

University of Mumbai



Revised Syllabus for

T.Y.B.Sc.

Applied Component (Heavy & Fine Chemicals)

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. Applied Component (Heavy & Fine Chemicals)
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
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Faculty of Science &
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Offg. Dean
Prof. Shivram S. Garje
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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

Building a robust foundation in Applied Component principles is indeed crucial for anyone aiming to excel in scientific disciplines. This solid grounding not only prepares one for the complexities of the field but also enhances adaptability to the dynamic nature of scientific research. As the field of chemistry continues to expand, professionals who embrace continuous learning and exhibit a strong sense of curiosity will likely be at the forefront of pioneering discoveries. Moreover, the versatility of chemistry as a discipline offers a plethora of career opportunities across various industries, ensuring that those with a passion for the subject can find their niche and contribute meaningfully to society.

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 Semester and Grading System

To be implemented from the Academic year 2024-25

Applied Component: Heavy & Fine Chemicals

SEMESTER V

Course Code: USACHFC501	Credits: 02	Lectures: 60
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Unit	Topic	No. of Lectures	Total No. of Lectures
I	1.1 Introduction to Heavy and Fine Chemicals 1.1.1 Introduction, commercial classification of chemicals, Classification of heavy and fine chemicals 1.1.2 The Fine Chemical Industry Fine Chemical/Custom Manufacturing Companies, Contract Research Organizations and Laboratory Chemical Suppliers. 1.1.3 The Heavy Chemical Industry- Organic and Inorganic chemicals	3	15
	1.2 Silicates: 1.2.1 Introduction to silicates 1.2.2 Properties, structure and types of silicates. Preparation of sodium silicate.	4	
	1.3 Manufacture and applications of the following: 1.3.1 Talcum powder 1.3.2 Nitric acid 1.3.3 Sodium dichromate 1.3.4 Chromium trioxide	8	
II	2.1 Pumps for chemical work: Introduction of pumps 2.1.1 Pumping equipment's for liquids: piston pump 2.1.2 Diaphragm pump 2.1.3 Gear pump 2.1.4. Screw pump 2.1.4 Rotary Vane pumps 2.1.5 Centrifugal pumps.	8	15
	2.2 Vacuum systems oil sealed pumps, ejectors.	3	
	2.3 Fertilizers: Preparation, properties and uses of- 2.3.1 Normal superphosphate 2.3.2 Triple Superphosphate 2.3.3 Ammonium nitrate	4	

		2.3.4 Ammonium Sulphate		
III	3.1	3.1 Brief idea about the economic aspects of chemical manufacturing processes with respect to - 3.1.1 Location 3.1.2 Raw materials 3.1.3 Energy 3.1.4 Capital 3.1.5 Manpower 3.1.6 Ecological aspects 3.1.7 Tax benefits. 3.1.8 Writing a Project Report for setting up MSME	7	15
	3.2	Brief account of perfumes, flavours and sweeteners: 3.2.1 Perfumes: Introduction, classification (ethers, esters and essential oils) Composition, formation, blending and applications. Synthesis of α and β - ionone's from citral. 3.2.2 Flavours: Introduction, Classification (natural and synthetic), applications of Vanillin, Coumarin (structures), Synthesis of Vanillin. 3.2.3 Sweeteners: Introduction, classification with examples and structures of :- Natural Sweeteners: Carbohydrates (Glucose, Fructose) Synthetic sweeteners: i) Sucralose, ii) Sulphonamide: Saccharin, iii) Peptides: Aspartame, Synthesis of Saccharin.	8	
IV	4.1	Industrial solvents: 4.1.1 Manufacture and uses of ethyl acetate, isopropyl alcohol, Acetone, Acetic acid, Dimethyl formamide, 4.1.2 Brief idea of green solvents.	6	15
	4.2	Introduction to drugs and drug intermediates : 4.2.1 Terminology, Classification with one example each. 4.2.2 Synthesis and uses of the following i) p-Acetyl amino benzenesulphonyl chloride from Aniline ii) Epichlorohydrine from propene iii) Ethambutol iv) Mebendazole v) Miconazole vi) Diazepam.	6	
	4.3	Fluoroaromatics: Introduction, important reagents used for fluorination, Halex reaction, Super Halex reaction, Preparation of ortho-fluorotoluene and 3-chloro-4-fluoro aniline.	3	

