PANJAB UNIVERSITY, CHANDIGARH
OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR B.Sc. (HONS. SCHOOL) IN CHEMISTRY FOR FIRST YEAR (MAJOR) (SEMESTER SYSTEM) EXAMINATION, 2012-2013

OUTLINES OF TESTS

OBJECTIVE OF THE COURSE
To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

MAJOR SUBJECTS (CHEMISTRY)

<table>
<thead>
<tr>
<th>Semester I</th>
<th>200 Marks</th>
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<tbody>
<tr>
<td>Theory Papers:</td>
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<td>There shall be three theory papers:</td>
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<tr>
<td>Paper CH-111  Physical Chemistry  50 Marks</td>
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<td>Paper CH-112  Inorganic Chemistry  50 Marks</td>
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<td>Paper CH-113  Organic Chemistry  50 Marks</td>
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<td>Practicals : Inorganic Chemistry  50 Marks</td>
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<td>Paper CH-122  Inorganic Chemistry  50 Marks</td>
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<td>Paper CH-123  Organic Chemistry  50 Marks</td>
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<tr>
<td>Practicals : Organic Chemistry  50 Marks</td>
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EVALUATION
1. There shall be one Mid Term Examinations of 20% Marks (10 marks) in each semester.
2. End-semester examination will be of 80% of total marks (40 marks).
3. Each practical examination shall be of 3 hours duration.
4. There shall be continuous internal assessment for practicals of 20% marks. The final examination will be of 80% marks.
Pattern of end-semester question paper

(i) Nine questions in all with equal weightage (8 marks). The candidate will be asked to attempt five questions.

(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus. There will be no choice in this question.

(iii) The remaining eight questions will have Four Units comprising two questions from each Unit.

(iv) Students will attempt one question from each unit and the compulsory question.

SUBSIDIARY COURSES (CHEMISTRY)

For the students of the Departments of Physics, Geology, Botany, Zoology, Biophysics, Microbiology, Anthropology, Biochemistry and Biotechnology.

<table>
<thead>
<tr>
<th>Semester I</th>
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<tr>
<td>Theory Paper (CHS-116)</td>
<td>75 Marks</td>
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<tr>
<td>Practicals</td>
<td>25 Marks</td>
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<td>Total</td>
<td>100 marks</td>
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<th>Semester II</th>
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<tbody>
<tr>
<td>Theory Paper (CHS-126)</td>
<td>75 Marks</td>
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<tr>
<td>Practicals</td>
<td>25 Marks</td>
</tr>
<tr>
<td>Total</td>
<td>100 marks</td>
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Evaluation

1. There shall be one Mid Term Examinations of 20% Marks (15 marks) in each semester.
2. End-semester examination will be of 80% of total marks i.e (60 marks).
3. Each practical examination shall be of 3 hours duration.
4. There shall be continuous internal assessment for practicals of 20% marks.
   The final examination will be of 80% marks.

Pattern of end-semester question paper

(i) Nine questions in all with equal weightage (12 marks). The candidate will be asked to attempt five questions.

(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus. There will be no choice in this question.

(iii) The remaining eight questions will have Four Units comprising two questions from each Unit.

(iv) Students will attempt one question from each unit and the compulsory question.
ENVIRONMENT AND ROAD SAFETY EDUCATION

(25 hr. course)

UNIT I (ENVIRONMENT)

1. Environment Concept:
Introduction, concept of biosphere—lithosphere, hydrosphere, atmosphere; Natural resources—their need and types; principles and scope of Ecology; concepts of ecosystem, population, community, biotic interactions, biomes, ecological succession.

2. Atmosphere:
Parts of atmosphere, components of air; pollution, pollutants, their sources, permissible limits, risks and possible control measures.

3. Hydrosphere:
Types of aquatic systems. Major sources (including ground water) and uses of water, problems of the hydrosphere, fresh water shortage; pollution and pollutants of water, permissible limits, risks and possible control measures.

4. Lithosphere:
Earth crust, Soil—a life support system, its texture, types, components, pollution and pollutants, reasons of soil erosion and possible control measures.

5. Forests:
Concept of forests and plantations, types of vegetation and forests, factors governing vegetation, role of trees and forests in environment, various forestry programmes of the Govt. of India, Urban forests, Chipko Andolan.

6. Conservation of Environment:
The concepts of conservation and sustainable development, why to conserve, aims and objectives of conservation, policies of conservation; conservation of life support systems—soil, water, air, wildlife, forests.

7. Management of Solid Waste:
Merits and demerits of different ways of solid waste management—open, dumping, landfill, incineration, resource reduction, recycling and reuse, vermicomposting and vermiculture, organic farming.

8. Indoor Environment:
Pollutants and contaminants of the in-house environment; problems of the environment linked to urban and rural lifestyles; possible adulterants of the food; uses and harms of plastics and polythene; hazardous chemicals, solvents and cosmetics.

9. Global Environmental Issues:
Global concern, creation of UNEP; Conventions on climate change, Convention on biodiversity; Stratospheric ozone depletion, dangers associated and possible solutions.

10. Indian Laws on Environment:
Indian laws pertaining to Environmental protection : Environment (Protection) Act, 1986; General information about Laws relating to control of air, water and noise pollution. What to do to seek redressal.
11. **Biodiversity:**
What is biodiversity, levels and types of biodiversity, importance of biodiversity, causes of its loss, how to check its loss; Hotspot zones of the world and India, Biodiversity Act, 2002.

12. **Noise and Microbial Pollution:**
Pollution due to noise and microbes and their effects.

13. **Human Population and Environment:**

14. **Social Issues:**
Environmental Ethics: Issues and possible solutions, problems related to lifestyle, sustainable development; Consumerisms and waste generation.

15. **Local Environmental Issues:**
Environmental problems in rural and urban areas, Problem of Congress grass & other weeds, problems arising from the use of pesticides and weedicides, smoking etc.

**Practicals:**
Depending on the available facility in the college, a visit to vermicomposting units or any other such non-polluting eco-friendly site or planting/caring of vegetation/trees could be taken.

*Note: Above 15 topics to be covered in 25 hour lectures in total, with 2 lectures in each topics from 2 to 11 and one each for the topics 1 and 12 to 15.*

**UNIT II (ROAD SAFETY)**

1. Concept and Significance of Road Safety.
2. Role of Traffic Police in Road Safety.
4. Traffic Signs.
5. How to obtain Driving License.
7. Common Driving mistakes.
8. Significance of First-aid in Road Safety.
9. Role of Civil Society in Road Safety.

**Examination Pattern:**

- Seventy multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong or un-attempted question).
- The paper shall have two units: **Unit I (Environment) and Unit II (Road Safety).**
• Unit I shall comprise of 50 questions with minimum of 2 questions from each topics 1, and 12 to 15 and minimum of 4 questions from topics 2 to 11.

• Unit II shall comprise of 20 questions with minimum of 1 question from each topics 1 to 10.

• The entire syllabus of Unit I is to be covered in 25 hours and that of Unit II is to be covered in 10 hours.

• All questions are to be attempted.

• Qualifying Marks 33 per cent i.e. 23 marks out of 70.

• Duration of examination : 90 minutes.

• The paper setters are requested to set the questions strictly according to the syllabus.

Suggested Readings


2. Road Safety Signage and Signs (2011), Ministry of Road Transport and Highways, Government of India.

Websites:

(a) www.chandigarhpolicenic.in
(b) www.punjabpolice.gov.in
(c) www.haryanapolice.gov.in
(d) www.hppolicenic.in
Outlines of tests syllabi and courses of reading for B.Sc. (Honours School) First Year English Subsidiary (Semester System)

FIRST SEMESTER

Objectives:
The objective of teaching English to the science students is to create general awareness among them about literature and its impact on their lives. At the same time, it is expected that the students, on reading this course, shall develop proficiency in reading and writing skills, while acquiring a sensitive and analytical attitude towards literature in particular, and life in general. It is with this aim in mind that the new text has been selected and it is hoped that the objectives of the course will not only be reflected but also realized through necessary shift in the teaching practices, design of the question paper and mode of evaluation.

Note:
(i) There will be one paper of 80 marks, 10 marks are reserved for the Internal Assessment and 10 for the Practical Work. Total is 100.
(ii) The paper shall consist of Two Units. Unit I will be text specific and Unit II shall deal with different aspects of communications and language learning skills.
(iii) For Unit I, the prescribed text is Varieties of Expression, Ed. A. H. Tak, Foundation Books, which shall replace the existing text Patterns in Prose by Jagdish Chander, P.U., Chandigarh. It may be pointed out here that only certain sections of this text i.e prose and drama are prescribed. Poetry has been deleted completely. Only five prose and five plays have been recommended for the study. The relevant sections, however, are as follows:

Prose:
I. The Judgement Seat of Vikramaditya, Sister Nivedita
II. Engine Trouble, R. K. Narayan
III. The Conjurer’s Revenge, Stephen Leacock

Drama:
I. The Rising of the Moon, Lady Gregory
II. Waterloo, Arthur Conan Doyle

(iv) No text book is recommended for Unit II, but a few books that may be used for this Unit are listed towards the end Unit II shall consist of the following:

Communication: It shall focus on different aspects of communication, types of communication, and significance of positive attitude in improving communication.

Writing Skills: This section shall focus on précis-writing, letters of all kinds; curriculum vitae, short, formal reports (no exceeding 200 words); public notices and advertisements relating to product promotion etc.,

Modern Forms of Communication: Here special emphasis shall be given to teaching the format of e-mails, fax messages, telegrams, audio-visual aids and power-point presentations. Apart from this, the students shall also be given basic lessons in effective listening, non-verbal communication, how to prepare for an interview and group discussion etc.
Practical work:-
Teacher should assign some project or practical work to the students. This should be in the nature of guided activity, which the students shall have to complete under the direct supervision of the teacher. The students may be given projects on a variety of subjects relating to their discipline i.e. science in general or a specific area of science they are specializing in. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 20 pages) in consultation with teachers of science. However, the evaluation of the projects should be done only by the Language Teachers, who must keep all the basic criteria of good writing in mind while doing so.

Note: In case of private candidates and students of School of Open Learning, the marks obtained by them out of 80 will be proportionately increased out of 100.

Testing Scheme:
The examination paper shall be divided into two sections, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Section I shall be as follows:

Section I (It is text-based and corresponds to unit I in the syllabus)
Q1. It shall consist of five short questions (not exceeding 100-120 words) out of which a student will be expected to attempt any three. This question shall be based upon the prescribed text Varieties of Expression and cover a wide range of issues, topics and problems. It shall consist of 12 marks.

Q2. It shall consist of two long questions (not exceeding 300-350 words) out of which a student will be expected to attempt only one. This question shall have internal choice, be based upon the prescribed text Varieties of Expression. This shall carry 10 marks.

Note: The question 1 & 2 should be so designed as to cover all the chapters prescribed, as well as the major issues and problems listed therein.

Q3. It shall consist of an Unseen Passage for Comprehension (not more than 800 words), with minimum six questions at the end. These questions should be designed in such a way that we are able to test a student’s comprehension ability, language/presentation skills and vocabulary etc. This question shall be of 12 marks.

Q4. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given six words in one column and asked to match them with words/meanings in the next column, This shall carry 6 marks.

Section II (Based upon Unit II)
Q.5 (a) The students shall be asked to write a short survey report on a situation, incident, problem of science or the possibility of starting a new scientific venture (in about 150-200 words). The students shall be given an internal choice in this question. This question shall carry 8 marks.

(b) This question shall be on notices/advertisements of various types (as mentioned in the syllabus). It’ll carry 4 marks.
Q.6. This question shall test a student’s ability to write letters of various kinds (in not more than 250 words). Again, there will be internal choice here and the question will be of 8 marks.

Q.7. There will test a student’s ability to write a Précis. A passage of about 200 words shall be given and the students shall have to write a précis of about 70 words (including the title). This question shall carry 10 marks.

Q.8. This question shall test a student’s understanding of various aspects of communication and modern forms of communication. It shall be divided into two parts:
   (a) Two short questions to be attempted (in not more than 100-120 words each) on different aspects of communication. It’ll carry 6 marks.
   (b) Definitions/format of modern forms of communication to be tested. This shall again carry 4 marks.

