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# FIRST-YEAR OF MASTER OF SCIENCE CHEMISTRY REVISED SYLLABUS ACCORDING TO CBCS NEP2020

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COURSE TITLE: PHYSICAL CHEMISTRY-II  
SEMESTER-I  
W.E.F. 2023-2024

**RECOMMENDED BY THE BOARD OF STUDIES IN CHEMISTRY  
AND  
APPROVED BY THE ACADEMIC COUNCIL**

Devrukh Shikshan Prasarak Mandal's  
Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce, and  
Vid. Dadasaheb Pitre Science College (Autonomous), Devrukh.  
Tal. Sangameshwar, Dist. Ratnagiri-415804, Maharashtra,  
India

Academic Council Item No: 03 dated 08 July 2023

Name of the Implementing Institute	:	Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce, and Vid. Dadasaheb Pitre Science College (Autonomous), Devrukh. Tal. Sangameshwar, Dist. Ratnagiri-415804,
Name of the Parent University	:	University of Mumbai
Name of the Programme	:	Master of Science
Name of the Department	:	Chemistry
Name of the Class	:	First Year
Semester	:	First
No. of Credits	:	02
Title of the Course	:	Physical Chemistry-II
Course Code	:	S506CHT
Name of the Vertical in adherence to NEP 2020	:	Elective
Eligibility for Admission	:	Chemistry Graduate learner seeking Admission to Post Graduate Programme in adherence to Rules and Regulations of the University of Mumbai and Government of Maharashtra
Passing Marks	:	40%
Mode of Assessment	:	Formative and Summative
Level	:	PG
Pattern of Marks Distribution for SEE and CIA	:	60:40
Status	:	NEP-CBCS
To be implemented from Academic Year	:	2023-2024
Ordinances /Regulations (if any)		

**Syllabus for First Year of Master of Science in Chemistry**  
**(With effect from the academic year 2023-2024)**

**SEMESTER-I**

**Course Title: Physical Chemistry-II**

**No. of Credits - 02**

**Type of Vertical: Elective**

**COURSE CODE: S506CHT**

**Learning Outcomes Based on BLOOM's Taxonomy:**

After completing the course, the learner will be able to...		
Course Learning Outcome No.	Blooms Taxonomy	Course Learning Outcome
CLO-01	Understand	explain Debye-Hückel theory of activity coefficient.
CLO-02	Apply	solve rate law expressions for organic and inorganic reactions.
CLO-03	Analyse	deduce Goldman equation.

## Syllabus for First Year of Master of Science in Chemistry

(With effect from the academic year 2023-2024)

### SEMESTER-I

Course Title: Physical Chemistry-II

No. of Credits - 02

Type of Vertical: Elective

COURSE CODE: S506CHT

COURSE CONTENT			
Module No.	Content	Credits	No. of Hours
1	<p><b>Chemical Dynamics-I</b></p> <ul style="list-style-type: none"><li>○ Composite Reactions: Recapitulation: Rate laws, Differential rate equations Consecutive reactions, Steady state Approximation, rate determining steps, Microscopic Reversibility and Detailed Balanced</li><li>○ Chain reactions-chain initiation processes. Some inorganic mechanisms: formation and decomposition of phosgene, decomposition of ozone, Reaction between Hydrogen and Bromine. Some general examples Organic Decompositions: Decomposition of ethane, decomposition of acetaldehyde Gas phase combustion: Reaction between hydrogen and oxygen, Semenov – Hinshelwood and Thompson mechanism, Explosion limits and factors affecting explosion limits.</li><li>○ Polymerization reactions: Kinetics of stepwise polymerization, Calculation of degree of polymerization for stepwise reaction. Kinetics of free radical chain polymerization, Kinetic chain length and estimation of average no. of monomer units in the polymer produced by chain polymerization.</li><li>○ Reaction in Gas Phase Unimolecular Reactions: Lindeman-Hinshelwood theory, Rice-Ramsperger-Kassel (RRK) theory, Rice- Ramsperger-Kassel Marcus (RRKM) theory.</li></ul>	01	15