PRACTICALS

SEMESTER V

Course Code: USACHFC5P1	Credits: 02
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Preparation: (Micro scale)

1. Nerolin
2. Copper sulphate pentahydrate.
3. Green synthesis of benzillic acid from benzil

Estimations:

4. Determination of the amount of phosphoric acid from a given sample using 1-naphtholphthalein and phenolphthalein indicator. (Students to prepare succinic acid solution for standardization of NaOH).
5. Determination of the amount of magnesium hydroxide in a commercial sample of milk of magnesia.
6. Estimation of tincture iodine from commercial sample.
7. Estimation of methyl salicylate. (Back titration method).

SEMESTER VI

Course Code: USACHFC506	Credits: 02	Lectures: 60
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Unit	Topic		No. of Lectures	Total No. of Lectures
I	1.1	Refrigeration: System, media used for cold transfer (i.e. brine and other)	3	15
	1.2	Different Sources of Energy: Generation, Treatment of boiler feed water, Properties of steam, steam table	3	
	1.3	Glass: Composition, types and applications.	3	
	1.4	Manufacturing process properties and applications of : 1.4.1 Sulphuric acid (Contact Process) 1.4.2 Ammonia (Haber's process) 1.4.3 Sodium hydroxide	6	
II	2.1	Zeolites, Clays and Ion-exchange resins	3	15
	2.2	Design of vessel: Classification of chemical reactors, pressure vessels for internal or external pressure, Maintenance, storage vessels for liquids and gases.	4	
	2.3	Manufacture and uses of Industrial gases : Hydrogen and Acetylene	2	
	2.4	Industrial preparation of Inorganic Fine chemicals: KMnO ₄ , FeSO ₄ .7H ₂ O	2	

	2.5	Composite materials: Introduction, Constitution of composites, Classification of composites, Particle Reinforced composites, Fiber reinforced composites, Structural Composites or Layered composites, Applications of composite materials.	4	
III	3.1	Small Scale Industries, R & D and Technology transfer : Introduction- Industry Structure, Need and scope of small scale industry, SSI rules and regulations, R and D, technology transfer, Role of R and D, Functional structure of R and D unit, Research strategies and manufacturing interface, University-Industry interface, IPR- Patents, Trade Mark.	5	15
	3.2	Manufacture of soaps: Raw materials, Preparation, properties and types of soaps, Continuous process for the manufacture of soap.	3	
	3.3	Oils and Fats: Introduction, Classification, Properties of oils and fats, extraction of oils from oil seeds, hydraulic pressing and solvent extraction, extraction of animal fats, hardening of oils.	4	
	3.4	Detergents: Introduction, Classification, manufacture of DDBS, Industrial applications	3	
IV	4.1	Unit Operations: General idea of the following operations used in Industries: 4.1.1 Filtration: Introduction, factors affecting the rate of Filtration, Filtration processes- i) Plate and frame filter Press ii) Rotary Drum filter 4.1.2 Distillation: Introduction, Distillation methods i) Bubble cap column distillation ii) Fractional distillation 4.1.3 Crystallization : Introduction, Solubility, Super saturation, Nucleation, Crystal growth, Crystallization process- i) Agitated Tank Crystallizer, ii) Swenson Walker Crystallizer. 4.1.4 Centrifugation: Introduction, Centrifugation process used in Industry.	9	15
	4.2	Introduction to Dyes and dye intermediates: 4.2.1 Definition, types of dyes, properties. 4.2.2 Synthesis and uses of the following dye intermediates and dyes: i) Nitro derivatives of benzene and naphthalene ii) Indigo iii) Alizarin iv) Eriochrome Black-T v) Congo red	6	

PRACTICALS

SEMESTER VI

Course Code: USACHFC6P2

Credits: 02

The Regional Case-Study Project (30 Hrs.)

Introduction:

As per the guidelines from UGC, HEIs are expected to introduce a compulsory course to provide community engagement to all undergraduate students so that their appreciation of Social realities is holistic, respectful and inspiring. Such course will enable students to learn about rural/urban challenges and develop understanding of social wisdom and life-style in a respectful manner.