Suggested Reading:

SECOND SEMESTER

Objectives:
The objective of teaching English to the science students is to create general awareness among them about literature and its impact on their lives. At the same time, it is expected that the students, on reading this course, shall develop proficiency in reading and writing skills, while acquiring a sensitive and analytical attitude towards literature in particular, and life in general. It is with this aim in mind that the new text has been selected and it is hoped that the objectives of the course will not only be reflected but also realized through necessary shift in the teaching practices, design of the question paper and mode of evaluation.

Note:
(i) There will be one paper of 80 marks, 10 marks are reserved for the Internal Assessment and 10 for the Practical Work. Total is 100.
(ii) The paper shall consist of Two Units. Unit I will be text specific and Unit II shall deal with different aspects of communications and language learning skills.
(iii) For Unit I, the prescribed text is Varieties of Expression, Ed. A. H. Tak, Foundation Books, which shall replace the existing text Patterns in Prose by Jagdish Chander, P.U., Chandigarh. It may be pointed out here that only certain sections of this text i.e. prose and drama are prescribed. Poetry has been deleted completely. Only five prose and five plays have been recommended for the study. The relevant sections, however, are as follows:

Prose:
I J. C. Bose, Aldous Huxley
II The Position of Women in Ancient India, Padmini Sen Gupta

Drama:
I The Proposal, Anton Chekhov
II Riders to the Sea, J. M. Synge
III Lithuania, Rupert Brooke

(iv) No text book is recommended for Unit II, but a few books that may be used for this Unit are listed towards the end Unit II shall consist of the following:

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Q2. It shall consist of *two* long questions (not exceeding 300-350 words) out of which a student will be expected to attempt only one. This question shall have internal choice, be based upon the prescribed text *Varieties of Expression*. This shall carry **10 marks**.

**Note:** The question 1 & 2 should be so designed as to cover all the chapters prescribed, as well as the major issues and problems listed therein.

Q3. It shall consist of an *Unseen Passage for Comprehension* (not more than 800 words), with minimum six questions at the end. These questions should be designed in such a way that we are able to test a student’s comprehension ability, language/presentation skills and vocabulary etc. This question shall be of **12 marks**.

Q.4. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given six words in one column and asked to match them with words/meanings in the next column. This shall carry **6 marks**.

**Section II (Based upon Unit II)**

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(a) Two short questions to be attempted (in not more than 100-120 words each) on different aspects of communication. It’ll carry 6 marks.
(b) Definitions/format of modern forms of communication to be tested. This shall again carry 4 marks.

Suggested Reading:
SYLLABI AND COURSES OF READING
B.Sc. (Hons. School) First Year (Major)
Semester I
Paper: CH-111: PHYSICAL CHEMISTRY

(45 Hrs.)
M. Marks: 50 (40+10)
Time: 3 Hours/week

OBJECTIVE OF THE COURSE
To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT- I

Equation of State:

Kinetic molecular theory of gases, derivation of kinetic gas equation, deduction of gas laws from kinetic gas equation, imperfection in real gases, the compressibility of real gases, isotherms of real gases, equations of state, vander Waal’s equation, effect of attractive forces, Liquification of gases, critical phenomenon, P-V isotherms of carbon dioxide, principle of continuity of state, vander Waal’s equation and critical constants, principle of corresponding states.

UNIT- II

Properties of Liquids:

The Kinetic molecular description, Intermolecular forces in liquids, Vapour pressure and its determination, surface tension and determination of surface tension using capillary rise method and drop formation method, viscosity and measurement of viscosity –Ostwald method, refractivity and its measurement, Optical activity and its measurement using polarimeter.

UNIT- III

The First Law of Thermodynamics:

Thermodynamic terms and basic concepts, Intensive and extensive properties, State functions and differentials, partial derivative relations, thermodynamic processes, reversibility, irreversibility, Nature of heat and work, Conservation of energy, various statements of first law, Manipulations of first law, internal energy (U) and
enthalpy (H). Work done in reversible isothermal expansion, Molar heat capacity at constant pressure $C_p$ and at constant volume $C_v$, relation between $C_p$ and $C_v$, work of adiabatic expansion, Joule Thomson effect.

**Thermochemistry :** (4 Hrs.)
The reaction enthalpy, standard enthalpies, Hess’s law and reaction enthalpies, Kirchoff’s equation. Relation between $H$ and $U$ for reactions, calorimetric measurements, varieties of enthalpy changes.

**UNIT-IV**

The Second Law of Thermodynamics: (12 Hrs.)
Spontaneous change, Carnot Cycle, conclusions from Carnot cycle, efficiency of heat engines, second law of thermodynamics, entropy, entropy as a state function, clausius inequality, entropy as criterion of spontaneity, natural processes, different types of entropy changes under isothermal and non-isothermal conditions, entropy change in irreversible processes.
Helmholtz function (A), Gibbs function (G), standard molar free energy changes, Maxwell relations, dependence of free energy functions on temperature and pressure, total differential equations. Gibbs Helmholtz equations, thermodynamic criteria for spontaneity. Heat capacity at low temperature, Nernst heat theorem, third law of thermodynamics, third law entropies.

**Instructions for paper setters and candidates:**
I. **Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.**

II. **The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.**

III. **All questions carry equal marks.**

**Suggested Books**

**ESSENTIAL:**

**FURTHER READING:**
1. Physical Chemistry by G. W. Castellan, 3rd Ed., Addison Wisley/Narosa, 1985 (Indian Print)
OBJECTIVE OF THE COURSE
To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT-I

Atomic Structure:  (7 Hrs.)
Schrodinger’s Wave equation, Significance of $\Psi$ and $\Psi^2$. The four quantum numbers and their significance. Radial and angular probability. The shapes of s, p, d and f orbitals. Recall of relative energies of atomic orbitals as a function of atomic number, effective nuclear charge and shielding effect, Slater rules. Calculation of screening constant. Recaptulation of fundamental properties of atoms such as atomic volume, the sizes of atoms, ionization energy, electron affinity and their periodic trends.

Chemical Bonding-I
Electronegativity and Polarity of bond: Electronegativity, different scales and methods of determination. Recent advances in electronegativity theory, variation of electronegativity, Group electronegativity. Polarities of bonds and molecules, Dipole moments. Percentage of ionic character form dipole moment and electronegativity difference.

UNIT-II

Valence Bond theory and Molecular Orbital Theory  (10 Hrs.)
valence bond (VB) approach. Resonance structures. Bond angles and shapes of molecules and ions (containing bond pairs and lone pairs) Criterion of bond strength and bond length. Molecular orbitals (MO) approach of bonding (LCAO Method). Symmetry and overlap, symmetry of molecular orbitals, Bonding in Homonuclear molecules (H$_2$ to Ne$_2$) and NO, CO, CN$^+$, CO$^+$, CN$^-$, HF, HCl, BeH$_2$, CO$_2$, Comparison of VB and MO theories.
UNIT- III

The Periodic Table and Chemical Periodicity

Nomenclature of Inorganic compounds: (6 Hrs.)

The relationship between chemical periodicity and electronic structure of the atom. The long form of the periodic Table – Classification of elements in s,p,d and f block of elements. Periodicity in oxidation state of valence, metallic/non-metallic character, oxidizing or reducing behaviour; acidic and basic character of oxides; trends in bond type with position of element and with oxidation state for a given element; trends in the stability of compounds and regularities in methods used for extraction of elements from their compounds; Trends in the stability of coordination complexes. Anomalous behaviour of elements of 2\textsuperscript{nd} short period (Li to F) compared to other members in the same groups of s & p block elements; Anomalous behaviour of the post transition element series (Ga to Br). Effect of lanthanide contraction on the elements following lanthanides. The diagonal behaviour between elements. The inert pair effect; variability of oxidation states of transition elements, colour, magnetic properties and other characteristics of transition elements. Similarities in Chemical and Physical properties of f-block elements.

Hydrogen (4 Hrs.)

Its unique position in the periodic table, isotopes, ortho and para hydrogen, Industrial production, Hydrides and their chemistry; Heavy water, Hydrogen bonding, Hydrates.

UNIT- IV

The s-block elements: (5Hrs.)

Production and uses of metals; chemical reactivity and trends in alkali and alkaline earth metals; structure and properties of oxides, halides and hydroxides, coordination complexes, Organometallic compounds of alkali metals, Crown and Crypts, Behaviour of solutions in liquid ammonia.

Acids-bases: (8 Hrs.)

Various definitions of acids and bases, A generalized acid-base concept, Measurement of acid-base strength, Lewis interactions in non-polar solvents, Systematics of Lewis acid-base interactions, Bond energies, steric effects, solvation effects and acid-base anomalies, Classification of acids and bases as hard and soft. Pearson’s HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.
Instructions for paper setters and candidates:

I. Examiner will set total of **NINE** questions comprising **TWO** questions from each unit and **ONE** compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

III. All questions carry equal marks.

**Suggested Books**

**ESSENTIAL:**

**FURTHER READING:**

**Paper-CH-113:** ORGANIC CHEMISTRY

**Time:** 3 Hours/week

(45 Hrs.)

M. Marks: 50 (40+10)

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.
UNIT-I
Structure and Bonding
(4 Hrs.)
Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions
(7 Hrs.)

UNIT-II
Stereochemistry of Organic Compounds
(11 Hrs.)
Concept of isomerism. Types of isomerism. Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometric isomerism – determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.


UNIT-III
Alkanes and Cycloalkanes
(11 Hrs.)
IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to
Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids. Physical properties and chemical reactions of alkanes.
Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.
Cycloalkanes – nomenclature, methods of formation, chemical reactions, Baeyer’s strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring; banana bonds.

UNIT-IV

Alkenes, Cycloalkenes, Dienes and Alkynes (12 Hrs.)

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rules, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes – mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff’s rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO₄.
Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.
Methods of formation, conformation and Chemical reactions of cycloalkenes.

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


Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.
III. All questions carry equal marks.
Suggested Books

ESSENTIAL:

FURTHER READING:

CHEMISTRY PRACTICALS (MAJOR)
(Inorganic Chemistry)

90 Hrs.
M. Marks: 50(25+25)
Time: 3 Hours/week

1. Qualitative Analysis:
Qualitative analysis of inorganic mixtures containing not more than six radicals including interfering radicals like phosphate, oxalate, tartrate and similar radicals.

2. Quantitative Analysis:
Volumetric Methods
(a) Acid-base titrations – Preparation of standard hydrochloric acid and sodium hydroxide solution. Preparation of some buffers and measuring their pH value, pH titration of unknown soda ash.
(b) Oxidation Reduction titrations –
   (i) Potassium permanganate and potassium dichromate titrations
   (ii) Iodimetric and iodometric titrations
   (iii) Potassium Iodate titrations.
(c) Precipitation titrations - Titrations involving silver nitrate.

Suggested Books:
1. Svehla G., Vogel’s Qualitative Inorganic Analysis (revised); 7\textsuperscript{th} edition, Pubs: Orient Longman, 1996.
B.Sc.(Hons.School) First Year Chemistry (Subsidiary)  
Semester-I

(For all students from the departments of Physics, Geology, Botany, Zoology, Biophysics, Microbiology, Anthropology, Biochemistry and Biotechnology)

Paper CHS-116  GENERAL CHEMISTRY  60 Hrs.  
M. Marks: 75(60+15)  
Time: 4 Hours/week

OBJECTIVE OF THE COURSE
To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

(Physical & Organic Chemistry)

UNIT-I

Chemical Thermodynamics And Chemical Equilibrium  
(15Hrs.)

Objectives and limitations of Chemical Thermodynamics, State functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy.

Enthalpy change and its measurement, standard heats of formation and absolute enthalpies. Kirchoff’s equation.


Third law of thermodynamics: Absolute entropies.

UNIT-II

Chemical Equilibrium : (8 Hrs.)
General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van’t Hoff reaction isotherm. Relation between $K_p$, $K_c$ and $K_x$. Temperature dependence of equilibrium constant-Van’t Hoff equation, homogeneous & heterogeneous equilibria, Le Chetaliére’s principle.

Compounds of Carbon (7 Hrs.)
Differences in chemical and physical behaviour as consequences of structure. Discussion (with mechanism) of reactions of hydrocarbons’ ranging from saturated acyclic and alicyclic, unsaturated dienes and aromatic systems. Huckel rule; as applied to $4n+2$ systems. Industrial sources and utility of such compounds in daily life for medicine clothing and shelter.

UNIT-III

Stereochemistry (15 Hrs.)

UNIT-IV

SPECTRA OF ORGANIC MOLECULES (15 Hrs.)
Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

Suggested Books

ESSENTIAL:


FURTHER READING:

B.Sc.(Hons.School) First Year Chemistry (Subsidiary)  
Practicals Semester-I

(Subsidiary for the students of Physics, Botany, Zoology, Geology, Biotechnology, Biophysics, Biochemistry and Microbiology, (for both one year and two year chemistry subsidiary course)

45 Hrs.
M. Marks: 25(12.5+12.5)
Time: 3 Hours/week

1. Analysis of the given mixture containing six radicals with at least one interfering (PO$_4^{3-}$, Oxalate, Tartarate).
2. Volumetric Analysis:
   (i) Acid-Alkali/Base: Involving use of one of one indicator and two indicators.
   (ii) Oxidation-Reduction : KMnO$_4$/K$_2$Cr$_2$O$_7$ Titrations.

Suggested Books:

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT- I (11Hrs.)

Partial Molar Properties and Fugacity: (5Hrs.)
Partial molar properties. Chemical potential of a perfect gas, dependence of chemical potential on temperature and pressure, Gibbs-Duhem equation, real gases, fugacity, its importance and determination, standard state for gases.

Changes of State, Physical Transformation of Pure Materials: (6 Hrs.)

First and second order phase transitions. Attainment of low temperature and energetics of refrigeration, adiabatic demagnetization.

UNIT-II (12 Hrs.)

Phase Equilibria: (6Hrs.)
Thermodynamics of Simple Mixtures:  (6Hrs.)

UNIT –III (11Hrs.)
Chemical Equilibrium:  (5 Hrs.)
Direction of spontaneous change in a chemical reaction, extent of reaction, stoichiometric coefficients, equilibrium constant in terms of G. Temperature and pressure dependence of equilibrium constant, homogeneous & heterogeneous equilibria.

Thermodynamics of Electrolytic Solutions:  (6 Hrs.)
Activities of ions in solutions, a model of ions in a solution, qualitative idea of Debye-Huckel theory, ionic strength, mean ionic activity coefficient and the Debye-Huckel limiting law for activity coefficients.

UNIT-IV (11 Hrs.)
Colligative Properties:  (3Hrs.)
Solutions of non-volatile solutes: colligative properties, elevation in boiling point, depression in freezing point, osmosis and osmotic pressure

Electrochemical Cells:  (8Hrs.)

Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.
Suggested Books

**ESSENTIAL:**
1. Atkins P.W., Physical Chemistry, 8\textsuperscript{th} Edn., Pubs: Oxford University Press, 2006 (Indian Print).

**FURTHER READING:**

Paper:CH-122: INORGANIC CHEMISTRY (45 Hrs.)
M. Marks: 50 (40+10)
Time: 3 Hours/week

**OBJECTIVE OF THE COURSE**
To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

**UNIT-I**

**Chemical Bonding-II:** (10 Hrs.)
**Ionic bond:** Factors affecting the stability of ionic compounds. Lattice energy, Born Lande equation and its applications, Madelung constant, Born-Haber cycle, applications of lattice energy, covalent character in ionic compounds, polarizing power and polarizability, Fazan’s rules, Ionic radii, Factors affecting the radii of ions, Radii of polyatomic ions, Efficiency of packing and crystal lattices, Radius ratio rule, calculation of some limiting radius ratio values for different coordination members, Structure of crystal lattices, NaCl,CaCl, ZnS(Zinc blende and Wurzite), fluorite, rutile and cadmium iodide. Predictive power of thermochemical calculations on ionic compounds.

**UNIT-II**

**Perfect and imperfect crystals:** (10 Hrs.)
intrinsic and extrinsic defects, point defects, line and plane defects, vacancies-Schottky and Frenkel defects. Thermodynamics of Schottky
and Frenkel defect formation, colour centres, non-stoichiometry and defects. Metals insulators and semiconductors, Band theory, Band structure of metals, Insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, High temperature super conductors.

**Intermolecular forces and metallic bond:** (3 Hrs.)
Van der Waals forces (Keesom, Debye & London Interactions). Structure of metals, valence bond and bond model.

### UNIT -III

**The p-block elements**

**(Group III)** (10 Hrs.)

(i) Boron, Al, Ga, In, Ti family: Chemical reactivity and trends.
Boron: Structures of crystalline boron, electronic and/or crystal structures of borides, boranes and carboranes, metallo-carboranes and their chemistry. Boron halides. Boric acid, borates, boron-nitrogen compounds, LiAlH$_4$ — its uses as a reducing and hydrogenating reagent, structure of alumina and aluminates. Chemistry of manufacture and setting of Portland cement, Organometallic compounds of Al.

### UNIT-IV

**(Group IV)** (12 Hrs.)

(ii) Carbon, Si, Ge, Sn, Pb family: Chemical reactivity and group trends
Carbon: Allotropic forms, graphitic compounds, graphite intercalation compounds, carbides.
Silicon: Silicon carbides, silicides, silanes and silylamines structures of silicate mineral, organo silicon compounds and silicones.
Tin and lead oxides, halides, Pb accumulators, organometallic compounds of Sn and Pb.

### Instructions for paper setters and candidates:

I. **Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.**

II. **The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.**

III. **All questions carry equal marks.**
**Suggested Books**

**ESSENTIAL:**


**FURTHER READING:**


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**Paper: CH-123: ORGANIC CHEMISTRY**

**OBJECTIVE OF THE COURSE**

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

**UNIT-I**

**Arenes and Aromaticity**


UNIT II

Alkyl and Aryl Halides (11 Hrs.)

UNIT III

Alcohols (11 Hrs.)

UNIT IV

Phenols (8 Hrs.)

Ethers and Epoxides (3 Hrs.)
Instructions for paper setters and candidates:

I. **Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.**

II. **The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.**

III. **All questions carry equal marks.**

Suggested Books

**ESSENTIAL :**


**FURTHER READING :**

B.Sc. (Hons.School) First Year Semester-II
CHEMISTRY PRACTICALS (MAJOR)
(Organic Chemistry)

90 Hrs.
M. Marks: 50(25+25)
Time: 3 Hours/week

1. **Calibration of Thermometer**
   80-82° (Naphthalene), 113-114° (acetanilide).
   132.5-133° (Urea), 100° (distilled Water)

2. **Determination of melting point**
   Naphthalene 80-82°, Benzoic acid 121.5-122°
   Urea, 132.5-133°, Succinic acid 184-185°
   Cinnamic acid 132.5-133°. Salicylic acid 157-5-158°
   Acetanilide 113-5-114°, m-Dinitrobenzene 90°
   p-Dichlorobenzene 52°. Aspirin 135°.

3. **Determination of boiling points**
   Ethanol 78°, Cyclohexane 81.4°, Toluene 110.6°, Benzene 80°.

4. **Mixed melting point determination**
   Urea-Cinnamic acid mixture of various compositions
   (1:4,1:1,4:1)

5. **Distillation**
   Simple distillation of ethanol-water mixture using water condenser
   Distillation of nitrobenzene and aniline using air condenser.

6. **Crystallization**
   Concept of induction of crystallization
   Phthalic acid from hot water (using fluted filter paper and stemless funnel)
   Acetanilide from boiling water
   Naphthalene from ethanol
   Benzoic acid from water.

7. **Decolorisation and crystallization using charcoal**
   Decolorisation of brown sugar (sucrose) with animal charcoal using gravity filtration.
   Crystallization and decolorisation of impure naphthalene
   (100g of naphthalene mixed with 0.3g of Congo Red using 1g decolorising carbon) from ethanol.
8. **Sublimation (Simple and Vacuum)**
   Camphor, Naphthalene, Phthalic acid and Succinic acid.

9. **Extraction: The separatory funnel, drying agent:**
   Isolation of caffeine from tea leaves

10. **Steam distillation**
   Purification of aniline/nitrobenzene by steam distillation.

**Suggested Books**


B.Sc. (Hons. School) First Year Chemistry (Subsidiary)
Semester -II

(For all students from the departments of Physics, Geology, Botany, Zoology, Biophysics, Microbiology, Anthropology, Biochemistry and Biotechnology)

CHS-126 GENERAL CHEMISTRY 60 Hrs.
M. Marks: 75(60+15)
Time: 4 Hours/week

OBJECTIVE OF THE COURSE
To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

(Physical & Inorganic Chemistry)

UNIT-I

Chemical Kinetics And Catalysis (10 Hrs.)
Rates of reactions, rate constant, order and molecularity of reactions.

Catalysis: Homogeneous catalysis, Acid-base catalysis and enzyme catalysis (Michaelis-Menten equation). Heterogeneous catalysis. Unimolecular surface reactions.

Electro-Chemistry (5 Hrs.)
Specific conductance, molar conductance and their dependence on electrolyte concentration.
UNIT -II

**Electrochemical cells:** (5Hrs.)
Distinction between electrolytic and electrochemical cells. Standard EMF and electrode potential. Types of electrodes Reference electrode. Calculation of \( \Delta G \), \( \Delta H \), \( \Delta S \) and equilibrium constant from EMF data. Potentiometric determination of pH. Potentiometric titrations.

**Covalent Bond:** (10 Hrs.)
Various types of hybridization and shapes of simple inorganic molecules and ions (BeF\(_2\), BF\(_3\), CH\(_4\), PF\(_5\), SF\(_6\), IF\(_7\), SnCl\(_2\), XeF\(_4\), ClF\(_3\), SF\(_4\), ClO\(_4^-\), ClO\(_3^-\), NO\(_3^-\)).

Concept of molecular orbitals. Molecular orbital theory of homonuclear (Li\(_2\) to Ne\(_2\)) molecules and ions and heteronuclear diatomic molecules (CO, CO\(^+\), NO, NO\(^+\)). Concept of electronegativity, polarity of bonds and dipole moments.

UNIT-III

**Ionic Solids** (10 Hrs.)
Factors affecting the formation of ionic solids, concept of close packing, radius ratio rule and coordination number. Calculation of limiting radius ratio for tetrahedral and octahedral sites.

Structures of some common ionic solids NaCl, ZnS (zinc blende and wurtzite), CsCl and CaF\(_2\).

Lattice energy. Born-Hable cycle and its applications.

**s and p Block of Elements** (5Hrs.)
variation in size effects, ionization energy, electron affinity, electronegativity, polarizability and metallic character. Variation in the properties of oxides, hydrides and halides. Some special characteristics.

UNIT- IV

**Coordination Chemistry/Compounds:** (10 Hrs.)
Coordinate Bond. Werner’s coordination theory, ligands, chelates. Nomenclature of coordination compounds. Stereochemistry of different coordination numbers, isomerism. Valence-bond and crystal-field theories of bonding in complexes. Explanation of properties such as geometry colour and magnetism.

**d and f-Block of Elements:** (5Hrs.)
Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

Suggested Books

ESSENTIAL:

FURTHER READING:
1. Analysis of the given organic compounds (solid) (Elemental Analysis, Detection of functional groups and (m.pt.). The compounds to be given are acids, phenols, carbohydrates, amides, amines and Thiourea etc.).

2. Iodimetry/Iodometry: Volumetric titrations

3. Gravimetric Determinations
   Ba$^{2+}$ (as BaSO$_4$), Ag$^+$ (as AgCl), Ni$^{2+}$ (as DMG)

**Suggested Books**


OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR B.Sc. (HONS. SCHOOL) IN CHEMISTRY FOR SECOND YEAR (MAJOR) (SEMESTER SYSTEM) EXAMINATION, 2012-2013

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Semester III

MAJOR SUBJECTS 300 Marks

Theory Papers:
There shall be four theory papers:
Paper CH-211  Physical Chemistry  50 Marks
Paper CH-212  Inorganic Chemistry  50 Marks
Paper CH-213  Organic Chemistry  50 Marks
Paper CH-214  Analytical Chemistry  50 Marks

Practicals : 100 Marks
(i). Physical Practical  50 marks
(ii) Inorganic Practical  50 marks

Semester IV

MAJOR SUBJECTS 300 Marks

Theory Papers:
There shall be four theory papers:
Paper CH-221  Physical Chemistry  50 Marks
Paper CH-222  Inorganic Chemistry  50 Marks
Paper CH-223  Organic Chemistry  50 Marks
Paper CH-224  Industrial Chemistry  50 Marks

Practicals : 100 Marks
(i). Physical Practical  50 marks
(ii) Organic Practical  50 marks

EVALUATION

1. There shall be one Mid Term Examination of 20% Marks (10 marks) in each semester.
2. End-semester examination will be of 80% of total marks i.e (40 marks).
3. Each practical examination shall be of 3 hours duration.
4. There shall be continuous internal assessment for practicals. 20% marks will be assigned for internal evaluation.
The end-semester question paper shall consist of:

(i) Nine questions in all with equal weightage (8 marks). The candidate will be asked to attempt five questions.

