

As Per NEP 2020

University of Mumbai



Syllabus for Minor (Scheme III) Vertical 2

Faculty of Science & Technology

Board of Studies in Chemistry

Third Year Programme in Minor B.Sc. (Chemistry)

Semester	V	Credit
Title of Paper	Concise Chemistry	1
	Practical in Concise Chemistry	1
Total Credits		2
From the Academic Year	2026-27	

Sem. - V

Syllabus B.Sc. (Chemistry) (Sem.- V)

Title of Paper: Concise Chemistry

Sr. No.	Heading	Particulars
1	Description of the course : Including but Not limited to :	Concise Chemistry is an interdisciplinary minor course designed to introduce fundamental chemical concepts relevant to energy, materials, environment and analytical science for students from diverse academic backgrounds. The course provides basic understanding of renewable energy resources such as solar and hydrogen energy, emphasizing the importance of sustainable technologies. Core concepts of chemical bonding and bioinorganic chemistry highlight the role of ionic interactions and essential metal ions in biological systems. The course also introduces polymers, their classification, preparation, applications and environmental impact including biodegradable plastics and recycling practices. Basic principles of instrumental analysis through UV spectroscopy and Beer–Lambert law are included to develop understanding of quantitative chemical measurements. The course emphasizes real-life applications of chemistry in sustainable development, materials science and analytical techniques.
2	Vertical :	Minor
3	Type :	Theory
4	Credit:	1 credit
5	Hours Allotted :	15 Hours
6	Marks Allotted:	25 Marks
7	Course Objectives: The course aims to: COB1: Provide knowledge of renewable energy resources, including solar energy, photovoltaic effect, semiconductors, and hydrogen as a future fuel.	

	COB2: Develop understanding of ionic bonding, types of ionic crystals, and factors influencing formation and stability of ionic compounds. COB3: Introduce concepts of bioinorganic chemistry, including essential elements and biological role of metal ions such as sodium, potassium, and iron. COB4: Provide knowledge of polymer chemistry, including classification, preparation, properties, applications, and environmental aspects of polymers. COB5: Introduce basic principles of UV spectroscopy, including nature of electromagnetic radiation and interaction of light with matter. COB6: Develop understanding of Beer–Lambert law and instrumentation of colorimeter and spectrophotometer for quantitative chemical analysis.
8	Course Outcomes: At the end of the course, students will be able to: CO1: Explain principles of renewable energy resources, including solar cells, semiconductors, and hydrogen as alternative energy sources. CO2: Explain formation, properties, and structure of ionic compounds using radius ratio rules. CO3: Describe the biological importance of metal ions and role of essential elements in living systems. CO4: Classify polymers and explain preparation, properties, applications, and environmental impact of polymeric materials. CO5: Explain fundamental concepts of UV spectroscopy and interaction of electromagnetic radiation with matter. CO6: Apply Beer–Lambert law for quantitative analysis and describe basic instrumentation of colorimeter and spectrophotometer.
9	Modules:- Module 1: 1.1 Renewable Energy Resources (4 Hours) 1.1.1 Introduction: Need of renewable energy resources 1.1.2 Solar energy: Solar cells, Photovoltaic effect, Differences between conductors, semiconductors, insulators and its band gap, Semiconductors as solar energy converters, Silicon solar cell. 1.1.3 Hydrogen: Fuel of the future, production of hydrogen by direct electrolysis of water, advantages of hydrogen as a universal energy medium. 1.2 Chemical bonding (Non directional bonding) (2 Hours) 1.2.1 Ionic Bond: Conditions for the Formation of Ionic Bond and properties. 1.2.2 Types of Ionic Crystals, Radius Ratio Rules.

