laboratory	0-0-4	2
Minor Discipline Elective **(MDE)**	**CH1 205**	Chemistry of Materials	2-0-0	2
	CH1 206	Chemistry of Materials Laboratory	0-0-4	2
Multi-Disciplinary **(MDS)**	**CH1 207**	Physics of Semiconductor Devices	2-0-0	2
	CH1 208	Physics of Semiconductor Devices Laboratory	0-0-4	2
Ability Enhancement Course **(AEC)**	**CH1 209**	**AEC-1:** English Language-2	2-0-0	2
Skill Enhancement Course **(SEC)**	**CH1 210**	**SEC-1:** Techniques of Chemical Analysis	1-0-2	2
Value Added Course **(VAC)**	**CH1 211**	Health and Nutrition	1-0-2	2
		Total	**12L+0T+20P**	**22**

Course structure: Semester III

Semester-III	**Minimum Semester Credit Required: 22 Cumulative Semester Credit Required: 66**			
Course Type	**Course Code**	**Course Name**	**L-T-P**	**Credits**
Major Discipline Core **(MDC)**	**CH2 101**	Organic Chemistry-II	2-0-0	2
	CH2 102	Inorganic Chemistry-II	2-0-0	2
	CH2 103	Physical Chemistry-II	2-0-0	2
	CH2 104	Organic Chemistry-II Laboratory	0-0-4	2
	CH2 105	Inorganic Chemistry - II Laboratory	0-0-4	2
	CH2 106	Physical Chemistry – II Laboratory	0-0-4	2
Minor Discipline Elective **(MDE)**				
Multi-Disciplinary **(MDS)**	**CH2 107**	Semiconductor Devices	2-0-0	2
	CH2 108	Semiconductor Devices Laboratory	0-0-4	2
Ability Enhancement Course **(AEC)**	**CH2 109**	Soft Skills	2-0-0	2
Skill Enhancement Course **(SEC)**	**CH2 110**	Laboratory Operations and Safety Measures	2-0-0	2
Indian Knowledge System **(IKS)**	**CH2 111**	Indian Culture and Civilization	2-0-0	2
Total			**14L+0T+16L=30**	**22**

Course structure: Semester IV

Semester-IV	**Minimum Semester Credit Required: 22 Cumulative Semester Credit Required: 88**			
Course Type	**Course Code**	**Course Name**	**L-T-P**	**Credits**
Major Discipline Core **(MDC)**	**CH2 201**	Organic Chemistry-III	2-0-0	2
	CH2 202	Inorganic Chemistry-III	2-0-0	2
	CH2 203	Physical Chemistry-III	2-0-0	2
	CH2 204	Organic Chemistry–III Laboratory	0-0-4	2
	CH2 205	Inorganic Chemistry-III Laboratory	0-0-4	2
	CH2 206	Physical Chemistry–III Laboratory	0-0-4	2
Minor Discipline Elective **(MDE)**	**CH2 207**	Application of Semiconductors	2-0-0	2
	CH2 208	Application of Semiconductors Laboratory	0-0-4	2
Multi-Disciplinary **(MDS)**				
Ability Enhancement Course **(AEC)**	**CH2 209**	Professional Communications	2-0-0	2
Skill Enhancement Course **(SEC)**	**CH2 210**	Software for Scientific Learning	2-0-0	2
Indian Knowledge System **(IKS)**	**CH2 211**	Renewable Energy	2-0-0	2
Total			**14L+0T+16L = 32 h**	**22**

B.Sc. Chemistry Semester I
Detailed syllabus

Course Code	**CH1 101**
Course Name	**MDC-1: Organic Chemistry-I**
L-T-P-C	**2-0-0-2**

Unit I

Syllabus	**Hours**
Fundamentals of Organic Chemistry Physical Effects, electronic displacements: inductive effect, electrometric effect, resonance and hyperconjugation. Cleavage of bonds: Homolysis and heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive intermediates: Carbocations, carbanions and free radicals. Examples of simple natural molecules synthesized by cationic and anionic intermediates. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **Stereochemistry** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and optical isomerism; Enantiomerism, diastereomerism and meso compounds). *Threo* and *erythro*; D and L; *cis – trans* nomenclature; CIP Rules: R/ S (for up to 2 chiral carbon atoms) and E/Z nomenclature (up to two carbon systems).	**15**

Unit II

Syllabus	**Hours**
Aliphatic Hydrocarbons Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkanes** (up to 5 carbons): Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, Corey House reaction, from Grignard reagent. Reactions: Free radical Substitution: Halogenation. **Alkenes** (up to 5 carbons): Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule), cis alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), addition of HX (Markownikoff's and anti-Markownikoff's addition), hydration, ozonolysis, oxymecuration-demercuration, hydroboration-oxidation. Example of polymer synthesis (Zeigler Natta). **Alkynes** (up to 5 Carbons): *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. **Reactions:** Formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$.	**15**

Reading references

1. Morrison Boyd and Bhattacharjee. Organic Chemistry. Pearson Education India. 2010, 7th Ed.
2. S. M. Mukherji, S. P. Singh and R. K. Kapoor. Organic Chemistry. Narosa Publishers. 2017, Volume I and II.
3. Arun Bahl and B. S Bahl. A text book of Organic Chemistry. S. Chand Publications. 2016, 22nd Ed.
4. R L Madan. Chemistry for Degree students B. Sc semester-I Inorganic/Organic. S. Chand Publications. 2016.
5. I. L. Finar. Organic Chemistry (Volume I), Dorling Kindersley (India) Pvt. Ltd. Pearson Education. 1963, 4th Ed.
6. L. G. Wade, J. W. Simek and M. S. Singh. Organic Chemistry. Pearson India Education Services Pvt. Ltd. 2020, 9th Ed.

Course Code:	**CH1 102**
Course Name:	**MDC-2: Analytical Chemistry-I**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
Language of analytical chemistry: Definitions: Analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method. Significant figures. **Errors and treatment of analytical data:** Limitations of analytical methods. **Errors:** Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. External standard calibration - regression equation (least square method), correlation coefficient (R2). Accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range).	**15**

Unit II	
Syllabus	**Hours**
Titrimetric analysis: Basic principle of titrimetric analysis. Classification, Preparation and dilution of reagents/solutions. Equivalent masses of compounds, normality, molarity and mole fraction, per cent solution. Use of $N_1V_1 = N_2V_2$ formula, preparation of ppm level solutions from source materials (salts), conversion factors. **Acid-base titrimetry:** Basic principle, example, titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations. Titration curves, Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity. **Complexometric titrimetry:** Basic principle, examples, indicators for EDTA titrations, theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations. Application-determination of the hardness of water. **Precipitation titrimetry:** Basic principle, examples, titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate, Volhard's and Mohr's methods and their differences. **Gravimetric analysis:** Requisites of precipitation, mechanism of precipitation, Factors influencing precipitation, Co-precipitation, post-precipitation. Advantages of organic reagents over inorganic reagents, reagents used in gravimetry (8-hydroxy quinoline (oxine) and dimethyl glyoxime (DMG) Numerical problems. Comparison of different processes. Choosing of analytical methods under different situations (food industry, pharmaceutical industry).	**15**

Reading references

1. J. Mendham, R. C. Denney, J. D. Barnes and M. J. K. Thomas. Vogel's Textbook of Quantitative Chemical Analysis, Third Indian Reprint, Pearson Education Pvt. Ltd. 2007, 6th Ed.
2. G.D. Christian. Analytical Chemistry. Wiley-India. 2007, 6th Ed.
3. B. B. L Shrivastava and Amarnath Mishra. Fundamentals of Analytical Chemistry. Innovative Publications. 2019, Reprint Ed.
4. S. M. Khopkar Basic Concepts of Analytical Chemistry. New Age International. 2022, 5th Ed.

Course Code:	**CH1 103**
Course Name:	**MDC-2: Lab-1: Organic Practicals-I**
L-T-P-C	**0-0-4-2**

List of experiments to be conducted

S.No.	**Objectives**	**Hours**
1.	Detection of elements (N, S, Cl, Br, I) in organic compounds (containing up to two extra elements)	4
2.	Selection of suitable solvents for purification/crystallization of organic compounds.	4
3.	Simple distillation of a volatile compound from a mixture of components	4
4.	Visualization of molecular chirality in the organic chemistry laboratory	4
5.	Identification and separation of the components in a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine, or any other amino acid) by paper chromatography	4
6.	Identification and separation of the sugars present in the given mixture by paper chromatography.	4
7.	Preparation of acetanilide from aniline using Zn/acetic acid (Green method).	4
8.	Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture.	4
9.	Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventional method)	4
10.	Synthesis of diazoamino benzene from aniline (conventional method).	4
11.	Preparation of dibenzalacetone (Green method).	4

List of virtual experiments

Separation of mixtures by chromatography: Measurement of R_f value (separation of two components)
Separation of chemical components using column chromatography

Reading references

1. G. Svehla and B. Sivasankar. Vogel's Qualitative Inorganic Analysis. Pearson Education. 2012, 7th Ed.
2. J. Mendham. Vogel's Quantitative Chemical Analysis. Pearson. 2009, 6th Ed.
3. A. I. Vogel, A. R. Tatchell, B. S. Furniss, A. J. Hannaford and Smith, P. W. G. Textbook of Practical Organic Chemistry. Prentice-Hall. 1996, 5th Ed.
4. F. G Mann and B. C. Saunders. Practical Organic Chemistry Orient-Longman, Pearson Education India. 1960, 4th Ed.

