

University of Mumbai



No. AAMS_UGS/ICC/2024-25/07

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office Circular No. UG/73 of 2018-19 dated 06th July, 2018 relating to the revised syllabus as per the (CBCS) for the Chemistry of T.Y.B.Sc. Physical Chemistry, Inorganic Chemistry, Organic Chemistry and Analytical Chemistry (Sem -V & VI) (3 and 6 units) including Applied Component Drugs and Dyes, Heavy Fine Chemicals and Petrochemicals.

They are hereby informed that the recommendations made by the Board of Studies in Chemistry at its meeting held on 11th May, 2024 and subsequently passed by the Board of Deans at its meeting held on 24th May, 2024 vide item No. 6.10 (R) have been accepted by the Academic Council at its meeting held on 24th May, 2024 vide item No. 6.10 (R) and that in accordance therewith, the revised syllabus for T.Y.B.Sc. (Physical Chemistry) – Sem V & VI (CBCS) has been brought into force with effect from the academic year 2024-25.

(The said circular is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
25th June, 2024

Baliram
(Prof. (Dr.) Baliram Gaikwad)
I/c. REGISTRAR

To,

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.10 (R) /24/05/2024

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies Chemistry,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Director, Department of Information & Communication Technology,
- 6) The Co-ordinator, MKCL,
- 7) The Deputy Registrar, Admissions, Enrolment, Eligibility & Migration Department (AEM),
- 8) The Deputy Registrar, Result Unit,
- 9) The Deputy Registrar, College Affiliations Development Department (CAD)

Copy to :-

- 1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
- 2. The Deputy Registrar, College Affiliations & Development Department (CAD),**
- 3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
- 4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
- 5. The Deputy Registrar, Executive Authorities Section (EA),**
- 6. The Deputy Registrar, PRO, Fort, (Publication Section),**
- 7. The Deputy Registrar, (Special Cell),**
- 8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
- 9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

- 1. P.A to Hon'ble Vice-Chancellor,**
- 2. P.A Pro-Vice-Chancellor,**
- 3. P.A to Registrar,**
- 4. All Deans of all Faculties,**
- 5. P.A to Finance & Account Officers, (F.& A.O),**
- 6. P.A to Director, Board of Examinations and Evaluation,**
- 7. P.A to Director, Innovation, Incubation and Linkages,**
- 8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
- 9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
- 10. The Director of Board of Student Development,**
- 11. The Director, Department of Students Welfare (DSD),**
- 12. All Deputy Registrar, Examination House,**
- 13. The Deputy Registrars, Finance & Accounts Section,**
- 14. The Assistant Registrar, Administrative sub-Campus Thane,**
- 15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
- 16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
- 17. The Assistant Registrar, Constituent Colleges Unit,**
- 18. BUCTU,**
- 19. The Receptionist,**
- 20. The Telephone Operator,**
- 21. The Secretary MUASA**

for information.

University of Mumbai



Revised Syllabus for
T.Y.B.Sc. (Physical Chemistry)
Semester – (Sem V and VI)
(Choice Based Credit System)

(With effect from the academic year 2024-25)

University of Mumbai



Syllabus for Approval

O: _____	Title of Course	T.Y.B.Sc. (Physical Chemistry)
O: _____	Eligibility	As per University Ordinance
R: _____	Passing Marks	40%
No. of years/Semesters:		Three
Level:		UG
Pattern:		Semester
Status:		Revised
To be implemented from Academic Year :		From Academic Year: 2024-25

Sign of the BOS
Coordinator
Dr. Sunil Patil
BOS in Chemistry

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

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

Preamble

1) Introduction

The B.Sc (Chemistry) program is meticulously structured to foster a deep understanding of chemical principles and their real-world applications. The curriculum is a blend of theoretical knowledge and hands-on experience, ensuring that students not only grasp the core concepts but also develop a passion for the subject. With a focus on continuous assessment through quizzes, class tests, and assignments, the program emphasizes the importance of a strong conceptual foundation. This approach is complemented by practical experiments, where theoretical knowledge is applied, enhancing the learning experience and preparing students to tackle the multifaceted challenges in the field of chemistry.

2) Aims and Objectives

The B.Sc (Chemistry) program is structured to equip students with a comprehensive understanding of chemical principles and their real-world applications. It aims to foster a deep appreciation for the subject, encouraging students to engage in critical thinking and problem-solving. By integrating theoretical knowledge with practical skills, the course prepares graduates for diverse careers in research, industry, education, and beyond, contributing to their holistic academic and professional growth.

3) Learning Outcomes

A strong foundation in the fundamental principles of Physical, Inorganic, organic, and Analytical chemistry is essential for a successful career in the sciences. Continuous learning and self-improvement are critical for staying current in the ever-evolving field of chemistry. A curiosity-driven approach to scientific inquiry fosters innovation and discovery. Identifying potential career paths in chemistry-related fields opens up a world of opportunities in diverse industries. Applying acquired skills to entry-level positions can lead to significant advancements in sectors like pharmaceuticals, materials science, and environmental science.

4) Any other point (if any)

The program is meticulously designed to lay a solid foundation in the subject, equipping students with essential skills and knowledge. Through a blend of theoretical understanding and practical application, the curriculum aims to fortify the students' grasp of the basics, ensuring they are well-prepared for advanced study or professional application in the field. This foundational strength is crucial for their academic and career progression, providing a robust platform from which they can build expertise and specialization.

T.Y.B.Sc. CHEMISTRY (6 UNITS)

Choice Based Credit System

To be implemented from the Academic year 2024-2025

SEMESTER V

PHYSICAL CHEMISTRY (USCH 501)

COURSE CODE: USCH501

CREDITS: 02

LECTURES: 60

UNIT	TOPIC	NO. OF LECTURES
UNIT-I	1.0 Molecular Spectroscopy	15 L
	1.1 Introduction Definition of Spectroscopy, Electromagnetic radiation, Inter-conversion of units, Electromagnetic Spectrum, Molecular energy levels, 1.2 Rotational Spectroscopy Dipole moment and Polarisation of bond, Permanent dipole moment and induced dipole moment. Definition and conditions of rotational spectra, Bond length of simple diatomic molecule (rigid rotor). Rotational spectrum of a diatomic molecule, Isotopic shift in rotational spectra, limitations of rotational spectra, applications of rotational spectra. (Numerical expected) 1.3 Vibrational Spectrum Definition and conditions of vibrational spectra, modes of vibrations, Hookes law, vibrational frequency, force constant, zero point energy, vibrational spectra of simple harmonic oscillator, vibrational spectra of simple unharmonic oscillator, hot band. Infrared spectra of simple molecules like H ₂ O and CO ₂ , Applications of vibrational spectroscopy. (Numerical expected) 1.4 Raman Spectroscopy Raman phenomenon, Raman shift, quantum theory of Raman effect, rule of mutual exclusion, comparative study of IR and Raman spectra, Applications of Raman spectroscopy. (Numerical expected on Raman Shift)	
UNIT-II	2.0 Chemical Thermodynamics	10 L
	2.1.1 Colligative Properties: Vapour pressure and relative lowering of vapour pressure, Measurement of lowering of vapour pressure- Static and Dynamic method. (Numerical Expected) 2.1.2 Solution of Solid in Liquid : 2.1.2.1 Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute. (Numerical Expected) 2.1.2.2 Depression in freezing point of a solution, thermodynamic derivation relating	

