

Academic Council dated 15th July, 2023 as per Item Number: 1.03



**DOMBIVLI SHIKSHAN PRASARAK MANDAL'S,
K.V. PENDHARKAR COLLEGE OF ARTS, SCIENCE AND COMMERCE,
(AUTONOMOUS) DOMBIVLI (EAST), DIST. THANE
(Affiliated to University of Mumbai)**

Faculty of Science

DEPARTMENT OF CHEMISTRY

(Programme: Bachelor of Science, B.Sc.)

SYLLABUS FOR

F. Y. B.Sc. – CHEMISTRY (Semester I and II)

Choice Based Credit System (CBCS)

(as per NEP-2020)

(With effect from the Academic Year: 2023-2024)

**DOMBIVLI SHIKSHAN PRASARAK MANDAL'S,
K.V. PENDHARKAR COLLEGE OF ARTS, SCIENCE AND COMMERCE,
AUTONOMOUS.
DOMBIVLI (EAST), MAHARASHTRA, 421 203, INDIA.**

**Faculty of Sciences
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CONTENT

Programme- F.Y.B.Sc. NEP 2020

SEM-I

Sr. No.	Course Code	Course Title	Category	Teaching hours/week	Total Marks	Credits
1	CH23101MM	Paper –I (Physical & Inorganic Chemistry)	Major	2	100	2
2	CH23102MM	Paper –II (Organic & Inorganic Chemistry)	Major	2	100	2
3	CH23103MM	General Chemistry Practical-I	Major	4	100	2
4	PH23102MN BO23101MN ZO23101MN	Nuclear Physics and Modern Physics Botany Paper-I Wonders of Animal World	Minor	2	100	2
5	AC23123OE CO23121OE	Investment Portfolio Management Paper I OR Advertising Paper-I	Open Elective I	2	50	2
6	GE23104E PS23105OE	Disaster Management and Mitigation OR Stress Management Paper-I	Open Elective II	2	50	2
7	PH23106SE BO23103SE ZO23103SE	Measurement Techniques in Physics Practical's of Botany Exploring the wonders of animal world	SEC	4	100	2
8	CH23105VS	Skill Based Practical -I	VSC	4	100	2
9	EN23101AE	Communication Skill in English	AEC	2	50	2
10	HI23101VE	Value Education I	VEC	2	50	2
11	CH23106IK	Metallurgy	IKS	2	50	2
Total Credit						22

SEM- II

Sr. No.	Course Code	Course Title	Category	Teaching hours/week	Total Marks	Credits
1	CH23201MM	Paper –I (Physical & Inorganic Chemistry)	Major	2	100	2
2	CH23202MM	Paper –II (Organic & Inorganic Chemistry)	Major	2	100	2
3	CH23203MM	General Chemistry Practical-II	Major	4	100	2
4	PH23202MN BO23202MN ZO23202MN	Nuclear Physics and Modern Physics Botany Paper-II Aquaculture	Minor	2	100	2
5	AC23223OE CO23221OE	Investment Portfolio Management Paper II OR Advertising Paper-II	Open Elective I	2	50	2
6	GE23204OE PS23105OE	Disaster Management and Mitigation OR Stress Management Paper-II	Open Elective II	2	50	2
7	PH23106SE BO23204SE ZO23204SE	Measurement Techniques in Physics Practical's of Botany Principles of Pisciculture	SEC	4	100	2
8	CH23205VS	Skill Based Practical -II	Major	4	100	2
9	EN23201AE	Communication Skill in English	AEC	2	50	2
10	HI23201VE	Value Education II	VEC	2	50	2
11	CH23206CC	Co-curricular Activity	CC	2	50	2
Total Credit						22

Semester-I

Paper-I (Physical and Inorganic Chemistry)

Course Code: CH23101MM

Learning objectives:

The learner to be imparted with:

- 1) Knowledge of Thermodynamics, the terms involved, First Law of Thermodynamics.
- 2) Understanding chemical calculations.
- 3) Fundamentals of Chemical Kinetics.
- 4) Various features of Liquid state of matter.
- 5) Detailed study of Atomic Structure and periodicity of elements

Learning Outcomes:

On successful completion of this course students will be able to:

- 1) Explain the concept of Thermodynamics, explain First Law of Thermodynamics.
- 2) Distinguish between various types of systems, surroundings etc.
- 3) Understand the concept of Mole concept and carry out all related calculations.
- 4) Understand Chemical Kinetics, rate of reactions, order of reactions and solve numerical problems.
- 5) Explain the nuance of Surface tension, Viscosity, Refractive index.
- 6) Understand Atomic Structure and correlate the changes in periodic properties of elements.

	<p>viscosity, specific viscosity, reduced viscosity, determination of viscosity by Ostwald viscometer (Numericals expected)</p> <p>Refractive index: Introduction, molar refraction and polarizability, determination of refractive index by Abbe's refractometer (Numericals expected)</p>	
III	<p>3.1 Atomic structure: (Qualitative treatment only; it is expected that the learner knows the mathematical statements and understands their physical significance after completing this topic. No derivations of the mathematical equations required)</p> <p>a) Historical perspectives of the atomic structure; Rutherford's Atomic Model, Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Structure of hydrogen atom.</p> <p>b) Hydrogenic atoms: 2. Atomic orbitals i) Hydrogenic energy levels ii) Shells, subshells and orbitals iii) Electron spin iv) Radial shapes of orbitals 3. Many Electrons Atoms i) Penetration and shielding ii) Effective nuclear charge 4. Aufbau principle</p> <p>3.2: Periodic Table and periodicity: long form of Periodic Table; Classification for elements as main group, transition and inner transition elements; Periodicity in the following properties: Atomic and ionic size; electron gain enthalpy; ionization enthalpy, effective nuclear charge (Slater's rule);</p>	<p>[6L]</p> <p>[4L]</p>

Justification: Some of the topics like angular shape of orbitals are already studied in lower classes. Some topics will be learned in higher classes. Some are job-oriented topics that can be useful in industries.

Learners Space:

1. Thermodynamic processes.
2. Rate of reaction of various types of reactions.
3. Solving interrelated Chemical calculations.
4. Applications of Surface Tension, Viscosity, refractive index.
5. Derivations of the mathematical equations for various models of Atomic Structures.

References:

Units I & II

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Ltd., New Delhi (2014).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
13. Chemical Kinetics and Reaction Dynamics, Santosh K. Upadhyay
14. S. Glasstone, Physical Chemistry.

Unit III

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry, Oxford, 1970.
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Paper-II (Organic and Inorganic Chemistry)

Course Code: CH23102MM

Learning Objectives:

The learner to be imparted with:

- 1) Classification and Nomenclature of organic compounds.
- 2) Fundamentals of organic reaction mechanism.
- 3) Knowledge of Stereo-isomers of organic molecules.
- 4) Comparative study of group I and II elements and some important inorganic compounds.

Learning Outcomes:

On successful completion of this course students will be able to:

- 1) Explain the IUPAC rules and write the names of organic molecules.
- 2) Understand various intricacies of organic reaction mechanism.
- 3) Identify stereo-isomers of various organic molecules.
- 4) Differentiate the elements on the basis of their properties. Visualize the use different compounds.

Unit	Topics	Lectures
I	Basics of Organic Chemistry 1.1 Classification and Nomenclature of Organic Compounds	[5L]

	<p>Review of basic rules of IUPAC nomenclature. Nomenclature of mono and bi-functional aliphatic compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines; including their cyclic analogues.</p> <p>1.2 Fundamentals of organic reaction mechanism:</p> <p>Bond fission: Homolytic and Heterolytic fission with suitable examples. Electrophiles and Nucleophiles; Nucleophilicity and basicity</p> <p>Types (primary, secondary, tertiary, allyl, benzyl), shape and their relative stability of reactive intermediates: Carbocations, Carbanions and Free radicals.</p> <p>Introduction to types of organic reactions: Addition, Elimination and Substitution reaction. (With one example of each)</p>	[5L]
II	<p>2. Stereochemistry I</p> <p>Fischer Projection, Newman and Sawhorse Projection formulae (of erythro, threo isomers of tartaric acid and 2,3-dichlorobutane) and their interconversions.</p> <p>Geometrical isomerism in alkene and cycloalkanes: cis-trans and syn-anti isomerism E/Z notations with C.I.P rules.</p> <p>Relative and absolute configuration: D/L and R/S designations.</p> <p>Conformation analysis of alkanes (ethane, propane and n-butane): Relative stability with energy diagrams.</p>	[10L]
III	<p>3.0 Comparative chemistry of Main Group Elements:</p> <p>Metallic and non-metallic nature, oxidation states, electronegativity, anomalous behavior of second period elements,</p>	[10L]

	allotropy, catenation, diagonal relationship of Group I and Group II elements. Some important compounds- NaHCO_3 , Na_2CO_3 , NaCl , NaOH , CaO , CaCO_3 ; oxides of carbon, oxides and oxyacids of sulphur and nitrogen with respect to environmental aspects.	
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Justification:

Some of the topics like angular shape of orbitals are already studied in lower class. Some topics will be learned in higher classes. Some are job-oriented topics can be useful in industries.

Learners Space:

- 1) Understand IUPAC rules for naming organic molecules containing 3-4 functional groups.
- 2) Study various reaction mechanisms.
- 3) Various intricacies of isomerism and reactions.
- 4) Industrial preparation of the compounds studied.

References:

Unit I & II

1. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
- 2) Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
- 3) Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
- 4) Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
- 5) Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005. 6. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

Unit III

- 1) Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.

- 2) Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry, Oxford, 1970.
- 3) Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
- 4) Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
- 5) Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition,

General Chemistry Practical-I

Course Code: CH23103MM

Learning Objectives:

The learner will be imparted with

1. Ability to perform time-oriented experiments like Kinetics.
2. Knowledge of *Lab to Industry* experimentations, commercial analysis.
3. Knowhow to analyze organic compounds in wet Labs with emphasis on microscale technique from an early age.
4. Basics of quantitative experimentations – Volumetric and Gravimetric experiments.

Learning outcomes:

On completion of these experimentations, the learner will be able to

1. Perform time-oriented experiments.
2. Understand *Lab to Industry* journey in experimentations.
3. Use microscale techniques.
4. Understand the nuance of quantitative experiments.

1. Chemical Kinetics

- (1) To prepare 0.1 N succinic acid and standardize NaOH solution of two different concentrations.
- (2) To determine the rate constant for the hydrolysis of ester using HCl as a catalyst.
- (3) To determine enthalpy of dissolution of salt (like KNO_3).

2. Commercial Analysis

Commercial Analysis of:

- a) To determine the strength of commercial sample of hydrochloric acid.
- b) To determine the strength of acetic acid – an organic acid by titrimetric method.
- c) To determine the strength of salt of weak acid and strong base.

3. Titrimetric/volumetric analysis:

To analyze the solution of Na_2CO_3 and NaHCO_3 using double indicator.

4. Gravimetric analysis:

1. To determine the percentage purity of sample of BaSO_4 containing NH_4Cl .
2. To determine percentage purity of sample of ZnO containing ZnCO_3 .

5. Demonstration Experiment:

Colorimetry: To determine the concentration of given sample of KMnO_4 by colorimetric method.

Chromatography: Separation of a mixture of two sugars by ascending paper chromatography.

6. Analytical tools.

Skill Based Practical -I (VSC)

Course Code: CH23105VS

1. **Characterization of organic compounds:** Characterization of organic compound containing C, H, (O), N, S, X elements. (Minimum of ten compounds having not more than one functional to be analyzed using microscale technique.)