Course Code:	**CH1 104**	
Course Name:	**MDC-2: Lab-2: Analytical Practicals-I**	
L-T-P-C	**0-0-4-2**	
List of experiments to be conducted		
S. No.	**Objectives**	**Hours**
1.	Safety practices in the chemistry laboratory, knowledge about common toxic chemicals, and safety measures in the handling, cleaning, and drying of glass wares.	4
2.	Calibration of the pipette, burette, and volumetric flask. Concept of primary and secondary standard.	4
3.	Determination of sodium carbonate and sodium bicarbonate in a mixture.	4
4.	Determination of alkali present in soaps and detergents. Comparison with the listed quantity in commercial products. Discussion of discrepancies.	4
5.	Estimation of iron (II) using potassium dichromate	4
6.	Standardization of potassium permanganate using oxalic acid primary standard solution	4
7.	Standardization of EDTA solution and determination of hardness of water	4
8.	Determination of alkali content in antacid	4
9.	Standardization of silver nitrate and determination of chloride in tap water	4
List of virtual experiments		
Determination of ferric ion in ferric oxide salt Gravimetric estimation of barium from its salt solution Gravimetric estimation of nickel from its salt solution		

Reading references

1. John H. Kennedy. Analytical Chemistry Practice. Saunders College Publishing. 1990, 2nd Ed.
2. J. Mendham. Vogels Textbook of Quantitative Chemical Analysis. Pearson Education. 2002, 6th Ed.
3. A. I. Vogel. A Text Book of Quantitative Inorganic Analysis. Elbs Publication. 1969, 3rd Ed.

Course Code:	**CH1 105**
Course Name:	**MDE-1: Chemistry in Daily Life**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
Dairy Products: Composition of milk and milk products. Analysis of major/minor components, fat content, and minerals in milk and butter. Estimation of added water in milk. Compare milk from different sources. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages. **Food additives, adulterants, and contaminants:** Food preservatives like benzoates, propionates, sorbates, and disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, MSG, melamine, formalin, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate. **Vitamins:** Classification and nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1. Comparison of vitamins from food and pills (bioavailability). **Oils and fats:** Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test.	**15**

Unit II	
Syllabus	**Hours**
Soap and Detergents: Definition classification, history of soap synthesis, manufacturing of soaps and detergents, compositions and uses. **Chemistry of Cosmetics & Perfumes:** A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. **Chemistry of Pesticide:** General introduction to pesticides (natural and synthetic), benefits and adverse effects, uses of representative pesticides in the following classes: Organochlorines (DDT, gammexene,); Organophosphates (malathion, parathion); Carbamates (carbofuran and carbaryl); Quinones (Chloranil), Anilides (alachlor and butachlor). Hazards associated with the synthesis and use of pesticides.	**15**

Reading references

1. B. K. Sharma. Introduction to Industrial Chemistry. Goel Publishing, Meerut. 1998.
2. Ashutosh Kar. Medicinal Chemistry. New Age International Publishers. 2018, 7th Ed.
3. H. E. Cox and David Pearson. Analysis of Foods. Chemical Pub Co. 1962.
4. Fred Billmeyer. Textbook of polymer science. Willey. 2007, 3rd Ed.
5. N. Shakuntala Many and S. Swamy. Foods: Facts and Principles. New Age International. 1998, 4th ed.
6. Swaminathan and Goswamy. Handbook on Fertilizer Technology. FAI. 2001, 6th Ed.

Course Code:		**CH1 106**
Course Name:		**MDE-3: Lab-3: Chemistry in Daily Life**
L-T-P-C		**0-0-4-2**
List of experiments to be conducted		
S. No.	**Objectives**	**Hours**
1.	Preparation and characterization of soaps and detergents.	10
2.	Synthesis. of aspirin from salicylic acid	10
3.	Detection of aldehyde using Fehling's test.	10
4.	Test of unsaturation in ghee and oil using potassium permanganate or Bromine water	10
5	Chemical analysis of caffeine content in tea and coffee samples	10
6.	Identification of cottonseed oil (Halphen's Test).	10
Virtual experiments		
Detection of Castor Oil (Molybdate Method)		
Detection of food adulterations; e.g.; test of urea in milk, metallic colors in haldi, bran in wheat flower, sugar in honey, chalk in salt etc.		

Reading references

1. Elias Anil. A Collection of Interesting General Chemistry Experiments. J. University Press. 2008, Revised Ed.

Course Code:	**CH1 107**
Course Name:	**MDS-1: Biology for Chemists**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
Basics of living organisms and five kingdom classification, Introduction and classification of organisms by cell structure (prokaryote and eukaryote), Cell wall: Structure and function, cell Membrane and its functions, nucleus: Structure and function, chromosomes: structure and function.	**15**

Unit II	
Syllabus	**Hours**
Mitochondria: Structure, function, and biogenesis, Chloroplasts: Structure-function, and biogenesis, Endoplasmic reticulum: Structure and function, Golgi complex: Structure and functions, Lysosomes: Structure and functions, Ribosomes: Structure and functions, Cytoskeleton and cell motility, Cell cycle and cell division.	**15**

Reading references

1. G. Karp. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc. 2010, 6th Ed.
2. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. Lippincott Williams and Wilkins, Philadelphia. 2006. 8th Ed.
3. G. M. Cooper, and R. E. Hausman. The Cell: A Molecular Approach. Sinauer Associates Inc. 2009, 5th Ed.
4. W. M. Becker, L. J. Kleinsmith, J. Hardin. and G. P. Bertoni. The World of the Cell. Pearson Benjamin Cummings Publishing, San Francisco. 2009, 7th Ed.

Course Code:	**CH1 108**
Course Name:	**MDS-2: Lab-4: Biology for Chemists**
L-T-P-C	**0-0-4-2**

List of experiments to be conducted		
S. No.	**Objectives**	**Hours**
1.	Principle and operation of a microscope	8
1.	Gram staining for the characterization of microorganisms	8
2.	Observation of distinguishing features of prokaryotic and eukaryotic cells	8
3.	Mitosis and the cell cycle in onion root-tip cells	8
4.	Blood smear preparation and staining (horizontal staining procedure)	8
5.	Staining of cell organelle (mitochondria)	8
6.	Permanent slide preparation	8
7.	Identification of barr body by Buccal smear	8

List of virtual experiments
1. Cell Counting and viability
2. Fluorescent In Situ Hybridization (FISH) Assay

Reading references

1. G. Karp. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc. 2010, 6th Ed.
2. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. Lippincott Williams and Wilkins, Philadelphia. 2006, 8th Ed.
3. G. M. Cooper, and R. E. Hausman. The Cell: A Molecular Approach. Sinauer Associates Inc. 2009, 5th Ed.
4. W. M. Becker, L. J. Kleinsmith, J. Hardin. and G. P. Bertoni. The World of the Cell. Pearson. 2009. 7th Ed.

Course Code:	**CH1 109**
Course Name:	**AEC-1: English Language-1**
L-T-P-C	**1-1-0-2**

Unit I	
Syllabus	**Hours**
Communication Skills: Importance of communication skills, communication cycle, types, flows, barriers, nonverbal communication **Listening skills:** Types of listening, barriers to effective listening, tips to improve listening skills	**15**
Unit II	
Syllabus	**Hours**
Grammar: Articles, prepositions, tenses, concord, adjectives & degrees of comparison, adverbs **Speaking Skills:** Impromptu, short situational dialogues/conversation, short speeches, presentations **Reading Skills:** Difference between skimming & scanning, identifying the main idea and topic, and guessing the meanings of words.	**15**

Reading references
Textbooks

1. Dr. Sanjay Kumar and Dr. Pushp Lata. Communication Skills. Oxford University Press. 2018, 1st Ed.
2. Meenakshi Raman and Sangita Sharma. Technical Communication; Principles and Practice. Oxford University Press. 2015, 3rd Ed.

Reference books

1. M Ashraf Rizvi. Effective Technical Communication. SIA Publishers. 2022, Latest Ed.
2. Vitthal Patel and Unnat Patel. Text Book of Communication Skills. Ria Publishing House. 2013.
3. Wren and Martin High. School English Grammar. S. Chand & Company Pvt. Ltd. 2022. 1st Ed.
4. Asha Kaul. Communication Skills. Tata McGraw Hill. 2007, 2nd Ed.

Note: Tutorials via Language Lab sessions will be based on the above course.

Course Code:	**CH1 110**
Course Name:	**SEC-1: Computer Technology & IT Skills for Chemists**
L-T-P-C	**1-0-2-2**

Unit I	
Syllabus	**Hours**
Introduction to Computers Computer system: characteristics and capabilities. Computer Hardware and Software: Block Diagram of a Computer, Data Processing System, Storing Data, Processing Data. Types of Computers, Generation of Computers. Number systems: Decimal Number system, Binary number system, Octal & Hexadecimal number system.	**7**
Unit II	
Syllabus	**Hours**

Computer Peripherals & amp; Basic Components & amp; Storage Introduction to Input Devices: Categorizing input hardware, keyboard, direct entry — card readers, scanning devices — OMR, character readers, thumb scanner, MICR, smart cards, voice input devices, pointing devices Central processing unit: the microprocessor, control unit, buses, main memory, main memory (RAM) for microcomputers, Read Only Memory (ROM). Storage Devices: Storage fundamentals, primary and secondary storage, hard disks, disk cartridges, optical disks, CD ROM.	**8**

List of experiments to be conducted		
S. No.		**Hours**
1.	Introduction to DOS	6
2.	Introduction to Windows	6
3.	Introduction to Microsoft Office	6
4.	Introduction to Microsoft Excel and Spreadsheet	6
5.	Applications of computer knowledge in Chemistry	6

Reading references

1. P. K. Sinha. Computer Fundamentals. BPB Publications. 2004. 6th Ed.
2. V. Rajaraman. Introduction to Information Technology. PHI. 2013. 2nd Ed.
3. Suresh K Basandra. Computers Today. Galgotia Publications. 1995.
4. Peter Norton. Computing Fundamentals. McGraw Hill-Osborne. 2005, 6th Ed.
5. S. Jain. Microsoft Office 2007 Training Guide. BPB Publications. 2010.