Objectives:

- To develop an appreciation of rural/urban culture, life style and wisdom amongst students.
- To understand a real life situation about a problem.
- To apply classroom knowledge of Chemistry courses to field realities and thereby improve quality of learning.
- To interact with key stakeholders such as government officials, people Representatives, common people etc.
- To communicate key findings of the study to stakeholders.

Learning Outcomes:

After completing course, students will be able to

- Gain an understanding of rural/urban life, culture and social realities
- Gain an understanding real-life problems
- Develop a sense of empathy and bonds of mutuality with local community
- Learn to value the local knowledge and wisdom of the community
- Identify opportunities for contributing to community's socio-economic improvement

Course Contents:

Part-I Theory of case study:

- Introduction to case study
- What is a case study?
- Types of case studies
- Planning a Case Study
- Researching a Case Study
- Strengths and Weaknesses of Case Studies
- Writing a Case Study
- References

Part II Case study Project (Field work)

Typical Key Areas for field-based project activities:

- **Environmental Problems:** For example estimation of PAH from soil/sewage samples, estimation of water pollution in nearby locality, estimation of the micro-plastics in Soil in the nearby locality, study of solid and liquid waste generation in a ward/city/village etc.

- **Analysis of food Material:** For example, identification and estimation of food adulterants, estimation of selenium content in bread available in the local market etc.
 - **Soil, Water, material analysis:** For example, examination and analysis water quality in nearby locality, study of materials and dyes used in a local industry, conduct soil health test (for analysis of Pb, N, P, K, S, C, moisture content, pH and micronutrient contents such as Cu, Zn, Mn, Fe) etc.
 - **Study of government development programs:** For example effects of Swachh Bharat Abhiyan on the quality of soil and water, to prepare a village sanitation plan, Energy use and fuel efficiency surveys etc.
 - **Agriculture:** For example, Organise orientation programmes for farmers regarding Organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants etc.
- (Above activities represent some of the possible activities that can be undertaken by Students. However, depending upon local needs students can select and undertake relevant Case-study projects. It is recommended that a practical batch of 20 students can undertake minimum 5-6 case-study projects i.e. one case-study project can be undertaken by group of maximum four students)

Case-Study Project Evaluation:

Project Report:

After successful completion of a case-study project, the student group will prepare a consolidated report covering title, Rational and gap analysis, objectives, hypothesis, project design and methodology, preliminary work/survey, expected out-come, benefits to society (Project outcome), SWOC analysis and important references etc.

Project presentation (by students Group):

The students group will present the case study project at the time of practical examination.

Evaluation scheme:

Evaluation of student based on Part -I	10 Marks
Identification of problem, Rational, Problem statement and expected benefits-	10Marks
Case-study design and methodology, Data management and interpretation, , clarity, coherence and appropriateness of case study design, Organisation and logical flow of ideas and materials	30 Marks
Presentation skills, role, responsibilities involvement of group members, learning mechanism in group, clear, concise and thoughtful responses to questions, team work	20 Marks

Major findings and outcome reported, Stakeholders feedback-	10 Marks
Industrial Visit – Detailed report- GMP/ETP/FDA/ISO/ /ENVIRONMENTAL QA, QC and TQM and R & D etc.	20 Marks

References:

1. C. D. Dryden: Outlines of Chemical Technology, edited & revised by M. Gopala Rao & Marshall Sittig East West Press, New Delhi.
2. Faith Keyes and Clerk's Industrial Chemicals, 4th Edn., Wiley Inter-science 1975.
3. Foust A. S. et-al.: Principles of Unit Operations John Wiley & Sons.
4. Macabe W.L., Smith J. C. and Harriott. P. Unit Operations of Chemical Engineering (7th edition) (McGraw Hill Chemical Engineering series).
5. P. H. Groggins: Unit Processes in Organic Synthesis, McGraw Hill.
6. Kirk & Othmer: Encyclopaedia of Chemical Technology, John Wiley and sons.
7. A. I. Vogel: Text book of Quantitative Analysis including Instrumental Analysis.
8. A. I. Vogel: Text book of Quantitative Organic Analysis.
9. Industrial Inorganic Chemistry-Buchner, Schliebs, Winter, translated by D. H. Tenell, VCH Publishers, New York.
10. Industrial Organic Chemistry- K. Welssermel, H. J. Arpe, VCH Publishers, New York.
11. B.Pearson- Speciality Chemical Innovations in Industrial Synthesis.
12. Text Book of Organic Medicinal and Pharmaceutical Chemistry Wilson & Giswold
13. Text Book of Pharmacology – Satoskar & Bhandarkar.
14. The Chemistry of Synthetic Dyes – Edited by K. Venkatraman. Academic press Inc. London.
15. Shreeves _Chemical Process Industries' 5th Edition, G. T. Oustin, McGraw Hill.
16. Industrial Chemistry- B. K. Sharma, Goyal publishing house, Mirut.
17. Riegel's Hand Book of Industrial Chemistry, 9th Edition, Jems A. Kent.
18. Industrial Chemistry- E Stoch, Vol- I, Ellis Horwood Ltd. UK.
19. An Introduction to Industrial Organic Chemistry- Wiseman and Peter, —ll

20. Unit Operations and Processes- P. H. Groggins.

21. Unit Operations I and II- P.P. Kale- Pune Vidyarthigruh Prakashan.

22. Unit Operations in Chemical Engineering by W. L. McCabe and Smith.

23. Riegel's Handbook of Industrial Chemistry, J. A. Kent, CBS Publishers, New Delhi

24. Riegel's Handbook of Industrial Chemistry, James A. Kent, 7th Edition,

Van Nostrand Reinhold Company.

25 Fine Chemicals, The Industry and The Business Second Edition Peter Pollak, PhD Reinach, Switzerland A John Wiley & Sons, Inc., Publication

26 Research and Development in The Chemical and Pharmaceutical Industry By Peter Bamfield, Third Completely Revised And Enlarged Edition, Publication WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 2006.

27 MSMEF

i) https://msme.gov.in/sites/default/files/MSME_Schemes_English_0.pdf

ii) <https://msme.gov.in/sites/default/files/Sch-vol1-151214.pdf-sri.pdf>

28 Patent & Trademark-

i) <https://www.ipindia.gov.in/manual-patents.htm>

ii) E- Handbook On Patent & Trade Mark Registration-
https://www.msmedithrissur.gov.in/assets/home/pdf/Patent_and_TM.pdf

iii) https://www.ipindia.gov.in/writereaddata/Portal/Images/pdf/Manual_for_Patent_Office_Practice_and_Procedure.pdf

iv) <https://www.ipindia.gov.in/resources.htm#Manuals>

29 other Suggested websites;

i) <https://nptel.ac.in/courses/103/106/103106108>

ii) <https://nptel.ac.in/courses/104/105/104105103/>

iii) [Commodity chemicals - Wikipedia](#)

iv) https://resources.perkinelmer.com/lab-solutions/resources/docs/WHP_Fine-and-Specialty-Chemicals-154169.pdf

Suggested Readings for Case study:

1. Abramson, P.R. (1992). A Case for Case Studies: An Immigrant's Journal. Newbury Park: Sage.

2. Bassey, M. (1999). Case Study Research in Educational Settings. Buckingham: Open University.

3. Campbell, D.T. & Stanley, J.C. (1966) Experimental and Quasi-experimental Designs for Research. Chicago: Rand McNally.

4. Kazdin, A. E. (1982). *Single-case Research Designs: Methods for Clinical and Applied Settings*. New York: Oxford Press.

5. Zaidah Zainal, Case study as a research method, *JurnalKemanusiaan bil.9*, (2007)

6. WALTER ISARD, *Methods of Regional Analysis: An Introduction to Regional Science*, THE M. I. T. PRESS, Cambridge, Massachusetts, (1960).

muquestionpapers.com

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 is 100 Marks.
2. Every student shall perform **two experiments** (If there are two major parts in the curriculum of applied component then assign one experiment from Component I for first session and another experiment from Component II for second session).
3. Each experiment shall carry 50 Marks.
4. 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.

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