2	<p><b>Electrochemistry</b></p> <ul style="list-style-type: none"> <li>○ Debye-Hückel theory of activity coefficient, Debye-Hückel limiting law and its extension to higher concentration (derivations are expected).</li> <li>○ Electrolytic conductance and ionic interaction, relaxation effect, Debye-Hückel-Onsager equation (derivation expected). Validity of this equation for aqueous and non- aqueous solution, deviations from Onsager equation, Debye -Falkenhagen effect (dispersion of conductance at high frequencies), Wien effect.</li> <li>○ Batteries: Alkaline fuel cells, Phosphoric acid fuel cells, High temperature fuel cells [Solid –Oxide Fuel Cells (SOFC) and Molten Carbonate Fuel Cells]</li> <li>○ Bio-electrochemistry: Introduction, cells and membranes, membrane potentials, theory of membrane potentials, interfacial electron transfer in biological systems, adsorption of proteins onto metals from solution, electron transfer from modified metals to dissolved protein in solution, enzymes as electrodes, electrochemical enzyme-catalysed oxidation of styrene. Goldman equation. (Derivations are expected)</li> </ul>	01	15
	<b>Total</b>	<b>2</b>	<b>30</b>

### Access to the Course

The course is available for all the students admitted for Master of Science.

### Methods of Assessment

The assessment pattern would be 60:40, 60% for Semester End Examination (SEE) and 40% for Continuous Internal Assessment (CIA). The structure of the SEE and CIA would be as recommended by the Board of Studies and approved by the Board of Examination and the Academic Council of the college.

## References:

1. Peter Atkins and Julio de Paula, Atkin's Physical Chemistry, 7th Edn., Oxford University Press, 2002.
2. K.J. Laidler and J.H. Meiser, Physical Chemistry, 2nd Ed., CBS Publishers and Distributors, New Delhi, 1999.
3. Robert J. Silby and Robert A. Alberty, Physical Chemistry, 3rd Edn., John Wiley and Sons (Asia) Pte. Ltd., 2002.
4. Ira R. Levine, Physical Chemistry, 5th Edn., Tata McGraw-Hill New Delhi, 2002.
5. G.W. Castellan, Physical Chemistry, 3rd Edn., Narosa Publishing House, New Delhi, 1983.
6. S. Glasstone, Text Book of Physical Chemistry, 2nd Edn., McMillan and Co. Ltd., London, 1962
7. B.K. Sen, Quantum Chemistry including Spectroscopy, Kalyani Publishers, 2003.
8. A.K. Chandra, Introductory Quantum Chemistry, Tata McGraw – Hill, 1994.
9. R.K. Prasad, Quantum Chemistry, 2nd Edn., New Age International Publishers, 2000.
10. S. Glasstone, Thermodynamics for Chemists, Affiliated East-West Press, New Delhi, 1964.
11. W.G. Davis, Introduction to Chemical Thermodynamics – A Non – Calculus Approach, Saunders, Philadelphia, 19772.
12. Peter A. Rock, Chemical Thermodynamics, University Science Books, Oxford University Press, 1983.
13. Ira N. Levine, Quantum Chemistry, 5th Edn., Pearson Education (Singapore) Pte. Ltd., Indian Branch, New Delhi, 2000.
14. Thomas Engel and Philip Reid, Physical Chemistry, 3rd Edn., Pearson Education Limited 2013.
15. D.N. Bajpai, Advanced Physical Chemistry, S. Chand 1st Edn., 1992.
16. Bockris, John O'M., Reddy, Amulya K.N., Gamboa-Aldeco, Maria E., Modern Electrochemistry, 2A, Plenum Publishers, 1998.
17. Physical Chemistry by Gurtu and Gurtu