2. Demonstration Experiment:

Potentiometry: Standardisation of Potentiometer and determination of e.m.f.

3. Calculations for preparation of chemical solutions.

Reference Books for Practicals:

- 1) Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
- 2) Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
- 3) Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001).
- 4) Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
- 5) Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
- 6) Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
- 7) Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

Metallurgy (IKS)

Course Code: CH23106IK

Learning objectives:

The learner to be imparted with:

- 1) Knowledge of Metals, ores, minerals.
- 2) Understanding calcination, roasting, smelting process.
- 3) Various purification techniques.
- 4) Detailed study of silver and nickel metallurgy.

Learning Outcomes:

On successful completion of this course students will be able to:

- 1) Explain the concept of metallurgy.
- 2) Various types of metallurgy.
- 3) Detailed process of extraction of metal.
- 4) Explain silver and nickel metallurgy.

Unit	Topics	Lectures
I	Introduction : Minerals, Ore, Gangue, Native Ores, Ore Dressing, Calcination and Roasting, Smelting, Flux and Slag, Air reduction, Electrolytic reduction, Purification of Metals Corrosion.	[10]
II	Pyro metallurgy : Processes involved in pyrometallurgical treatment, Flux, Criteria for choosing flux, Slags silicate Melts, Reason of high viscosity of slag, Reduction smelting using carbon, Metallathothermic reduction of oxide.	[10]
III	3.1 Silver Metallurgy : Ore, Cupellation process, Amalgamation process, Desilveriation of lead. AgNO ₃ (Preparation, Properties, Uses). 3.2 Nickel Metallurgy : Ores, Crushing and Concentration, Production of NiS, Orford's, process.	[05] [05]

Learners Space:

1. Metallurgical concept.
2. Purification methods.
3. Pyrometallurgy process.
4. Silver Metallurgy.
5. Nickel Metallurgy.

References:

1. Materials Science and Engineering: An Introduction by William D., Callister, David G. Rethwisch
2. Introduction to Physical Metallurgy by Sidney Avner
3. Mechanical Metallurgy by George E. Dieter –
4. Principles of Pyrometallurgy C. B. Alcock

ICT Backup:

1. https://drive.google.com/file/d/15Sjx7IL9XEwXLwo_mhhFcB_YjOOri46k/view
2. https://www.udemy.com/course/an-introduction-to-metallurgy/?--=&utm_source=adwords&utm_medium=udemyads&utm_campaign=LongTail_la.EN_cc.INDIA&utm_content=deal4584&utm_term=.ag_118445032537.ad_618853564450.kw.de_m.dm.pl.ti_dsa-1212271230479.li_1007785.pd.&matchtype=&gclid=CjwKCAjw-vmkBhBMEiwAlrMeFx5KQgL6mIXbrSUtZJQTA9BfoiLcufeV2-K0Y4rWrRKc6c-kznxr5BoCpocQAvD_BwE

Platform and link	Course duration	Similarity index(%)	Tentative cost
1. Platform- https://www.classcentral.com/classroom/mit-opencourseware-biological-chemistry-i-fall-2013-40913	12weeks	30	free
2. Platform- udemy https://www.udemy.com/course/an-introduction-to-metallurgy/#instructor-2	14weeks	50	449
3.Platform- careers360 https://www.careers360.com/courses-certifications/udemy-material-science-physical-metallurgy-i-course	10 weeks	25	799

Sem-II**Paper-I (Physical and Inorganic Chemistry)****Course Code: CH23201MM****Learning Objectives:**

The learner will be imparted with

1. Different Gas Laws, derivation of such Laws and solving numerical problems.
2. Understanding of second law of thermodynamics.

3. Knowledge of Ionic equilibria and concept of Buffer.
4. Understanding of Molecular Spectroscopy on the basis of Electromagnetic radiation.
5. Detailed study of Concept of Qualitative Analysis, common ion effect and acid-base theories.