1.3 Introduction to Bioinorganic Chemistry (2 Hours)

1.3.1 Essential and non-essential elements in biological systems.

1.3.2 Biological importance of metal ions such as Na^+ , K^+ , $\text{Fe}^{+2}/\text{Fe}^{+3}$.

1.4 Polymers (4 Hours)

1.4.1 Introduction to Polymers: Definition of monomer and polymers, Classification and Nomenclature of polymers

1.4.2 Preparation, properties and uses of: Polyethylene (LDPE & HDPE), PVC, Polystyrene, Nylon-6,6, PET, Bakelite.

1.4.3 Biodegradable polymers (PLA, PHB — awareness only)

1.4.4 Environmental aspects: Plastic pollution and microplastics, Recycling of plastics (basic types)

1.5 Instrumental Methods (UV Spectroscopy) (3 Hours)

1.5.1 Basic Terms:

i) Monochromatic Light and Polychromatic Light

ii) Energy of light, Wavelength, frequency, velocity of light

iii) Intensity of light

1.5.2 i) Statement of Beer's Law and Lambert's Law (Derivation not expected) Relationship and Terms)

ii) Combined Mathematical Expression of Beer-Lambert's Law (Numericals Expected)

1.5.3 Single beam Colorimeter with reference to

i) Source ii) Wavelength selector iii) Detector

10

Reference Books:

Module 1

Physical Chemistry

- 1 G.N. Tiwari and R.K. Mishra – Advanced Renewable Energy Sources – Royal Society of Chemistry, 2011
- 2 Martin A. Green, Solar Cells: Operating Principles, Technology and Systems Applications – University of New South Wales, 1986
- 3 Detlef Stolten, Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications, Wiley-VCH, 2010

Inorganic Chemistry

Chemical bonding (Non directional bonding)

- 1 B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013.
- 2 W. W. Porterfield, Inorganic Chemistry-A Unified Approach, 2nd Ed., Academic Press, 1993.
- 3 J. Huheey, F. A. Keiter and R. I. Keiter, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Ed., Harper Collins, 1993.
- 4 G. Miessler and D. Tarr, Inorganic Chemistry, 3rd Ed., Pearson Education, 2004
- 5 C. J. Ballhausen and H. B. Gray, Molecular orbital Theory, McGraw-Hill, New York, 1965.
- 6 C, M, Day and Joel Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd., 1985.
- 7 F. A. Cotton and R. A. Walton, Multiple Bonds between Metal Atoms, 2nd edition, Clarendon Press, Oxford, 1993.

	Introduction to Bioinorganic Chemistry 1. R. R. Crichton, Biological Inorganic Chemistry, A new introduction to molecular structure, and function, 2nd Edition, Elsevier, 2012. 2. I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine, Bioinorganic chemistry, First South Indian Ed., Viva Books, New Delhi, 1998. 3 G. N. Mukherjee and A. Das, Elements of Bioinorganic chemistry, Dhuri and Sons, Calcutta, 1988. 4 J. A. Cowan, Inorganic biochemistry-An introduction, VCH Publication, 1993. 5 R. W. Hay, Bioinorganic chemistry, Ellis Harwood, England, 1984. 6 S. J. Lippard and J. M. Berg, Principles of bioinorganic chemistry, University Science Publications, Mill Valley, Californic, 1994. 7 Ivano Bertini, Harry Gray, Stephen Lippard, Joan Valentine, Bioinorganic Chemistry, Viva Books Private Limited, 1998 8. Ajay Kumar, Organometallics and Bioinorganic Chemistry, Aaryush Education, 4th Edn, 2021. Organic Chemistry 1 Premamoy Ghosh, Polymer Science & Technology, Tata McGraw Hill Education Pvt. Ltd., New Delhi. 3rd edition, 2011 2 G. Odian, Principles of polymerisation, John Wiley & Sons., 3 rd edition, 2004 3 G. S. Misra, Introductory Polymer Chemistry New age International Publishers & Distributors, New Delhi, 1993. 4 V. K. Ahluwalia& A. Misra, Polymer Science-A Text Book, Ane Books, India, New Delhi. 2009 5 J. R. Fried, Polymer Science & Technology, Prentice Hall of India Pvt. Ltd, New Delhi, 2014 Analytical Chemistry 1 D. A. Skoog, Holler, Crouch, Principles of Instrumental Analysis, 7th Ed. 2 David Harvey, Modern Analytical Chemistry, McGraw-Hill. 2nd Ed., 2000. 3 Gary D. Christian, Purnendu Dasgupta, Analytical Chemistry, Wiley. 7th Ed., 2014	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, creative writing, assignment (any 2)	