Course Code:	**CH1 111**
Course Name:	**IKS-1: Traditional Yoga and its Modernization for Health Benefits**
L-T-P-C	**1-0-2-2**

Unit I	
Syllabus	**Hours**
Different terminologies and meanings of Yoga, types of yoga, illusions of yoga, benefits of yoga. Details about Ashtanga Yoga, and its types. Understanding of complementary asanas with examples. Pranayama, types and its forms, benefits of pranayama. Understanding of pratyahar and examples.	**15**

Unit II	
Syllabus	**Hours**
Practicing Suryanamaskar, Padmasana, Gomukhasan, Dhanurasan, Tadasan, Padahastasan, Bhadrasan, Shavasan, Utthanpadasan, Purnatitli asan.	**15**

Reading references

1. Swami Vivekananda Complete Book of Yoga Karma Yoga, Bhakti Yoga, Raja Yoga, Jnana Yoga. Arushi Book Enterprises 2023

B.Sc. Chemistry Semester II
Detailed syllabus:

CH1 201: Inorganic Chemistry-I (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 201	**Course name:** Inorganic Chemistry-I

Units	Content	Hours
I	**Atomic Structure:** Bohr's theory, its limitations, and the atomic spectrum of the hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, the significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atoms. 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.	**15**
II	**Ionic bond:** General characteristics, types of ions, size effects, radius ratio rule, and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle, and its application, Solvation energy. **Covalent bond:** Lewis structure, Valence Bond theory and its limitations, types of hybridization and shapes of inorganic molecules and ions, VSEPR theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2^-, and H_2O. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (the idea of s-p mixing and orbital interaction to be given). Formal charge, multiple bonding (σ and π bond approach), and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability, bond strength bond order and bond energy relations, Fajan's rules and consequences of polarization. **Weak Chemical Forces:** Hydrogen bonds, van der Waal's interaction.	**15**

Reading references

Textbooks

1. R L Madan. Chemistry for Degree Students. S. Chand Publications. 2016, 1st Ed.

Reference books

1. H. Petrucci Ralph. *General Chemistry: Principles, Patterns, and Applications*. Saylor Foundation. 2011. 11th Ed. (A free online textbook)
2. J. D. Lee. Concise Inorganic Chemistry. Van Nostrand Reinhold Company. 1977, 3rd Ed.
3. F. A. Cotton, G. Wilkinson and Paul.L. Gaus. Basic Inorganic Chemistry. Wiley Publishers 2001, 3rd Ed.
4. James E. Huheey, Ellen A. Keiter, Richard L. Keiter and Okhil K. Medhi. Inorganic Chemistry: Principles of Structure and Reactivity. Delhi Pearson Education. 2022, 5th Ed.
5. Madan, Malik and Tuli. Selected topics in Inorganic Chemistry. S. Chand Publications New Delhi. 2010 Revised Ed.
6. B. R. Puri, L. R. Sharma and K. C. Kalia. Principles of Inorganic Chemistry. Vishal Publications. 1996.

CH1 202: Physical Chemistry-I (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 202	**Course name:** Physical Chemistry-I

Units	Content	Hours
I	Gaseous State: Kinetic theory of gases, derivation of Boyle's law, Charles law, Avogadro's law from Kinetic theory, 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, degrees of freedom and molecular basis of heat capacities. Behavior of real gases: Deviations from ideal gas behavior, 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 behavior, virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, the relation between critical constants and van der Waals constants, and the law of corresponding states.	**15**
II	Solid State: Types of solids, differences between crystalline and amorphous solids. Types of crystal, space lattice and unit cell of a crystal, different types of unit cells, structures of sodium chloride, cesium chloride, zinc blende, packing of crystals, radius ratio rules, Miller indices, Bragg's law. Liquid State: Intermolecular forces in liquid, vapor pressure, boiling point, surface tension, surface energy, capillary action, and coefficient of viscosity of liquid. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids, refractive index, and Snell's law.	**15**

Reading references

Textbooks

1. Dr. R. L. Madan. Chemistry for Degree Students. S. Chand Publications New Delhi. 2022, 1st Ed.
2. B. R. Puri, Madan S. Pathania, L. R. Sharma. Principles of Physical Chemistry. Vishal Publishing. 2011.
3. R. Gurdeep. Advanced Physical Chemistry. Krishna Prakashan. 2018, 4th Ed.
4. B. R. Puri, L. R. Sharma. Principles of Physical Chemistry. Vishal Publishing. 2018, 1st Ed.

Reference books

1. P. L. Soni. Textbook of Physical Chemistry. P. L. Sultan Chand New Delhi. 2016.
2. C. Kittel. Introduction to Solid State Physics. John Wiley & Sons. 2018, 8th Ed.
3. Prutton and Marron. Principles of physical chemistry. 2017, 4th Ed.
4. Puri and Sharma. Text Book of Physical Chemistry. Vishal Publishing Co. 2020. 1st Ed.
5. K. L. Kapoor. Text Book of Physical Chemistry. McGraw Hill. 2020, 4th Ed.

CH1 203: Inorganic Chemistry-I Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 203	**Course name: Inorganic Chemistry-I Laboratory**

S. No.	Objectives	Hours
1.	Making models for different orbitals with playdough and ball and stick models	**4**
2.	Demonstration of atomic orbitals using virtual labs (https://www.golabz.eu/lab/building-atomic-orbitals)	**4**
3.	Analysis and identification of copper chloride, potassium iodide, calcium chloride, strontium chloride, lithium chloride, barium chloride, and sodium chloride by flame test. (Practice identification of unknown samples by flame test, explain the color with electronic configuration).	**6**
4.	Determination of comparative strength of ionic and covalent bonds using a conductometer (https://www.slideshare.net/Qacey/investigate-the-properties-of-ionic-bond-and-covalent-bond-through-an-experiment)	**6**
5.	Practical demonstration type of bonding using solubility, melting point, and conductivity. (https://www.pasco.com/resources/video/3zJksoLtThA)	**4**
6.	Qualitative analysis of two- and three-ionic mixture using H_2S of mixtures of following ions: NH_4^+, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+ Anions: CO_3^{2-}, S^{2-}, SO_4^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^- (Spot tests should be carried out wherever feasible)	**6**

Reading references

1. Orient Longman. Vogel's Textbook of Quantitative Chemical Analysis. Longman scientific & technical. 1989, 5th Ed.
2. Orient Longman. Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis. Orient Longman. 1982, 5th Ed.
3. Mala Nath. Inorganic Chemistry: A Laboratory Manual Hardcover. Narosa Publishing House Pvt. Ltd. 2016.

CH1 204: Physical Chemistry - I Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 204	**Course name:** Physical Chemistry - I Laboratory

S. No.	Objective	Hours
1.	Demonstration of Kinetic Theory of Gas at different temperatures. (https://sciencing.com/how-8211482-convert-atm-pressure-celsius.html)	**4**
2.	Comparative analysis of physical properties of different liquids. (https://www.youtube.com/watch?v=jFWjjUKwCAk)	**4**
3.	Study of different states of matter (using ice cream bags)	**4**
4.	Determination of surface tension of liquid using various analytical samples	**4**
5.	Study of the variation of surface tension of a detergent solution with concentration.	**4**
6.	Estimation of viscosity coefficient of various analytical liquid samples by Ostwald's viscometry.	**4**
7.	Determination of percent composition of a binary mixture by using surface tension	**4**
8.	Determination of specific refractivity of a given liquid	**2**

Reading references

1. B. D. Khosla, V. C. Garg, Adarsh Gulati. Senior Practical Physical Chemistry. R. Chand & Delhi. 2018.
2. B. Viswanathan, P. S. Raghavan. Practical Physical Chemistry. Navi Mumbai Viva Books Private Limited. 2017.
3. A. K Nad, B. Mahapatra, A. Ghoshal. An Advanced Course in Practical Chemistry Paperback, New Central Book Agency P LTD. 2022.
4. B. Vishwanathan and P.S. Raghavan. Practical Physical Chemistry. Viva Books. 2012.

CH1 205: Chemistry of Materials (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 205	**Course name:** Chemistry of Materials

Units	Content	Hours
I	**Solid State Materials:** Basic concept, Lattice energy, size effects, covalent character in ionic bonds, structures of complex solids, conductivity in ionic solids, and solids held together by different interactions. **Amorphous and Porous Materials:** Crystalline vs. amorphous solids, glass formation, structural models of amorphous materials, evolution and development of porous materials, the chemistry of microporous materials, mesoporous materials, zeolite and zeolite-like materials, polymers and carbon materials in zeolites.	**10**
II	**Polymeric Materials:** Different schemes of classification of polymers, polymer nomenclature, molecular forces, chemical bonding in polymers, and texture of polymers. Synthesis, characterization techniques, properties, and applications of any well-known polymer. Conducting polymers, porous polymers. **Dielectric Materials:** Dielectric constant and polarizability, insulating materials, ferroelectrics, piezoelectrics, measurement of dielectric properties. Representative examples of specific dielectric materials, preparation, characterization techniques, basic properties, and applications. **Silicates:** Glassy state and its properties, classification (silicate and nonsilicate glasses). Composition and properties of the following types of glasses: Soda lime glass, lead glass, armored glass, safety glass, borosilicate glass, fluorosilicate, colored glass, and photosensitive glass. **Nanomaterials:** Properties of nanomaterials, role of size and shape, chemical and biological methods for synthesis, basic characterization techniques.	**20**

Reading references

Textbooks

1. *General Chemistry: Principles, Patterns, and Applications*. Saylor Foundation, 2011.
2. A. R. West. Solid State Chemistry and its applications. Wiley. 2014, 2nd Ed.
3. J. Shackelford. *Introduction to Materials Science for Engineers*. Pearson. 2004, 6th Ed.
4. B. D. Cullity and S. R. Stock. *Elements of X-Ray Diffraction*. Pearson. 2001, 3rd Ed.
5. B. Averill and P. Eldredge. *Chemistry: Principles, Patterns, and Applications*. Pearson. 2007.