Learning outcomes:

On successful completion of this course students will be able to

1. Explain different Gas Laws, derive relations between them and solve numerical problems.
2. Explain equilibrium constants and understand second law of thermodynamics.
3. Explain ionic equilibria, ionization constants, pH, buffer – its use.
4. Understand fundamentals of molecular spectroscopy, electromagnetic radiation.
5. Apply common ion effect, explain precipitation, acid-base theories, distinguish between hard and soft acids and use these for understanding reactions.

Unit	Topics	Lectures
I	1.1 Gaseous State Ideal gas laws, kinetic theory of gases, Maxwell-Boltzmann's distribution of velocities (qualitative discussion), ideal gases, real gases, compressibility factor, Boyle's temperature (Numericals expected) Deviation from ideal gas laws, reasons for deviation from ideal gas laws, Van der Waals equation of state, Joule-Thomson effect: qualitative discussion and experimentation, inversion temperature. (Numericals expected)	[7L]
	1.2 Thermodynamic Parameters: Statement of second law of thermodynamics, concepts of entropy and free energy, spontaneity and physical significance of free energy, thermodynamic derivation of equilibrium constant (Numericals expected)	[3L]
II	2.1 Ionic Equilibria:	[7L]

Industry.

3. Use of different types of Molecular spectroscopy.
4. Various reagents in qualitative analysis.

References:

Units I & II

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd., New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).

Unit III

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry, Oxford, 1970.
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.

Paper-II (Organic and Inorganic Chemistry)

Course Code: CH23202MM

Learning Objectives:

The learner will be imparted with

1. Various properties and reactions of alkanes, alkenes and alkynes.
2. Cycloalkanes, their relative stability and conformational analysis.
3. Aromaticity, Huckel's rule, different reactions of aromatic compounds.
4. Different types of chemical bond, theories and their limitations.
5. Various aspects of Redox reactions.

Learning outcomes:

On successful completion of this course students will be able to

1. Distinguish between carbon-carbon single bond, double bond and triple bond compounds.
2. Explain identify reactions of alkanes, alkenes and alkynes.
3. Understand the reasons behind the stability of cycloalkanes and explain their conformations.
4. Understand aromaticity and write and explain reactions of aromatic compounds.
5. Distinguish between different types of bonds, theories behind their formation and drawbacks.
6. Write and balance redox reactions.

Unit	Topics	Lectures
I	1. Chemistry of Aliphatic Hydrocarbons	
	1.1 Carbon-Carbon sigma bonds: Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.	[3L]
	1.2 Carbon-Carbon pi bonds: Formation of alkenes and alkynes by elimination reactions: Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann	[7L]

	<p>eliminations.</p> <p>Reactions of alkenes: Mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2-and 1, 4-addition reactions in conjugated dienes.</p> <p>Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.</p>	
II	<p>2.1 Stereochemistry-II: Cycloalkanes and Conformational Analysis:</p> <p>Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy.</p> <p>2.2 Aromatic Hydrocarbons:</p> <p>Aromaticity: Hückel's rule anti-aromaticity, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft alkylation/acylation with their mechanism.</p>	<p>[4L]</p> <p>[6L]</p>
III	<p>3.1: Chemical Bond and Reactivity:</p> <p>Types of chemical bond, comparison between ionic and covalent bonds, polarizability (Fajan's Rule), shapes of molecules, Lewis dot structure, Sidgwick Powell Theory, basic VSEPR theory for AB_n type molecules with and without lone pair of electrons, isoelectronic principles, applications and limitations of VSEPR theory.</p> <p>3.2: Oxidation Reduction Chemistry:</p> <p>a) Reduction potentials</p> <p>b) Redox potentials: half reactions; balancing redox equations.</p>	<p>[7L]</p> <p>[3L]</p>

Learners Space:

1. Structure, reactions and mechanism of cycloalkanes and cycloalkenes.
2. Conformation analysis of different cycloalkanes.
3. Aromaticity in fused heterocyclic compounds.
4. Molecular orbital theory.
5. Use of redox reactions in Industry.