Syllabus B.Sc. (Chemistry) (Sem.- V)

Title of Paper: Practical in Concise Chemistry

Sr. No.	Heading	Particulars
1	Description of the course : Including but Not limited to :	Practical in Concise Chemistry provides basic laboratory exposure in physical, inorganic, organic and analytical chemistry through selected simple experiments suitable for students of non-chemistry majors. The course introduces fundamental experimental techniques such as viscosity measurement, pH-metric titration, complexometric estimation and colorimetric analysis. Experiments include determination of physicochemical parameters, estimation of pharmaceutical compounds and evaluation of concentration of analytes using calibration curve method. Emphasis is placed on developing basic laboratory skills, careful observation, safe handling of chemicals and interpretation of experimental data relevant to healthcare, materials and environmental analysis.
2	Vertical :	Minor
3	Type :	Practicals
4	Credit:	1 credit
5	Hours Allotted :	30 Hours
6	Marks Allotted:	25 Marks
7	Course Objectives: The course aims to: COB1: Develop understanding of viscosity and pH-metric methods used for determination of physicochemical parameters. COB2: Explain principles of complexometric titration for estimation of metal ions. COB3: Develop understanding of thermal method for determination of water of crystallization in hydrated salts.	

	COB4: Explain analytical principles involved in estimation of pharmaceutical compounds and antacid capacity. COB5: Develop understanding of calibration curve method and spectrophotometric determination of analytes. COB6: Interpret experimental observations for accurate evaluation of concentration and physicochemical parameters.
8	Course Outcomes: At the end of the course, students will be able to: CO1: Determine molecular weight of polyvinyl alcohol using viscosity measurement method and evaluate strength of borax solution using pH-metric titration. CO2: Estimate zinc ions using EDTA complexometric titration method. CO3: Determine water of crystallization in $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ using thermal decomposition method. CO4: Estimate ibuprofen content and evaluate acid neutralizing capacity of antacid samples. CO5: Determine fluoride concentration using colorimetric method. CO6: Determine concentration of KMnO_4 using calibration curve method and calculate molar extinction coefficient.
9	Modules:- Module 1: 1.1 Physical Chemistry Experiments 1) To determine the molecular weight of Polyvinyl alcohol by viscosity measurement. 2) To find out the strength of borax solution by titrating it against HCl pH metrically. 1.2 Inorganic Chemistry Experiments 1) Estimation of Zn metal ions complexometrically. 2) Determination of water of crystallization by thermal decomposition $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$. 1.3 Organic Estimations 1) Estimation of Ibuprofen 2) Estimation of Acid neutralizing capacity of antacid 1.4 Analytical Chemistry Experiments 1) Determination of fluoride in the given sample solution colorimetrically.

- 2) Determination of concentration of KMnO_4 from sample by calibration curve method and calculate molar extinction coefficient.

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Reference Books:

Module 1

Physical Chemistry

- 1 J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2006
- 2 J. N. Gurtu and R Kapoor, Advanced Experimental Chemistry., S.Chand and Co. Vol-I, 1980
- 3 V. D. Athawale, Experimental Physical Chemistry , New Age International (P) Limited, 2001

Inorganic Chemistry

- 1 A. I. Vogel, Quantitative Inorganic Analysis, 5th Edn Longman Scientific and Technical, 1989.
- 2 J. D. Woolins, Inorganic Experiments. Hohn Wiley and Sons, 2010
- 3 W. G. Palmer, Experimental Inorganic Chemistry, Cambridge University Press, 1954
- 4 G. Raj, Advanced Practical Inorganic Chemistry. Goel Publication, 2010
- 5 J. E. House, Inorganic chemistry, Academic press, 2nd edition, 2013.
- 6 G. N. Mukherjee, Advanced Experiments in Inorganic Chemistry., U. N. Dhur & Sons Pvt. Ltd. 2010.
- 7 W. Conard Fernelius, Inorganic syntheses, Mc-Graw Hill, Vol.II, 1946.
- 8 G. Pass and H. Sutcliffe, Practical Inorganic Chemistry- Preparation, reactions and instrumental methods, Springer, 2nd edition.1974.
- 9 G. Marr and B. W. Rockett, Practical Inorganic Chemistry, Van Nostrand Reinhold Company 1972.
- 10 G. Christian, Analytical Chemistry, John Wiley, New York 4th edition 1986.