(iv) One Compulsory question (consisting of short answer questions) covering whole syllabus. There will be no choice in this question.

(v) The remaining eight questions will have Four Units comprising two questions from each Unit.

(iv) Students will attempt one question from each unit and the compulsory question.

Subsidiary Courses**
For the students of the Departments of Geology, and Biochemistry Biotechnology.

<table>
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<td>75 marks</td>
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<tr>
<td>Practicals</td>
<td>25 Marks</td>
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Evaluation
1. There shall be one Mid Term Examination of 20% Marks in each semester.
2. End-semester examination will be of 80% of total marks.
3. Each practical examination shall be of 3 hours duration.
4. There shall be continuous internal assessment for practicals. 20% marks will be for continuous evaluation.

The end-semester question paper shall consist of:

(i) Nine questions in all with equal weightage (12 marks). The candidate will be asked to attempt five questions.

(ii) One Compulsory question (consisting of short answer questions) covering whole syllabus. There will be no choice in this question.

(iii) The remaining eight questions will have Four Units comprising two questions from each Unit.

(iv) Students will attempt one question from each unit and the compulsory question.
CH-211: PHYSICAL CHEMISTRY (MAJOR)

45 Hrs.
M. Marks: 50 (40+10)
Time: 3 Hours/week

OBJECTIVE OF THE COURSE
To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT–I

Kinetic theory of gases and transport properties (11 Hrs.)


UNIT–II

Thermodynamics of diffusion (11 Hrs.)

Electro-Chemistry

Equilibrium Electrochemistry
UNIT–III
Dynamic Electrochemistry : (11 Hrs.)
Processes at electrodes, double layer at the interface, non-equilibrium electrode potentials, overpotential, derivation of Butler-Volmer equation, Tafel plot, Polarization and electrolysis, concentration overpotential, diffusion current and polarography, current and cell emf, Power. Applications of dynamic electrochemistry: Power generation (Fuel cells), power storage (batteries), photochemical cells, corrosion and passivation.

UNIT-IV
Chemical Kinetics (12 Hrs.)
Rate of reaction, rate constant and rate laws, the order of reaction, first, second & third and zero order reactions, half-lives; determination of reaction order. Temperature-dependence of reaction rates, reaction mechanism, rate-determining step approximation, steady-state approximation. From rate-law to mechanism, unimolecular reactions, bimolecular reactions. Kinetics of Complex reactions: Reversible first order reactions, consecutive first order reactions, parallel first order reactions, Chain reactions, Explosive/branched chain reactions, catalysis, homogeneous catalysis, autocatalysis, oscillation reactions, bistability. Enzyme catalysis, heterogeneous catalysis.

Instructions for paper setters and candidates:

i. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

ii. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

iii. All questions carry equal marks.

Suggested Books:

ESSENTIAL:


FURTHER READING

PHYSICAL CHEMISTRY PRACTICALS (MAJOR)

1. Treatment of experimental data
   Recording of experimental data. Significant number, accuracy and precision, error analysis.

2. Liquids and Solutions
   (i) To determine relative viscosities of aqueous solutions of glycerol at different concentrations. Calculate partial molar volume of glycerol at infinite dilution from density measurement.
   (ii) To determine viscosity-average molecular weight, number-average molecular weight and mean diameter of polyvinyl alcohol molecule from intrinsic viscosity data.

3. Thermochemistry
   (i) To determine heat capacity of a calorimeter and heat of solution of a given solid compound.
   (ii) To determine heat of solution of Solid calcium chloride and calculate lattice energy of calcium chloride using Born-Haber cycle.
   (iii) To determine heat of hydration of copper sulphate.

4. Distribution Law
   (i) To determine distribution (i.e. partition) coefficient of a solute between water and a non-aqueous solvent.

5. Surface Phenomena
   To study the adsorption of acetic acid/oxalic acid from aqueous solution on charcoal. Verify Freundlich and langmuir adsorption isotherms.

6. Colorimetry
   (i) To verify Lambert-Beer law.

7. pH-metry:
   (i) To titrate a strong acid against a strong base pH-metrically.
   (ii) To titrate a weak acid against a strong base and determine the ionization constant of the weak acid.

Suggested Books

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT-I

The p-Block Elements-II (13 Hrs.)

Nitrogen, P, As, Sb & Bi family: Chemical reactivity and group trends.
Nitrogen: Introduction, types of covalence in nitrogen, stereochemistry, chemical reactivity, dinitrogen complexes (basic idea only), hydrides of nitrogen, liquid NH₃ as a solvent, nitrogen halides, oxides and oxoacids.

Phosphorus, As, Sb & Bi: Stereochemistry of their compounds, production of elemental P and its allotropic forms, hydrides, halides, oxides and oxy-acids, phosphorus-nitrogen compounds, some organo-metallic compounds.

Oxygen, S, Se and Te Family: Chemical Reactivity, group trends & stereochemistry, dioxygen as a ligand (basic idea only), structure of O₃ and H₂O₂, clathrate hydrates allotropic forms of S & Se, structures of halides, oxides and oxyacids of S, Se & Te, liquid SO₂ and 100% sulphuric acid as solvent, S-N compounds (neutral) Polyatomic cations of S, Se & Te.

UNIT-II

The Halogen Family: (12 Hrs.)
Chemical Reactivity, group trends, chemistry of preparation of fluorine, hydrogen halides, HF as a solvent, inter-halogen compounds (their preparation and structures), polyhalide and polyhalonium ions; polyatomic cations of halogens, oxides and oxyacide of halogens.

Noble gases
Chemical reactivity and group trends, Clathrate compounds; preparation, structure & bonding of noble gas compounds.

UNIT- III

Symmetry and group theory (Part I) (10 Hrs.)

Symmetry elements and symmetry operations, point groups, definitions of group, subgroup relation between orders of a finite group and its subgroup; group multiplication tables, conjugacy relation and classes. Schoenflies symbols, Representation of groups character of a representation.
UNIT-IV

Symmetry and group theory (Part II) (10 Hrs.)

Properties of irreducible representations, the great orthogonality theorem (without proof) and its importance. Character Tables, Symmetry criteria for optical activity, Symmetry restrictions on dipole moment, Hybridization schemes of orbitals.

Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

Suggested Books


INORGANIC CHEMISTRY PRACTICALS (MAJOR)  

90 Hrs  

M. Marks: 50 (25+25)  

Time: 3 Hours/week  

1. Gravimetric Methods  
   
   Estimation of Ba\(^{2+}\) as BaSO\(_4\) and Ni\(^{2+}\) as Nickel dimethylglyoxime Complex and Co\(^{2+}\) gravimetrically. Determination of two metal ions, Cu-Ni and Cu-Fe.  

2. Preparation of Salicyladehyde diaquolithium (I) : Li (C\(_7\)H\(_5\)O\(_2\))-2H\(_2\)O and its structure elucidation by IR and \(^1\)H-NMR.  

3. Preparation of anhydrous stannous chloride.  

4. Preparation of SnI\(_3\) and its complex with pyridine. Structure elucidation of the complex by IR and \(^1\)H-NMR. data.  

5. Preparation of Pb(OOCCH\(_3\))\(_4\) and its complex (C\(_5\)H\(_3\) NH\(_2\)) PbCl\(_6\) Thermal analysis of Pb(OOCCH\(_3\))\(_4\) and IR, \(^1\)H-NMR. data of the complex are to be investigated.  


7. Complexometric titrations involving EDTA for quantitative determination of individual cation/mixture of cations.  

8. Computer based experiment on “Covalent Bonding”  

9. Chromatography  
   
   Separation of cations and anions by  
   (i) Paper Chromatography  
   (ii) Column Chromatography – Ion exchange  

Note: In addition to or in lieu of the above specific experiments, any other experiments on the Chemistry of Main-Group Elements may be included in the event of non-availability of starting materials/equipment for the above experiment.  

Suggested Books:  


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UNIT-I

Electromagnetic Spectrum : Absorption Spectra: (11 Hrs.)

Ultraviolet (UV) absorption spectroscopy – absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromatic shifts. UV spectra of conjugated enes and enones.

Infrared (IR) absorption spectroscopy – molecular vibrations, Hooke’s law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

UNIT-II

Spectroscopy : (11 Hrs.)

Nuclear magnetic resonance (NMR) spectroscopy.

Proton magnetic resonance (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

UNIT-III

Aldehydes and Ketones (12 Hrs.)

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.


UNIT-IV

Carboxylic Acids: (7 Hrs.)


Carboxylic Acid Derivatives: (4 Hrs.)


Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

Suggested Books

ESSENTIAL:


FURTHER READING:

OBJECTIVE OF THE COURSE
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UNIT –I

1.a Elementary concepts
Qualitative and quantitative analysis, concepts important to quantitative analysis classification of methods for quantitative analysis, choice of method for analysis, sampling and theories of sampling. Preparation of samples for analysis, calibration standards, solution concentration in terms of various conventions, simple equilibrium calculations, calibration of analytical weights and glass wares, significance of calibration.

b. Volumetric and Gravimetric Methods of Analysis
Theory of volumetric and gravimetric methods of analysis, equivalent points, standard solutions, Primary and Secondary standards, and point detection, theory of indicators and their selection for volumetric analysis, precipitation methods, purity of precipitates, optimum conditions for precipitation, washing and filtration of precipitates, drying and ignition of precipitates important organic precipitants, estimation of nickel by the use of organic precipitants.

c. Acid-Base Equilibria
Preparation of standard solutions of acids and bases, mono and poly functional acids and bases and their pH titration curves, typical applications of neutralization titrations in elemental analysis and determination of inorganic salts in mixtures like mixtures of carbonates with hydroxides and bicarbonates.

UNIT-II

a. Precipitation Equilibria
Solubility of precipitates, effect of competing equilibria on solubility of precipitates, separation of ions by control of concentration of precipitating reagents, effect of electrolyte concentration on solubility, solubility product and analytical calculations based on it. The Volhard and the Mohr’s methods of analysis, adsorption indicators

b. Complexation Equilibria
Complexation, Formation constants, EDTA equilibria, effect of pH on EDTA equilibria, complexometric titration curves. Use of indicators, Applications of complexometric equilibria.
UNIT-III
Chromatographic Methods: (12Hrs.)
Principles, classification of chromatographic techniques, Column chromatography
techniques, Band shapes and band broadening Optimization of column
performance, size exclusion chromatography. Effect of pH and separation of
amino-acids. Some applications of ion-exchange chromatography. Paper and
thin layer chromatography. HPLC and its applications.

UNIT-IV
a. Solvent Extraction and Ion-Exchange Separation (11Hrs.)
Basic principles of solvent extraction, solvent extraction of metals, extraction
process, separation efficiency of metal chelates, ion-exchange processes, ion-
exchange resins, techniques and applications of ion-exchange separation.
b. Atomic Spectrometric Methods
Emission spectroscopy, Flame emission spectrometry Plasma emission
spectrometry, Distribution between ground and excited states, Atomic absorption
spectrophotometry.

Instructions for paper setters and candidates:
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each unit and ONE compulsory question of short answer type covering whole
syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from
each unit and the Compulsory question.
III. All questions carry equal marks.

Suggested Books
ESSENTIAL:
4. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., Vogel’s Textbook of
   Quantitative Inorganic Analysis (revised); 4th edition, Pubs: Orient
5. Willard H.H., Merritt L.L. Jr, Dean J.A., Settle F.A. Jr., Instrumental Methods of

FURTHER READING:
1. Ewing G. W., Instrumental Methods of Chemical Analysis, 5th edn., Pubs: MacGraw
CHEMISTRY (SUBSIDIARY) THEORY  
( FOR BIOCHEMISTRY STUDENTS)- SECOND YEAR  
Semester –III  
Paper – CHS-216: ORGANIC CHEMISTRY  

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UNIT-I

Alkyl Halides (8 Hrs.)
Structure of alkyl halides and their physical properties. Preparation from alcohols, hydrocarbons, alkenes and by halide exchange method. Reactions : (i) Nucleophilic substitution (SN2 and SN1) kinetics, mechanism, stereochemistry, steric and electronic factors, reactivity of alkyl halides, rearrangement, dependence on nucleophile, role of solvent (ii) Elimination E2 and E1 mechanism, stereochemistry, kinetics, rearrangement, (iii) Reaction with magnesium-Grignard reagent.