References:

Unit I & II

1. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
4. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International,2005.
6. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
7. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, and E. Wothers, Oxford Univ. Press, Oxford (2001).

Unit III

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry, Oxford, 1970.
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
5. Rodger, G.E. Inorganic and Solid-State Chemistry, Cengage Learning India Edition, 2002.

General Chemistry Practical-II

Course Code: CH23203MM

Learning Objectives:

The learner will be imparted with

1. Additional time bound reaction abilities.
2. Knowledge of MSDS
3. Intricacies of semi-micro qualitative analysis of inorganic ions.
4. Knowledge of crystallization of organic compounds.
5. Information on TLC
6. Technique of performing redox titration (quantitatively).

Learning outcomes:

On completion of these experimentations, the learner will be able to

1. Carry out Kinetics experiments with greater ease.
2. Write MSDS of compounds.
3. Analyze and determine different inorganic ions.
4. Perform redox titrations.

1. Chemical Kinetics:

- (1) Determine the rate constant for saponification reaction between ethyl acetate and NaOH.
- (2) Determine the rate constant for saponification reaction between methyl acetate and NaOH.

2. Analysis of commercial samples:

- 1) To standardize commercial sample of HCl using borax.
- 2) Write material safety data sheets (MSDS) of chemicals involved.

3. Volumetric analysis/redox titration:

- 1) To determine the percentage of Copper (II) present in the given copper sulphate solution by iodometric titration.
- 2) To determine the percentage of Iron (II) present in the given ferrous sulphate solution by redox titration.

4. Demonstration Experiment:

1. Spectrophotometry:

To determine the concentration of given sample of KMnO_4 spectrophotometrically.

2. pH metry:

To determine the pH of given buffer solution by using pH meter.

3. Chromatography: Separation of a mixture of o-and p-nitrophenols by thin layer chromatography (TLC).

4. Molecular models: Displaying the shapes of molecules and ions using models.

5. Acquaintance with Safety Measures in a Laboratory.

6. Water analysis:

To determine the acidity of given water sample solution.

7. Inorganic preparation:

Preparation of copper sulphate pentahydrate crystals from copper oxide.

Skill Based Practical -II (VSC)

Course Code: CH23205VS

1. Semi-micro qualitative analysis:

Qualitative analysis: (at least 5 mixtures to be analyzed)

Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions.

Cations (from amongst): Pb^{2+} , Ba^{2+} , Ca^{2+} , Sr^{2+} , Cu^{2+} , Cd^{2+} , Fe^{2+} , Ni^{2+} , Mn^{2+} , Mg^{2+} , Al^{3+} , Cr^{3+} , K^+ , NH_4^+

Anions (from amongst): CO_3^{2-} , S^{2-} , SO_3^{2-} , NO_2^- , NO_3^- , Cl^- , Br^- , I^- , SO_4^{2-} , PO_4^{3-}

(Scheme of analysis should avoid use of sulphide ion in any form for precipitation / separation of cations. Mixtures should contain no interfering radicals and not forming insoluble residue)

2. Purification of organic compounds by recrystallization:

Purification of any five organic compounds by recrystallization selecting suitable solvent. (Provide 1g of sample).

Learners are expected to report a) Solvent for recrystallization. b) Mass and the melting points of purified compound.

3. Conductometry: To determine the conductivity of given solution.

4. Complexometric titration: Estimation of Total Hardness of given water sample.

Reference Books for Practicals:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001).
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
5. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
6. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
7. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

Self-Study ICT Backup

1. <https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/video-lectures/>
2. <https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/>
3. <https://ocw.mit.edu/courses/chemistry/5-111sc-principles-of-chemical-science-fall-2014/>
4. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-84j-atmospheric-chemistry-fall-2013/>
5. <https://ocw.mit.edu/courses/chemistry/>
6. <https://ocw.mit.edu/courses/captioned/>
7. <https://ocw.mit.edu/courses/captioned/#chemistry>
8. <https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/>

- [res/lecture-33/](#)
9. <https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-1/>
 10. <https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-7/>
 11. <https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-16/>
 12. <https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-1/>
 13. <https://www.youtube.com/user/MIT/search?query=chemistry>
 14. <http://mit.uvt.rnu.tn/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010/organic-materials/27-introduction-to-organic-chemistry/>
 15. http://ifs.se/IFS/Documents/Other/Video%20Lectures%20book%20Organic%20Chemistry_Attaur-Rahman%20and%20Syeda%20Sadia%20Khatoon.pdf
 16. <https://www.coursera.org/learn/physical-chemistry>

PEDAGOGY

Chemistry is necessarily an experimental science: its conclusions are drawn from data, and its principles supported by evidence from facts.

MICHAEL FARADAY

Every aspects of the world today – even politics and international relations – is affected by Chemistry.

LINUS PAULING

The curiosity of humans has driven them to explore the world. Manipulation of nature for the benefit of humans has become an objective of exploration. The exploratory activities of human beings have resulted in the accumulation of a vast source of knowledge called natural science. This knowledge is organized in several disciplines for the convenience of study and is based on inquiry, observations and logical extensions, and is testable by experiment or has logically convincing explanation. Science is a domain of inquiry born out of natural curiosity, logical reasoning and experimentation. Chemistry is one of the main core subjects of science.

F.Y.B.Sc being the entry point for the students to undergraduate classes, acts like a guiding force to make up their mind in selecting a subject, they would wish to pursue their studies in future for carving their career in a particular field.

The syllabus committee in the subject of Chemistry for F.Y. B.Sc. has designed the syllabus in such manner that it enhances the effectiveness, excellence, diversity and creativity in the area of teaching-learning of Chemistry. The committee have tried to provide learner with some basic ideas and strategies to help learner in the development of concepts of Chemistry. It is intend to encourage teacher and learner to organize learner-centered, activity-based, participatory learning experiences through observation, dialogue, discussion, projects, problem solving and field work/ research laboratory visit to integrate the learning of Chemistry with its content and process. Learners are encouraged to ask questions not only during transaction of a concept but also when involved in any teaching-learning experience so that learners get motivated to talk over the issue. This syllabus meant not only to be read, but to be engaged with and involvement in thinking critically. Relevance, Individualization, Feedback, Reinforcement, Facilitation are considered while framing the syllabus.

The content in this syllabus is divided in two papers per semester. In both the semesters parts of Physical Chemistry and Inorganic Chemistry are covered in paper-I while Organic Chemistry and Inorganic Chemistry are covered in paper-II. An added dimension to the syllabus is the non-binding *Learners Space*. It is included to lure the learner to think at a higher level and do things differently, remaining a few yards ahead.

The syllabus gives wide scope for effective use of Collaborative Learning Approach, Problem Solving Approach, Inquiry Approach, Deductive Approach, Inductive Approach, Constructivist Approach, Experiential Learning, Analogy Strategy and use of Information and Communication Technology (ICT) which all makes teaching-learning effective and interesting.

The use of 5E Learning Model i.e. Engage, Explore, Explain, Elaborate and Evaluate makes teaching-learning and evaluation effective. The outcome of the syllabus is to develop learner's Critical thinking, Logical thinking, Scepticism and increase the Knowledge Dimension which includes Factual knowledge, Conceptual knowledge, Procedural knowledge and Metacognitive knowledge.

MOOC:

Platform and link	Course duration	Similarity index	Tentative cost
1. Swayam- Chemical Thermodynamics https://onlinecourses.nptel.ac.in/noc23_cy38/preview	12 weeks	95%	Free
2. Swayam- Mechanisms in Organic Chemistry https://onlinecourses.nptel.ac.in/noc23_cy54/preview	8 weeks	80%	Free
3. Swayam- Stereochemistry https://onlinecourses.nptel.ac.in/noc23_cy57/preview	8 weeks	85%	Free

Job oriented/ Entrepreneurship development.

Basis of organic reaction mechanism could be applicable in industries for organic synthesis.

Spectroscopy techniques could be applied for spectral analysis.

SYLLABUS OF FOLLOWING UNIVERSITIES REFERRED:

1. Savitribai Phule Pune University, Pune.
2. Shivaji University, Kolhapur.
3. University of Kolkata, Kolkata.
4. Banaras Hindu University, Varanasi.
5. Harvard University, Massachusetts, USA

EVALUATION SCHEME:

EXAMINATION PATTERN FOR MAJOR, MINOR , VSC/SEC:

External Exam: 60 marks

Internal Exam: 40 marks

External Exam Paper Pattern

Total marks: 60

Duration: 2 hr.

1.	EXTERNAL ASSESSMENT FOR THEORY (Semester End Examination)	60 Marks
	N.B. 1. All questions are compulsory 2. All questions carry equal marks.	
Q.1	Based on Unit-I, II and III A) Multiple choice questions B) Fill in the blanks C) Short questions (one or two line)	06 03 03
Q.2 A) OR B) P) OR Q)	Unit-I	06/07 06/05
Q.3 A) OR B) P) OR Q)	Unit-II	06/07 06/05
Q.4 A) OR B) P) OR Q)	Unit-III	06/07 06/05
Q.5	Unit-I to III (Solve any three out of six)	12

Internal Exam Pattern: 40 marks

2.	INTERNAL ASSESSMENT	40 Marks
2.1	One class test (Objectives/ Multiple Choice)	15 Marks
2.2	Assignment/ Project/ Presentation/Book or research paper Review	20 Marks
2.3	Active participation, Overall performance	05 Marks

Evaluation Pattern for Practicals

3.	EXTERNAL ASSESSMENT FOR PRACTICALS	300 Marks
	Sem-I and Sem-II Practicals (Each paper carries 100 marks. Distribution of marks is shown below.)	
	Two experiment from each paper	80
	Viva	10
	Journal	10
	TOTAL MARKS	100 X 3 = 300

Practical examination of each paper for 100 marks will be held in two sessions. Students will have to perform two experiments in two sessions. Each session will be three and half hours. Students will have to perform the necessary experiments in each semester and all experiments should be reported in journal.

EXAMINATION PATTERN FOR OE, AEC, VEC, IKS, CC:

External Exam: 30 marks

Internal Exam: 20 marks

External Exam Paper Pattern

Total marks: 50

Duration: 1 hr.

1.	EXTERNAL ASSESSMENT FOR THEORY (Semester End Examination)	30 Marks
	N.B. 1. All questions are compulsory 2. All questions carry equal marks.	
	Q.1 Unit-I	

	A) OR B) P) OR Q)		05/05 05/05
	Q.2 A) OR B) P) OR Q)	Unit-II	05/05 05/05
	Q.3 A) OR B) P) OR Q)	Unit-III	05/05 05/05

Internal Exam Pattern: 40 marks

2.	INTERNAL ASSESSMENT	20 Marks
2.1	One class test (Objectives/ Multiple Choice)	10 Marks
2.2	Assignment/ Project/ Presentation/Book or research paper Review	05 Marks
2.3	Active participation, Overall performance	05 Marks

Passing Standard:

1. The student will have to secure a minimum of 40% marks in internal assessment as well as semester end examination per theory paper, for all the theory papers.
2. The college will conduct all the semester examinations of 100 marks per practical paper at the end of each semester. The student will have to secure a minimum of 40% marks in the examination per practical paper, for all the above practical papers.