	<p>the depression in the freezing point of a solution and molar mass of the non-volatile solute, Rast Method. (Numerical expected)</p> <p>2.1.3 Osmotic Pressure: Introduction, thermodynamic derivation of Vant Hoff factor, Measurement of Osmotic Pressure – Berkeley and Hartley’s Method, Reverse Osmosis. (Numerical expected)</p>	
	2.2 Chemical Kinetics	5 L
	<p>2.2.1 Collision Theory of Reaction Rates: Molecular Activation and Energy of Activation, Application of collision theory w.r.t. Bimolecular reaction (derivation not expected), Collision theory w.r.t. Unimolecular reaction (Lindeman theory) (derivation expected), Demerits of collision theory.</p> <p>2.2.2 Classification of reaction as slow, fast and ultra-fast, Study of kinetics of fast reactions by Stop flow method and Flash photolysis. (derivation not expected)</p>	
UNIT-III	3.0 Nuclear Chemistry	15 L
	<p>3.1 Introduction: Radioactive substance, radioactivity, Types of nuclear radiations Basic terms-radioactive constants (decay constant, half-life and average life) and units of radioactivity.</p> <p>3.2 Detection and Measurement of Radioactivity: Detection and measurement of nuclear radiations using G.M. Counter and Scintillation Counter.</p> <p>3.3 Radioactive Equilibrium, difference between chemical equilibrium and radioactive equilibrium (Numerical expected)</p> <p>3.4 Application of use of radioisotopes as Tracers: Chemical reaction mechanism, age determination- dating by C^{14}.</p> <p>3.5 Nuclear Transmutation: Nuclear transmutation (one example for each projectile), artificial radioactivity, Q- value of nuclear reaction, threshold energy. (Numerical expected)</p> <p>3.5 Fission Process: Fissile and fertile material, chain reaction, factor controlling fission process, multiplication factor and critical size or mass of fissionable material, Nuclear reactor: Essential parts of nuclear reactor, power reactor</p> <p>3.6 Fusion Process : Thermonuclear reactions occurring on stellar bodies and earth</p>	
UNIT-IV	4.1 Surface Chemistry	6L
	4.1.1 Adsorption: Physical and Chemical Adsorption, types of adsorption isotherms, Langmuir’s adsorption isotherm (Postulates and derivations expected). B.E.T. equation for multilayer adsorption, (derivation not expected), Determination of surface area of an adsorbent using B.E.T. equation.	
	4.2 Colloidal State	9L
	<p>4.2.1 Introduction to colloids: Dispersed phase and dispersion medium, types of colloids</p> <p>4.2.2 Electrical Properties: Origin of charges on colloidal particles, Concept of electrical double layer, Zeta potential, Helmholtz and Stern model, Electro-kinetic phenomena – Electrophoresis, Electro-osmosis, Streaming potential, sedimentation</p>	

potential, Donnan Membrane Equilibrium.

4.2.3 Colloidal Electrolytes: Introduction, micelle formation

4.2.4 Surfactants: Classification and applications of surfactants in detergents and food industry.

Reference Books :

1. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
2. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford University Press Oxford.
3. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
4. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkata.
5. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition, John Wiley & Sons, Inc [part 1]
6. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
7. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint, 2006 Springer
8. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
9. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
10. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
11. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan, New Age International (P) Ltd., Publishers, 2011.
12. Chemical Kinetics, K. Laidler, Pearson Education India, 1987.
13. Modern Nuclear Chemistry Hardcover by Walter D. Loveland (Author), David J. Morrissey, Glenn T. Seaborg, Wiley.
14. A Textbook of Physical Chemistry - Dynamics of Chemical Reactions, Statistical Thermodynamics, Macromolecules and Irreversible Processes| Volume 5, 3rd Edition by K L Kapoor, McGraw Hill Education.

T.Y.B.Sc
Physical Chemistry Practical
SEMESTER V

COURSE CODE: USCHP01

CREDITS: 02

NON-INSTRUMENTAL EXPERIMENT

Colligative properties

1) To determine the molecular weight of compound by Rast Method.

Chemical Kinetic

2) To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant

Surface phenomena

3) To investigate the adsorption of acetic acid on activated charcoal and test the validity of Freundlich adsorption isotherm.

INSTRUMENTAL EXPERIMENT

Potentiometry

4) To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and ceric sulphate potentiometrically

Conductometry

5) To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method.

pH- metry

6) To determine acidic and basic dissociation constants of amino acid and hence to isoelectric point.

Reference books

1. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication
2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
3. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
4. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
5. Experimental Physical Chemistry By V.D.Athawale.
6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co.. 2011

T.Y.B.Sc. CHEMISTRY (6 UNITS)

Choice Based Credit System

To be implemented from the Academic year 2024-2025

SEMESTER VI

PHYSICAL CHEMISTRY (USCH 601)

COURSE CODE: USCH601

CREDITS: 02

LECTURES: 60

UNIT	TOPIC	NO. OF LECTURES
UNIT-I	1.1 Electrochemistry	7 L
	<p>1.1.1 Activity and Activity Coefficient: Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye Huckel limiting law (No derivation) (Numerical expected)</p> <p>1.1.2 Classifications of cells: Chemical cells and Concentration cells. Chemical cells, Electrode concentration cells, Liquid junction potential, Electrolyte concentration cells with and without transference</p>	
	1.2 Applied Electrochemistry	8 L
	<p>1.2.1 Polarization : Concentration polarization and its elimination</p> <p>1.2.2 Decomposition Potential and Overvoltage: Introduction, experimental determination of decomposition potential, Factors affecting decomposition potential.</p> <p>1.2.3 Over Voltage: Experimental determination of over-voltage. Hydrogen over voltage, Tafel's equation for hydrogen overvoltage. (Numerical expected)</p>	
UNIT-II	2.1 Polymers	10 L
	<p>2.1.1 Recapitulations: Basic terms of polymer</p> <p>2.1.2 Classification of polymer: Classification based on Source, Thermal response, physical properties</p> <p>2.1.3 Method of determination molar masses of polymer: by Ultra-Centrifuge method (limiting velocity method), Viscosity method using Ostwald Viscometer (derivation and numerical expected),</p> <p>2.1.4 Light Emitting Polymer: Introduction, Characteristics, Method of preparation and applications.</p> <p>2.1.5 Antioxidants and Stabilizer: Antioxidants, Ultraviolet stabilizers, Colorants, Antistatic agent.</p>	

	2.2 Phase Equilibria	5 L
	<p>2.2.1 Introduction: Gibbs Phase rule and terms involved it, condensed phase rule.</p> <p>2.2.2 Three component System- Introduction of three component system and explanation of phase diagram with example of</p> <p>Type I - Formation of one pair of partially miscible liquids.</p> <p>Type II- Formation of two pairs of partially miscible liquids</p> <p>Type III – Formation of three pairs of partially miscible liquids.</p>	
UNIT III	3.1 Basic of Quantum Chemistry	10 L
	<p>3.1.1. Classical mechanics: Introduction, limitation of classical mechanics, Black body radiation, photoelectric effect, Compton effect.</p> <p>3.1.2 Quantum mechanics: Introduction, Planck's theory of quantization, wave particle duality, de-Broglie's equation, Heisenberg's uncertainty principle. (Numerical expected)</p> <p>3.1.3 Progressive and standing waves – Introduction, boundary conditions, Schrodinger's time independent wave equation (No derivation expected), interpretation and properties of wave function.</p> <p>3.1.4 Quantum mechanics: State function and its significance, Concept of operators – definition, addition, subtraction and multiplication of operators, commutative and non-commutative operators, linear operator, Hamiltonian operators, Eigen function and Eigen value. (Numerical expected)</p>	
	3.2 Renewable Energy Resources	5 L
	<p>3.2.1 Renewable energy resources: Need of renewable energy resources</p> <p>3.2.2 Solar energy: Solar cells, Photovoltaic effect, Differences between conductors, semiconductors, insulators and its band gap, Semiconductors as solar energy converters, Silicon solar cell.</p> <p>3.2.3 Hydrogen: Fuel of the future, production of hydrogen by direct electrolysis of water, advantages of hydrogen as a universal energy medium.</p>	
UNIT-IV	4.1 NMR -Nuclear Magnetic Resonance Spectroscopy	8 L
	<p>4.1.1 Principle : Nuclear spin, magnetic moment, nuclear 'g' factor, energy levels, Larmor precession, Relaxation processes in NMR (spin-spin relaxation and spin- lattice relaxation)</p> <p>Instrumentation : NMR Spectrometer</p>	
	4.2 ESR-Electron Spin Resonance Spectroscopy	7 L
	<p>4.2.1. Principle: Fundamental equation, g-value- dimensionless constant or electron g – factor, hyperfine splitting.</p> <p>4.2.2 Instrumentation: ESR spectrometer, ESR spectrum of hydrogen and deuterium</p>	