Alcohols (6 Hrs.)

Ethers (2 Hrs.)

UNIT-II

Expoxides (2 Hrs.)
Preparation : From Halohydrins, Peroxidation of Carbon-carbon double bonds. Reactions with acid, base and Grignard reagents.

Aldehydes and Ketones (9 Hrs.)
Structure, Physical Properties; Methods of Preparation : Oxidation of Primary and secondary alcohols, Oxidation of methylbenzenes, Reduction of acid chlorides, Friedel-Crafts Acylation, By reaction of acid chlorides with organacadmium compounds.
Reactions; Nucleophilic addition, Addition of Grignard reagents, Addition of cyanide. Addition of Bisulphite, Addition of derivatives of ammonia.

Acetal Formation, Cannizzaro reaction, Oxidation; reduction. Acidity of – Hydrogen and Carbon ion reactions: Base promoted halogenation of ketones, Aldol Condensation, Spectroscopic Analysis of aldehydes and ketones.

**Polyfunctional Compounds:** (4 Hrs.)
Mechanism and synthesis of acetoacetic easter, Acetoacetic easter synthesis of ketones, Decarboxylation of ketoacids, Ketoenol aautomerism, Reformatsky reaction, configuration of Tartario acid (meso and optically active forms). Unsaturated carbonyl compounds, Electrophilic and Nucleophilic additions, Michael addition.

**UNIT-III**

**Carboxylic Acids** (7 Hrs.)
Structure, physical properties.
Preparation: Oxidation of alkylbenzenes, carbonation of Grignard reagents, hydrolysis of nitriles.
Reactions: Acidity and effect of substituents on acidity, salt formation, Alpha-halogenation of aliphatic acids.
Functional derivatives of carboxylic acids: Nucleophilic acyl substitution, Conversion of acids into acid chlorides, esters and amides, acetic anhydride from acetic acid and ketone. Conversion of acid chlorides into acids, amides, esters, ketones, conversion of acid anhydrides into acids, amides, esters, ketones, Acidic and basic hydrolysis of amides and esters.

**Sulpholic Acids:** (1 Hrs.)
Preparation by sulphonation mechanism of sulphonation. Reactions: Acidity, Conversion into sulphonyl chlorides, Desulphonation, Ring substitution, Fusion with Alkali.

**Amines:** (6 Hrs.)
Structure, Physical properties, Methods of preparation: Reduction of nitro compounds, Reaction of halides with ammonia and amines, Reductive ammination, reduction of nitriles, Hofmann degradation of amides-mechanism.

**UNIT-IV**

**Diazonium Salts:** (2 Hrs.)
Preparation by reaction of amines with nitrous acid.
Reactions: Replacement by –CL, -Br, -CN (Sandmeyer reaction), -I, -F, -OH, -H coupling reaction.

**Phenols:** (2 Hrs.)
Structure and physical properties.
Preparation: Hydrolysis of diazonium salts, Alkali Fusion of sulphonates.
Aryl halides: (4Hrs.)
Structure

Heterocyclic Compounds: (7 Hrs.)

Instructions for paper setters and candidates:
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II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.
III. All questions carry equal marks.

Suggested Books
CHEMISTRY (SUBSIDIARY) THEORY
(for Geology Students of 2-year course) – Second Year
Semester III

CHS-216                  60Hrs.
M. Marks: 75(60+15)
Time: 4 Hours/week

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UNIT-1
Inorganic Materials:                  (15 Hrs.)

UNIT-II
Elementary Concepts:                   (5 Hrs.)
Sampling and theories of sampling, preparation of samples for analysis, Calibration Standards, solution concentrations in terms of various conventions, simple equilibrium calculations, Calibration of analytical weights and glass wares, significance of calibration, role of instrumental methods of analysis in analytical chemistry.

Evaluation of Analytical data:         (5 Hrs.)
Terms mean, median, precision and accuracy in chemical analysis, types of errors in analysis, determining accuracy of methods, improving accuracy of analysis, data treatment for series involving relatively few measurements, least square curve fitting propagation of errors, significant figure convention, standard derivations, confidence limits, rejection of measurements.

Analysis of Complex materials :

UNIT-III
Aspects of Inorganic Geochemistry & Metallurgy                  (15 Hrs.)
Element distribution in the whole earth. Common ores, Mineral wealth of India, Metallurgical principles for common ores. Metallurgical processes, such as crushing & pulverization, concentration, calcinations and roasting, smelting purification and refining. Lanthanides, actinides, general properties, extraction from Monazite, Lanthanide contraction, transuranic elements, extraction of Uranium and Thorium, Ores of Lanthanides & actinides and their compositions.

UNIT-IV

Natural Resources: (5 Hrs.)
Mineral resources, Wood, Fuel and energy resources, such as coal petroleum & natural gas; nuclear fission and fussion, star energy hydrogen, etc. World energy resources : consumption and conservation, Environmental management.

Solid State: (10 Hrs.)
Solvent extraction with emphasis on separation and isolation of heavier elements. Classification of crystals on the basis of bond types, crystals containing finite complexes, crystals containing infinite one-dimensional complexes. Crystals containing infinite two-dimensional complexes. Crystals containing infinite three dimensional complexes, their examples and structures.

Instructions for paper setters and candidates:
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III. All questions carry equal marks.

Suggested Books

ESSENTIAL:

FURTHER READING:
CHEMISTRY (SUBSIDIARY) PRACTICALS
(FOR THE STUDENTS OF GEOLOGY)
SECOND YEAR

Chemistry Practicals 45 Hrs.
M. Marks: 25 (12.5+12.5)
Time: 3 Hours/week

Semester III
Preparation of coordination compounds:

(a) Preparation of crystals of ferrous oxalate (estimation of iron and oxalate).
(b) Preparation of double salt CoSO₄ (NH₄)₂ SO₄6H₂O (estimation of copper and sulphate).
(c) Preparation of mercury tetrathiocynato Cobalt (II), Hg[Co(SCN)₄] (estimation of cobalt and mercury).
(d) Preparation of tris (thiourea) Copper (I) sulphate (estimation of copper and sulphate).
(e) Preparation of tris ethylenediamine nickel (II) thiosulphate [Ni (en)₃]S₂O₃ (estimation of nickel and thiosulphate).

Suggested Books:
B.Sc. (Hons.School) Chemistry (Subsidiary)
Second Year (2 years course) (for the students of Biochemistry)
CHEMISTRY PRACTICALS  45 Hrs.
M. Marks: 25(12.5+12.5)
Time: 3 Hours/week

Semester III

I. Preparation of Organic Compounds
Preparation of (i) iodoform (ii) Benzamide (iii) acetanilide (iv) nitrobenzene
(v) m-dinitrobenzene

II. Volumetric analysis
(a) Complexometric titrations
   Use of EDTA for the estimation of calcium and magnesium.
(b) Ceric sulphate titration
   Estimation of nitrite and oxalate.
(c) Potassium iodate titrations
   Estimation of hydrazine, of iodide by Andrew’s method.

Suggested Books
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UNIT-I

Surface Chemistry

Bulk phases and interfacial region, types of interfaces; Surface tension and interfacial tension. Thermodynamics of surfaces, plane interface, curved interface, Laplace and Kelvin equations. Wetting and adhesion in solid-liquid systems, the contact angle, capillary rise and surface tension. Surface tension of solutions, Gibbs adsorption equation and its derivation from thermodynamic considerations. Surfactants, Surface films on liquids.

X-ray diffraction

UNIT-II

Adsorption

Colloids

UNIT-III

Nuclear Chemistry:
Introduction to atomic nucleus: size and shape, magnetic effects due to orbiting and spinning of nucleus. Nuclear stability; Liquid drop model and shell model, Introduction to Nuclear Reactions, Nuclear fission-fusion and Nuclear energy.
Diffraction techniques

UNIT-IV

Macromolecules (12 Hrs.)
Introduction, macromolecular concept and nomenclature, classifications of macromolecules; natural and synthetic polymers; organic and inorganic polymers. Addition and condensation polymerization. Molecular weight heterogeneity, number average and weight average molecular weights, molecular weight distribution. Configuration and conformation, polymer chain flexibility; polymer chain dimensions, end to end distance and radius of gyration. Dimensions of freely joined chain and restricted chains, unperturbed dimensions (no derivations). Determination of molecular weights by Osmosis. Viscosity, centrifugation and light scattering.

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III. All questions carry equal marks.

Suggested Books:

ESSENTIAL:

FURTHER READING
PHYSICAL CHEMISTRY PRACTICALS (MAJOR)

90 Hrs
M. Marks: 50(25+25)
Time: 3 Hours/week

1. **Treatment of experimental data**
   Recording of experimental data. Significant number, accuracy and precision, error analysis.

2. **Liquids and Solutions**
   (i) To determine surface tensions of solutions of amyl alcohol in water at different concentrations and to calculate surface excess.
   (ii) To determine refractive index and molar refractivity of some organic liquids.

3. **Thermichemistry**
   (i) To determine heat of neutralization of a strong acid by a strong base.
   (ii) To determine heat of ionization of a weak acid from heat of neutralization.

4. **Distribution Law**
   (i) To determine the equilibrium constant of the reaction \( I_2 + KI = KI_3 \) by the partition method and the corresponding free energy change.
   (ii) To determine distribution coefficient between water and a non-aqueous solvent of a solute which associates or dissociates in one of the solvents.

5. **Phase Rule**
   To construct a binary solid-liquid phase diagram by the cooling curve method. Determine the eutectic temperature and eutectic composition.

6. **Colorimetry**
   (i) To determine the composition of a complex by Job’s method of continuous variations (Ferric-salicylate Complex)/
   (i) To titrate copper with EDTA photometrically.

7. **pH-metry** :
   (i) To titrate a weak base against a strong acid and determine the ionization constant of the weak base.

8. **Use of computational tools to plot and analyze data.**

**Suggested Books**


CH-222 : INORGANIC CHEMISTRY (MAJOR)

45 Hrs.
M. Marks: 50 (40+10)
Time: 3 Hours/week

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UNIT-I
Coordination Compounds
Various definitions, types of ligands: classical ligands, non-classical ligands (π-bonding or π-acid ligands); The Chelate and Microcyclic effects, Multidentate ligands, conformation of Chelate rings, stereochemistry and various coordination numbers, isomerism in coordination compounds, nomenclature, stability of coordination compounds, thermodynamic and kinetic stability, stability constants, experimental and statistical ratios of stability constants factors which influence the stability constant and chelate effect.

UNIT-II
Theories for bonding in complexes:
Valence bond theory for bonding in coordination compounds; concept of multiple bonding and back bonding, strength and weaknesses of valence bond approach.

UNIT-III
Crystal field theory
The splitting of d-orbitals in different fields (octahedral, tetrahedral, tetragonally distorted octahedral, square planar, trigonal bipyramidal), Consequences and applications of orbital splitting, crystal field stabilization energy magnetic properties, Factors affecting extent of splitting and spectrochemical series, colour of transition metal complexes. Structural effect of crystal field splitting; ionic radii, Jahn Teller effect in octahedral and tetrahedral complexes.

UNIT-IV
Thermodynamic effects of crystal field splitting, enthalpies of hydration of $M^{2+}$ ions, lattic energies of MCl₂ compounds, etc.
Evidence of covalence and adjusted crystal field theory.
Molecular orbital treatment of octahedral complexes and bonding; complexes with no bonding and complexes with bonding. Molecular orbital diagrams for tetrahedral and square planar complexes.

**Instructions for paper setters and candidates:**

**I.** Examiner will set total of **NINE** questions comprising **TWO** questions from each unit and **ONE** compulsory question of short answer type covering whole syllabi.

**II.** The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

**III.** All questions carry equal marks.

Suggested Books

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UNIT-I
Organic Compounds of Nitrogen: (8 Hrs.)

Organosulphur Compounds: (3 Hrs.)
Nomenclature, structural features, Methods of formation and chemical reactions of thiols, trioethers, sulphonic acids, sulphonamides and sulphaguanidine.

UNIT-II
Heterocyclic Compounds: (11 Hrs.)
Introduction to condensed five and six-membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

UNIT-III
Carbohydrates: (9 Hrs.)
An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

**Fats, Oils and Detergents:** (2 Hrs.)
Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

**UNIT-IV**

**Amino Acids, Peptides, Proteins and Nucleic Acids:** (8 Hrs.)

**Synthetic Dyes:** (4 Hrs.)
Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

**Instructions for paper setters and candidates:**
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III. **All questions carry equal marks.**

**Suggested Books**

**ESSENTIAL :**

**FURTHER READING :**
ORGANIC CHEMISTRY PRACTICALS

90 Hrs
M. Marks: 50(25+25)
Time: 3 Hours/week

Organic Chemistry

A. Thin Layer and Column Chromatography

I. Determination of Rf value and purity of organic compounds by use of thin layer chromatography.
II. To analyse the analgesic drug APC by thin layer chromatography.
III. Separation of mixture of \( o \)-nitroaniline and \( p \)-nitroaniline by column Chromatography.

B. Qualitative Analysis

To perform qualitative analysis of single organic compound (hydrocarbons, aldehydes, ketones, phenols, carboxylic acids/(derivative), amines, amides, nitro compounds and carbohydrates).

I. Test for elements (other than C, H, O).
II. Functional group determination
III. Melting point, derivative preparation and Rf value determination.

C. Synthesis of organic compounds

II. Acetylation/benzoylation of salicylic acid, aniline, hydroquinone and glucose.
III. Preparation of \( m \)-dinitrobenzene from nitrobenzene.
IV. Preparation of \( p \)-nitroacetanilide from acetanilide.
V. Preparation of \( p \)-bromoacetanilide from acetanilide.
VI. Preparation of \( m \)-nitroaniline from \( m \)-dinitrobenzene.
VII. Preparation of benzoic acid from toluene/benzyl chloride.

Suggested Books

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UNIT-I

Water and its treatment: (11 Hrs.)

Coal Chemicals: Ultimate and proximate analysis of coal and their significance. Role of different impurities like sulphur and ash in coal. Coking of coal by high temperature (By-product coke-oven) process. Distillation of coal tar.

UNIT-II

Sugar, Starch and Allied Industry: (11 Hrs.)
Manufacture and refining of sugar from sugar cane. Study of various starch bearing materials. Manufacture of starch from corn

Cellulose Industry:

UNIT-III

Petroleum Industry: (10 Hrs.)
Composition and classification of crude petroleum. Refining of petroleum and brief introduction regarding each refining product. Thermal and catalytic cracking of petroleum products. Significance of octane number and cetane number. Manufacture of chemicals like ethyl alcohol, styrene and phenol.

Paints and Varnishes: Classification, constituents and manufacture of paints and varnishes. Enamels & lacquers.
UNIT-IV

Plastic and Rubbers: (13 Hrs.)
Classification of plastics. Manufacture, properties and uses of polyesters (Terylene), polyamide (nylon 6 and 66 including)


Oils, Fats and Waxes:


Instructions for paper setters and candidates:

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Books Recommended:

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INORGANIC CHEMISTRY (30 Hrs., 2Hrs/Week)

UNIT-I
Stability and Reaction Mechanism (10 Hrs.)
Factors that influence the stability of coordination compounds. The chelate effect, methods for the determination of stepwise stability constants, Nature and classification of substitution reactions, substitution reactions in octahedral complexes, water exchange in aqua ions, anation reactions, substitution reactions in square complexes, nonlabile ligands, the trans effect.  
Election transfer reactions, the outer-sphere mechanism, the inner sphere mechanism, stereochemical nonrigidity, six-coordinate complexes, racemization of tris-chelate complexes.  
Election transfer reactions, the outer-sphere mechanism, the inner sphere mechanism, stereochemical nonrigidity, six-coordinate complexes, racemization of tris-chelate complexes.

Environmental Chemistry (5 Hrs.)
Air Pollutants such as CO, SO₂, Oxides of nitrogen, particulates such as soot, dust, pollen & asbestos fibres. Smogs. Green house effect. Biochemical effects of common pollutants.

UNIT-II
Bioinorganic Chemistry: (15 Hrs.)
Trace elements, metalloporphyrins chlorophyll haemoglobin myoglobin, haemoglobin modeling. Non heme proteins, the bioinorganic chemistry of cobalt : vitamin B₁₂, metalloenzymes, nitrogen fixation.
Suggested Books

BIOPHYSICAL CHEMISTRY (30 Hrs., 2Hrs/Week)

UNIT-III

Enzyme Catalysis: (15 Hrs.)

Michaelis – Menten Mechanism. Effect of temperature and pH on enzyme catalysis.

Physical Chemistry of Macromolecules

(a) Classification of macromolecules. Biological and Synthetic Polymers, Atactic and isotactic polymers. Polydispersity.

(b) Distribution of molar masses (statistical treatment)

Number-average and mass-average molar masses (molecular weights). Conformations of Macromolecules in solution: In freely jointed chain (the three dimensional, random walk model). Evaluation of the root-mean-square end-to-end distance, most-probable distance and average distance, from the distribution function.

(c) Thermodynamics and Macromolecular solutions (Quantitative Treatment)

Entropy of mixing, free energy and heat of mixing of polymer solutions.

(d) Methods for Separation of Polymers: Electrophoresis.

UNIT-IV

Physical Chemistry of Macromolecules (15 Hrs.)

Methods for the determination of the Molar mass of Polymers:

(a) (i) Intrinsic viscosity


(iii) Osmotic Pressure Measurements.

(iv) Light Scattering from Polymer Solutions. The Zimm Plot.

(b) Diffusion in Polymers. The Einstein-Stokes Equation.
Structural Determination of Biopolymers:
Brief qualitative description of the following techniques:
(i) Diffuse X-ray scattering of polymer solutions.
(ii) Optical activity: Circular dichroism (C.D.) optical rotatory dispersion (O.R.D.) and magnetic optical activity.

Instructions for paper setters and candidates:

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II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.
III. All questions carry equal marks.

Suggested Books:

Essential

3. Tanford C., Physical Chemistry of Macromolecules, Pubs: Wiely, N.York, 1961

FURTHER READING:

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT-I

Radioisotope Methodology and its applications (15 Hrs.)


UNIT-II

Metals: (15 Hrs.)


UNIT-III

PHYSICAL CHEMISTRY

Phase Equilibria: (15 Lectures)

(a) Introduction of phase rule & definitions:

Phase, component, polyphase systems, conditions for equilibrium between phases, thermodynamic derivation of phase rule, degrees of freedom, reduced phase rule.

(b) Phase change in one-component systems:

Solid-liquid, liquid-vapour & solid-vapour equilibria, Clapeyron equation, Clausius-Clapeyren equation, their application in the study of phase equilibria, phase diagrams of water, carbon dioxide & triple point.

Application of phase rule to two-component systems:

Construction of phase diagram from cooling curves, interpretation of phase diagrams showing eutectics, phenomena of congruent &
incongruent melting, solid solution series, phase diagrams for silver-lead & iron-carbon systems, equilibrium between salts, their hydrates & solutions, phase diagrams for Na\textsubscript{2} SO\textsubscript{4}-H\textsubscript{2}O & Fe\textsubscript{2} Cl\textsubscript{6}-H\textsubscript{2}O systems.

**UNIT-IV**

**Phase rule applied to three-component systems** (15Hrs.)

Brief scheme of Triangular phase diagrams.

**Solutions – Ideal & Real:**

(a) **None-electrolyte Solutions:**
Thermodynamics of ideal solutions. Mention of Chemical Potential as partial molar free energy, activity and activity coefficients of component. Different types of standard states.

(b) **Electrolyte Solutions:**

**Instructions for paper setters and candidates:**

I. **Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.**

II. **The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.**

III. **All questions carry equal marks.**

**Suggested Books**

**ESSENTIAL:**


**FURTHER READING:**

CHEMISTRY (SUBSIDIARY) PRACTICALS
(FOR THE STUDENTS OF GEOLOGY)
SECOND YEAR

CHEMISTRY PRACTICALS
45 Hrs.
M. Marks: 25(12.5+12.5)
Time: 3 Hours/week

Semester IV

Volumetric Analysis:
(a) Complexometric titrations
   Use of EDTA for estimation of calcium and magnesium.
(b) Ceric sulphate titrations
   Estimation of nitrite and Oxalate.
(c) Potassium iodate and bromate titrations.
   Estimation of Hydrazine or iodide by Andrew’s method. Determination of
   arsenic or antimony.

III. Quantitative analysis of Portland cement.

IV. Quantitative analysis of limestone or calcium oxalate monohydrate by
   conventional methods and also by mean of derivatograph.

Suggested Books
B.Sc. (Hons.School) Chemistry (Subsidiary)
Second Year (2 years course) (for the students of Biochemistry)

CHEMISTRY PRACTICALS

45 Hrs.
M. Marks: 25(12.5+12.5)
Time: 3 Hours/week

**Semester IV**

III. Preparation of Coordination Compounds
(a) Preparation of crystals of ferrous oxalate (estimation of iron and oxalate)

(a) Bassett, J., Denney, R.C., Jeffery, G.H., Preparation of double salt: CuSO$_4$ (NH$_4$)$_2$SO$_4$·6H$_2$O (estimation of copper and sulphate).
(c) Preparation of mercury tetrathiocyanate Cobalt (II) Hg Co (CNS)$_4$
   (estimation of Cobalt and Mercury)
(d) Preparation of tris (thiourea) Copper (I) sulphate (estimation of copper and sulphate).

IV. Physical
(a) Preparation of simple colloidal sol. and their precipitation value.
(b) Determination of viscosity and surface tension.
(c) Distribution Law and its verification.

**Suggested Books**

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR B.Sc. (HONS. SCHOOL) IN CHEMISTRY FOR THIRD YEAR (MAJOR) (SEMESTER SYSTEM) EXAMINATION 2012-2013

OUTLINES OF TESTS

OBJECTIVE OF THE COURSE

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THIRD YEAR

MAJOR SUBJECTS

Evaluation
There shall be one Mid Term Examination of 20% Marks (20) in each semester.

Semester V (November/December)

Theory Papers:
There shall be five theory papers:

Paper CH-311 Physical Chemistry 100 Marks
Paper CH-312 Inorganic Chemistry 100 Marks
Paper CH-313 Organic Chemistry 100 Marks
Paper CH-314 Industrial Chemistry 80 Marks

The theory examination shall be of 3 hours duration.

Practicals: 120 Marks
Practical examination will be divided into three parts (Duration: 18 Hrs./Week):

(a) Physical Practical 40 Marks
(b) Inorganic Practical 40 Marks
(c) Organic Practical 40 Marks

Each practical examination shall be of 3 hours duration.
There shall be continuous internal assessment for practicals of 20% marks.
Semester VI (April/May)

**Theory Papers:**
There shall be five theory papers:

- Paper CH-321  Physical Chemistry  100 Marks
- Paper CH-322  Inorganic Chemistry  100 Marks
- Paper CH-323  Organic Chemistry  100 Marks
- Paper CH-324  Analytical Chemistry  80 Marks

The theory examination shall be of 3 hours duration.

**Practicals :** 120 Marks
Practical examination will be divided into three parts (Duration: 18 Hrs./Week):

(a) Physical Practical  40 Marks
(b) Inorganic Practical  40 Marks
(c) Organic Practical  40 Marks

Each practical examination shall be of 3 hours duration.
There shall be continuous internal assessment for practicals of 20% marks.
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UNIT–I (11)

Elementary Quantum Chemistry
Historical background, classical ideas of energy and particle trajectory. Black body radiation and Planck’s hypothesis of quantization of energy, photoelectric effect. Line spectra of atoms, diffraction of electrons, wave-particle duality. De Broglie’s relation Heisenberg’s uncertainty principle.

Schrödinger-wave equation, concept of wave function (ψ) physical significance of ψ and ψ², normalization of ψ constraints on ψ.

Free particle, particle in a one dimensional box, translational energy, energy levels, quantization of energy, wave functions for particle in a box, comparison with classical theory, concepts of orthogonality and orthonormality. Kronecker delta. Particle in a three dimensional box, cubical box and concept of degeneracy of energy levels.

Operators, definitions, linear operators, eigenvalue operators, operators for various observables, concept of Hermitian operators, orthogonality. Postulates of quantum mechanics, time dependent Schrödinger equation, expectation, values, applications of particle in a box model.

UNIT–II (12)

Vibrational motion, classical one-dimensional harmonic oscillator. Quantum mechanical harmonic, oscillator, Energy and energy levels of simple harmonic oscillator (no derivation), wave functions for simple harmonic oscillator; tunnel effect. Hermite polynomials as even and odd functions, average kinetic energy and average potential energy of simple harmonic oscillator, virial theorem.
Rotational motion: two dimensional rotation (particle on a ring), energy levels, angular momentum and position of particle on a ring. Rotation of a particle in three dimensions, Schrödinger equation and its elementary solution, spherical harmonics, applications to diatomic molecule (rigid rotator).