Reference books

1. A.K. Cheetham and P. Day, Solid State Chemistry: 1. Techniques and 2. Applications
2. P.A. Cox, The electronic structure and chemistry of solids
3. Klabunde, K. J., Ed. *Nanoscale Materials in Chemistry*, Wiley Interscience (2001)

4. N.N. Greenwood, Ionic crystal, lattice defect and non-stoichiometry
5. C.N.R. Rao and J. Gopalakrishnan, New directions in solid state chemistry

Web reference

https://ocw.mit.edu/courses/3-091sc-introduction-to-solid-state-chemistry-fall-2010/pages/syllabus/

CH1 206: Chemistry of Materials Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 206	**Course name:** Chemistry of Materials Laboratory

S. No.	Objectives	Hours
1.	Analysis of the crystal structure of a given sample	4
2.	Identification and analysis of crystal imperfections in a given sample	4
3.	Observation and analysis of the thermosetting of plastic	4
4.	Synthesis and characterization of nanoparticles by sol-gel method	4
5.	Analysis of the properties of various types of plastics	4
6.	Preparation and characterization of CNTs	4
7.	Preparation and characterization of metallic nanoparticles	4
8.	Preparation of porous materials	2

Reading references

1. A.K. Cheetham and P. Day, Solid State Chemistry: 1. Techniques and 2. Applications
2. P.A. Cox, The Electronic Structure and Chemistry of Solids
3. Klabunde, K. J., Ed. *Nanoscale Materials in Chemistry*, Wiley Interscience (2001)
4. N.N. Greenwood, Ionic Crystal, Lattice Defect and Non-Stoichiometry
5. C.N.R. Rao and J. Gopalakrishnan, New Directions in Solid State Chemistry

CH1 207: Physics of Semiconductor Devices (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 207	**Course name:** Physics of Semiconductor Devices

Units	Content	Hours
I	Band Theory of Solids: Introduction, Metals, Insulators and Semiconductors, Energy band gap, Fermi Level and Fermi energy, Types of magnetic material, Superconductivity, Properties of superconductors, Types of superconductors (Type I and Type II), London's Penetration depth, Applications of Superconductors.	**15**
II	PN Junction diode, FB and RB condition for PN junction and IV characteristics, LED, Half wave-full wave rectifier, Photodiode, Varactor Diode, Filter circuits: L, C and Π type filters, Transistor, IV characteristics of CE mode, Binary-octal-hex decimal number system and mutual conversions, Illustrative examples.	**15**

Reading references
Textbooks

1. R. K. Puri and V. K. Babbar. Solid State Physics. S. Chand & Co. Ltd. 2010.
2. V. K. Mehta. Principles of Electronics. S. Chand & Co. Ltd. 2014, 7th Ed.
3. A. Bieser. Concepts of Modern Physics. Tata McGraw-Hill. 2002, 6th Ed.

Reference books

1. R. K. Hair and S. L. Gupta**.** Engineering Physics. Dhanpat Rai. 2012.
2. Charles Kittel. Introduction to Solid State Physics. John Wiley & Sons. 2018, 8th Ed.
3. S. M. Sze and Kwok K. Ng. Physics of Semiconductor Devices. Wiley. 1996.
4. P. Bhattacharya. Semiconductor Opto-Electronic Devices. Prentice Hall. 1996. 2nd Ed.
5. M. K. Achuthan and K. N. Bhat. Fundamentals of Semiconductor Devices. McGraw Hill Education. 2007. 1st Ed.
6. J. Allison. Electronic Engineering Materials and Devices. McGraw Hill Education. 1990.

CH1 208: Physics of Semiconductor Devices Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 208	**Course name: Physics of Semiconductor Devices Laboratory**

S. No.	Objectives	Hours
1.	Determination of lengths of different objects using vernier caliper and screw gauge.	4
2.	Verification of the Truth Table of Logic Gates.	4
3.	Verification of the functionality of the PN junction diode in forward bias and reverse bias.	4
4.	Analysis of the charging & discharging of a given capacitor.	4
5.	Analysis of the frequency response characteristics of a series and parallel resonance circuits	4
6.	Construction of a half-wave and full-wave rectifier circuit and analysis of its output.	2
7.	Determination of the Hall voltage developed across the sample material and the Hall coefficient of the sample material.	4
8.	Determination of the provided high resistance by the substitution method	2
9.	Evaluation of frequency response of a single pnp transistor using the common emitter transistor amplifier	2

Reading references

1. R. K. Puri and V. K. Babbar. Solid State Physics. S. Chand & Co. Ltd. 2010.
2. V. K. Mehta. Principles of Electronics. S. Chand & Co. Ltd. 2014, 7th Ed.
3. https://www.amrita.edu/course/physics-semiconductor-devices/

CH1 209: English Language-2 (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 209	**Course name:** English Language-2

Units	Content	Hours
I	**Communication Skills, Speaking & GrammarCommunication & Speaking Skills** Oral Communication: 6 C's of Communication, conversation in pairs with the help of Cue-cards and effective presentation strategy, P's of presentation preparing outline of the presentation. Explaining their ideas and feelings in simple English. Situations will be drawn from their everyday experiences, group discussion dynamics, and brainstormingon current news affairs. **Advance Grammar and Vocabulary** Voice –Active/Passive, Use of Adjective and Adverb, Difference between Simple, Compound and Complex sentences, confusables, affixes, idioms, and one-word substitutes.	**15**
II	**Reading Skills & Writing SkillsReading Skills** Reading comprehension of general passages, Reading Technicalpassages, Reading General passages, Reading cases/cases and advertisements from newspaper/magazines. **Writing Skills** Defining report, the purpose of report writing & its significance, explaining various characteristics, types, and elements of report writing Discussing the difference between reference and bibliography, Explaining the difference between Resume and Bio-data, preparing resume, Explaining Précis writing and its significance and practice, Preparing Advertisement	**15**

Reading references

1. Dr. Sanjay Kumar and Dr. PushpLata. Communication Skills, A Workbook. Oxford University Press. 2018, 1st Ed.
2. Meenakshi Raman and Sangeeta Sharma. Technical Communication; Principles and Practice. Oxford University Press. 2015, 3rd Ed.
3. R. C. Sharma and Krishna Mohan. Business Correspondence and Report writing. Tata Mcgraw Hill. 2015, 8th Ed.
4. M Ashraf Rizvi. Effective Technical Communication. SIA Publishers. 2022, Latest Ed.

CH1 210: Techniques of Chemical Analysis (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 210	**Course name:** Techniques of Chemical Analysis

Units	Content	Hours
I	Chromatographic Techniques: Principles of chromatographic separation, Rf factor, paper and thin layer chromatography, solvent system, eluents	**7**
II	Chemical Conductivity: Types of solutions, electrolysis and electrolytes,conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration	**8**

Experiments to be performed		
S. No.	**Objectives**	**Hours**
1.	Chromatographic Techniques: Separation of two or more components by Paper Chromatography	6
2.	Separation of two or more components by Thin Layer Chromatography	6
3.	Comparison of Rf value in different Solvent System	4
4.	Chemical Conductivity: Measurement of chemical conductivity	6
5.	Determination of pH by pH meter	4
6.	Comparison of conductivity of different electrolytes	4

Reading references

1. A Handbook of Chromatography by Anna P. G. Nikalje, Scholar's Press VerlagOmniscriptam, Deutschland, Germany. ISBN: 978-3-330-65032-9.

CH1 211: Health and Nutrition (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 211	**Course name:** Health and Nutrition

Units	Content	Hours
I	**Food and Nutrition:** The basics of plant and animal foods, their types, structure and composition, and nutritional value. Balance diet, Calorificvalues of different food items. Cereals and MilletsPulses Fats & oils Fruits and vegetables milk and milk products	**15**
II	**Food Borne Diseases:** Types and control measures, Food Infection and Intoxication- Bacteria and Non-bacteria, Probiotics-Nutritional and therapeutic aspects,Therapeutic values of fermented foods Diseases related to food, vitamins and mineral deficiencies	**15**

Reading references

1. B. Srilakshmi., (2018). Food Science. K. R., New Age International Pvt.Ltd. 7th Edition.
2. L. H. Meyer., (2006). Food Chemistry. CBS Publishers and Distributors,New Edition.
3. B. Poornima., (2012). Fundamentals of Food Science, Technology andProcessing and Preservation. Centrum Press.

B.Sc. Chemistry Semester III
Detailed syllabus with Course Learning Outcomes

Program: B. Sc. Chemistry	**Semester:** III
Course code: CH2 101	**Course Name:** Organic Chemistry -II

Lect.	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Pass (%)
2	-	2	30	Lecture	CCE, ESE	50	40

Course Description: This course deals with understanding the chemistry of oxygenated hydrocarbon and carbonyl compounds. It covers preparation, physical and chemical properties, and reactivity of oxygenated hydrocarbon and carbonyl compounds. This course also explains the reaction mechanism of related name reactions.

Course Learning Outcomes: At the end of this course students will be able to
CLO1: Remember the related name reaction of alcohols and carbonyl compounds
CLO2: Understand the mechanism name reactions related to carbonyl compounds
CLO3: Apply the knowledge of name reactions of carbonyl compounds
CLO4: Explain the reaction mechanism of alcohols and carbonyl compounds

Detailed Syllabus

Units	Content	Hours
I	**Chemistry of oxygenated Hydrocarbons**: **Alcohols:** preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt Blanc Reduction; Oxidation of diols by periodic acid and lead tetraacetate, Pinacol Pinacolone rearrangement; **Phenols**: Preparation and properties; Acidity and factors affecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism. **Ethers and Epoxides:** Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4.	**15**
II	**Chemistry of Carbonyl Compounds:** Structure, reactivity, preparation and properties; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Benzoin condensation, Knoevenagel condensation, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α - substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$) Addition reactions of α, β- unsaturated carbonyl compounds: Michael addition.	**15**

Reading references

1. S. M. Mukherji and S.P. Sing. Mechanism and Structure in Organic Chemistry. New Age Publishers. 2017.
2. Morrison Boyd and Bhattacharjee. Organic Chemistry. Pearson Education India. 2010, 7th Ed.
3. I. L. Finar. Organic Chemistry (Volume I), Dorling Kindersley (India) Pvt. Ltd. Pearson Education. 1963, 4th Ed.
4. V. K Ahluwalia, P. Bhagat, R. Aggarwal, R. Chandra. Intermediate for Organic Synthesis. I. K. International. 2005.

5. T. W. G. Solomons, C. B. Fryhle, S. A. Snyder. Organic Chemistry. Wiley. 2016, 12th Ed.
6. R. Chandra, S. Singh, A. Singh. Organic Reactions and their Nomenclature. Arcler Education Inc. 2019.
7. Bhupinder Mehta and Manju Mehta. Organic Chemistry. PHI Learning Private Limited. 2015, 2nd Ed.

Program: B. Sc. Chemistry	**Semester:** III
Course Code: CH2 102	**Course name:** Inorganic Chemistry-II

Lect.	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Pass (%)
2	--	2	30	Lecture	CCE, ESE	50	40

Course Description: This course deals with understanding different chemical bonding in a molecule. This course also explains polarity, the deformation of ions, and the consequences of deformation. This course also delivers the idea about molecular orbital theory (MOT) of some small molecules and weak chemical forces including H-bonding.

Course Learning Outcomes: At the end of this course students will be able to
CLO1: Define different bonding patterns in a molecule.
CLO2: Predict the geometry of any molecule using VSEPR theory.
CLO3: Apply the concept of Fazan's rule, Born-Haber Cycle, Born-Lande equation.
CLO4: Analyze different weak intermolecular forces.

Detailed Syllabus

Units	Content	Hours
I	**Chemical Bonding**: Lewis structure, Resonance and resonance energy, Formal charge, multiple bonding (σ and π bond approach), and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules and consequences of polarization, bond strength bond order and bond energy relations, Hydrogen bond, intramolecular hydrogen bond and intermolecular hydrogen bond, Hybridization of orbitals, Valence Bond theory and its limitations, types of hybridization and shapes of inorganic molecules and ions, VSEPR theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2^-, and H_2O. Bent's rule, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2.	10
II	**Ionic Bond**: General characteristics of ionic compounds, melting point, boiling point, hardness, solubility, conductance, radius ratio rule, coordination number, limitation of radius-ratio rule, lattice energy, Born-Lande equation for lattice energy, comparison between lattice energy and hydration energy, Born-Haber cycle, metallic bond, Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference. Metallic Bond.	10
III	**Non-bonding interaction:** Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Hydrogen bond, intramolecular and intermolecular hydrogen bond, Application of hydrogen bonding, factors determining Van der Waal's force, Repulsive forces, Hydrogen bonding: types, applications, Effects of chemical forces	10

Reading references

1. J. D. Lee. Concise Inorganic Chemistry. Blackwell Science. 2008, 5th Ed.
2. R. P. Sarkar. General and Inorganic Chemistry. vol-I&II. New Central Book Agency. 2012.
3. F. A. Cotton, G. Wilkinson, Paul. L. Gaus. Basic Inorganic Chemistry. Wiley. 2007, 3rd Ed.
4. Dr. R. L. Madan. Chemistry for degree students. S Chand and Company Limited. 2010, 2nd Ed.

Program: B. Sc. Chemistry	**Semester:** III
Course Code: CH2 103	**Course Name:** Physical Chemistry-II

Lect.	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Pass (%)
2	-	2	30	Lecture	CCE, ESE	50	40

Course Description: This course is designed to fully understand the major concepts of Chemical Thermodynamics. It covers principles of classical thermodynamics. Develops understanding of mass, energy, heat, work, efficiency, entropy, enthalpy, Gibbs free energy, ideal and real thermodynamic cycles and processes. The course also covers the first, second, third, and zeroth laws of thermodynamics and concepts in thermochemistry. More emphasis will be given to various free energy functions.

Course Learning Outcomes: At the end of this course students will be able to

CLO1: Recognize and use the thermodynamic parameters correctly.

CLO2: Understand the first, second, third, and zeroth laws of thermodynamics.

CLO3: Apply the knowledge of chemical thermodynamics to interpret the chemical reactions.

CLO4: Correlate thermodynamics to solve practical problems in physical and chemical systems.

Detailed Syllabus

Units	Content	Hours
I	Intensive and extensive variables; state and path functions; isolated, closed, and open systems; zeroth law of thermodynamics. **First law:** Concept of heat, work, internal energy, and statement of first law; enthalpy, *H*, the 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, bond dissociation energy, and resonance energy from thermochemical data, the effect of temperature (Kirchhoff's equations) and pressure on the enthalpy of reactions. Adiabatic flame temperature, explosion temperature.	**15**
II	**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, calculation of absolute entropy of molecules. **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; Maxwell relations; thermodynamic equation of state. Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases	**15**

Reading references

Textbooks

1. G. W. Castellan Physical Chemistry by Narosa Publication 2004 3rd Edition

2. P. C. Rakshit Physical Chemistry Levant Books 2020 7th Edition
3. R. L. Madan Chemistry for Degree Students S. Chand Publications, 2022 1st Edition.
4. Advanced Physical Chemistry, Raj, Gurdeep, Meerut: Krishna Prakashan, 2018 4th Edition
5. Principles of Physical Chemistry, Puri, B. R., Sharma, L. R., Vishal Publishing CO. Delhi: 2016 4th Edition

Reference books

6. Prutton and Maron. Principles of Physical Chemistry Oxford & IBH Publishing Ltd., 2017
7. P. K. Nag Basics and Applied Thermodynamics Tata Mcgraw-Hill 2006, 8th Edition

Program: B. Sc. Chemistry	**Semester:** III
Course Code: CH2 104	**Course Name:** Organic Chemistry-II Laboratory

Lect.	**Practical (Hours)**	**Credits**	**Total Hours**	**Evaluation Scheme**			
				Component	**Exam**	**Max. Marks**	**Pass (%)**
--	4/week	2	60	Lab	CCE, ESE	50	40

Course Description: This is a practical course in organic chemistry. This covers learning and analyzing the various functional groups of organic compounds. This course also deals with the determination of the melting points, and solubility of given organic compounds. This course also deals with the synthesis of organic compounds such as *m*-nitroaniline, and acetanilide.

Course Learning Outcomes: At the end of this course students will be able to
Find the suitable test for the detection of different functional group
Learn the acetylation, oxidation, and reduction of organic molecules
Learn the preparation of derivatives

Detailed Practical

S. No.	**Name of the Experiment**	**Hours**
1	Analyzing the solubility of a given compound	5
2	Determination of the melting point of a given solid sample	5
3	Functional group analysis: characteristic tests for aromatic amine group	5
4	Functional group analysis: characteristic tests for ketone group	5
5	Functional group analysis: characteristic tests for phenolic hydroxy group	5
6	Functional group analysis: characteristic tests for carboxylic acid group	5
7	Acetylation of one of the following compounds: amines (aniline, *o-, m-, p-* toluidine and *o-, m-, p*-anisidine) and phenols (β -naphthol, vanillin, salicylic acid) by any one method: i. Using the conventional method. ii. Using a green approach	10
8	Oxidation of ethanol/ isopropanol (Iodoform reaction	10
9	Selective reduction of meta dinitrobenzene to m-nitroaniline	10

Reading references

1. B. S. Furniss. Vogel Textbook of Practical Organic Chemistry. Pearson Education. 2011,
2. A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hannaford and Smith, P. W. G. Textbook of Practical 3. Organic Chemistry. Prentice-Hall. 1996, 5th Ed.
4. A. K. Nad and B Mahapatra. An Advanced Course in Practical Chemistry. New Central Book Agency. 2022, 3rd Ed.
5. V. K Ahluwalia and Sunita Dhingra. Practical Organic Chemistry. New Central Book Agency. 2017, 1st Ed.
6. N. K. Vishnoi. Advanced Practical Organic Chemistry. Vikas Publication. 2009, 3rd Ed.

Program: B. Sc. Chemistry	**Semester:** III
Course code: CH2 105	**Course name:** Inorganic Chemistry-II Laboratory

Lect.	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Pass (%)
--	4/week	2	60	Lab	CCE, ESE	50	40

Course Description: This is a practical course of inorganic chemistry. This covers learning and analyzing the various group I and II. This course also deals preparation and estimation of coordination complexes of metals like Cu and Ni. This course also deals with determination of water of hydration in a given sample.

Course Learning Outcomes: At the end of this course students will be able to
CLO1: Identify the suitable reagent for group I and group elements.
CLO2: Understand the preparation and characterization of coordination complexes.
CLO3: Demonstrate the formation of Cu and Ni complexes
CLO4: Analyze the water of hydration in coordination compounds.

Detailed Practical

S. No.	Name of the Experiment	Hours
1.	Analysis and identification of group-I halides (potassium iodide, lithium chloride, and sodium chloride by flame test	5
2.	To analyze and identify the group-II halides (calcium chloride, strontium chloride, barium chloride	5
3.	Preparation of tetramine-copper (II) sulfate Complex and calculation of the yield from the stoichiometric equation.	5
4.	To Prepare hexamine nickel (II) chloride and calculate the yield from the stoichiometric equation	5
5.	To Determine the formula of an unknown hydrated sample	5
6.	To separate the given inorganic mixture using the filtration process	5
	Virtual Experiments	
7.	Determination of comparative strength of ionic and covalent bonds using a conductometer (https://www.slideshare.net/Qacey/investigatethe-properties-of-ionic-bond-and-covalent-bonthroughan-experiment)	10
8.	Practical demonstration type of bonding using solubility, melting point, and conductivity. (https://www.pasco.com/resources/video/3zJksoLtThA)	10

Reading references

1. Vogel's Textbook of Quantitative Chemical Analysis, 5th Ed., Orient Longman, 1989.
2. Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, 5th Ed, Orient Longman, 1982.
3. Inorganic Chemistry: A Laboratory Manual by Mala Nath, 2016

Program: B. Sc. Chemistry	**Semester:** III
Course code: CH2 106	**Course name:** Physical Chemistry-II Laboratory

Lect.	**Practical (Hours)**	**Credits**	**Total Hours**	**Evaluation Scheme**			
				Component	**Exam**	**Max. Marks**	**Pass (%)**
-	4/week	2	60	Lab	CCE, ESE	50	40

Course Description: This course is a practical course in Physical Chemistry. Through this course, the students will get an insight into learning by performing hands-on experiments and practicals. From this course, they can understand and learn basic thermodynamic parameters like work done, enthalpy, entropy change, etc.

Course Learning Outcomes: At the end of this course students will be able to
CLO1: Identify the first law of thermodynamics
CLO2: Recognize the second law of thermodynamics
CLO3: Estimate property changes of mixing
CLO4: Evaluate Hess's law

Detailed Syllabus

S. No.	**Experiment**	**Hours**
1.	Demonstration of the first law of thermodynamics using simple household systems	6
2.	Determination of heat loss by the reactants in an exothermic reaction by calculating the heat gained by the products of that reaction.	6
3.	Experimental demonstration of the second law of thermodynamics with glow sticks	6
4.	Determination of the integral heats of dilution of H_2SO_4 starting with 10M acid and going down to 5M acid in the order 9M, 8M, 7M, 6M.	6
5.	Determination of heat loss by the reactants in an exothermic reaction by calculating the heat gained by the products of that reaction.	6
6.	Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide using a coffee mug calorimeter	6
7.	Investigation of the solubility of benzoic acid in water and determination of change in enthalpy.	6
8.	Determination of enthalpy of hydration of copper sulphate	6
9.	Experimental determination of ΔH values of two reactions using the technique of constant pressure calorimeter	6

List of virtual experiments

1.	Work done by the system and on the system
2.	Model of a heat engine
3.	Demonstration of adiabatic expansion – cloud in a bottle

Reading references

1. B. D. Kholsa, V. C. Garg, Senior Practical Physical Chemistry Delhi: R. Chand, 2018, 18th Edition
2. B. Viswanathan, P. S. Raghavan Practical Physical Chemistry Navi Mumbai Viva Books Private Limited 2017, 1st Edition
3. A. K. Nad, B. Mahapatra, A. Ghoshal. An Advanced Course in Practical Chemistry Paperback, l New Central Book Agency P LTD 2012, 3rd Edition
4. J. N. Gurtu and Amit Gurtu Advanced Physical Chemistry Experiments Pragati Prakashan 2008,

Program: B. Sc. Chemistry	**Semester:** III
Course code: CH2 107	**Course name:** Semiconductor Devices

Lect.	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing (%)
2	--	2	30	Lecture	CCE, ESE	50	40

Course Description: In this course, students will learn basics of the lattice vibrations, different theories to understand the physical properties of solids. This course will also be helpful to understand the concepts of semiconductor devices such as diodes and transistors which can help the students to apply the concepts in the real-life problems.

Course Learning Outcomes: At the end of this course students will be able to
CLO1: Remember the basic concept of different semiconducting devices.
CLO2: Understand the concept of phonons, diodes and transistors, and related fields.
CLO3: Examine the behavior of physical properties of solid materials.
CLO4: Analyze the concepts of diodes and transistors and apply them to real-life problems.

Detailed Syllabus

Units	Content	Hours
I	**Lattice Vibrations:** Elastic and atomic force constant, Brillioun zone, Dispersion relation, Dynamics of a chain of atoms, chain of two types of atoms, optical and acoustic modes, Phonons, Momentum of phonon, interaction of light with ionic crystals, inelastic collision of photon by phonon, Einstein's and Debye's theories of specific heat of solids, lattice heat capacity, density of modes, Debye approximation, examples	**15**
II	**Semiconductor Diodes & Transistors:** Drift of Carriers in Electric and Magnetic Fields, Principal and Application of Light Emitting Diode, Photodiode, Varactor Diode, Zener Diode, Tunnel Diode Illustrative examples and related problems. Characteristics of npn and pnp transistor, active and saturation region, common emitter, common base and common collector configuration, input and output characteristics, basics of field effect transistor (FET) and junction field effect transistor (JFET).	**15**

Reading references
Textbooks

1. R. K. Puri and V. K. Babbar. Solid State Physics. S. Chand & Co. Ltd. 2010.
2. V. K. Mehta. Principles of Electronics. S. Chand & Co. Ltd. 2014, 7th Ed.
3. A. Bieser. Concepts of Modern Physics. Tata McGraw-Hill. 2002, 6th Ed.

Reference books

7. Charles Kittel. Introduction to Solid State Physics. John Wiley & Sons. 2018, 8th Ed.
8. S. M. Sze and Kwok K. Ng. Physics of Semiconductor Devices. Wiley. 1996.
9. P. Bhattacharya. Semiconductor Opto-Electronic Devices. Prentice Hall. 1996. 2nd Ed.
10. M. K. Achuthan and K. N. Bhat. Fundamentals of Semiconductor Devices. McGraw Hill Education. 2007. 1st Ed.
11. J. Allison. Electronic Engineering Materials and Devices. McGraw Hill Education. 1990.

Program: B. Sc. Chemistry	**Semester:** III
Course code: CH2 108	**Course name:** Semiconductor Devices Laboratory

Lect.	**Practical (Hours)**	**Credits**	**Total Hours**	**Evaluation Scheme**			
				Component	**Exam**	**Max. Marks**	**Pass (%)**
-	4/week	2	60	Lab	CCE, ESE	50	40

Course Description: This is a practical course in physics that deals with the characteristics of different types of semiconductor devices. This course also explains the experimental learning of the semiconductor devices. This course will also help to understand and learn the designing of different electrical circuits.

Course Learning Outcome: At the end of this course students will be able to
CLO1: Record the change in current due to the change in voltage supply.
CLO2: Estimate the I-V characteristics of semiconductor devices such as diodes and transistors.
CLO3: Examine whether the provided semiconductor device is working or not by demonstrating the proper circuits.
CLO4: Design different types of electrical circuits such as in logic gates.

Detailed Syllabus

S. No.	**Experiments**	**Hours**
1.	Using Common Emitter Transistor Amplifier plot the Frequency response of a single PNP Transistor.	8
2.	To design the electrical circuit of different logic gates and verify the truth table for the same.	8
3.	(a) To determine the Hall voltage developed across the given material. (b) To calculate the Hall coefficient of the same material.	10
4.	To analyze the half wave and full wave rectifier output using a capacitor in shunt as a filter.	10
5.	Determine the figure of merit of a given Galvanometer.	8
6.	To verify Stefan's Law of radiation (The law states that the amount of energy radiated through unit time from the surface of a black body is directly proportional to the fourth power of its absolute temperature).	8
7.	To determine the given high resistance by the Substitution method.	8

Reading reference

1. V. K. Mehta, Principles of Electronics, S. Chand & Co. Ltd., 2007
2. Kumar P. R. S., Practical Physics, PHI, 2011
3. Harnam Singh and P. S. Hemne, Practical Physics, S. Chand & Ltd., 2000.
4. S. K. Ghosh, Advanced Practical Physics, NCBA, 2010

Program: B. Sc. Chemistry	**Semester:** III
Course code: CH2 109	**Course name:** Soft Skills

Lect.	**Practical (Hours)**	**Credits**	**Total Hours**	**Evaluation Scheme**			
				Component	**Exam**	**Max. Marks**	**Passing (%)**
2	--	2	30	Lecture	CCE, ESE	50	40

Course Description: In this course, students will be able to learn basics of the communication skills and SWOT analysis. This course will also be helpful for students in their goal-setting, self-analysis, and creative thinking. This course will also help to understand the corporate etiquette.

Course Learning Outcomes: At the end of this course students will be able to
CLO1: Remember the basics of communication skills and self-analysis.
CLO2: Understand the goal-setting and creative thinking.
CLO3: Observe the effective communications and presentation.
CLO4: Analyze the corporate etiquette.

Detailed Syllabus

Units	**Content**	**Hours**
I	SWOT Analysis • Who am I? • Factors influencing Self Perception • Self Esteem • Understanding positive and negative attitudes Goal Setting • Types of Goals: Immediate, Short term, Long term Strategies to Achieve Goals	15
II	Creativity • Out-of-box thinking • Lateral Thinking • Innovative Thinking Corporate Etiquettes • E-mail etiquette, Telephone etiquette, Dining etiquette, Office meeting etiquettes, Dress etiquette	15

Reading references

1. Jeff Butterfield, Soft Skills for Everyone by. Cengage publications. 2020, 2nd Ed.
2. Barun K Mitra. Personality Development and Soft Skills. Oxford University Press India. 2016, 2nd Ed.
3. Edward de Bono. Lateral Thinking: Creativity Step by Step. Harper Perennial. 2015, Reissue Ed.

Program: B. Sc. Chemistry	**Semester:** III
Course code: CH2 110	**Course name:** Laboratory Operations and Safety Measures

Lect.	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Pass
2	-	2	30	Lecture	CCE, ESE	50	20

Course Description: This course deals with understanding of various chemical operations in the laboratory. This course also explains the handling of chemicals and materials with proper guide and regulations. This course also delivers essential safety measures required in chemical laboratories.

Course Learning Outcomes: At the end of this course students will be able to

CLO1: Understand the safe working practices in a chemistry laboratory.

CLO2: Handle safely different glass apparatus.

CLO3: Analyze the chemicals and equipment safety in the laboratory.

CLO4: Apply protocols and methods for instruments in the laboratory.

Detailed Syllabus

Units	Content	Hours
I	**Laboratory Operations** Understanding of handling and use of common laboratory apparatus, various types of apparatus in labs such as glass apparatus, Plastic Apparatus, Metal Apparatus *etc.*, and Protocol of Cleaning and drying of glassware apparatus. Identification and set up of Apparatus assemblies and operational procedural protocols such as calibration of Volumetric/ Graduated Glassware Apparatus along with description, Knowledge and working protocol for various heating equipment in laboratory: Burners, Hot Plates, Heating Mantles, Muffle Furnace, Stirring apparatus in a laboratory: Use of Magnetic Stirrer and Mechanical Shaker, Heating and Cooling Bath. Various types of Filter Paper, Use of Analytical Balance: Mass and Weight, Use of melting point apparatus. assemblies of apparatus for distillation and refluxing, Assessment of distillation of inflammable solvents. Preparation of Chemical Laboratory Reagents.	**15**
II	**Safety Measures** Design a chart exhibiting of Do's and Don'ts instructions in a chemistry laboratory, Classification and labeling of the given set of chemicals, preparation of the indicative MSDS (Material Safety Data Sheet), Design of Common Safety Symbols along with its description. Identify and enlist the Incompatible Chemicals from a given set of chemicals, Describe procedure for the storage, maintenance and handling of compressed gas cylinders, Explore guidelines for the Storage of shelf chemicals and reagents, Carry out a detailed study of the Limits of Exposure of given Chemicals, Classify the Hazard based on storage, handling, and disposal of chemicals, procedural protocols for safe Disposal of Chemicals, Carry out investigations of the data regarding Institute Safety Policies: Safety Audits / Inspections.	**15**

Reading references

1. D. A. Skoog, D. M. West and F. J. Holler. Fundamentals of Analytical Chemistry. Saunders College Publishing. 1991, 2nd Ed.
2. J. Mendham. Vogels Textbook of Quantitative Chemical Analysis, Pearson Education. 2002, 6th Ed.
3. B. S. Furniss, A. J. Hannaford, Smith, W. G. Peter, A. R. Tatchell, Vogel's Text Book of Practical Organic Chemistry. Longman Scientific and Technical, Longman Group Ltd. 5th Ed. 1989.

Program: B. Sc. Chemistry	**Semester:** III
Course Code: CH2 111	**Course Name:** Indian Culture and Civilization

Lect.	**Practical (Hours)**	**Credits**	**Total Hours**	**Evaluation Scheme**			
				Component	**Exam**	**Max. Marks**	**Pass (%)**
2	-	2	30	Lecture	CCE, ESE	50	20

Course Description: The course on Indian Culture and Civilization will deliver in-depth knowledge regarding various aspects of Indian culture. The course also intends to understand the development of early civilizations in India. It will introduce the students to various dynasties that ruled over India. It will inspire students to appreciate, the literature, art, and architecture of ancient India.

Course Learning Outcomes: At the end of this course students will be able to
CLO1: Understand Indian culture and history.
CLO2: Describe Indian heritage and ethnicity.
CLO3: Explain Indian science, art, literature, and architecture.
CLO4: Analyze the underlying unity amidst diversity in all aspects of India's culture.

Detailed Syllabus

Units	**Content**	**Hours**
I	Characteristics of Indian culture, importance of Indian culture in one's life, variety in unity, secular outlook, universalism, Materialism and spiritualism, Ethics of Indians, Indian language, literature (an introduction of Vedic Samhitas and Upnishadas), painting, music, dance, drama, movies, Indian architecture (town planning of Indus valley civilization. Sculpture and Architecture of Indus valley civilization), India's contribution to global world heritage, through its culture civilization and diversity. Religion and Philosophy in Ancient and Medieval India, Religious Reforms in modern India, cultural history of Gujarat during ancient, medieval, and modern ages.	**15**
II	Surveys the rise of civilization and kingdoms on the Indian subcontinent from the first urban centers of the Indus Valley through the establishment of the Mughal Empire in the 16th century. Uses literary, archeological, linguistic, ethnological, and inscriptional evidence on the diversity of Indic peoples and their complex social, religious, and caste integration into the major states and empires of pre-modern India; considers wider civilizational networks and extensions of the Indian cultural sphere into other parts of Asia; integrates a historical and anthropological perspective on various primary materials.	**15**

Reading references

1. A. L. Basham. The Wonder That Was India. Vol - I. Rupa books New Delhi. 2004, 16th Ed.
2. Thaper Romila. A History of India Vol – I. Penguin India. 2000, 14th Ed.
3. D. D. Kosambi. The Culture and Civilization of Ancient India. Vikas Publishing House Pvt Ltd. 1997, 1st Ed.
4. D. D. Kosambi. An Introduction to the Study of Indian History. Sangam Books Ltd. 2023.
5. R. C. Majumdar. Ancient India. Motilal Banarsidass. 2017, 10th Ed.

B.Sc. Chemistry Semester IV
Detailed syllabus

Course Code	**CH2 201**
Course Name	**Organic Chemistry-III**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
Carboxylic Acids and their Derivatives: General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength. Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann- bromamide degradation and Curtius rearrangement. **Aromaticity of polynuclear hydrocarbons:** structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.	**15**

Unit II	
Syllabus	**Hours**
Nitrogen Containing Functional Groups: Preparation and important reactions of nitro compounds, nitriles and isonitriles. Amines: Preparation and properties: Effect of substituent and solvent on basicity; Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications. **Heterocyclic Compounds**: Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Indole(Fischer indole synthesis and Madelung synthesis), Quinoline and isoquinoline, (Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner- Miller, Pictat-Spengler reaction, Pomeranz-Fritsch reaction).	**15**

Reading references

1. Morrison Boyd and Bhattacharjee. Organic Chemistry. Pearson Education India. 2010, 7th Ed.
2. I. L. Finar. Organic Chemistry (Volume I), Dorling Kindersley (India) Pvt. Ltd. Pearson Education. 1963, 4th Ed.
3. I. L. Finar. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. Pearson Education. 2002, 5th Ed.
4. R. M. Acheson. Introduction to the Chemistry of Heterocyclic Compounds. John Welly & Sons. 2008, 3rd Ed.
5. T. W. Graham Solomons. Organic Chemistry. John Wiley & Sons, Inc. 2017, 12th Ed.
6. P. S. Kalsi. Textbook of Organic Chemistry. New Age International (P) Ltd. Pub. 2000, 1st Ed.
7. Greeves, Warren, and Wothers Clayden. Organic Chemistry. Oxford University Press. 2014, 2nd Ed.
8. J. Singh, S. M. Ali, J. Singh. Natural Product Chemistry. Pragati Parakashan. 2010.

Course Code:	**CH2 202**
Course Name:	**Inorganic Chemistry-III**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
Periodicity of Elements: s, p, d, f-block elements, the long form of the 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 the periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, and group electronegativity.	**15**
Unit II	
Syllabus	**Hours**
Chemistry of s and p Block Elements: Inert pair effect, Relative stability of different oxidation states, diagonal relationship, and anomalous behavior of the first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent, and interstitial. Basic beryllium acetate and nitrate. Study of the following compounds with emphasis on structure, bonding, preparation, properties, and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides, and oxoacids of nitrogen, phosphorus, and chlorine. Peroxo acids of sulfur, interhalogen compounds, polyhalide ions, pseudo halogens, and basic properties of halogens.	**15**

Reading references

1. R. L. Madan. Chemistry for Degree Students. S. Chand Publications. 2016, 1st Ed.
2. R. Sarkar. General and Inorganic Chemistry. New Central Book Agency. 2011, 3rd Ed.
3. J. D. lee. Concise Inorganic chemistry. Oxford University Press. 2008, 5th Ed.
4. F. A. Cotton, G. Wilkinson, Paul. L. Gaus. Basic Inorganic Chemistry. Wiley. 2007 3rd Ed.
5. N. N. Greenwood and A. Earnshaw. Chemistry of the elements. Pergamon Press 1989.

Course Code:	CH2 203
Course Name:	Physical Chemistry-III
L-T-P-C	2-0-0-2

Unit I	
Syllabus	**Hours**
Ionic equilibrium: Strong, moderate, and weak electrolytes, degree of ionization, factors affecting the 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 (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis, Buffer solutions; Henderson equation and its applications; buffer capacity, buffer range, buffer action Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Theory of acid-base indicators; selection of indicators and their limitations. **Chemical equilibrium:** 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. A coupling of exoergic and endoergic reactions.	15

Unit II	
Syllabus	**Hours**
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 principle. **Chemical kinetics:** Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated forms 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. Collision theory of reaction rates.	15

Reading references

Textbooks

1. R. L. Madan. Chemistry for Degree Students. S. Chand Publications. 2016, 1st Ed.
2. B. R. Puri. Principles of Physical Chemistry. Jalandhar Vishal Publishing Co. 2020, 49th Ed.
3. G. W. Castellan. Physical Chemistry. Narosa Publication. 3rd Ed.
4. Raj, Gurdeep, Meerut Advanced Physical Chemistry, Raj, Gurdeep, Meerut: Krishna Prakashan, 2018 4th Edition
5. B. R. Puri. Sharma. Principles of Physical Chemistry, L. R., Vishal Publishing CO. Delhi: 2018, 4th Edition
6. Physical Chemistry, Puri, B. R., Sharma, L. R., Vishal Publishing CO. Delhi: 2018.

Reference books

8. P.L. Soni. Textbook of Physical Chemistry. Sultan Chand New Delhi. 2016.
9. C. Kittel. Introduction to Solid State Physics. John Wiley & Sons. 2004, 8th Ed.
10. Prutton and Marron. Principles of physical chemistry. CBS PUBLISHERS AND DISTRIBUTORS PVT LTD. 2017. 4th Ed.
11. Soni and Dharmahara. Text Book of Physical Chemistry. Sultan Chand & Sons. 2011.
12. B. R. Puri and L. R. Sharma. Text Book of Physical Chemistry. Vishal Publishing. 2020, 1st Ed.
13. K. L. Kapoor. Text Book of Physical Chemistry. Macmillan. 2010, Volume 6.

