

# Maharshi Dayanand University Rohtak



## Ordinances, Syllabus and Courses of Reading for B.Sc. (Hons.) Chemistry Part-I, II & III Examination

Session—1998-99

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## **ORDINANCE : B.A./B.SC./B.COM.(HONOURS) EXAMINATION**

1. The Bachelor of Arts(Hons.), the Bachelor of Science (Hons.) and the Bachelor of Commerce (Hons.) Examinations shall be in three parts. Part-I Examination shall be held at the end of the first year Part-II Examination at the end of the second year and Part-III Examination at the end of the third year.

The Examinations in Part-I,II & III shall be held once a year, ordinarily in the month of April/May, on such dates as may be fixed by the Vice-Chancellor.

A supplementary Examination for those who are to re-appear in one or more subsidiary or/and qualifying subject in Part-III shall be held ordinarily in the month of September/October of the same year on a date to be fixed by the Vice-Chancellor.

- 2.(a) No one shall be eligible to join the first year (Part-I) class of B.A./B.Sc./B.Com. (Hons.) Course unless he/she has passed (a) Senior Secondary Certificate (10+2) Examination of Haryana Board of School Education, Bhiwani or (b) B.A./B.Sc./B.Com./B.Sc. (Home Science) Part-I Examination, as the case may be under old scheme of this University; or (c) any other Examination recognised by this University as equivalent to (a) or (b) above, obtaining :-
  - i) For admission to B.A. (Hons.) 50% marks in aggregate or 50% marks in the subject of Hons. course.
  - ii) For B.Sc. (Hons.) 60% marks in aggregate and 65% marks in the subjects of Hons. Course.
  - iii) For B.Com. (Hons.) 55% marks in aggregate or 55% marks in the subject of Hons. Course.
- b) No one shall be eligible to join the 2nd year (Part-II), class of the B.A./B.Sc./B.Com. (Hons.) course unless he has passed First year (Part-I) Exam. of the B.A./B.Sc./B.Com. (Hons.) under new scheme of this University.

- c) No one shall be eligible to join the third year (Part-III), class of the B.A./B.Sc./B.Com. (Hons.) Course of this University, unless he had passed 2nd year (Part-II) Exam. (Hons.) under new scheme of this University.
- d) A regular candidate of a Department/College admitted to the privileges of this University in the subject of B.A./B.Sc./B.Com./(Hons.) can attend the course of subsidiary and qualifying subjects in other College/Deptt. in case there is no arrangement to teach these subjects in the College/Deptt. where he has taken admission for his main subjects of Hons. Course. The Principal/Head of the College/Deptt. where a student is attending subsidiary and qualifying subjects shall certify that the said student has completed the prescribed number of lectures etc.
3. The Examination in Part-I/Part-II/Part-III shall be open to person.
- A. Who has passed not less than one academic year previously the requisite Examination as laid down in Clause-2 above.
- B. i) who has been on the rolls of a University Teaching Deptt./College admitted to the privileges of this University throughout the academic year preceding the Examination.
- ii) Whose name is submitted to the Registrar/Controller of Examinations by the Head of the Department/Principal of College he has last attended provided that the Head of the Department/Principal of the College certified that the candidate has :
- a) attended not less than 75% of the full courses delivered to his class in each subject offered by him and 75% of the periods assigned to practical work in each Science subject.
- (Lectures and Practical work shall be counted upto 21 days before the commencement of the Examination).
- b) satisfactorily performed the work of his class; and

- c) Obtained not less than 25% marks in the aggregate of all the subject(s) paper(s) of the result of half yearly house examination held in November/December with 100 marks in each subject.
4. a) A student who is unable to appear in the Annual Examination due to shortage of attendance and has complied with the requirements of Clause-3 (b) (ii) (c) may be exempted from this requirement when he appears in the Examination in the following year or thereafter, after making up the deficiency in lectures.
- b) A student who has completed the required percentage of Lectures and practicals may be permitted to appear in the Examination in the same year or the following year as an ex-student even if as a regular student he did not comply with the requirements of Clause-3 (b) (ii) (c).
- i) For promotion from B.A./B.Sc./B.Com.(Hons). Part-I to Part-II a candidate shall be required to clear 50% of theory papers atleast one theory papers of the main subject and from part-II to Part-III he shall have to clear atleast 50% of the theory paper of the main subject of Part-I and Part-II taken together. While calculating 50% papers fraction may be ignored. For Example, if the number of papers is 5 the candidate will be required to clear atleast two papers. A student will be considered to have cleared Honours Paper(s) if he obtains atleast 40% marks in that/ those paper(s).

Provided that a student joining Honours in the 2nd year may be allowed to clear the first year. Honours paper either in second year or in second and third year together.

- ii) For promotion from Part-II to Part-III, a student shall be required to clear all the subsidiary/qualifying subjects of Part-I of the Honours Course even if such a subject is studied in 2nd year in terms of Clause-2 (b) (ii).

5. a) A student after passing B.A./B.Sc./B.Com.(Hons.) Part-I Examination may be permitted to change over to the B.A./B.Sc./B.Com. Part-II Course within one month of the start of admission to this course provided that the Principal of the College/Head of Department where he is studying, is satisfied that the student will be able to carry on with the new course.

Provided a student after passing B.Sc./B.Com. (Hons.) Part-I Examination shall have to appear in the subject of English of B.A. Part-I alongwith B.A. Part-II Examination, unless he has already qualified in this subject.

- b) A student who joins B.A. Part-II class may be allowed to change one or more of his elective subjects within one month of his joining B.A. Part-II Class.
- c) A candidate appearing in B.A. Part-II Privately may offer elective subjects other than taken by him for B.A. (Hons.) Part-I Examination.
6. The amount of admission fee shall be as under :-

Name of Examination	Regular students	Ex-students
1. B.A.(Hons.) I,II &III	100/-	110/-
2. B.Sc.(Hons.) I,II &III	120/-	130/-
3. B.Com.(Hons.) I,II &III	100/-	110/-

Plus Rs.10/- per practical subject for B.A./B.Sc./B.Com.(Pass & Hons.)

7. A candidate shall submit his admission application to the Registrar/Controller of Examinations on the prescribed form with the required certificates signed by the Head of the University Teaching Department/Principal of the college, the candidate has last attended, both in the case of students of University Teaching Departments/College admitted to the privileges of the University and ex-student.

8. i) The medium of instruction shall be:-
- Hindi in case of Hindi
  - English in case of English, Physics, Chemistry and Maths;
  - English/Hindi or Sanskrit in case of Sanskrit
  - English/Hindi in case of other subjects.
- ii) The question papers will be set:
- in Hindi in case of Hindi
  - in English in case of English, Physics, Chemistry and Maths:
  - in English and Hindi in case of Sanskrit.
  - English/Hindi in case of other subjects.
- iii) The candidates shall write their answers:
- in Hindi in case of Hindi.
  - in Hindi or English or Sanskrit in case of Sanskrit.
  - in English in case of English, Physics, Chemistry and Mathematics; and
  - in English or Hindi in case of other subjects.
9. The minimum number of marks required to pass shall be as under:-
- Main subject (Honours) 40% marks in the aggregate and 35% in each papers (written and practical separately).
  - Qualifying and subsidiary subjects: 35% marks in each for qualifying and subsidiary subjects (written and practical separately)
- 10.i) A candidate who fails in one or more qualifying/subsidiary subjects(s) may be admitted to the supplementary exam. held in the same year and/or at the next annual Examination in the subjects(s) and if he passes in it he shall be deemed to have passed the examination.

A candidate who fails in one or more paper(s) of main subjects of Hons. Part-I/Part-II may be allowed on the recommendation of the Principal of the college/Head of the Deptt. concerned to appear/re-appear in the Examination in the papers(s) as an ex-student, without attending a fresh course of instructions within the period permissible to him to clear the papers of Hons. Part-III under clause-12.

- ii) A candidate who fails in an Examination or having been eligible fails to appear in an Examination, shall take the Examination as an ex-student according to the syllabus prescribed by the University for regular students appearing for the Examination provided that the syllabus for the candidates who are to re-appear in the Supplementary Examination to be held in September shall be the same as was in force for the regular student in the last Annual Examination.
11. A candidate who has completed the prescribed course of instruction in a recognised College/University Department for B.A./B.Sc./B.Com.(Hons.) Part-III Examination but does not appear in it or having appeared fails, may be allowed on the recommendation of the Principal of the College/Head of the University Deptt. concerned, two consecutive chances as an ex-student to appear/re-appear in the subject(s)/paper(s), as the case may be without attending a fresh course of instruction. While re-appearing in the Examination, the candidate shall be exempted from re-appearing in paper(s) and or practical(s) in which he has obtained atleast 40 marks.

Provided that the candidate who does not pass the B.A./B.Sc./B.Com.(Hons.) Examination with the two consecutive chances as an ex-student, may be awarded B.A./B.Sc./B.Com.(Pass) Degree without division, if he obtains atleast 35% marks in each qualifying/subsidiary subject, theory and practical separately and in each paper of the main(Honours) subject, theory and practical separately. Provided further that if he does not satisfy the conditions for the award of pass Degree without division as mentioned

above, he shall be declared to have failed in the Examination and shall be required to appear in the Examination denove, after attending the College/Department as a regular student.

12. The successful candidates of B.A./B.Sc./B.Com.(Hons.) Examination who obtain 60% marks or more in the aggregate of the main subject shall be placed in the first Division, those who obtain less than 60% marks but not less than 50% marks in the Second Division and those who obtain less than 50% marks in the Third Division. For the purpose of determining division at the end of Honours Part-III Examination the marks obtained by the candidate in the Hons. subject only at the Honours Part-I, Part-II and III Examination shall be taken in to account.

However the marks obtained in qualifying subjects and subsidiary subjects will be shown in the result card.\*

13. Six weeks after the termination of the Examination or as soon as thereafter as is possible, the Registrar/Controller of Examinations shall publish a list of the candidates who have passed the examination. Each successful candidate of B.A./B.Sc./B.Com.(Hons.) Examination shall received a Degree stating the division he obtains.

14. A candidate:

- i) Who has passed B.A./B.Sc./B.Com.(Hons.) Examination of this University or ;
- ii) Who resides within the territorial jurisdiction of the University and has passed an Examination declared equivalent to the B.A./B.Sc./B.Com.(Hons.) Examination of this University may appear in a subsequent B.A./B.Sc./B.Com. subsidiary Examination in one or more subjects prescribed for the Examination except the subject in which he has passed the Examination.

A candidate appearing under this Clause shall sit for Part-I and Part-II Examination simultaneously and shall pay admission fee of as prescribed for to the whole examination and additional fee of Rs. 10/- per Science subject Provided that if



the candidate is appearing in a Science subject, he shall study in a College admitted to the privileges of this University for both Part-I and Part-II classes for atleast one academic year preceding the Examination.

The minimum percentage of marks required to pass in each subject shall be as given in Clause-9 above.

15. The candidates who have passed the B.A./B.Sc./B.Com.(Hons.) Examination in the second or third division be allowed to re-appear in one or more subject(s) (Theory papers only) of main subjects of the Part-I,II and Part-III Examination for improvement of division.

The candidates may also be allowed to improve their score of marks upto 45% in the same manner. However for improvement of division from III to II and to I as well as improvement of score of marks upto 45% only one chance shall be allowed.

Only two consecutive chances will be allowed for improvement. A candidate re-appearing in one or more subject(s)/paper(s) for the purpose of passing/improvement of division shall pay fee as for the whole examination.

The higher score in the paper(s)/subject(s) in which he re-appears for improvement will be taken into account towards the final result and the marks already obtained by the candidate in the paper(s)/subject(s) in which he has not opted to improve his result shall be carried forwarded. In case the candidate does not improve the division his result shall be declared as, Previous Result Stands.

16. Notwithstanding the integrated nature of this course which spread over than one academic year, the Ordinance in force at the time a student join the course shall hold good only for the Examination held during or at the end of the academic year and nothing in this Ordinance shall be deemed to debar the University, from amending the Ordinance and the amended Ordinance, if any shall apply to all students, whether old or new.

## SCHEME OF EXAMINATIONS FOR B.Sc. (HONS.) IN CHEMISTRY PART-I

### MAIN PAPERS

		Max. Marks	Time
Paper-I	Inorganic Chemistry	50	3 Hours
Paper-II	Physical Chemistry	50	3 Hours
Paper-III	Organic Chemistry	50	3 Hours
Paper-IV	Practicals	75	10 Hours (Spread over two days)

### Subsidiary Papers

#### GROUP-A (Non-Medical)

Any two of the following:

*	1. Mathematics	Theory Practical	2 Papers 1 Paper
	2. Physics	Theory Practical	2 Papers 1 Paper
	* 3. Statistics	Theory Practical	2 Papers 1 Paper
**	4. Geology	Theory Practical	2 Papers 1 Paper
**	5. Electronics	Theory Practical	2 Papers 1 Paper

#### GROUP-B (Medical)

Any two of the following:-

*	1. Botany	Theory Practical	2 Papers 1 Paper
	* 2. Zoology	Theory Practical	2 Papers 1 Paper
**	3. Anthropology	Theory Practical	2 Papers 1 Paper

- NOTES :**
1. There will be two subsidiary subjects alongwith the papers of the main subject in Part-I & II and in Part-III there will be only main subject.
  2. The students will offer only those subsidiary subjects in Part-II which they have studied in Part-I.

\* The syllabi will be the same as that of prescribed for B.Sc. (Pass) Part-I Examination.

\*\* The syllabi will be prescribed later on.

**B.Sc. (Hons.) Part-I Examination-1998-99****Paper-I Inorganic Chemistry**

Max. Marks : 50

Time : 3 hrs.

**Atomic Structure:** Historical development of the subject Bohr's theory and its limitations.

Idea of de-Broglie matter waves, Heisenberg's uncertainty Principle, Schrodinger wave equation, significance of wave functions and quantum numbers, normal and orthogonal wave functions probability density pattern for hydrogen atom (qualitative idea), radial and angular wave functions. Sign of wave functions, shapes of s, p, d and f orbitals, idea of electron spin, four quantum numbers and their significance.

**Multielectron systems:** Pauli's exclusion principle, Hund's rule of maximum multiplicity, stability of half filled and fully filled orbitals, Aufbau principle and its limitations, energy level diagrams.

**Classification of Elements:** Periodicity of elements, s, p, d and f block elements: the long form of periodic table. Detailed discussion of the following properties of elements:

- a) Effective nuclear charge shielding or screening effect Slater: rules.
- b) Atomic radii (van der waals, Bragg-Slater, atomic radii).
- c) Ionic radii and crystal logarithmic radii.
- d) Covalent radii (octahedral and tetrahedral)
- e) Ionization potential and electron affinity.
- f) Successive ionization potentials and factors influencing ionization potential.
- g) Electro-negativity (Pauling, Mulliken, Allred Rochow, Mulliken-Jaffe's electro negativity scales), variation of electronegativity with bond order, partial charge, hybridization; group electronegativity, electroneutrality principle, Sanderson electron density ratio.

## Chemical Bonding

**Ionic Bond:** General characteristics, type of ions, size effects, radius ratio, packing of ions in crystal, lattice energy, Born equation (calculation of energy in ion pair and ion pair square formation), Madelung constant, Born-Haber cycle, Covalent character in Ionic compounds, Polarizing power and Polarizability (Fajan's rule). Bond Moment and dipole-moment. Percentage ionic character from dipole moments and electronegativity difference.

**Covalent Bond:** General characteristics, coordinate co-valent bond, valence bond approach, directional characteristics of covalent bond. Resonance and resonance energy, hybridization, multiple bonding, sigma and pi (three electron bond) bonds, bond length, bond order, formal charge, valence shell electron pair repulsion (VSEPR) theory of directed valence, shapes of simple inorganic molecules and ions containing one pair and bonds. Hydrogen bond (theories of hydrogen bonding, valence bond treatment) metallic bond (qualitative ideas of free electron, valence bond and bond theories.)

Elementary idea of LCAO and concept of united atoms in MO theory bonding and antibonding, non-bonding orbitals. MO configurations of simple diatomic molecules ( $H_2$ ,  $O_2$ ,  $C_2$ ,  $B_2$ ,  $F_2$ , CO, NO and their ions. Elementary idea of Linnett double quartet theory.

**Acids and Bases:** Bronsted-Lowry concept of acid-base reaction, relative strength of acids, mechanism of proton transfer, amphoterism, types of acid base reactions, levelling solvents-Lux-flood concept, Lewis acid-base concept, classification of Lewis acids (electrophilic and nucleophilic displacements) Usanovich concept. Hard and soft Acids and Bases (HSAB), Application of HSAB Principle.

## Paper-II(Physical Chemistry)

Max. Marks : 50

Time : 3 Hrs.

**Kinetic Theory of Gases:** Expression for the pressure exerted by the molecules of a gas. Derivation of gas laws, collision number, collision frequency, collision diameter and mean free path of molecules of a gas (including temperature and pressure dependence). Viscosities of gases, relation between mean free path and coefficient of viscosity : temperature and pressure and pressure dependence of  $\eta$  calculation of  $d$  from  $\eta$ . Degrees of freedom of motion, principle of equipartition of energy. Molecular basis of specific heats. Barometric formula and its use for determination Avogadro's number' Maxwell

distribution law of velocities, application to the calculation of molecular velocities and energy distribution curves at different temperatures. Calculation of the most probable, average and root mean square velocities of molecules. Real gases, compressibility factor, deviation from ideality; various equation of state of real gas with special emphasis on van der Waals equation of state and its application to the calculation of Boyle temperature, second virial coefficient and molecular diameter. Intermolecular forces and liquifaction of gases, critical state, relation between critical constants and Vander Waals constants. Continuity of state, law corresponding states derivation of the reduced equation of state.

**Liquid State:** Qualitative treatment of the structure of the liquid state including various approaches to the structure of liquids. Radiation distribution function. Physical properties of liquids (surface tension, parachor, viscosity, refractive index).

**Ionic Equilibria:** Ionic product of water pH, Mathematical treatment of multistage equilibria, ionization of acids, bases and salt hydrolysis, pH changes in acid base titrations weak and strong involving not more than two stages in aqueous medium; acid base indicator; common ion effect. Buffer solutions, buffer index, buffer capacity. Solubility product and its applications in analysis, complexions in solutions, concept of stability constant.

**Conductance:** Conductance (metallic and electrolytic): Faraday law of electrolysis, conductivity and its measurement, equivalent and molar conductance, Kohlrausch law of independent migration of ions, variation of equivalent conductivity with concentrations of weak and strong electrolytes and its qualitative explanation using Arrhenius and Debye-Huckel theories. Wien effect, Debye-Falkenhagen effect, Walden's rule. Transference numbers and their experimental determination using Hittorff's and moving boundary method. Anomalous transference numbers ionic velocities and mobility. Application of conductance for determining the solubility product, degree of ionization, ionic product of water and hydrolysis constants. Conductometric titrations.

**Chemical Kinetics:** Order of reaction (including fractional and negative orders), molecularity, Rate laws: differential form (integrated forms upto second orders only), experimental methods for determination of order of a reaction steady state approximation and reaction mechanism complex reactions, opposite, parallel consecutive and chain reactions and their differential rate equation (integrated rate equation only for first order reactions) Temperature

dependence of reaction rate. Collision theory reaction rate, collision theory of reactions, Lindeman's mechanism) Absolute reaction rate theory (qualitative). Primary salt effect in ionic reactions.

**Absorption and Catalysis:** Homogeneous and heterogeneous catalysis; Adsorption: Physical adsorption and chemisorption, various types of adsorption, isotherms (including qualitative discussion of BET) equation and its use in surface area determination, nature of adsorbed state. Heterogeneous catalysis. Kinetics of catalytic decompositions, promoters and inhibitors. Acid base catalysis, enzyme reactions (Michaelis-Menten equation).

**Paper-III (Organic Chemistry)**

Max. Marks : 50

Time : 3 Hrs.

**Introduction to Organic Chemistry:** Its interaction with every-day life.

**Purification of Organic Compounds:** Paper, thinlayer, column and gas chromatographic techniques, criteria of purity of organic substances. Structural and electronic formulae. Tetrahedral concept of carbon compounds: Types of isomerism. Nomenclature-IUPAC notation. The concept of functional group and classification of organic compounds. Use of Greek letters.

**Physical Organic Chemistry:** Hybridisation and types of bonds. Atomic and molecular orbitals. Shapes of simple organic molecules. Polarity of bonds, bond length, bond strength, bond energy, Hydrogen bond. Dipole moment. Electronic displacements inductive, electromeric, hyperconjugative and resonance effect. Characteristics of ionic and homolytic reaction. Nucleophiles and electrophiles. Arrhenius, Lowry-Bronsted and Lewis concepts of acids and bases. Effects of structure of  $\frac{pH}{pK}$  and  $\frac{PK}{pk}$  values.

The following are to be discussed with their mechanisms at appropriate places in the syllabus: Wurtz synthesis, Markownikoff's rule. Haloform reaction Aldol condensation, cannizzaro reaction, pinacol-pinacolone rearrangement, Hofmann bromamide reaction.

Preparation, typical reactions, structure and uses of the following classes of compounds (important members of the group to be discussed in detail). Alkanes, Alkenes, Diolefines Characteristics and types of organic reactions: Addition, elimination, substitution and rearrangement (only an elementary idea of the mechanistic aspects to be discussed).

Allylic compounds and their special characteristics Free radical substitution in alkanes and alkenes.

Alkyl halides and their importance in organic synthesis. Organometallic compounds of magnesium and lithium.

Monohydric alcohols (semi-micro determination of active hydrogen and acetoxyl groups) Glycols. glycerol, ethers. (Zeisel's semi-micro determination of methoxyl groups), epoxides. Nitro alkanes, nitriles and isonitriles. Monofunctional amines. Aldehydes and ketones. Monocarboxylic acids and their derivatives. Halogen substituted acids.

### Paper-I (Practical)

Time :10 hrs.  
spread over two days.

#### \*I. Inorganic Chemistry

Practical	15 marks
Viva-voce	5 marks
Laboratory Record	5 marks

#### 1. Preparation of the following:-

- Complex salts (atleast three preparations)
- Sodium peroxoborate
- Cuprous chloride
- Mangnese (III) Phosphate.

#### 2. Chromatographic Separation: Typical group separation of the cations of the following metal combinations using paper chromatography:

$\text{Ag}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Hg}_2^{2+}$ ,  $\text{Pb}^{4+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{As}^{3+}$ ,  $\text{Sb}^{3+}$ ,  $\text{Sn}^{2+}$ ;  
 $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Zn}^{2+}$  and  $\text{Mn}^{2+}$

#### 3. Volumetric Analysis :

- Acid base titrations (combinations of strong and work acids and bases).
- Oxidation reduction titrations (using  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$ )

### II Physical Chemistry (Practical)

Practicals

15 Marks

- Viva-voce 5 Marks  
 Laboratory Record 5 Marks
1. Determination of viscosities of liquids:
    - i) Pure liquids (ii) Binary mixtures of liquids.
  2. Measurement of surface tensions of (i) Pure liquids. (ii) Binary mixtures of liquids.
  3. Chemical Kinetics (i) Acide hydrolysis of an ester. (ii) Saponification of an ester.
  4. Adsorption (Acetic acid on active charcal).
  5. Solubility (solubility curve of benzoic acid in water, determination of pH).
  6. Refractive index measurements of (i) pure liquids, (calculation of molar refractions); and (ii) Solutions.

### III Organic Chemistry (Practical)

Practical	15 Marks
Viva-voce	5 Marks
Lab. record	5 Marks

1. Determination of extra elements (N.S. & halogens)
2. Determination of melting and boiling points.
3. Purification of organic compounds by crystallisation.
4. To determine the number of components in an organic mixture by TLC.

### B.Sc. Hons. Physics (Subsidiary)

#### Part-I

	Duration	Marks
Paper-I Properties of Matter	3	50
Paper-II Thermal Physics	3	50
Paper-III Practical Test	5	50



*Note: 20% of the marks shall be reserved for the Laboratory records of the candidates.*

**Paper-I Properties of Matter:**

Max. Marks : 50

Time : 3 Hrs.

Dimensional Formulas, Dimensional equations and their uses. Moment of Inertia. Radius of gyration Principle of Perpendicular and Parallel axes. Expressions (not derivations) for the M.I. of regular shaped bodies. Inertial and gravitational masses and Principle of equivalence. Gravitation. Newton's law of Gravitation. Kepler's laws. Boy's method. Mass and density of earth. Gravitational potential and field due to a sphere.

Acceleration due to gravity, compound pendulum. Kater's reversible pendulum. Variations of 'g' with altitude, depth and latitude, local changes of 'g'.

Moduli of elasticity-young's modulus, Bulk modulus; Modulus of rigidity and Poisson's ratio. Relation between elastic constants. Determination of elastic constants; Searls methods work done in determining a body (in simple cases). Bending of a beam and determination of young's modulus.

Jaegar's method. Surface tension and vapour pressure over flat and curved liquid surfaces and effects on evaporation and condensation.

Bernoulli's theorem, its derivation and its applications of the coefficient of viscosity-Rotary oil pump and mercury diffusion pump, Mcleod-gauge.

**Paper-II Thermal Physics:**

Max. Marks : 50

Time : 3 Hrs.

Measurement of temperature. Standard gas thermometer. Platinum resistance thermometer and thermoelectric thermometer

Concept of Maxwell-Boltzman-distribution law of velocities Experimental verification. Phenomenological description of Brownian motion.

Modes of transmission of heat, Conductivity of solids, Experimental determination by Searle's method, Forbe's method, Lee's method.

Isothermal and Adiabatic transformation, internal energy relation between adiabatic and isothermal elasticity. Joule Thomson effect Elementary derivation of the Joule Thomson Cooling. Liquification of gases.

First and second laws of thermodynamics. Reversible and irreversible processes. Carnot's cycle and the theorem. Absolute scale of temperature. Clausi's and Clapeyrons equation Effect of pressure on Point and boiling point. Simple ideas about Black body radiation and energy distribution in the spectrum of black body. Stefan's law determination of Stefan's Constant Radiation Pyrometers, toto Radiation and disappearing filament types. Solar constant.

### Paper-III Practicals

Max. Marks:50

Time :3 hrs.

#### List of Experiment

1. 'g' by compound pendulum (bar with holes)
2. 'g' by Kater's reversible pendulum
3. Moment of Inertia of a fly-wheel.
4. Radius of curvature of a convex mirror by convex lens.
5. Measurement for (i) heights (ii) altitudes by sextant.
6. Focal length of combination lens magnification method.
7. Magnifying power of a telescope using microscope slit method.
8. Refractive index of a liquid by travelling microscope.
9. Specific resistance by (i) P.O. Box.
10. Reduction factor of a Tangent galvanometer.
11. Resistance of a galvanometer by Kelvin's method.
12. Verification of Newton's law of cooling.
13. Specific heat of a liquid by law of cooling.
14. Pressure co-efficient of air.

15. J by electric method:
16. Laws of vibration of strings by sonometer.
17. Verification of Inverse-Square law.
18. Determination of M and H by magnetometers.

## SCHEME OF EXAMINATIONS FOR B.Sc.(HONS.) IN CHEMISTRY PART-II

### MAIN PAPERS

	Max. Marks	Time
Paper-V Inorganic Chemistry	50	3 Hrs.
Paper-VI Physical Chemistry	50	3 Hrs.
Paper-VII Organic Chemistry	50	3 Hrs.
Paper-VIII Practicals	75	10Hrs.

(Spread over two days)

### Subsidiary Papers

#### GROUP-A (Non-Medical)

Any two of the following:

*	1. Mathematics	Theory	2 Papers
		Practical	1 Paper
	2. Physics	Theory	2 Papers
		Practical	1 Paper
*	3. Statistics	Theory	2 Papers
		Practical	1 Paper
**	4. Geology	Theory	2 Papers
		Practical	1 Paper
**	5. Electronics	Theory	2 Papers
		Practical	1 Paper

#### GROUP-B (Medical)

Any two of the following:-

*1.	Botany	Theory	2 Papers
		Practical	1 Paper
*2.	Zoology	Theory	2 Papers
		Practical	1 Paper
**3.	Anthropology	Theory	2 Papers
		Practical	1 Paper

- Notes:**
1. *There will be two subsidiary subjects alongwith the papers of the main subject in Part-I & II and in Part-III there will be only main subject.*
  2. *The students will offer only those subsidiary subjects in Part-II which they have studied in Part-I.*

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\* The syllabi will be the same as that of prescribed for B.Sc. (Pass) Part-II Examination.

\*\* The syllabi will be prescribed latter on.

**B.Sc.(Hons.)Part-II Examination-1998-99**

**Paper-V Inorganic Chemistry**

**Max. Marks : 50**

**Time : 3 hrs.**

**1. General Principles of Metallurgy:**

Chief modes of occurrence of metals based on standard electrode potentials, principles of various concentration methods, calcination, roasting and smelting. Role of carbon and other reducing agents; electrolytic reduction, hydrometallurgy, Ellingham diagrams. Methods of refining and purification (electrolytic, chromatographic, ion-exchange, solvent extraction, oxidative refining parting process zone refining, Kroll's process, Van Arkelde Boer method, Von Bolton method, Mond's process).

2. **Hydrogen:** Isotopes various forms of molecular hydrogen, solvated proton, hydrides and their classification (ionic, covalent and interstitial).
3. Chemistry of elements and their compounds (Group-IA to Group-VIIA).

General trends in groups; electronic configuration, atomic radii, ionic radii, ionization potential, electron affinity, electronegativity, oxidation states relative stability and stereochemistry), aqueous chemistry and inert par effect.

A comparative study of the hydrides, oxides, oxo-compounds, halides, sulphides, carbides, nitrides and complexes.

4. Detailed study of the following (preparation, properties **bonding and structures**):

Metal alkyls of Group-I to Group III elements, boric acids and borates, boron-nitride, borazines, boron hydrides, metal borohydrides. Carboranes, metal borides. Allotropes of carbon, Lamellar compounds of graphite; carbides. Silicates, silances, silicones and siloxances.

Oxies & Oxyacids of nitrogen and phosphorus, hydrazine hydrozoic acid, hydroxylamine, phosphazines, peroxy acids of sulphure dioxide, thionic acids, halosulphonic acids, interhalogen compounds, polyhalide anions, pseudo halogens.

5. **Nobal gas compounds:**Preparation, properties and structure of non fluorides; nature of bonding (V.D. treatment).

**Paper-VI Physical Chemistry**

**Max. Marks : 50**

**Time : 3 hrs.**

**Chemical Thermodynamics:** Mathematical techniques: partial differentiation, total differentials, exact differentials, homogenous functions, Euler's theorem: Intensive and extensive variables, State and path Variables. Isolated, closed and open systems; Thermodynamic functions. Zeroth law of thermodynamics.

**First Law:** Internal Energy (E), Enthalpy (H), equivalence of heat and work (Joule's experiment), relation between  $C_p$  and  $C_v$  calculation of W, E and H for expansion of ideal and real gases under isothermal and adiabatic conditions, for reversible and irreversible processes including free expansion Enthalpies of formation, bond energy, bond dissociation energy and resonance energy (calculations from thermochemical data). Enthalpies of dilution (including heats of infinite dilution). Enthalpies of neutralisation Enthalpies of ionization and Enthalpy of formation of ions; use of Born-Haber Cycle for calculation of lattice energy. Kirchoff's equation maximum flame temperature and its calculation.

**Second Law:** Various statements of the law, concept of entropy (S). Thermodynamic scale of temperature, efficiency of Carnot Cycle, molecular interpretation of entropy.

**Third Law:** (Statement of the third Law including the concept of residual entropy), calculation of entropy for reversible and irreversible processes, Gibbs free energy (G) and Helmholtz free energy (A). Variation of S, G and A with P, V and T. Joule-Thomson experiment, Relation between Joule-Thomson coefficient and other thermodynamic quantities inversion temperature. Gibbs Helmholtz equation, Maxwell relations. Thermodynamic equation of state, compressibility and expansion coefficients.

System of variable composition: Partial molar quantities, chemical potential of ideal mixture, changes in the thermodynamic functions in mixing of ideal gases. Criteria of thermodynamic equilibria, degree of advancement of reaction chemical equilibria in ideal condensed systems, concept of activity and activity coefficients, derivation of the expression of equilibrium constant; temperature, pressure and concentration dependence of equilibrium constants, ( $K_o$ ,  $K_p$ ). Le-Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase; dependence of thermodynamic functions in composition; Gibbs-Duhem equation. Colligative Properties: Studies from Chemical potential consideration

Dilute solution; lowering of vapour pressure: Raoult's law and Henry law as limiting laws, and their derivation; osmosis; osmotic pressure and its experimental determination.

Elevation of boiling points and depression of freezing points, calculation of molecular weight, Vant's Hoff factor and calculation of abnormal molecular weight, molecular weight of polymer by osmotic pressure (distinction between weight average and number average molecular weights).

### **Paper-VII Organic Chemistry**

Max. Marks : 50

Time : 3 hrs.

The following reactions are to be discussed with their mechanism at appropriate place in the syllabus. Reformatsky reaction, Claisen condensation, Mannich reaction, Diels-Alder reaction.

Preparation, typical reactions, structures and uses of the following classes of compounds (typical examples only).

Aceto acetic ester and Malonic ester. Preparation and synthetic uses. Keto-enol tautomerism with different examples. Dibasic acids. Hydroxy acids, lactic, malic, tartaric and citric acids. Unsaturated alcohols, aldehydes Ketones and acids, Maleic and fumaric acids. Addition reaction of Unsaturated carbonyl compounds.

Urea, Urethan, Ketene, diazomethane and diazoacetic ester, stereochemistry and mechanism (simple examples only).

Stereoisomerisms, geometrical isomerism and methods of determining and geometry. Unsaturated dibasic acids maleic and fumaric acids. E & Z designation of geometrical isomers. Optical isomerism. Specific and molar rotation. Chirality and chiral molecules. Lactic, malic and tartaric acids.

Elements of symmetry and simple symmetry operations. Concepts of constitution, configuration and conformation. Conformation of ethane, n-butane and cyclohexane. Newman and Sawhorse representations.

Configurational nomenclature D and L designations. Absolute configuration in terms of R and S notations. Resolution of racemic mixture. Cycloparafins ( $C_3$  to  $C_7$ ). Ring strain and stability.

Displacement reactions: concepts of transition state and intermediates, nucleophilicity. Stereochemistry on  $SN^1$ ,  $SN^2$ ,  $SNi$  reactions. Effect of solvent, substrate, entering and leaving groups. Eliminations ( $E_1$  and  $E_2$  with typical examples).

Elimination versus substitution. Walden inversion carbohydrates: Occurrence, classification and general study of their properties. Inter-relationship among monosaccharides. Constitution of glucose and fructose. Mutarotation. Determination of ring size Configuration and the hydroxyl groups. Haworth projections, conformational structures, Structures of ribose, 2-deoxyribose, maltose, lactose and sucrose (excluding structure determination and synthesis) Elementary treatment of starch, cellulose and glycogen.

### Practical Test

Time :10 hours  
(Spread over two days.)

### Inorganic Chemistry (Practicals)

- |                    |          |
|--------------------|----------|
| Practicals         | 15 marks |
| Viva-voce          | 5 marks  |
| Laboratory records | 5 marks  |
- Iodimetry and iodometry:  $Cu^{2+}$ ,  $As^{3+}$ ,  $SbO^+$ ,  $S_2O_3^{2-}$  available chlorine in bleaching powder,  $MnO_2$  pyrolusite
  - Precipitation titrations of  $AgNO_3$  in neutral and acidic.
  - Complexometric titration  $Zn^{++}$ ,  $Mg^{++}$ ,  $Ca^{++}$  using EDTA and total hardness of water.

### Physical Chemistry (Practicals)

- |              |          |
|--------------|----------|
| Practicals   | 15 marks |
| Viva-voce    | 5 marks  |
| Lab. records | 5 marks  |
- Thermochemistry:**
    - Enthalpy of Neutralization.
    - Determination of basicity of an acid.
    - Enthalpy of solution.
    - Enthalpy of hydration.
    - Enthalpy of dilution. ( $H_2SO_4$ ).
    - Partial molar enthalpy.
  - Determination of partial molar volumes (benzene-toluene, acetone-chloroform and carbon tetrachloride-benzene mixtures).
  - Determination of equilibrium constant of the reaction between ethyl alcohol and acetic acid.
  - Determination of molar masses (Victor Mayer) of single liquids and mixtures.
  - Determination of molar masses by Rast Method.



## Organic Chemistry (Practicals)

Preparation of the following compounds involving single stage reactions:

Methylation, Esterification, Acetylation, Benzylation, Bromination, Nitration, azodyes, reduction & Oxidation. Suggested examples.

B.Nepthylmethylether, Ethylbenzoate, methyl salicylate, Amylacetate, acetanilide, Aspirin, Benznanilide, Tribromoaniline, P-Bromoacentanilide, Nitrobenzene, m-Dinitrobenzene, Methyl orange, Aniline, m-Nitroaniline, oxidation of benzyl alcohol & benzaldehyde.

To apply TLC to check the purity of the compounds and  $R_f$  to be determined alongwith m.p./b.p. in each case.

Practicals	15 marks
Viva-voce	5 marks
Lab.-record	5 marks

## B.Sc. Physics (Subsidiary) Part-II

	Duration	Marks
Paper-III Waves and Oscillation	3 Hours	50
Paper-IV Electromagnetism & Atomic Physics.	3 Hours	50
Paper-V Practical Test	5 Hours	50

*Note: 20% of the marks shall be reserved for the Laboratory records of the candidates.*

## SYLLABUS & COURSES OF READINGS

### Paper-III Waves and Oscillations

Max. Marks: 50  
Time :3 Hrs.

Free, damped and forced vibration and resonance. Nature and equation of wave motion. Principle of superposition. Formation of standing waves in air columns and stretched strings. Superposition of two travelling waves and beat phenomenon. Doppler effect.

Fermat's principle and its application. Refraction at spherical surfaces deduction of lens maker's formula.

Coaxial system of two thin lenses separated by a distance cardinal points. Defects of image-chromatic and spherical aberrations Achromatic combination of lenses and prisms.

Direct vision spectroscope. Sextant Eye-pieces (Ramsden and Huyghens).

Interference of two beams. Division of amplitude and division of wave front. Double slit, Bi-prism, Colour of thin films. Newton's rings. Michelson's interferometer.

Presnel class of diffraction. Half period of zones, zone plate; rectilinear propagation of light. Deffraction at a straight edge, slit and wire. Faunhofer class of diffraction. Expression for intensity due to a single slit Plane transmission grating. Rayleigh criterion for the resolving power. R.P. of a te-scope microscope and eye; resolving power of agrating. Double refraction. Polarisation Huyghen's construction of wave front. Quarter and half-wave plates. Analysis of polarised light Polarimetry.

**Paper-IV Electromagnetism & Atomic Physics.** Max. Marks : 50  
Time : 3 hrs.

## Electrostance

Coulomb's law, Gauss's theorem and its application. Force on the surface of charged conductor. Energy per unit volume of the medium.

## Current Electricity

Magnetic field due to current. Ampere Law, Field due to straight and circular current and due to a solenoid. Equivalence of a magnetic shall with a current circuit. Moving coil ballistic golvanometer.

Kirchhoff's laws and their applications in simple cases; Wheatstone's bridge and its sensitivity. Carey Foster's bridge. Crompton potionmeter.

Self and mutual inductance and their measurement, Calculation of L for a solenoid. Growth and decay of current in a circuit containing L, C. and R.

**Hysteresis:** B-H curve by ring method. Alternating current. A.C. circuits containing L.C. and R. Tuned circuits (paralled and series). Rotating magnetic field and induction motor. Electromagnetic waves, Hert's experiment. Diode Valve, Rectifier. Triode valve as detector, amplifier and oscillator.

## Atomic Physics

Measurement of  $e/m$  by Millikan's method of positive rays by Parabolic method Isotopes and Isobars. Cathode Ray oscillograph.

Diffraction of X-rays. Bragg's law. Determination of X-ray wave length. Radioactivity Law of decay and growth. Half life and average life. Large angle scattering of a particles and Rutherford model of an atom Nuclear model of the atom. Bohr's theory of hydrogen spectra. Photoelectric effect. Determination of Plank's constant. Wave theory of matter.

## Paper-V Practical

Max. Marks : 50

Time : 5 hrs.

## List of Experiment

1. Rigidity of a Wire-Maxwell's needle.
2. Young's modulus of a Wire Searle's Apparatus by Optical lever.
3. Determination of Elastic constants by Searle's app.
4. 'Y' by bending using (i) microscope (ii) optical lever
5. Viscosity of water.
6. Refractive index of prism using spectrometer.
7. Wavelength of sodium light by Diffraction grating.
8. Wavelength of sodium light by Newton's ring.
9. Specific rotation using Polarimeter.
10. Resolving power and Dispersive power of a prism using mercury light.
11. Low resistance by (i) Carey Foster Bridge
12. Characteristic curves for a Triode Valve
13. To draw a graph between temperature and thermoe emf using a potentiometer.
14. Study of ballistic galvanometer charge sensitivity and C.D.R.
15. Transistor characteristics.
16. Melde's Experiment.

**SCHEME OF EXAMINATION FOR B.Sc. (HONS.)  
CHEMISTRY PART-III-1998-99**

Paper No.	Name of paper	Max. Marks	Time
Paper-IX	Inorganic Chemistry-A	50	3 hrs.
Paper-X	Inorganic Chemistry	50	3 hrs.
Paper-XI	Physical Chemistry-A	50	3 hrs.
Paper-XII	Physical Chemistry	50	3 hrs.
Paper-XIII	Organic Chemistry-A	50	3 hrs.
Paper-XIV	Organic Chemistry	50	3 hrs.
Paper-XV	Practical-Inorganic Chemistry	50	5 hrs.
Paper-XVI	Practical-Physical Chemistry	50	5 hrs.
Paper-XVII	Practical-Organic Chemistry	50	5 hrs.

**B.Sc. (Hons.) Part-III Examination**

**Paper: IX Inorganic Chemistry-A**

Max. Marks : 50  
Time : 3 hrs.

**1. Redox Potential**

Standard electrode potential, uses of redox potential-reaction feasibility, equilibrium constants.

**2. Theory of Analysis: (Qualitative & Quantitative)**

Chemistry of analysis of various groups of basic and acidic radicals, Chemistry of identification of acid radicals in typical combinations. Chemistry of interferences of acid radicals

including their removal in the analysis of basic radicals. Theory of precipitation, co-precipitation, post-precipitation, purification of precipitates.

Elementary idea of separation of inorganic compounds by:

- i) Solvent extraction
- ii) Chromatography
- iii) Ion-exchange.

### 3. Nuclear Chemistry

Fundamental particles of nucleus, concept of nuclides, representation of nuclides-isobars, isotopes and isotones with specific examples. Natural and artificial radioactivity, Types of nuclear reactions, Separation of isotopes and their use as tracers.

### 4. Lanthanides and Actinides:

Electronic structure, oxidation states, colour and spectra, magnetic properties, Lanthanide contraction and its consequences.

### 5. Reactions in non-aqueous solvents ( $\text{NH}_3$ , $\text{SO}_2$ and $\text{HF}$ ).

## Paper-X Inorganic Chemistry

Max. Marks : 50

Time : 3 hrs.

### 1. Environment Chemistry

An elementary study of pollutants like dust, carbon,  $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{NO}_2$ ,  $\text{SO}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{Cl}_2$  in air and water.

### 2. Transition Metals

General Group trends with special reference to electronic configuration, colour, variable magnetic properties, catalytic properties, ability to form complexes, stability of various oxidation states.

Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states.

### 3. Co-ordination Compounds

Concept of co-ordination complexes and co-ordination numbers, Werner's theory, Isomerism in coordination compounds.

IUPAC nomenclature of co-ordination compounds. Elementary idea of V.B. and crystal field theories to explain bonding in transition metal complexes; explanation of geometry, colour and trends in crystal field splittings of co-ordination complexes on the basis of above theories.

Factors influencing the formation of complexes (thermodynamic and kinetic stability).

Stereochemistry of complexes with co-ordination numbers 4 and 6

Applications of complexes in analytical and biological field.

**Paper: XI Physical Chemistry-A**

Max. Marks : 50

Time : 3 hrs.

#### Crystalline State

The nature of the solid state. Law of constancy of angles. Seven crystal systems. Law of rational indices, Miller indices, Indexing of the crystal faces. Qualitative idea of point and space groups. Elementary ideas of symmetry. Symmetry elements and Bravais lattices and lattice planes.

X-ray diffraction, Bragg's Law, a simple account of Laue's method. Rotating Crystal Method; powder pattern method, crystal structures of NaCl and KCl.

Packing in crystals; closed packed structures

#### Phase Equilibria

Phases, components, degrees of freedom, derivation of phase rule for non-reactive systems. Clausius-Clapeyron equation, its derivation and applications to solid-liquid, liquid, vapour and solid-vapour equilibria, phase diagrams of one and two component systems. Deviations from Raoult's Law and Henry's law of solutions of liquids in liquids. Duhem-Margules equation and its application to fractional distillation of binary miscible liquids, Azeotropes, Lever rule, partial miscibility of liquids, miscible pairs, steam distillation. Nernst

distribution law, derivation and application, thermal analysis and solubility method for determining solid-liquid equilibria; typical phase diagrams of two component systems, involving eutectics, congruent and incongruent melting points, solid solutions. Fractional crystallization, zone refining. Three component systems, triangular plots, partially miscible three liquids systems (formation of one, two and three immiscible pairs), systems of two solids and a liquid including formations of binary, ternary compounds and complete series of solid solutions. Methods of wet residue and salting out.

### **Electrochemical Cell**

Electrochemical and galvanic cells, reversible and irreversible cells, Electromotive force of cell and its measurement. Free energy, entropy and enthalpy changes of cell reactions, Nernst equation, standard electrode (reduction) potential. Types of electrodes (including reference electrode). Determination of  $E_0$ , equilibrium constant, solubility product and ionic product of water. Concentration cells with and without transference, liquid junction potential. pH determination using hydrogen electrode, glass electrode, quinone-hydroquinone electrode,  $Sb/Sb_2O_3$  electrode, potentiometric (acid-base redox and precipitation) titrations.

### **Polarography and Amperometry:**

Basic Principles. Experimental techniques, dropping mercury electrodes, platinum indicator electrodes, its advantages and limitation, migration current, diffusion current, half wave potential, Ilkovic equation and its application in quantitative analysis. Amperometric titrations.

**Paper: XII Physical Chemistry**

Max. Marks : 50

Time : 3 hrs.

### **Atomic Structure and Chemical bonding:**

Planck's quantum hypothesis. Quantum mechanical operators. Schrodinger equation, particle in a box, Schrodinger equation for hydrogen-like atoms covalent bonding; statement of variation theorem, valence bond and molecular orbital approaches. LCAO-MO treatment of  $H_2^+$  and  $H_2$ , valence bond treatment of  $H_2$  molecule. Molecular orbitals of homonuclear and heteronuclear diatomic and triatomic molecules ( $BeH_2$ ,  $HCN$ ,  $H_2O$ ).

### **Electrical and Magnetic Properties:**

Basic ideas of electrostatics, electrostatics of dielectric media, Clausius-Mosottii equation, Lorenz-Lorentz equation, dipole moment and molecular polarizabilities, and measurements.

Diamagnetism, paramagnetism and their molecular interpretation, magnetic susceptibility and its measurement.

### **Molecular Spectra:**

Electromagnetic radiation, the quantization of different forms of energies in molecules (translational, rotational, vibrational and electronic): Interaction of electromagnetic radiation with molecules, various types of spectra, Born-Oppenheimer approximation.

### **Rotational Spectra:**

Rigid rotator model, rotational spectra, intensities of spectral lines and determination of bond distance of diatomic molecules; linear triatomic molecules; isotopic substitution.

### **Vibrational Spectra:**

Classical equation of vibration (Hooke's law), vibrational energies of diatomic molecules, zero-point energy, evaluation of force constant, stiffness of the bond. Amplitude of diatomic molecular Vibration.

Anharmonicity; Morse potential Dissociation energies, Fundamental frequencies, overtones, hot bands, degrees of freedom of polyatomic molecules, concept of group frequencies Vibration-Rotation Spectra: Diatomic Vibrating rotator P, Q and R branches.

### **Raman Spectra Qualitative Treatment:**

Raman effect, rotational Raman Spectra, vibrational Raman spectral, Stokes and anti-Stokes lines and their intensity difference. Rule of mutual exclusion.

### **Electronic Spectra:**

Fronck-Condon principle, electronic transitions, singlet and triplet states. Fluorescence and phosphorescence redissociation and predissociation, calculation of electronic transitions of polyenes using free electron model (particle in a box).



**Photochemistry:**

Grotthuss-Draper Law, Lambert. Beer's law quantum yield, actionmetry, Einstein law of photochemical equivalence. Nature of primary and secondary processes. Examples of low and high quantum yields, Photochemical reactions. Photosensitized reactions, quenching, flash photolysis technique.

**Statistical Mechanics:**

Brief resume on mathematical probability ensembles (Qualitative), Boltzmann distribution law, Partition function.

Relation between thermodynamic functions and partition functions. Translational, electronic and nuclear partition function of atoms and molecules. Rotational and vibrational partition functions for diatomic molecules.

**Paper-XIII Organic Chemistry-A**

Max. Marks : 50

Time : 3 hrs.

**Coal, Petroleum and Petrochemicals:**

Coaltar distillation and coaltar chemicals. Petroleum: Origin, fractionation, cracking, reforming and aromatisation. Petrochemicals, Synthetic fuels, octane and extane numbers, anti-knock additives.

Constitution of benzene, resonance and aromaticity. Huckel's rule including aromatic character of Ferrocene and tropolone, Orientation or substitutions. Mechanism of electrophilic substitution (well known examples only).

The following are to be discussed with their mechanism at appropriate places in the syllabus. Friedal-Crafts reaction, hyper-conjugation, benzene intermediate. Sandmeyer reaction, Perkin reaction, benzoin condensation, Benzil-Benzilic acid rearrangement. Beckmann rearrangement, Riemer-Tiemann reaction, Fischer's indole synthesis, Skarup's synthesis of quinoline.

Methods of preparation and chemistry of the following Aromatic hydrocarbons, halogen derivatives, nucleophilic substitution, nitro-benzene, amines, diazonium salts and their reactions. Phenyl hydrazines aromatic alcohols phenols aldehydes, Ketones, carboxylic acids phenolic ldehyde phenolic ketones and acides, Quinones.

## Polynuclear Aromatic Hydrocarbons:

Naphthalene, anthracene and phenanthrene-structure, synthesis and important derivatives. Carcinogenicity.

Synthesis, reactions, aromaticity, mechanism of substitution in an important derivatives of furan, pyrrole, indole, thiophene, pyridine, quinoline and isoquinoline.

## Polymers:

Natural and synthetic. Mechanism of Polymerisation. Condensation and addition polymers. Synthetic plastics, thermosetting and thermoplastic. Ureaformaldehyde phenol-formaldehyde plastics. Teflon polystyrene and polyurethanes. Natural and synthetic rubbers. Synthetic fibres: polyesters, polyamides, polyacrylates and rayons, foaming agents: plasticisers and stabilisers. Silicones.

## Dye-Stuffs

Synthesis of typical azo, triphenylmethane, phthalein and phthalocyanine dyes. Methods of determination of structure of typical azo dyes. Structure and synthesis of indigo and alizarin, chemistry of dyeing. Colour in relation to structure modern views. chromophore and auxochrome.

Spectroscopy: Principle of I.R. spectroscopy, Modes of vibrations Regions of frequencies of OH, amino group (primary, secondary and tertiary amines) alkyl, carbonyl groups (aldehydes, ketones, esters, anhydrides and carboxylic acids).

Principles of U.V.: Electronic excitation transitions, chromophore, auxochrome, colour and constitution, band shifts in Unsaturated carbonyl compounds (crotonaldehyde, crotonic acid and cyclohexenone).

Elementary principles of NMR spectroscopy-chemical shift, coupling constant, factors such as inductive, mesomeric, anisotropic and hybridization effects on the chemical shifts. Discussions on NMR spectra of the following: Acetylene, ethylbromide, ethanol, benzaldehyde, acetophenone, 1,1-dibromoethane 1,1,2-tribromoethane, toluene & P-nitrotoluene.

**Paper-XIV Organic Chemistry**

Max. Marks : 50

Time : 3 hrs.

**Fats, Oils and Detergents:**

Occurrence, Chemical composition and importance. Hydrogenated oils, soaps, synthetic detergents, rancidity acid value, saponification and iodine numbers, Difference between toilet and washing soaps.

**Amino-acids, peptides and proteins:**

Introduction, classification and sources of amino acids. Essential and non-essential amino acids. Modern methods of synthesis of amino acids. Physical properties. Zwitterion structure. Isoelectric points. Chemical reactions configuration of amino acids. Peptides and polypeptides. Geometry of peptide linkage. Peptide synthesis structure determination of Polypeptides. End group analysis. Introduction to proteins, classification and general characteristics. Denaturation primary, secondary, tertiary and quaternary structure of proteins. Helical and sheet structures.

**Topics in biological Chemistry:**

Introduction to enzymes, nomenclature, characteristics, general picture of mechanism of enzyme action. co-enzymes: co-enzymes derived from niacin and thiamine lipoic acid; co-enzyme-A. Energy production in biological system, glycolysis, tricarboxylic acid cycle.

**Fermentation:**

Anaerobic and aerobic fermentation, production of alcohol, citric acid and lactic acid.

**Purines & Pyrimidines:**

Introduction to purines and pyrimidines. Preparation and reaction of adenine, guanine cytosine, uracil, thymine, uric acid and caffeine, Tautomerism in Purines and Pyrimidines. Relationship to nucleic acids.

**Organo-sulphur and Organo-Phosphorus Compounds:**

Thiols, Thioethers, Methods of preparation chemistry of sulohonic acids, phosphorus ylides, wittig reaction.

### Natural Products:

Terpenoids: Introduction, essential oils, classification of terpenes, isolation, Isoprene rule. Isolation, structure elucidation and synthesis of citral, geraniol.

### Alkaloids:

Introduction, classification, Extraction, Physiological action in alkaloids, General characteristics, General methods of determining structures, Hofmann's exhaustive methylation, Isolation, structure elucidation and synthesis of nicotine, cocaine, cohine and piprin.

### Drugs and Pesticides:

Classification of drugs, preparation and use of aspirin, phenacetin, paracetamol, analgin, phonylbutazone sulphanyl amide, sulphaguanidine, sulphathiazole, sulphapyridine, quinine, chloroquinine, plasaquin, primaquine, mepaquine paludrine. Mechanism of action of sulpha-drug.

Introduction to pesticides, classification, general Survey of some important natural and synthetic pesticides.

### Paper-XV Practical Inorganic Chemistry Max. Marks : 50 Time : 3 hrs.

Practicals	30 marks
Viva-voce	10 marks
Lab. record	10 marks

1. Qualitative analysis: Mixtures of salts (by semi-micro methods) containing not more than six radicals including insolubles, interfering anions. Spot tests to be carried out for final identification, wherever necessary.
2. Gravimetric analysis: (Any six of the following may be done):
  - i) Nickel as complex with dimethylglyoxime.
  - ii) Copper as thiocyanate.
  - iii) Pb as  $PbCrO_4$ .
  - iv) Aluminum as oxinate.
    - v) Ag as  $AgCl$ .
  - vi) Mg as  $MgNH_4PO_4 \cdot 6H_2O$  or  $Mg_2P_2O_7$ .
  - vii) Ba as  $BaSO_4$ .
  - viii) Fe as  $Fe_2O_3$ .

**Paper-XVI(Practicals) Physical Chemistry** Max. Marks : 50  
Time : 5 hrs.

Practicals	30 marks
Viva-voce	10 marks
Lab. record	10 marks.

1. Distribution coefficients: (i) Simple distribution (ii) Study of dimerization: (iii) Study of complex formation.
2. Phase Diagrams: (i) Critical solution temperature, effect of inorganic and organic impurities on C.S.T. (ii) Binary systems involving eutectic, solid solutions, congruent compounds, incongruent compounds (iii) Three-component Phase Diagram (acetic acid, chloroform, water).
3. Preparation of buffer solutions and measurement of their pH values using indicators and knowledge of ionization constant of weak acids and bases involved.
4. Conductometric titrations of strong acids and strong base
5. Colorimetry:
  - i) Verification of Lambert-Beer Law
  - ii) Determination of  $P^K$  of phenolphthalein.
6. Potentiometric Titrations.  
Strong Acid/strong base.  
Strong Acid/Weak base.

Precipitation titrations (Silver Nitrate/MX)

**Paper: XVII (Practical) Organic chemistry**

Max. Marks : 50  
Time : 5 hrs.

Practicals	30 marks
Viva-voce	10 marks
Lab. record	10 marks

1. Systematic identification of Organic Compounds (monofunctional and simple bifunctional) and preparation of their derivatives.
2. Estimation of Phenol (bromide-bromite method) and aniline (bromide-bromate and acetylation methods).
3. Equivalent weight of an acid neutralisation and silver salt methods).