References Books :

1. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint, 2006 Springer.
2. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
3. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkata.
4. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition, John Wiley & Sons, Inc [part 1]
5. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
6. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
7. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford University Press Oxford.
8. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
9. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal Publishing Company, 2008.
10. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
11. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.
12. S. Glasstone, Thermodynamics for Chemists, Affiliated East- West Press, New Delhi, 1964.
13. D. N. Bajpai, Advanced Physical Chemistry, S. Chand 1st Edn. 1992.
14. Quantum Chemistry Paperback by Donald A. McQuarrie.

T.Y. B. Sc. Physical Chemistry Practical

SEMESTER VI

PHYSICAL CHEMISTRY

COURSE CODE: USCHP02

CREDITS: 02

NON-INSTRUMENTAL EXPERIMENTS

Viscosity

1) To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement

Phase equilibria

2) To study phase diagram of three component system water- chloroform/ toluene- acetic acid by weight method.

INSTRUMENTAL EXPERIMENTS

Potentiometer

3) To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.

4) To determine the Solubility product and solubility of AgCl potentiometrically using chemical cell.

Conductometry

5) To titrate a mixture of weak acid and strong acid against strong base and estimate the amount of each acid in the mixture conductometrically.

Colorimetry

6) To estimate the amount of Fe (III) in the complex formation with salicylic acid by Static method.

Reference Books:

1. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication
2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
3. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
4. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
5. Experimental Physical Chemistry By V.D.Athawale.
6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co. 2011

Evaluation Pattern for Semesters V and VI

Semester End Theory Examination

Internal Continuous Assessment: 25% (25 Marks)	Semester End Examination: 75% (75 Marks)	Duration for End Semester Examination
Continuous Evaluation through: Quizzes, Class Tests, Presentations, Projects, Role Plays, Creative Writings, Assignments, etc.	As per following pattern	2 hrs 30 minutes

Pattern for Semester End Examination (75 Marks):

1. Duration - This examination shall be of **Two hours and 30 minutes** duration.
2. Theory question paper pattern:
 - a. There shall be **05** questions each of **15 marks**.
 - b. All questions shall be compulsory with internal choice within the questions.

Question	Option	Marks	Based on Units
Q.1	Subjective questions 3 out of 5	15	Unit I
Q.2	Subjective questions 3 out of 5	15	Unit II
Q.3	Subjective questions 3 out of 5	15	Unit III
Q.4	Subjective questions 3 out of 5	15	Unit IV
Q.5	A. True or False (Any Five out of Eight)	05	All Units
	B. Fill in the Blank with correct alternative. (MCQs with Four Options) (Any Five out of Eight)	05	
	C. Match the following (Any Five out of Eight)	05	
Total		75	--

Practical

1. Total Marks for Practical Examination per major component is 50 Marks.
2. Every student shall perform **one experiment** from each Major Component
3. Scheme of Examination:
 - a. Experiment : 40 Marks
 - b. Journal : 05 Marks
 - c. Viva-Voce : 05 Marks

Total : 50 Marks

Practical Book/Journal:

The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**Sign of the BOS
Coordinator
Dr. Sunil Patil
BOS in Chemistry**

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

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