Course Code:	**CH2 204**	
Course Name:	**Organic Chemistry-III Laboratory**	
L-T-P-C	**0-0-4-2**	
S. No.	**List of Experiments to be Conducted**	**Hours**
1.	Execution of Aldol condensation between acetone and benzaldehyde	6
2.	Execution of Hofmann-bromamide rearrangement for Ph-CO-NH_2 yielding $PhNH_2$	6
3.	Execution of Curtius rearrangement with a practically suitable example	6
4.	Synthesis of Gabriel phthalimide through a practically suitable example	6
5.	Identification of primary amines through Carbylamine test ($PhNH_2$ to PhNC)	6
6.	Execution of Mannich condensation reaction with benzaldehyde, aniline and acetophenone	6
7.	Preparation of benzenediazonium chloride and its application as azodye	6
8.	Identification of 1º, 2º, and 3º amines through the Hinsberg Test	6
9.	Aromatic Electrophilic Substitution reaction with a practically suitable example	6
10.	Preparation of Carbazole (Dibenzopyrrole)	6
List of virtual experiments		
1.	Acetylation of Salicylic acid	4
2.	Preparation of Tribromoaniline from Aniline	4
3.	Preparation of 1-Phenyl-3-methyl-5-pyrazolone	4

Reading references

1. B. S. Furniss. Vogel Textbook of Practical Organic Chemistry. Pearson Education. 2011,
2. A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hannaford and Smith, P. W. G. Textbook of Practical 3. Organic Chemistry. Prentice-Hall. 1996, 5th Ed.
4. A. K. Nad and B Mahapatra. An Advanced Course in Practical Chemistry. New Central Book Agency. 2022, 3rd Ed.
5. V. K Ahluwalia and Sunita Dhingra. Practical Organic Chemistry. New Central Book Agency. 2017, 1st Ed.
6. N. K. Vishnoi. Advanced Practical Organic Chemistry. Vikas Publication. 2009, 3rd Ed.

Course Code:	**CH2 205**	
Course Name:	**Inorganic Chemistry-II Laboratory**	
L-T-P-C	**0-0-4-2**	
S. No.	**List of Experiments to be Conducted**	**Hours**
1.	To determine the water of crystallization of a given salt. $BaCl_2$ $2H_2O$, $Mg.SO_4$ $7H_2O$	8
2.	To determine the Percentage of Purity of a given salt (Na_2CO_3, $NaHCO_3$)	8
3.	To separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry	8
4.	To determine the exchange capacity of cation exchange resins and anion exchange resins.	8
5.	To separate the amino acids from organic acids by ion exchange chromatography.	8
6.	To separate metal ions from their binary mixture.	8
List of virtual experiments		
1.	Describe the difference between coefficients and subscripts in a chemical equation.	4
2.	Describe ambidentate ligand and chelating ligand	4
3.	Practical demonstration of different types of chromatographic separation.	4

Reading references

1. Vogel's Textbook of Quantitative Chemical Analysis, 5th Edn, Orient Longman, 1989.
2. Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, 5th Edn, Orient Longman, 1982.
3. Inorganic Chemistry: A Laboratory Manual Hardcover – Import, 30 June 2016 by Mala Nath

Course Code:	**CH2 206**
Course Name:	**Physical Chemistry-III Laboratory**
L-T-P-C	**0-0-4-2**

S. No.	**List of experiments to be conducted**	**Hours**
1.	Preparation of buffer solutions of different pH a. Sodium acetate-acetic acid b. Ammonium chloride-ammonium hydroxide	4
2.	pH-metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.	8
3.	Determination of dissociation constant of a weak acid.	8
4.	Study of the shift in equilibrium in the reaction of ferric and thiocyanate ions.	8
5.	Validation of the Le Chatelier Principle using simple laboratory methods	8
6.	Determination of order by initial rate method: Iodide-persulphate reaction	8
7.	Compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of methylacetate.	8
8.	Determine the rate constant for the inversion of sucrose using a polarimeter	8
List of virtual experiments		
1.	pKa determination by half-neutralization method (https://www.youtube.com/watch?v=JjMHbN3BdBs)	

Reading references

1. B. D. Khosla, V. C. Garg, Adarsh Gulati. Senior Practical Physical Chemistry. R. Chand. 2018.
2. B. Viswanathan and P. S. Raghavan. Practical Physical Chemistry. Navi Mumbai Viva Books Private Limited. 2017.
3. A. K. Nad, B. Mahapatra, A. Ghoshal. An Advanced Course in Practical Chemistry. Paperback, New Central Book Agency P LTD. 2022.
4. B. Vishwanathan, P. S. Raghavan. Practical Physical Chemistry. Viva Publisher. 2012.
5. J. N. Gurtu and Amit Gurtu. Advanced Physical Chemistry Experiments. Pragati Prakashan. 2011.

Course Code:	**CH2 207**
Course Name:	**Applications of Semiconductors**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
Photonic Device Radiative and non radiative transitions, optical absorption, diode photodetectors, solar cell, LED, diode laser, optical gain and threshold current for lasing, Fabry-Perrot cavity length for lasing, and the separation	**15**

Unit II	
Syllabus	**Hours**
Memory Devices Static and Dynamic Random Access memories (SRAM and DRAM), CMOS and NMOS, nonvolatile – NMOS, magnetic, optical and ferroelectric memories, charge coupled devices (CCD)	**15**

Reading references

Textbooks

1. R. K. Puri and V. K. Babbar. Solid State Physics. S. Chand & Co. Ltd. 2010.
2. V. K. Mehta. Principles of Electronics. S. Chand & Co. Ltd. 2014, 7th Ed.
3. A. Bieser. Concepts of Modern Physics. Tata McGraw-Hill. 2002, 6th Ed.

Reference books

1. R. K. Hair and S. L. Gupta**.** Engineering Physics. Dhanpat Rai. 2012.
2. Charles Kittel. Introduction to Solid State Physics. John Wiley & Sons. 2018, 8th Ed.
3. S. M. Sze and Kwok K. Ng. Physics of Semiconductor Devices. Wiley. 1996.
4. P. Bhattacharya. Semiconductor Opto-Electronic Devices. Prentice Hall. 1996. 2nd Ed.
5. M. K. Achuthan and K. N. Bhat. Fundamentals of Semiconductor Devices. McGraw Hill Education. 2007. 1st Ed.
6. J. Allison. Electronic Engineering Materials and Devices. McGraw Hill Education. 1990.

Course Code:	CH2 208	
Course Name:	Applications of Semiconductors Laboratory	
L-T-P-C	0-0-4-2	
S. No.	**List of experiments to be conducted**	**Hours**
1.	Numerical aperture of a fiber	8
2.	Fabry-Perrot interferometer	8
3.	Michelson's interferometer	8
4.	Laser characteristics	8
5.	Characteristics of a solar cell	8
6.	LED Characteristics	8
List of virtual experiments		

Reference books

1. V. K. Mehta, Principles of Electronics, S. Chand & Co. Ltd., 2007
2. Kumar P. R. S., Practical Physics, PHI, 2011
3. Harnam Singh and P. S. Hemne, Practical Physics, S. Chand & Ltd., 2000.
4. S. K. Ghosh, Advanced Practical Physics, NCBA, 2010

Course Code:	**CH2 209**
Course Name:	**Professional Communications**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
• Oral communications • Written communications • Foundation of creative expressions • Interpersonal communications	**15**

Unit II	
Syllabus	**Hours**
• Skill enhancement • Personality grooming • Role play practice	**15**

Reading references

Textbooks

1. Jeff Butterfield, Soft Skills for Everyone by. Cengage publications. 2020, 2nd Ed.

Reference books

1. Barun K Mitra. Personality Development and Soft Skills. Oxford University Press India. 2016, 2nd Ed.
2. Edward de Bono. Lateral Thinking: Creativity Step by Step. Harper Perennial. 2015, Reissue Ed.

Course Code:	**CH2 210**
Course Name:	**Software for Scientific Learning**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
Chem Draw: Chemical structure drawing, Name-to-Structure, Structure-to-Name, Realistic 3D conformation of molecules, 1H and 13C NMR predictions, and integrations to scientific literature databases. Access safety data from regulatory agencies, and find chemical suppliers. Biochemical drawings. *Chem Craft:* Chemical structure drawing of various molecules. *EndNote:* Techniques of scientific literature management.	**15**

Unit II	
Syllabus	**Hours**
Origin: Drawing of scientific graphs using data files in various formats such as ASCII text, Excel, etc. Exports of graphs to various image file formats such as JPEG, PNG, GIF, EPS, TIFF, etc. *Adobe Illustrator/Photoshop:* Draw and edit scientific graphs and images. *Gauss view:* Making a graphical interface to build molecules, Set up calculations, and analyze the results.	**15**

Reading references

1. ChemDraw 21.0 User Guide. PerkinElmer
2. ChemDraw 17.0 User Guide. PerkinElmer
3. Prof. Dr. Stefan Bienz. Short Manual to the Chemical Drawing Program ChemDraw®. University of Zurich.
4. EndNote: a Beginner's Guide. Library Subject Guide. RMT University.

Course Code:	**CH2 211**
Course Name:	**Renewable Energy**
L-T-P-C	**2-0-0-2**

Unit I	
Syllabus	**Hours**
Fossil fuels and Alternate Sources of Energy: Fossil fuels and nuclear energy, their limitation, need for renewable energy, and nonconventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, and Hydroelectricity.	**15**

Unit II	
Syllabus	**Hours**
Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of the solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar greenhouses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun-tracking systems.	**15**

Unit III	
Syllabus	**Hours**
Wind and hydro Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, grid interconnection topologies, Hydropower resources, hydropower technologies, the environmental impact of hydropower sources.	**10**

Reading references

1. B.H. Khan. Non-conventional energy sources. McGraw Hill Education India Private Limited. 2017, 3rd Ed.
2. Suhas P Sukhative. Solar energy. Tata McGraw - Hill Publishing Company Ltd. 2017 4th Ed.
3. Godfrey Boyle. Renewable Energy, Power for a sustainable future. Oxford University Press. 2012, 3rd Ed.

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