Organic Chemistry

- 1 Furniss, Hannaford, Smith & Tatchell, Vogel's Textbook of Practical Organic Chemistry, Pearson Education, 5th Edition, 1989
- 2 F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Pearson Education, 4th Edition, 2009
- 3 John C. Gilbert & Stephen F. Martin, Experimental Organic Chemistry — Cengage Learning, 5th Edition, 2011

Analytical Chemistry

- 1 Vogel, A. I. Vogel's Textbook of Quantitative Chemical Analysis, 6th ed.; Pearson Education: London, 2000.
- 2 Harris, D. C. Quantitative Chemical Analysis, 9th ed.; W. H. Freeman and Company: New York, 2016.
- 3 Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M. J. K. Vogel's Quantitative Chemical Analysis, 6th ed.; Pearson Education: New Delhi, 2000.

	4 Fifeild, F. W.; Kealey, D. Principles and Practice of Analytical Chemistry, 5th ed.; Blackwell Science: Oxford, 2000.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, creative writing, assignment (any 2)	

QUESTION PAPER PATTERN (External)

Time: 30 minutes

Marks: 15

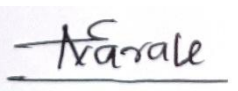
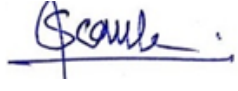
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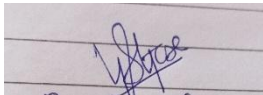
1. All Questions are Compulsory.
2. Draw neat and labelled diagrams wherever necessary.

Q. No	Type	Marks	Module
Q.1	Multiple Choice Question / Fill in the Blanks (Any 5 out of 10) (5 from each Module)	5	1
Q.2	Answer any 2 of the following. (Any 2 out of 4)	10	1

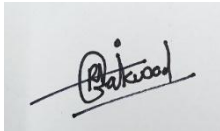
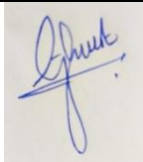
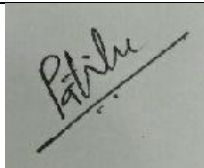
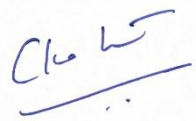
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Physical Chemistry (Mandatory, Minor and VSC)

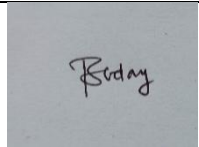
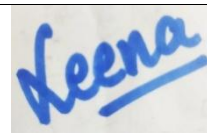
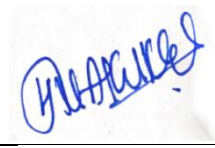
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Inorganic Chemistry (Mandatory, Minor and VSC)

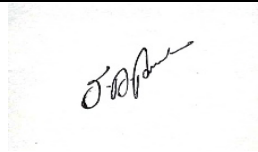
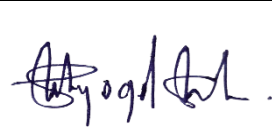
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Organic Chemistry (Mandatory, Minor and VSC)

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Analytical Chemistry (Mandatory, Minor and VSC)

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7	Dr. Gurumeet Wadhawa Veer Wajekar Arts, Science and Commerce College, Phunde, Raigad wadhava.gurumeet@gmail.com	
8	Dr. Momin Shaziya Mohammed Irfan G.M.Momin Women's college Bhiwandi shaziyamomin79@gmmomincol.org	
9	Dr. Vijay Laxman Gurav Dapoli Urban Bank Senior College, Dapoli, Dist.- Ratnagiri vlgurav83@gmail.com	

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BOS in Chemistry

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Faculty of Science &
Technology

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Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology