ORDINANCES AND SYLLABUS

for

B.Sc. (Honors)
Chemistry

SEMESTER SYSTEM
CHOICE BASED CREDIT SYSTEM

2015-16 Session

PUNJABI UNIVERSITY,
PATIALA – 147 002

ORDINANCES
For B.Sc.(Hons) (Semester System)
(UNDER THE +3 SCHEME)
According to Choice Based Credit System

Applicability of Ordinances for the time being in force

1. CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.
Outline of Choice Based Credit System:

1.1. Core Course:

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

2. Elective Course:

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

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

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

2.3Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:

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

3.1 AE Compulsory Course (AECC): Environmental Science, English Communication /MIL Communication.

3.2 AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A

Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper

Notwithstanding the integrated nature of a course spread over more than one academic year, the ordinances in force at the time a student joins a course shall hold good only for the examination held during or at the end of the academic year. Nothing in these Ordinances shall be deemed to debar the University from amending the ordinances subsequently and the amended ordinances, if any, shall apply to all the students whether old or new.

1 B.Sc. Hons. (Chemistry) is an integrated course comprising three parts spread over three years. Each part will consist of two semesters. The course of study of B.Sc. shall be divided in six semesters and university examination will be held at the end of every semester in the months of November/December (for semester I, III & V) and May/June (for semester II, IV & VI) or as fixed by the Academic Council /CBCS given in point 1 above.

2 A candidate must complete and pass the whole course of three years within a maximum of six years from the date of admission in B.Sc. first semester.

3 The outlines of tests and syllabi shall be such as prescribed by the Academic Council from time to time.

4 A candidate will be eligible to join 1st semester of B.Sc. course, only if he/she has passed +2 examination (medical/Non-medical, without reappear) of Punjab School Education Board, or any other examination recognised as equivalent thereto.

5 Semester examination will be open to regular candidates who have been on the rolls of a college affiliated to this University and meet the attendance and other requirements as prescribed in the Ordinances No.7

6 Subject to fulfillment of requirement of House examinations, the attendance requirements and these ordinances there will be no condition of passing papers for promotion from odd semester to even semester in an Academic Session.

(a) To qualify for admission to 2nd year of the Course, the candidate must have passed 50% of total papers of the two semesters of the 1st year. Similarly, to qualify for admission to 3rd year of the course, the candidate should have passed 50% of total papers of four semesters of the earlier two years.

(b) A candidate placed under reappear in any paper, will be allowed two chances to clear the reappear, which should be availed within consecutive two years/chances i.e. to pass in a paper the candidate will have a total of three chances, one as regular student and two as reappear candidate.

The examination of reappear papers of odd semester will be held with regular examination of the odd semester and reappear examination of the even semester will be held with regular examination of even semester. But if a candidate is placed under reappear in the last semester of the course, he/she will be provided chance to pass the reappear with the examination of the next semester, provided his reappear of lower semester does not go beyond next semester.

7 **Attendance Requirements**

A candidate will be required to attend a minimum of 75% lectures delivered to that class in each paper as well as 75% of the laboratory work, seminars etc. separately. Provided that a deficiency in attendances may be condoned for special reasons, as per the relevant ordinances on the subject.

8 **Late College Students**: A candidate, who has completed the prescribed course of instructions for a semester but has not appeared in the examination or having appeared, has failed in the examination, may appear as a late college student within the prescribed period.

9 The pass and reappear students of B.Sc. Part-I and II from Panjab University, Guru Nanak Dev University and Punjab Technical University shall be treated at par with the

corresponding students of this University. But in case such a student is admitted in B.Sc. semester III in this University, he/she will be required to clear deficient papers, if any.

10 Amount of examination fee to be paid by a candidate for each semester shall be as fixed by the University from time to time.

11 Applications for admission to the examination shall be made on the prescribed form attested by the competent authority as per University rules. The last date by which admission forms and fees must reach the Registrar shall be as follows:

Semester	Without late fee	With late fee of Rs. 800/-	With late fee of Rs. 1200/-	With late fee of Rs. 5000/-	With late fee of Rs. 10000/-
Semester Exam (Nov/Dec)	Sept. 30	Oct. 15	Oct. 21	Oct. 31	Nov 10*
Semester Exam (May/June)	Feb. 28	Mar. 15	Mar. 21	Mar. 31	April 15*
* No Examination Form will be accepted after this date.					

12 University medal will be awarded to a candidate who secured first position in the University on the basis of the marks of all the six semesters taken together. The general rules and conditions of the University for the award of medal/prizes etc. will be applicable in the award of University medal to the topper of this examination.

13. The medium of instructions and examination will be English except for the non English subjects.

14. Subject to the restrictions contained in the Ordinances, a candidate for B.Sc.+3 Scheme shall be required to take up the following subjects as given in Page 4 of attached syllabus according to choice based credit system.

15. Punjab History and Culture in the lieu of Punjabi shall be allowed to the following categories of candidates :

1. Candidates who have passed their Matriculation examination from a School located outside the State of Punjab.
2. Candidates who have passed their Matriculation examination from a School located in the State of Punjab will not be allowed to take up the subject of Punjab History & Culture in lieu of Punjabi Compulsory at the graduate level. This clause will not apply to students covered by clause No. 3 given below.
3. Children of Defence personnel/Para military personnel (serving as well as retired) will be allowed to take up the subject of Punjab History & Culture, provided the father or the mother/guardian (in case father is deceased) of the candidate gives an affidavit that the candidate has not studied Punjabi at the School level.

16. The Candidate shall also be entitled to grace marks as admissible under the ordinances, relating to the 'Grace Marks.'

17. The minimum number of marks required to pass the examination in each Part shall be 35% in each subject, provided that in subject with practical the percentage shall be required separately in written and practical/map work.

18. **A Candidate shall be allowed to join:**

(i) **First Semester:**

Provided that he/she has passed at least, one academic year previously, the +2 examination of Punjab School Education Board, or any other examination recognised as equivalent thereto.

(ii) **Second Semester:**
Provided that he/she has undergone a regular course of studies of first semester as provided under the regulations and fulfils the conditions as laid in ordinance 6(a).

(iii) **Third Semester:**
Provided that he/she has undergone a regular course of studies of First and Second semesters as provided under the regulations in sequential order and fulfils the conditions as laid in ordinance 6(a).

(iv) **Fourth Semester:**
Provided that he/she has undergone a regular course of studies of First, Second and Third semesters as provided under the regulations in sequential order and has passed the First Semester Examination as a whole, and fulfils the conditions as laid in ordinance 6(a).

(v) **Fifth Semester:**
Provided that he/she has undergone a regular course of studies of First, Second, Third and Fourth semesters as provided under the regulations in sequential order and has passed the First and Second Semester examinations as a whole, respectively; and fulfils the conditions as laid in ordinance 6(a).

(vi) **Sixth Semester:**
Provided that he/she has undergone a regular course of studies of First, Second, Third, Fourth and Fifth semesters as provided under the regulations in sequential order and has passed First, Second and Third Semester examinations as a whole, respectively and fulfils the conditions as laid in ordinance 6(a).

20. Three weeks after the termination of examination or as soon thereafter as possible, the Registrar shall publish the result of the candidates. Each candidate shall receive a certificate indicating details of marks obtained in each examination. Successful candidates at the end of Semester-VI examination shall receive a degree stating the division according to **ordinance 21.**

21. The successful candidates shall be classified on the basis of aggregate marks secured in all the six semesters of B.Sc. taken together as under:
    (a) 75% or more with Distinction.
    (b) 60% or more in the First division.
    (c) 50% or more but less than 60% in the Second division.
    (d) below 50% in the Third division.

22. A candidate who has passed B.Sc. Hons. Chemistry in +3 examination scheme from this University shall have two chances within a period of two years after passing the examination to improve division 55% marks. Improvement shall be allowed in not more than 50% of total theory papers offered in Part-I, II and III examination. However, previous marks of Practical/Project will be carried forward in the paper(s) in which he/she appears for improvement.

SYLLABUS

B.Sc. (Honors) Chemistry

SEMESTER I and II

SEMESTER I

Paper Code	Title of Paper	No. of Lectures	Credits	Time
CH101	Inorganic Chemistry-I	60	4	3 hrs
CH102	Physical Chemistry-I	60	4	3 hrs
CH103	English Communications -I	60	2	3 hrs
CH104	Computer Science	60	4	3 hrs
CH105	Inorganic Chemistry-I Lab	60	2	3 hrs
CH106	Physical Chemistry-I Lab	60	2	3 hrs
CH107	Computer Science Lab	60	2	3 hrs

SEMESTER II

CH201	Organic Chemistry-I	60	4	3 hrs
CH202	Physical Chemistry-II	60	4	3 hrs
CH203	English Communications -II	60	2	3 hrs
CH204	Physics	60	4	3 hrs
CH205	Organic Chemistry-I Lab	60	2	3 hrs
CH206	Physical Chemistry-II Lab	60	2	3 hrs
CH207	Physics Lab	60	2	3 hrs

Semester I

CH101: INORGANIC CHEMISTRY-I

(Credits: 04)
Theory: 60 Lectures

SECTION - A

Atomic Structure:

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s, p, d* and *f* orbitals. Contour boundary and probability diagrams.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

(14 Lectures)

Periodicity of Elements:

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* & *p*-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

(16 Lectures)

SECTION - B

Chemical Bonding:

(i) *lonic 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.

(ii) *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. 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, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, 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.

Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

(iii) *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

(iv) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

(26 Lectures)

Oxidation-Reduction:

Redox equations, Standard Electrode Potential and its application to inorganic reactions.

Principles involved in volumetric analysis to be carried out in class.

(4 Lectures)

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
- Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
- Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
- Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962

CH102: PHYSICAL CHEMISTRY I

(Credits: 04)
Theory: 60 Lectures

SECTION - A

Gaseous state:

Kinetic molecular model of a gas: 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, calculation of σ from η; 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, degrees of freedom and molecular basis of heat capacities.

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 behaviour. vander Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); 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, relation between critical constants and van der Waals constants, law of corresponding states.

(18 Lectures)

Liquid state:

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

Qualitative discussion of structure of water.

(12 Lectures)

SECTION - B

Solid state:

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

(10 Lectures)

Ionic equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).

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.

Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

(20 Lectures)

Reference Books: • Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press(2006).

- Ball, D. W. Physical Chemistry Thomson Press, India (2007).
- Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
- Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

CH103: ENGLISH COMMUNICATION- I

(Credits: 04)
Theory: 60 Lectures

COURSE CONTENT

The course content of this paper shall comprise the following books :

1. *Perspectives: Selections from Modern English Prose and Fiction,* edited by S.A. Vasudevan and M. Sathya Babu, Published by Orient Longman.
2. *Six One-Act Plays,* edited by Maurice Stanford, Published by Orient Longman.

TESTING

The paper shall have two sections. Section-A shall comprise testing from *Perspectives* while Section-B from *Six One-Act Plays*.

SECTION - A : PERSPECTIVES

Q.1 (Based on the section entitled "Prose", comprising chapters I to VI)

(a) One essay-type question with internal alternative. The answer should not exceed 250 words.

(b) Five short-answer questions to be attempted out of seven. Each answer should be written in 25 to 30 words.

Q.2 (Based on the section entitled "Fiction", comprising chapter VII to IX)

(a) One essay type question with internal alternative on character/theme and incident/episode. The answer should not exceed 250 words.

(b) There will be one short answer question from each of the three stories. The candidate shall be required to attempt any two. Each answer should be written in 25 to 30 words.

Q.3 (Based on the section entitled "Biographies", comprising chapter X to XII)

(a) One essay type question with internal alternative. The answer should not exceed 250 words.

(b) There will be one short answer question from each chapter. The candidate shall be required to attempt any two. Each answer should be written in 25 to 30 words.

SECTION – B : SIX ONE-ACT PLAYS

Q.4 (a) One essay type question on character, incident/episode or theme with internal alternative. The answer should not exceed 250 words.

(b) Five short-answer questions to be attempted out of seven. Each answer should be written in 25 to 30 words.

CH104: COMPUTER SCIENCE

(Credits: 04)
Theory: 60 Lectures

SECTION - A

Computer Fundamentals : Historical evolution of computer, characteristics of computers, capabilities and limitations of computers. Computer generations.
Types of Computers : Desktops, Laptops, Palmtop, PDA
Application of Computers : Computer and their impact on society, computer in education, commercial data processing, public utilities and computes in home.
Concepts: Hardware, Software, Machine Language, Assembly Language, High level Language Block diagram of computer identifying various components and their functions.
Primary Memory : concepts of RAM, ROM, EPROM etc.
Secondary Memory : Floppy disk, hard disk, DVD, compact disk (Read only, Write only, Rewritable CD's)

(20 Lectures)

I/P Devices : Keyboard, light pen, mouse, joystick, trackball, scanner, barcode reader, data gloves, voice input systems.
O/P Devices : Types of printers like character, link page printers, impact and non impact printers, plotters, voice output systems. **Number system :** binary, octal, decimal, base conversion between two different number systems
Binary codes : BCD, ASCII, EBCDIC codes

(10 Lectures)

SECTION - B

Word Processing: MS Word 2007: Introduction to Word Processing, Toolbars, Ruler, Menus, Keyboard Shortcut. Previewing documents, Printing documents, Formatting documents, Checking the grammar and spelling, Formatting via find and replace, Using the Thesaurus, using Auto Correct, word count, Hyphenating, Mail merge, mailing Labels Wizards and Templates, Handling Graphics, tables as Converting a word document into various formats.

(15 Lectures)

MS PowerPoint 2007: Introduction, Elements of Power Point Package, Starting and exploring Power Point menus (Insert, Format, Tools, Slide Show, Window, Help options and all of their features, Options and sub options etc.), Creating, inserting, deleting and formatting slides, Formatting and enhancing text, Slides with graphs, Giving Animation to slides, Transfer of files between Power Point and other word processors and software packages.

(15 Lectures)

Text Books :

1. Vishal Goyal, Lalit Goyal, Pawan Kumar, A Simplified Approach to Data Structures, Shroff Publications.
2. Shubhnandan S. Jamwal, Programming in C, Pearson Publications.

References

1. V. Rajaraman, *Fundamentals of Computers,* PHI.
2. Lary Long and Nancy long, *Computers,* PHI.
3. Subrmanium, *Introduction to Computers,* Tata McGraw Hill.
4. Sanders, D.H. *Computers Today*, McGraw Hill. Publications.
5. Taineer, T., et. Al., *Computers,* McGraw Hill Publications.

CH105 : INORGANIC CHEMISTRY -I LAB

(Credits: 02)

Practical : 60 Lectures

(A) Titrimetric Analysis

(i) Calibration and use of apparatus
(ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.
(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Reference text:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

CH106 : PHYSICAL CHEMISTRY -I LAB

(Credits: 02)

Practical : 60 Lectures

1. **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.
2. **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.
3. **Indexing of a given powder diffraction pattern of a cubic crystalline system.**
4. **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

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed*.; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

CH107 : COMPUTER SCIENCE LAB

(Credits: 02)

Practical : 60 Lectures

The laboratory course will comprise of exercise to what is learnt under Computer Science Paper (GE I).

The break up of the practical will be as under :

Lab Record
Viva Voce
Program Development And Execution

Semester II

CH201: ORGANIC CHEMISTRY I

(Credits: 04)
Theory: 60 Lectures

SECTION - A

Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

(12 Lectures)

Stereochemistry:
Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

(18 Lectures)

SECTION - B

Chemistry of Aliphatic Hydrocarbons

A. Carbon-Carbon sigma bonds
Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

B. Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. *Reactions of alkynes:* Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

C. Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

(20 Lectures)

Aromatic Hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

(10 Lectures)

Reference Books:

- Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
- Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

CH202: PHYSICAL CHEMISTRY II

(Credits: 04)
Theory: 60 Lectures

SECTION - A

Chemical Thermodynamics:
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, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

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.

(30 Lectures)

SECTION - B

Systems of Variable Composition:
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.

(8 Lectures)

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. Coupling of exoergic and endoergic reactions. 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 (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

(10 Lectures)

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 Lectures)

Reference Books

- Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.*, Oxford University Press (2011).
- Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).
- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
- McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
- Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
- Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006)

CH203: ENGLISH COMMUNICATION II

(Credits: 04)
Theory: 60 Lectures

COURSE CONTENT

The course content of this paper shall comprise composition, comprehension, translation and grammar.

TESTING

The paper shall have two sections. Section-A shall test the candidate's skills in composition, comprehension and translation. Section-B shall test his/her skills in grammar.

SECTION - A

Q.1 An essay of 300-350 words on a topical or reflective subject (one to be attempted out of the five given).

Q.2 Letter-Writing with internal choice between personal and official letters.

Q.3 Precis

Q.4 Comprehension of an unseen passage

Q.5 Translation of a given passage from Punjabi/Hindi into English.

SECTION – B

Q.6 (a) Analysis of sentences : Converting simple sentences into complex and compound ones and identifying adverb clause, noun clause and adjective clause in the given sentences.

(b) Synthesis of sentences : (i) Combining two simple sentences into a single simple sentence by using a participle, an infinitive, a noun or phrase in apposition, too/enough + adjective/adverb + infinitive and the bare infinitive. (ii) Combining simple sentences into complex ones by using a noun clause, adjective clause or an adverb clause. (iii) Combining simple sentences into compound ones by using conjunctions such as 'and', 'as well as', 'not only.... but also' or 'either... or' 'neither....nor', 'but yet', 'nevertheless', 'so', 'therefore', for etc.

(c) Transformation of sentences. (i) Transformation of degree, i.e., from positive to comparative degree and positive to superlative degree. (ii) Transformation of kinds of statements, i.e. from rhetorical or interrogative into assertive statements, from affirmative into negative sentences and from statement into exclamatory sentences. (ii) Transformation from active into passive voice and vice-versa and from direct speech into indirect speech and vice-versa.

Note : In part (a) of Q. No. 6, the paper-setter shall set 8 sentences out of which the students shall have to attempt any 5. In part (b) and (c), a total of 15 sentences each shall be set out of which the students shall have to attempt any 10 in each part.

RECOMMENDED BOOK

The students are free to use any book. The following book is however recommended :
Current English Grammar and Usage with Composition by R.P. Sinha, Oxford University Press.

CH204: PHYSICS

(Credits: 04)
Theory: 60 Lectures

SECTION -A

MECHANICS

Vector Algebra and Co-ordinate Systems : Review of vector operations, rectangular Cartesian coordinate system, spherical polar coordinates, two dimensional displacement, velocity and acceleration.

Particle Dynamics: Dynamical concepts- mechanics of a system of particles. Conservation laws and Properties of space and time: Conservation of linear and angular momenta, homogeneity of flow of time.

Elastic and Inelastic Scattering : Types of scattering and conservation laws, Laboratory and centre of mass systems, collision of particles which stick together, General elastic collision of particles of different mass, Crosssection of elastic scattering, Rutherford scattering.

(18 Lectures)

Frames of Reference and Relativity: Definitions, inertial reference frames, coordinate transformations within reference frame, Newtonian mechanics and principle of relativity, Galilean transformations, origin and significance of the special theory of relativity, search of a universal frame of reference, postulates of the special theory of relativity, Lorentz transformations and their kinematical consequences, intervals, space-like and time-like, variation of mass with velocity, mass energy equivalence, Particles with zero rest mass.

(12 Lectures)

SECTION B

WAVES

Simple Harmonic Free Vibrations: Simple harmonic motion, energy of a SHO, Compound pendulum, Electrical Oscillations, Transverse Vibrations of a mass on a string, composition of two perpendicular SHMs of same period and of periods in ratio 1:2, Anharmonic Oscillations. Damped Simple Harmonic

Vibrations : Decay of free Vibrations due to damping, types of damping, Determination of damping coefficients – Logarithmic decrement, relaxation time and Q-factor. Electromagnetic damping.

Forced Vibrations and Resonance : A forced oscillator, Transient and Steady State Oscillations, velocity versus driving force frequency, Resonance, power supplied to forced oscillator by the driving force. Q-factor of a forced oscillator, Electrical, nuclear and nuclearmagnetic resonances.

(20 Lectures)

Waves in Physical Media : Wave motion in one dimension, Transverse and longitudinal waves, progressive harmonic waves and their energy, Transverse waves on a string, longitudinal waves on a rod, characteristic impedance of a string, waves in an absorbing medium, spherical waves.

(10 Lectures)

Recommended Books:

1. Mechanics: H.S. Hans and S.P.Purl (Tata McGrawHill) 1984.
2. Text Book of Vibrations and Waves: S.P. Puri (Macmillan India), 2004.

CH205 : ORGANIC CHEMISTRY – I LAB

(Credits: 02)

Practical : 60 Lectures

1. Checking the calibration of the thermometer

2. Purification of organic compounds by crystallization using the following solvents:

a. Water
b. Alcohol
c. Alcohol-Water

3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)

4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)

6. 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 o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)

CH206 : PHYSICAL CHEMISTRY -II LAB

(Credits: 02)

Practical : 60 Lectures

Thermochemistry

(a) 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).

(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(c) Calculation of the enthalpy of ionization of ethanoic acid.

(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

(e) 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.

(f) Determination of enthalpy of hydration of copper sulphate.

(g) Study of the solubility of benzoic acid in water and determination of ΔH.

Any other experiment carried out in the class.

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001).

CH207 : PHYSICS LAB

(Credits: 02)

Practical : 60 Lectures

1. Determination of ‘g’ by bar pendulum.
2. Determination of ‘g’ by Kater's pendulum.
3. Study of rotational motion using flywheel.
4. To determine Young's modulus of material of a bar by bending method.
5. Determination of modulus of rigidity by torsional pendulum.
6. Determination of coefficient of viscosity of a given liquid by Stoke's method.
7. Determination of coefficient of linear expansion
8. Determination of thermal conductivity of a bad conductor by Lee’s Disc method
9. Determination of Stefan's constant.
10. Determination of focal length of convex mirror by beam compass method.
11. Determination of magnifying power of a telescope by slit method.
12. Determination of resolving power of a telescope.
13. Determination of frequency of A.C. mains by using electrical vibrator.
14. Determination of refractive index of prism for different wave-lengths using Spectrometer.
15. To determine the wave-length of laser light using a plane diffraction grating.
16. Determination of wave-length of sodium light by Newton's rings method.
17. Determination of specific rotation of sugar using a Polarimeter.
18. Study of one dimensional collisions.
19. Determination of height (of inaccessible structure) using sextant.