Schrödinger equation for hydrogen-like atoms, elementary discussion of its solution, energy levels for hydrogen like atoms, wave functions for hydrogen atom, electron spin, concept of spin orbitals, spectral selection rules for one-electron atoms, spectrum of hydrogen atom.

UNIT-III (11)
Helium atom, Schrödinger equation, approximate solutions, variation method, its application to ground state of hydrogen atom, Pauli exclusion principle, two electron spin functions, Slater determinants and Pauli principle, excited state of helium atom, Lithium atom.

UNIT-IV (11)

Instructions for paper setters and candidates:
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III. All questions carry equal marks.

Suggested Books
ESSENTIAL:

FURTHER READING:
OBJECTIVE OF THE COURSE
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UNIT-I
a) Electronic Spectra of Transition Metal Complexes:
Electronic spectra of transition metal complexes: General features, Russell-Saunders coupling scheme, Selection rules, Orgel diagrams; weak field splitting, Intermediate and strong field splitting. Tanabe and Sugano diagrams. Electronic spectra of d$^1$-d$^9$ metal complexes and f type compounds. Calculation of $D_q$, $B$ and $\Delta'$ of d$^1$ d$^2$ & d$^8$ configurations. (6 Hrs.)

b) Magnetic properties of transition metal complexes: Types of magnetic behaviour shown by transition elements and inner transition elements and their compounds. Gouy’s method for measuring magnetic susceptibility, importance of magnetic susceptibility measurements in structure determination of transition metal compounds, anomalous magnetic moments, magnetic exchange coupling and spin crossover. (5 Hrs.)

UNIT-II
a) General Chemistry of 1$^{st}$ row d-block elements:
Electronic configuration, ionization potential, oxidation states, complex forming, magnetic, catalytic and spectral properties. (3 Hrs.)

b) The Chemistry of Ti and V complexes:
Solution Chemistry and complexes of Ti(III). Chemistry of vanadium (V) with emphasis on structure and formation of vanadates. Chemistry of vanadium(IV). (5 Hrs.)

c) Cr and Mn: Oxidation states and complexes:
Isolation of Cr from its chromite ore. Chemistry of Chromium(II); binuclear compounds, Chemistry of Cr(III) complexes; The Chemistry of Cr(VI) chromates, dichromates and peroxy complexes of Cr(IV), Cr(V) and Cr(V). Chemistry of Mn(II) and Mn(III) complexes. (4 Hrs.)
UNIT-III

a) Fe and Co, chemistry and complexes:
Aqueous and coordination chemistry of Fe(III). Mixed valence compounds of iron. Chemistry of complexes of Co(II) and Co(III). Oxidation of Co(II) by molecular oxygen. (3 Hrs.)

b) Ni and Cu complexes:
Stereochemistry of Ni (II) tetrahedral, square planar, octahedral and five coordinated derivatives. Anomalous structural properties of Ni(II) complexes. Chemistry of Cu(I) compounds and complexes. Stereochemistry of Cu(II) complexes. (4 Hrs.)

c) Stereo-electronic effects in Transition metal complexes:
Substitution in square planar complexes. The trans-effect, its synthetic application, I.D. theories of trans effects, Redox reactions., electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere type reactions, inner sphere type reactions. (4 Hrs.)

UNIT-IV

a) Reaction Mechanism of Transition Metal Complexes:
Nature and classification of ligand substitution reactions. Application of valence bond and crystal field theories to predict substitution reactions. Mechanism of ligand replacement reactions. Substitution in octahedral complexes, acid hydrolysis, base hydrolysis, acid-catalyzed acid hydrolysis and acid hydrolysis chelates. (11 Hrs.)

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Suggested Books
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UNIT-I

1. **Stereochemical Principles; conformation, steric and stereoelectronic effects:** (6 Hrs.)
   Enantiomeric relationships, Diastereomeric relationships, Dynamic stereochemistry, Prochiral relationships, Conformations of Acyclic molecules, cyclohexane derivatives, Rings other than six membered. Conformational effects on reactivity, angle strain and its effects on reactivity. Relationship between ring size and facility of ring closure. Torsional strain and related stereo electronic effects.

   **Free radical reactions:** (4 Hrs.)
   Generation and characterization, characteristics of reaction mechanisms involving and electron transfer reactions.

Unit-II

2. **Carbanions and other nucleophilic carbon species and their reactions:** (12 Hrs.)
   Acidity of hydrocarbons carbanions stabilized by functional groups, generation of carbon nucleophiles by deprotonations Regioselectivity, stereoselectivity in enolate formation, other methods of enolate generation, alklylation, Alkylation of aldehydes, esters nitriles, Enamines, stork enamine, Michael addition, Aldol condensations, Robinson annulation Amined Catalysed condensations, Mannich reactions acylation of carbanions, witting and related reaction, sulphur yields Darzen condensation, stevens Witting and Favorckii rearrangements. Stork-enamine reaction, sharpless asymmetric epoxidation.
UNIT-III

3. Photochemistry : (11 Hrs.)
General principles about light absorption, electronic transition, Jablonski diagram, inter-system crossing singlet and triplet states, Quantum yield. Brief introduction and description of photochemical reactions of simple carbonyl compounds, alkenes and aromatic compounds, Barton Reaction, Hofmann-Loffler-Freytag reaction.

Unit-IV

4. Concerted reactions, unimolecular rearrangement and elimination: (12 Hrs.)
Electrocyclic sigmatropic and cycloaddition reactions, Correlation diagrams and FMO theory. Diels-Alder reactions, general feature, Dienophiles, Dienes (2+2) cycloadditions, Cope and Claisen rearrangement, Ene reaction.

Instructions for paper setters and candidates:
I. Examiner will set total of Nine questions comprising two questions from each unit and one compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt five questions in all, one question from each unit and the Compulsory question.
III. All questions carry equal marks.

Suggested Books

ESSENTIAL :


FURTHER READING :

OBJECTIVE OF THE COURSE

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UNIT-I (11 Hrs.)


UNIT-II (13 Hrs.)


Heavy Chemical:

(a) Nitric acid: Manufacture of ammonia and nitric acid by Ostwald process. Methods to manufacture concentrate nitric acid.

(b) Sulphuric acid: Study of raw materials, Extraction of sulphur by Frasch Process. Manufacture of sulphuric acid by lead chamber and contact process. Concentration of sulphuric acid, Oleum.

(c) Sodium Carbonate: Manufacture by Solvay and modified Solvay Process.
(d) Sodium hydroxide, Chlorine and Hydrochloric acid: Manufacture of sodium hydroxide by causticization process and by electrolysis of brine using mercury electrolytic cell and diaphragm cell.

**UNIT-III (10 Hrs.)**


**UNIT-IV (11 Hrs.)**

Industrial Wastes and Treatment: Types and characteristics of industrial wastes. Treatment of industrial wastes with organic and inorganic impurities.

**Air Pollution:** Sources of air pollutants. Classification and effects of air pollutants. Control of air pollutants with reference to oxides of nitrogen and sulphur. Green house effect and its consequences. Ozone layer and its significance. Smog, Acid rain.

Industrial Hazards and Safety.

**Instructions for paper setters and candidates:**

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II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

III. All questions carry equal marks.

**Books Recommended**


I. **Conductometry**
   1. To study the effect of concentration of electrolyte on specific and molar conductance of a strong and weak electrolyte.
   2. Determination of degree of dissociation and dissociation constant of weak acid.
   3. Conductometric titration of a strong acid, a weak acid, mixture of a strong and weak acid and a dibasic acid with alkali.
   4. To compare the relative strengths of weak acids like acetic acid and monochloroacetic acid by conductivity measurements.
   5. To verify Debye-Huckel Onsager equation.

II. **Potentiometry**
   1. Potentiometric titration of monobasic acids (HC & CH₃ COOH) with NaOH.
   2. Determination of mean ionic activity co-efficients of hydrochloric acid at different concentrations.
   3. To study the effect of ionic strength on mean ionic activity coefficient of hydrochloric acid in a given solution and verify Debye-Huckel limiting law.

III. **Polarimetry**
   1. To determine the specific and molecular rotations of an optically active substance.
   2. To determine the composition of an unknown solution with a polarimeter.

IV. **Chemical Kinetics**
   1. To study the kinetics of hydrolysis of methyl acetate in the presence of hydrochloric acid.
   2. To study the effect of ionic strength (primary salt effect) on the kinetics of a reduction of toluidine blue with sodium sulfite.

V. **Determination of Molecular Masses by Cryoscopy**
   1. To determine the molecular weight of a non-volatile substances by a cryoscopic method.

VI. **Dipole-Metry**
   1. To determine the dielectric constant of an unknown liquid.
   2. To determine the dipole moment of a polar substance in solution.
INORGANIC CHEMISTRY PRACTICALS FOR B.Sc.(H.S.) Third Year  
Semester V (Major)

90 Hrs  
M. Marks: 40  
Time: 6 Hours/week

I. Preparation and characterization of:
   (i) cis and trans K[Cr(C\textsubscript{2}O\textsubscript{4})\textsubscript{2}]\textsubscript{2}H\textsubscript{2}O and the study of their infrared spectra
   (ii) Hg[Co(NCS)\textsubscript{4}] and its use as a standard substance for measurement of magnetic susceptibility, Guoy’s Method.
   (iii) Tris (acetylacetonato) cobalt (III) and its nitro or bromo derivative Characterization of these compounds by IR and \textsuperscript{1}H-NMR.
   (iv) K\textsubscript{2}[Cr(C\textsubscript{2}O\textsubscript{4})\textsubscript{2}]\textsubscript{3}H\textsubscript{2}O and NH\textsubscript{4}[Cr(NH\textsubscript{2})\textsubscript{2}(NCS)\textsubscript{4}].H\textsubscript{2}O and their characterisation by conductivity, IR and UV/VIS spectroscopy.
   (v) VO(acac)\textsubscript{2}

II. Strong acid-strong base titration in a non-acqueous solvent using visual, conductometric/potentiometric methods.

III. Study of reactions of the elements of first transition series:
   a. Titanium
   b. Vanadium
   c. Chromium
   d. Manganese

IV. Preparation of SnCl\textsubscript{4}.2acacH adduct and Cl\textsubscript{2} Sn (acac)\textsubscript{2} by reactions of tin(IV) Chloride with acetylaclactone and their structure determination by elemental analysis, IR and \textsuperscript{1}H-NMR.

V. Synthesis and characterization of any suitable inorganic/organometallic compounds involving the use of techniques available in the department.

VI. Ion exchange separation of oxidation states of vanadium.

Suggested Books:
Multistep preparations and estimations

I. Preparation of p-bromoaniline from acetanilide (protection, aromatic electrophilic substitution and deprotection).

II. Preparation of anthranilic acid from phthalic anhydride (nucleophilic addition of Hoffman degradation).

III. Preparation of o-chlorobenzoic acid from anthranilic acid. (diazoitization and Sandmayer reaction)

IV. Preparation of benzapinacol from benzophenone (photoreduction).

V. Preparation of benzpinacolone from benzpinacol (pinacol – pinacolone rearrangement).

VI. Preparation of triphenyl methane from benzpinacolone (nucleophilic cleavage of C-C bond).

VII. Preparation of triphenylmethyl bromide from triphenyl methane (free radical bromination by use of NBS).

VIII. Preparation of 1,5 – Diphenyl-1,4-pentadiene-3-one from benzaldehyde and acetone (cross aldol condensation).

IX. Preparation of E/Z-a-phenylcinnamic acid from benzaldehyde and phenylacetic acid (Perkin reaction).

X. Preparation of 1,3,5-tribromobenzene from aniline (diazoitization, aromatic electrophilic substitution and deamination).

