DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
Four Year Undergraduate Course Structure:
Subject: Chemistry Semester III NEP (Revised)
For students admitted in session 2024-25 onwards

Semester III						
Paper	**Paper Title**	**Type**	**Credits**	**Internal Assessment**	**Univ Exam**	**Total Marks**
Paper 5	Physical Chemistry 1	Theory (Major)	4	25	75	100
Paper 6	Chemistry Practical 3	Practical (Major)	4	-	100	100
CC 2	Co-Curriculum 2	Chemistry in Daily Life	2	25	75	100
P3"	Physical Chemistry 1A	Theory (Minor)	2	25	75	100
P5'	Second major subject	Theory	4	25	75	100
P6'	Second major subject	Theory	4	25	75	100
	Total Credits		**20**			

Physical Chemistry 1 (Major)

Semester III	Paper 5	Credits 4
		MM 100 (75 + 25)

Course outcome

- CO-1- Students would gain knowledge regarding the basic of computers and mathematical concepts of log, permutation and combination, differential and integration of some relevant functions.
- CO-2- Student would gain understanding of gaseous state, critical phenomenon, liquid state, solid state, colloidal state and liquid crystals.
- CO-3- It would help students recognize the importance of chemical kinetics and catalysis.

Unit 1
Mathematical Concepts and Computers

- **Mathematical Concepts:**
  - Logarithmic relations, curves scratching, equation of straight line and slopes, tracing of curves, differentiation of simple functions like x, e^x, x^n, $\sin x$, $\log x$; maxima and minima, partial differentiation. Integration of some useful/relevant functions; Permutations and Combinations. Factorials, Probability. Computers: binary numbers and its arithmetic.

- **Gaseous State:**
  - Deviation of gases from ideal behaviour, van der Waals equation of State. Critical phenomenon: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equations, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of states.

- **Molecular velocities:**
  - Qualitative discussion of the Maxwell's distribution of molecular velocities, collision numbers, mean free path and collision diameter

Unit 2
State of Matters: Solid, Liquid and Colloidal State

- **Solid State:**
  - Laws of crystallography, Diffraction: X-ray diffraction by crystals. Derivation of Bragg's equation. Laue's method and powder method, determination of crystal structure of NaCl, KCl and CsCl.

- **Liquid State:**
  - Intermolecular forces, structure of liquids (qualitative description), structural differences between solid, liquid and gases

- **Liquid crystals:**

- o Classification, structure of nematic, smectic and cholesteric liquid crystals. Thermography and seven segment cells.
- **Colloidal State:**
  - o Solids in liquids (sols): properties- Kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulz law, gold number.
- **Liquids in liquids (emulsions):**
  - o Types of emulsions, preparation. Emulsifier.
- **Liquids in solids (gels):**
  - o Classification, preparation and properties, inhibition, general applications of colloids.

Unit 3
Chemical Kinetics, Catalysis, Buffer Mixture

- **Chemical Kinetics:**
  - o Molecularity and order of reaction, integrated rate expression for- second order, pseudo-order reactions, half-life.
  - o Brief outlines of experimental methods of studying chemical kinetics; conductometric, potentiometric, optical methods, polarometry and spectrophotometry
- **Theories of chemical kinetics:**
  - o Effect of temperature on rate of reaction. Concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects (no derivation).
- **Catalysis:**
  - o Catalysis, classification of catalysis, characteristics of catalysed reactions, Buffers - Mechanism of buffer action, Henderson-Hazel equation. Hydrolysis of salts.

Unit 4
Thermodynamics-1 and Thermochemistry

- **Thermodynamics-1**
  - o First Law of Thermodynamics: Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – Joule Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.
- **Thermochemistry:**
  - o Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization.

Bond dissociation energy, effect of temperature on enthalpy of reaction, Kirchhoff s equation.

Text Books (Theory Courses):

1. Physical Chemistry, Puri Sharma & Pathania, Vishal Publishing Co
2. Pradeep's Physical Chemistry Vol II, S.C. Khetrapal, Pradeep Publication.
3. Computers and Common Sense, R. Hunt and Shelly, Prentice   Hall.

Reference Books:

1. Physical Chemistry. G.M. Barrow. International Student Edition, McGrawHill
2. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
3. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
4. Physical Chemistry Through problems, S.K. Dogra and S.   Dogra, Wiley Eastern Ltd, India
5. Basic Programming with Application, V.K. Jain, Tata McGraw   Hill, India
6. Textbook of Physical Chemistry, Samuel Glasstone, Ed 2, Macmillian 1942

Physical Chemistry 1A (Minor)

Semester III   **P3"**   **Credits 2**

MM 100 (75 + 25)

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Unit 1
Mathematical Concepts and Computers

- **Mathematical Concepts:**
  - Logarithmic relations, curves scratching, equation of straight line and slopes, tracing of curves, differentiation of simple functions like x, e^x, x^n, $\sin x$, $\log x$; maxima and minima, partial differentiation. Integration of some useful/relevant functions; Permutations and Combinations.

    Factorials, Probability. Computers: binary numbers and its arithmetic.