XI. Preparation of 2,5-dihydroxy acetophenone from hydroquinone (Fries reaction).

XII. Preparation of 3,5-diethoxycarbonyl-2,4-dimethylpyrrole from ethylacetocetate (Knorr synthesis).

XIII. To estimate the strength of given glucose solution (Fehling method).

XIV. To estimate acid value, iodine value and soaponification value of a given oil.

XV. To estimate percentage of sulphur in given organic compound by Messenger’s method.

Suggested Books


B.Sc.(Hons. School) Third Year Semester VI (Major)

CH-321: PHYSICAL CHEMISTRY

45 Hrs.
M. Marks: 100(80+20)
Time: 3+1(Tutorial)/week

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UNIT–I (11)

Molecular Interactions and other topics:

Electrical properties: Permanent dipole moment, polarizability, polarizability and refractive index, optical activity. Intermolecular forces: dipole, dipole-induced dipole, dispersive forces, repulsive forces and total interaction. Molecular interactions in beams. liquid crystals, difference between liquid crystals solid and liquid, classification, structure of nematic and cholesteric phases, movement in liquids, Ionic solids, Magnetic properties, magnetic susceptibility, permanent magnetic moment, induced magnetic moment.

Molecular spectroscopy:
Introduction: Electromagnetic radiation, absorption co-efficient, Einstein coefficient, transition moment and oscillator strength.
Microwave absorption: Rotational Spectra; rotational transitions, rotational spectra of diatomic molecules, molecular dimensions, polyatomic molecules. Rotational Raman Spectra.

UNIT–II (11)

Molecular spectroscopy and Nuclear spectroscopy:

Resonance Spectroscopy: Nuclear magnetic resonance, the techniques, relaxation processes, chemical shift, the fine structure, Fourier transform spectroscopy, line width and rate processes, spin relaxation, Electron spin resonance, hyperfine splitting, applications of ESR. Mossbauer spectroscopy.
Interaction of ionizing radiation with matter. Alpha, Beta and Gamma Ray spectrometry.

**UNIT-III (12 Hrs.)**

**Statistical Thermodynamics-I:**

*Molecular energy levels and the Boltzmann distribution:* configurations and weights, most probable configuration; the molecular partition function, physical interpretation of the partition function. The canonical ensemble, canonical partition function and its relation to molecular partition function for independent particles. The statistical entropy; heat, work and entropy; entropy and partition function, entropy of a monoatomic gas. Factorization of partition function; calculation of translational, rotational vibrational and electronic contributions, the overall partition function.

**UNIT-IV (11 Hrs.)**

**Statistical Thermodynamics-II:**

Calculation of thermodynamic functions in terms of partition functions. Mean energies and equipartition principle, heat capacities, residual entropies, equilibrium constant.

**Molecular reaction dynamics**

Collision theory, Diffusion controlled reactions Activated complex theory; reaction co-ordinates and transition state, formation and decay of the activated complex, Derivation and use of Eyring equation. Thermodynamic aspects; reactions between ions. Dynamics of molecular collisions; reactive encounters, potential energy surfaces, attractive and repulsive surfaces, reaction trajectories.

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**Suggested Books**

**ESSENTIAL:**

6. Molecular Quantum Mechanis by P.W. Atkins and R. S. Friedman,

**FURTHER READING:**

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UNIT I

Chemistry of 2nd and 3rd row d-block elements:
Comparison of the chemistry of elements of second and third row series with that of elements of the first transition series. Aqueous chemistry of Zr(IV). Chemistry of Nb(V) and third row series with that of elements of the first series. Dinitrogen complexes of Molybdenum. Mo-Mo and Re-Re quadrupole bonds. Chemistry of complexes of Rh(III), Pt(II) and Pd(II). (8 Hrs.)

Chemistry of f-block elements:
Chemistry of Lanthanide elements, their isolation from one another, their coordination chemistry. (3 Hrs.)

UNIT II

The actinide elements:
Their electronic configurations. Chemistry of Thorium and Uranium. (3 Hrs.)
Organometallics:
Importance of organometallic chemistry in modern times: Definition and terminologies. Preparation of metal carbonyls, binary carbonyls, mixed metal polynuclear carbonyls, chemical reactions of metal carbonyls, structures of metal carbonyls (evidence from spectral and diffraction methods), bonding in linear M-C-O groups. (8 Hrs.)

UNIT III

a) Metal carbonyls and related compounds:
Fluxionality in metal carbonyls, Additional structural and bonding features, vibrational spectra of metal carbonyls, carbonylate anions and carbonyl hydrides, Chemical behaviour of hydrido compounds. (7 Hrs.)
b) **Bonding and Structure:**
Molecular hydrogen compounds, metal-hydrogen interactions with C-H groups, carbonyl halides, Metal nitrosyl compounds, nitrosyl carbonyls. Dinitrogen and dioxygen complexes, tertiary phosphines as ligand.

(5 Hrs.)

**UNIT IV**

**Aromatic complexes:**

(6 Hrs.)

**Chemical reactivity:**
Coordinative unsaturation, Oxidative-addition reactions, Insertion reaction, Fluxional molecules and their Characterization.

(5 Hrs.)

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**Suggested Books**
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UNIT-I

1. Electrophilic additions to carbon-carbon multiple:  (5 Hrs.)

2. Reaction of electron-deficient intermediates:  (8 Hrs.)
   Carbenes Structures, generation, reactions, Addition, insertion, rearrangement reactions; Wolff rearrangement and Arndt-Eistert synthesis.

   Nitrines: Generation from azides, generation of carboalkoxynitrenes from alklazidoformates.

   Rearrangement of electron-deficient nitrogen:
   Backmann, curtius, Hofmann, Schmidt rearrangements (Bayer-villiger rearrangement)


UNIT-II

3. Oxidation  (7 Hrs)
   Oxidation of alcohols to aldehydes, ketones or carboxylic acids:
   Oxidation of alcohols to aldehydes, ketones or carboxylic acids
Transition metal oxidants: Cr(VI) Oxidants, MnO₂ and ruthenium tetraoxide. Other oxidants: DMSO-DCC, DMSO/AC₂O, Dimethyl sulphide/ N-chloro-succinimide, DMSO/Cl₂. Addition of oxygen at carbon-carbon double bonds. Transition metal oxidants. KMnO₄, OsO₄. Cleavage of carbon-carbon double bonds by transition metal oxidants; KMnO₄, Na₂Cr₂O₇/AC₂O, CrO₃/ACOH.

4. **Reductions** *(5 Hrs)*  
Reduction of Carbonyl group Addition of hydrogen. Catalytic hydrogenation, Group III hydride-transfer rearrangements. Reduction of carbonyl groups, halides, sulphonates, expoxides, acetylenes;

Group IV hydride donors: Reduction of alcohols, aromatic ketones, Carboxylic acids and esters with silanes, Cannizzaro reaction.

Hydron atom donors, reductive dehydrogenation of alkyl halides and acid chlorides and deoxygenation of alcohols with tributyl tin hydride.


### UNIT-III

5. **Organometallic Reagents:** *(10 Hrs.)*  
Organic derivatives of lithium and magnesium – their preparation, properties and reactions.

Organocopper intermediates.

Synthetic applications of other transition metals, reactions involving organonickel compounds, palladium, rhodium iron and cobalt.


### UNIT-IV

6. **Green Chemistry :** *(10 Hrs.)*  
**Solvents :** Reactions in solvent less systems, use of supercritical fluids such as CO₂, Ionic liquids.  
**Catalysts :** For increased selectivity, reduced energy requirement, photocatalytic reaction and asymmetric synthesis.  
**Synthetic Methodologies :** New synthetic protocols using new energy sources like Microwaves, Ultrasound etc. Use of bio-memetic approach, cascading reaction and molecular self assembly.
**Instructions for paper setters and candidates:**

I. Examiner will set total of **NINE** questions comprising **TWO** questions from each unit and **ONE** compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

III. All questions carry equal marks.

**Suggested Books**

**ESSENTIAL :**


**FURTHER READING ;**


**Pape-CH-324 ANALYTICAL CHEMISTRY**

45Hrs.

M.Marks: 80(64+16)

Time: 3 Hours/week

**OBJECTIVE OF THE COURSE**

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons. School) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

**UNIT- I**

a) **Elementary circuitry for analytical instruments:** Fundamental laws of AC and DC circuits. Operational amplifiers and readout devices. Semiconductor devises. Photosensitive detectors and photomultiplier tubes. Single beam and double beam spectrophotometers. (4 Hrs.)
b) **Potentiometry**: Importance of Nernst Equation in potential measurements. Types of electrodes. Cell with and without liquid junction. Saturated Calomel Electrode as reference electrode. Determination of concentration from potential measurements. The residual liquid junction potential. The glass pH electrode, construction, working principle and errors in measurements. Ion selective electrodes, types, construction and applications. (7 Hrs.)

**UNIT-II**


**UNIT-III**

a) **Introduction to Environmental Pollution**: Sampling of gases and water. The sampling train. Major pollutants in air. Analysis or organic and inorganic pollutants in air and water by chemical and instrumental methods of analysis. Determination of nitrate nitrogen in water, spectrophotometric determination of lead in plant leaves. (5 Hrs.)

b) **Surface characterization by Spectroscopy and Microscopy**: Introduction to the study of surfaces. Spectroscopic surface methods. Electron spectroscopy. X-ray photoelectron spectroscopy. Brief introduction of Scanning Electron Microscopy (SEM) Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM) and their applications. (6 Hrs.)

**UNIT-IV**

(a) **Food Analysis**: Sample preparation in food analysis, chemical methods of food analysis, analysis of food for moisture content, ash content crude fibres and mineral elements. Applications of instrumental methods in food analysis with special reference to polarographic radiochemical, polarimetric and chromatographic methods. Enzymes electrodes as analytical aids in food analysis. (6 Hrs.)

(b) **Clinical Chemistry**: Composition of Blood, collection and preservation of blood samples, brief discussion of commonly determined constituents in blood. Trace elements in the body. Radioimmuno assay (RIA)-principles, specificity and applications of RIA. (6 Hrs.)
Instructions for paper setters and candidates:

I. Examiner will set total of **NINE** questions comprising **TWO** questions from each unit and **ONE** compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

III. All questions carry equal marks.

**Books Recommended**

I. Conductometry

1. Determination of the solubility of a sparingly soluble substance.
2. Determination of the degree of hydrolysis of NH₄ Cl and CH₃COONa.
3. To study the kinetics of saponification of ethyl acetate by sodium hydroxide.

II. Potentiometry

1. Potentiometric titrations of diabasic acid, oxalic acid and malonic acid with base.
2. To determine potentiometrically the solubility and solubility product of a sparingly soluble salt.
3. Determination of heat of reaction, equilibrium constant and other thermodynamic functions of the reaction.
   \[ \text{Zn} + \text{Pb}^{2+} \rightarrow \text{Zn}^{2+} + \text{Pb}. \]

III. Polarimetry

1. To study the kinetics of inversion of cane sugar by means of polarimetry.

IV. Chemical Kinetics

1. To determine activation energy of a reaction by studying its temperature dependence.
2. To study the reaction between potassium iodide and potassium peroxodisulphate.
3. To study the kinetics of iodine clock reaction.

V. Determination of Molecular Masses by Cryoscopy

1. To determine molar depression constant (K_f) for a given solvent.
2. To determine cryoscopically the apparent degree of dissociation of KCl and Ca(NO₃)₂ in water.

VI. Experiment on radio chemistry

Radiation Detection
1. Statistical Nature of Radioactivity
2. Operational Characteristics of a GM Counter.
I. Preparation and characterization of:

(i) Prussian Blue and Turubull’s Blue  
(ii) Bromination of Cr(acac)$_3$  
(iii) SnI$_4$, SnI$_2$ and SnCl$_4$  
(iv) Magnetic moment of Cu(acac)$_2$.H$_2$O  
(v) Preparation of transition metal complexes of Ph$_3$P.  
(vi) Preparation of iron(II) chloride and its use as Friedel-Craft Chlorination source.

II. Strong acid-strong base titration in a non-aqueous solvent using visual, conductometric/potentiometric methods.

III. Study of reactions of the elements of first transition series:  
   a) Iron  
   b) Cobalt  
   c) Nickel  
   d) Copper

V. Preparation of chromium (II) acetate, Cr(CH$_2$COO)$_2$.H$_2$O (Use of inert atmosphere technique) and measurement of its magnetic susceptibility.

VI. Preparation and Identification of any suitable inorganic/organometallic compounds involving the use of techniques available in the department.

Suggested Books:

Qualitative Analysis:

To perform qualitative analysis of a given binary mixture
I. Separation by ether, sodium hydroxide, sodium bicarbonate and dil. hydrochloric acid.
II. Test for elements (Other than C,H,O)
III. Functional group determination
IV. Melting point, derivative preparation TLC for checking the purity and effectiveness of separation.

Suggested Books


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