Unit 2

- **Gaseous State:**
  - Deviation of gases from ideal behaviour, van der Waals equation of State. Critical phenomenon: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equations, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of states.
- **Molecular velocities:**
  - Qualitative discussion of the Maxwell's distribution of molecular velocities, collision numbers, mean free path and collision diameter

Unit 3
State of Matters: Solid, Liquid and Colloidal State

- **Solid State:**
  - Laws of crystallography, Diffraction: X-ray diffraction by crystals. Derivation of Bragg's equation. Laue's method and powder method, determination of crystal structure of $NaCl$, KCl and $CsCl$.
- **Liquid State:**
  - Intermolecular forces, structure of liquids (qualitative description), structural differences between solid, liquid and gases

- **Liquid crystals:**
  - Classification, structure of nematic, smectic and cholesteric liquid crystals. Thermography and seven segment cells.

Unit 4

- **Colloidal State:**
  - Solids in liquids (sols): properties- Kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulz law, gold number.
- **Liquids in liquids (emulsions):**
  - Types of emulsions, preparation. Emulsifier.
- **Liquids in solids (gels):**
  - Classification, preparation and properties, inhibition, general applications of colloids.

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4. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd, India

5. Basic Programming with Application, V.K. Jain, Tata McGraw Hill, India

6. Textbook of Physical Chemistry, Samuel Glasstone, Ed 2, Macmillian 1942

Chemistry Practical 3 (Major)

Semester III	Paper 6	Credits 4
		MM 100

Course Objective

- Identify the thermodynamic systems and processes, understand the basic principles of phase diagram, solutions and colligative properties, and know how to apply them to explain and interpret the observations in other areas of chemistry and related fields. The course gives basic knowledge necessary for the Physical course based on solutions.

Course Outcome

- CO-1. By interpreting the real gases, the student will be able to solve the problems.
- CO-2. Describes the ideal and real gases.
- CO-3. By interpreting some properties of liquids and solids, the student will be able to solve the problems.
- CO-4. Interpreting the phase equilibrium in simple systems, the student will be able to answer the questions.
- CO-5. Adopt distribution law to explain various phases.
- CO-6. By describing the ideal solution, the student will be able to recognize, use and compare the colligative properties.
- CO-7. Explain various reactions based on kinetics.
- CO-8. describe the kinds of solutions.

Physical Chemistry

- **Chemical Kinetics**
  - To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalysed by hydrogen ions at room temperature.

- **Viscosity, Surface Tension**
  - To determine the percentage composition of a given binary mixture (non interacting systems) by viscosity method.
  - To determine the percentage composition of a given binary mixture (non interacting systems) by surface tension method.

- T**hermochemistry**
  - To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
  - To determine the enthalpy of neutralisation of a week acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.

- To determine the enthalpy of solution of solid $CaCl_2$ and calculate the lattice energy of $CaCl_2$ from its enthalpy data using Born-Haber cycle.

Record and Viva

Books Recommended
- Chemistry Practical by S. Giri, D.N. Bajpai and O.P. Pandey, S. Chand Publication.
- Practical Chemistry Volume 1-3 by Fateh Bahadur, Vishal Publication
- Advanced Physical Chemistry by J.B. Yadav, Goel Publication

Distribution of Maximum Marks:
The maximum marks in the evaluation of the practical exercises, viva-voce and records of their class-work are given below.

Chemistry Practical 3				
Class	Physical Chemistry	Viva	Class Record	Total
B.Sc. Semester III	60 (35 + 25)	30	10	100

Note: For exempted students, marks of class record will be added to the marks of viva-voce for practical examinations since they do not have the class record.

Chemistry in Daily Life

Semester III   **Co Curriculum (CC 2)**   **Credits 2**
                                                          MM 100 (75 + 25)

Course Outcomes
- CO 1: Understand the role of Chemistry in household activities
- CO 2: Know about the chemistry involved in electronic, computerized gadgets and batteries
- CO 3: Understanding the importance of chemistry in food

Unit-I

- **Chemistry in the kitchen:**
  - Chemistry of cooking - physical and chemical changes, stability of nutrients during cooking, Microwave cooking, butter and cooking oil - saturated and unsaturated fatty acids, hydrogenation of oil.

Unit-II

- **Chemistry in the atmosphere:**
  - Pollution. Acid rain, Ozone layer, Global warming, Green chemistry and relevant international conventions.
- **Chemistry of Local Industries:**
  - Sugar and food industries and their implications on community, Cracking of petroleum, ethanol production,

Unit-III

- **Chemistry of common appliances:**
  - Printer inks, paints & Varnish and stainless steel, Corrosion and corrosion resistant materials.
- **Chemistry of Energy:**
  - Energy we use and energy we need, batteries, cells Cost of energy, Alternate energy - solar and fuel cell, Chemistry of motor vehicle, fuel additives, lubricating oils, brake fluid, accumulators.

Unit-IV

- **Chemistry of Thoughts:**
  - Positive and Negative thoughts (stress) chemicals and role of meditation and yoga to mitigate the stress related chemicals.
- **Ethical issues in chemical research:**
  - Chemical and nuclear weapons, Environmental issues. Integrity of scientific results, the welfare of research participants.

Books Recommended
1. Chemistry in Daily Life by Kripal Singh(Third Edition) ISBN-978-81-203-4b17-8
2. Chemistry in Daily Life By Trnst L. Tohn. ISBN 9781440084508.