SAVITRIBAI PHULE PUNE UNIVERSITY

(Formerly University of Pune)

Four Year B.Sc. Degree Program in Wine, Brewing and Alcohol Technology

(Faculty of Science and Technology)

Choice-Based Credit System Syllabus (2024 Pattern)

(As Per NEP 2020)

Second Year B.Sc. Sem. III and IV

To be implemented from Academic Year 2025-2026

Prepared by: B.O.S. MICROBIOLOGY, SPPU

Recommended by: Faculty of Science and Technology

Approved by: Academic Council, SPPU

(For Colleges Affiliated to Savitribai Phule Pune University, Pune)

Title of the Program: B.Sc. (Wine, Brewing and Alcohol Technology)

Preamble:

A preamble for a course in Wine, Brewing, and Alcohol Technology serves as an introduction that outlines the overarching objectives, goals, and the significance of the course. It sets the tone for the educational journey ahead, providing students with a clear understanding of what they can expect to gain from the program.

Introduction:

Welcome to the immersive and dynamic world of Wine, Brewing, and Alcohol Technology! This course is designed to be a captivating exploration into the art and science behind the production of wines, beers, and various alcoholic beverages. It aims to provide you with a comprehensive understanding of the entire spectrum of processes involved, from raw ingredients to the final, meticulously crafted libation.

Objectives to be achieved:

The primary objective of this course is to equip you with the knowledge and skills necessary to navigate the intricate realms of viticulture, brewing, and alcohol technology. Through a blend of theoretical insights and hands-on experiences, you will delve into the nuances of grape cultivation, fermentation, distillation, and the myriad techniques that transform humble ingredients into exquisite beverages.

Scope of the course:

In a world where the appreciation for fine wines, craft beers, and spirits is continuously evolving, this course offers a panoramic view of the industry. From the vineyards to the breweries and distilleries, you will explore the science, technology, and craftsmanship that contribute to the diversity and richness of alcoholic beverages.

Key Themes:

- **Viticulture:** Understanding grape varieties, cultivation practices, and the terroir effect on wine.
- **Brewing:** Exploring the alchemy of transforming grains, hops, and yeast into unique and flavorful beers.

- **Distillation:** Unraveling the intricacies of distillation processes for the creation of spirits and liquors.
- **Quality Control:** Developing skills in sensory evaluation, tasting, and ensuring consistency in production.
- **Sustainability:** Embracing eco-friendly practices in the production of alcoholic beverages.
- **Market Trends:** Analyzing consumer preferences, emerging trends, and the business aspects of the industry.

Embark on a journey where tradition meets innovation, science intertwines with artistry, and the world of Wine, Brewing, and Alcohol Technology unfolds before you. By the end of this course, you will not only possess a profound knowledge of the subject but also be prepared to contribute to and thrive in the dynamic landscape of the beverage industry.

Cheers to the exploration of flavors, aromas, and the boundless possibilities within the world of beverages!

This preamble aims to inspire students and convey the excitement and breadth of the course in Wine, Brewing, and Alcohol Technology.

Eligibility for Admission:

First Year B.Sc.:

Candidates applying for B.Sc. for wine technology should be H.S.C. in science disciplines OR 10 +2 years diploma course in Agriculture or Diploma in Fruit Processing and Wine Technology or Horticulture.

Admissions will be given as per the selection procedure / policies adopted by the respective college keeping in accordance with conditions laid down by the University of Pune.

Reservation and relaxation will be as per the Government rules.

Medium of Instruction: English

Program Outcomes (POs):

PO1. Apply scientific knowledge and principles of microbiology, biochemistry, and fermentation technology to the production and quality control of wine and other alcoholic beverages.

PO2. Demonstrate practical skills in handling laboratory and industrial equipment, microbial culturing, and fermentation monitoring to ensure safe, efficient, and hygienic alcohol production.

PO3. Analyze and interpret data related to raw material quality, fermentation parameters, and final product specifications using modern tools and techniques for informed decision-making in wine technology.

PO4. Understand and follow industry standards and environmental regulations, including sustainable practices and waste management in the wine and alcohol industries.

PO5. Communicate effectively in both technical and non-technical settings, work collaboratively in teams, and demonstrate ethical and professional behavior in academic and industrial environments.

Program Specific Outcomes (PSOs):

PSO1. Demonstrate comprehensive knowledge of microbiological and biochemical principles essential for understanding fermentation, microbial growth, and metabolic processes relevant to wine and alcoholic beverage production.

PSO2. Apply fermentation and biotechnological techniques in the production of wine, beer, and other alcoholic beverages, from raw material processing to product stabilization and packaging.

PSO3. Utilize laboratory techniques effectively in microbiology, biochemistry, and fermentation technology to analyze, control, and improve product quality and safety.

PSO4. Identify and manage industrially significant microorganisms such as yeast and bacteria involved in alcoholic fermentation and spoilage, using modern culturing and preservation methods.

PSO5. Operate, maintain, and calibrate equipment used in alcohol and wine production, ensuring adherence to industrial safety and hygiene protocols.

PSO6. Interpret and apply scientific principles to vineyard management, including grape cultivation, harvesting, soil and pest management, and seasonal vineyard practices.

PSO7. Develop and execute standard protocols for alcoholic beverage processing, including crushing, fermentation, clarification, maturation, and bottling.

PSO8. Understand the historical and cultural significance of Indian alcoholic beverages, incorporating traditional knowledge systems (IKS) into modern production contexts.

PSO9. Demonstrate skills in fruit processing and value addition, including experiments in blending, flavor enhancement, and preservation of fruit-based alcoholic and non-alcoholic products.

PSO10. Communicate effectively in both scientific and industrial settings, with the ability to document, report, and present data, adhering to regulatory and environmental standards in alcohol and wine production.

Board of Studies (BoS)
From 2023-24 to 27-28

Sr. No.	Name	Designation
1.	Dr. Pawar Sunil Trimbak	Chairman
2.	Dr. Pardesi Karishma Rajendra	Member
3.	Dr. Pabale Anupama Ashok	Member
4.	Dr. Wagh Pratima Pandit	Member
5.	Dr. Abhyankar Pragati Sunil	Member
6	Dr. Pathak Leena Pradeep	Member
7	Dr. Kulkarni Snehal V.	Member
8.	Dr. Kale Avinash Sudhakar	Member
9.	Dr. Shinde Shubhangi R.	Member
10.	Dr. Puranik Pravin R.	Member
11	Dr. Rajwade Jyotika Milind	Member
12.	Dr.Mali Gajanan Vishnu	Member
13	Dr. Shete Ashiwini Monish	Member
14	Dr. Patil Hemant jagatrao	Member

Semester/Level	Course Type	Course Code	Theory/Practical	Title/Course Name	Credits
SEM-I/4.5	Subject-1	WT-101 T	Theory	Basic Microbiology-I	2
	Subject-1	WT-102P	Practical	Laboratory techniques in Microbiology-I	2
	Subject-2	WT-103 T	Theory	Basic Biochemistry-I	2
	Subject-2	WT-104P	Practical	Laboratory techniques in Biochemistry-I	2
	Subject-3	WT-105 T	Theory	Basics of Wine technology-I	2
	Subject-3	WT-106P	Practical	Laboratory techniques in Wine technology-I	2
	Open Elective	OE-101 WT	Theory	Vine to wine	2
	Skill Enhancement Course	SECP-101 WT	Practical	Handling and maintenance of equipments in alcohol production	2
	Indian KnowledgeSystem	WT-101 IKS	Theory	Indian history of alcoholic beverages	2
	Abilityenhancementcourse	AEC-101-ENG	Theory	English	2
	Value educationCourse	VEC-101-ENV	Theory	Environmental Science	2
	Certificate course	CC-101-PE/NSS/NCC	-		
					Total (22)
SEM-II/4.5	Subject-1	WT-151 T	Theory	Basic Microbiology-II	2
	Subject-1	WT-152P	Practical	Laboratory techniques in Microbiology-II	2
	Subject-2	WT-153 T	Theory	Basic Biochemistry-II	2
	Subject-2	WT-154P	Practical	Laboratory techniques in Biochemistry-II	2
	Subject-3	WT-155 T	Theory	Basics of beer and alcohol technology-II	2
	Subject-3	WT-156P	Practical	Laboratory techniques of beer and alcohol technology	2

	Open Elective	**OEP-151 WT**	**Theory**	**Laboratory techniques in vine to wine**	**2**
	SkillEnhancementCourse	**SECP-151 WT**	**Practical**	**Experiments in fruit processing**	**2**
	Abilityenhancementcourse	**AEC-151-ENG**	**Theory**	**English**	**2**
	Value educationCourse	**VEC-151-ENV**	**Theory**	**Environmental Science**	**2**
	Certificate course	**CC-151-PE/NSS/NCC**	**-**	**-**	**2**
					Total (22)

Credit framework for First Year (UG)

Exit options, Award of credits, Evaluation pattern and ATKT rules are as per the SPPU

Semester/Level	Course Type	Course Code	Theory/Practical	Title/Course Name	Credits
SEM-III/5.0	Major Core	WT-201 MJ	Theory	Arts and Science of Wine	2
	Major Core	WT-202MJ	Theory	Basic of Fermentation Technology	2
	Major Core	WT-203 MJP	Practical	Laboratory techniques in Wine and Fermentation Technology	2
	Vocational Skill Course	WT-221 -VSC	Theory	Vineyard Management	2
	Field Project	WT- 231 – FP	Field Project		2
	Minor	WT- 241 MN	Theory	Yeast Culture Technology	2
	Minor	WT-242 MNP	Practical	Laboratory techniques in Yeast culture technology-I	2
	Open Elective	OE - 201 WT	Theory	Grains to beer	2
	Indian Knowledge System	IKS 201-WT	Theory	IKS major subject specific	2
	Ability Enhancement Course	AEC-201-WT	Theory	English	2
	Co-curricular Course/Minor	CC-201-PE/NSS/NCC		PE/NSS/NCC	2
					Total (22)
SEM-IV/5.0	Major Core	WT-251-MJ	Theory	Advances in Beer and Alcohol Technology	2
	Major Core	WT-252-MJ	Theory	Fermentation Technology	2
	Major Core	WT-253-MJP	Practical	Laboratory techniques in Beer, Alcohol, and Fermentation Technology	2
	Vocational Skill Course	WT-271 -VSC	Practical	Laboratory techniques in Vineyard Management	2
	Community E Programme	WT- 232 –CEP			2
	Minor	WT- 291 MN	Theory	Advances in Yeast Culture Technology	2
	Minor	WT-292-MNP	Practical	Laboratory techniques in Yeast Culture Technology-II	2
	Open Elective	OE – 251-WT	Practical	Laboratory techniques in Grains to Beer	2
	Skill Enhancement Course	SEC- 251-WT	Practical	Techniques in Horticulture	2
	Ability Enhancement Course	AEC-251-WT	Theory	English	2

	Co-curricular Course/Minor	**CC-251-PE/NSS/NCC**		**PE/NSS/NCC**	**2**
					Total (22)

Credit framework for Second Year (UG)

Exit options, Award of credits, Evaluation pattern and ATKT rules are as per the SPPU

External Students

There shall be no external students.

University Terms

Dates for the commencement and the conclusion of the first and second terms will be declared by the University authorities. Terms can be kept by only duly admitted students. The term shall be granted only on a minimum of 80 percent attendance at theory and practical courses and satisfactory performance during the term.

Current curriculum orientation

To accommodate more advanced topics in the syllabi, it is necessary to understand the basic science knowledge level of the students who have chosen the Wine, Brewing & Alcohol Technology discipline. Curricula of courses of state and central boards of higher secondary level were reviewed to avoid reiterations of previous syllabi.

Semester III
Major Core
WT-201-MJ Arts and Science of Wine

Total: 2 Credits Work-load: -15hrs/credit
(Total Workload: 2 credits × 15 hrs = 30 hrs in semester)

Course Objectives	
1	Understand the foundation principles and terminology of viticulture, including the classification and structure of grapevines and grape berries.
2	Gain knowledge of different white grape varieties and the chemical composition of grape juice relevant to wine production.
3	Acquire detailed knowledge of the production process of white wine, including pre-fermentation and post-fermentation operations.
4	Understand the importance of fermentation control, wine stabilization, filtration, bottling, and aging processes in white wine production.
5	Learn about cooperage in winemaking, including oak barrel selection, care, conditioning, and the impact of oak on wine flavor and aging.

	Course Outcomes (COs) On completion of the course, the students will be able to:
CO1	Define and explain key terminologies in viticulture, grapevine structure and functions, stages of grape berry development, and the impact of temperature on grape maturation.
CO2	Identify major white grape varieties and analyze the chemical composition of grape juice and perform grape berry sampling using standard methods.
CO3	Conduct basic chemical and sensory evaluations of grape berries to determine ripeness and suitability for winemaking.
CO4	Illustrate and describe the complete white wine production process, including harvesting, pre-fermentation treatments, fermentation, and post-fermentation practices.
CO5	Understand the role of cooperage in wine aging, differentiate between oak species used in barrel making, and describe the maintenance and conditioning of oak barrels used in wine production.

Credit no.	Unit/ topic details	No. of hours
I	**Unit I -Introduction to viticulture** 1.1.Viticulture – Terminologies of Viticulture, Classification of Grapevine 1.2 Grapevine: Structure and Function 1.3 Grape berry structure, berry development stages. 1.4. Effect of temperature on grape maturation. 1.4 Overview of White grape varieties. 1.5 Chemical composition of grape juice. 1.6 Grape berry sampling methods, chemical and sensory analysis of ripen Grape berry, importance of Grape berry sampling. 1.7 Concept of Vintage and its significance in wine production. 1.8 Mold associate with matured grapes	**15**
II	**Unit-II Production of white wine.** 2.1 Flow diagram of white wine production. 2.2. Prefermentation treatments of white wine –Harvesting, crushing & destemming , skin contact, pressing, grape juice adjustments, addition of active yeast, Fermentation process and Control of fermentation parameter. 2.3 Post-fermentation measures -Racking, clarification and stabilization, Blending, Barrel ageing /maturation, Filtration using filter aid, Bottling. **Unit –III Cooperage for wine making** 3.1 Oak and Cooperage. 3.2 Oak species and characteristics of oak. 3.3 Conditioning and care of oak barrel.	**15**

References -

1. Ribéreau-Gayon, P., Dubourdieu, D., Donèche, B., & Lonvaud, A. (2000). *Handbook of Enology: Volume I – The Microbiology of Wine and Vinifications*. John Wiley & Sons.
2. Jackson, R. S. (2000). *Wine Science: Principles, Practice, Perception* (2nd Ed.). Academic Press.
3. Zoecklein, B. W., Fugelsang, K. C., Gump, B. H., & Nury, F. S. (1999). *Wine Analysis and Production*. Springer Science Business Media.
4. Ough, C. S. (1992). *Winemaking Basics*. Springer.
5. Boulton, R. B., Singleton, V. L., Bisson, L. F., & Kunkee, R. E. (1996). *Principles and Practices of Winemaking*. Springer Science Business Media.
6. Iland, P., & Gago, P. (1997). *Australian Wine: From the Grape to the Glass*. Patrick Iland Wine Promotions.

Semester III
Major Core
WT-202-MJ Basics of Fermentation Technology

Total: 2 Credits Work-load: 15hrs/credit
(Total Workload: 2 credits × 15 hrs = 30 hrs in semester)

Course Objectives	
1	Understand the fundamental principles of fermenter construction and the design considerations involved in industrial-scale fermentation.
2	Analyze the operational parameters required to maintain aseptic conditions and optimal environmental control in bioreactors
3	Differentiate among various types of fermenters and select appropriate types based on process requirements.
4	Identify and evaluate the utility systems essential for fermentation operations, including sterilization, aeration, temperature control, and utility services.
5	Apply theoretical knowledge of fermentation technology to practical applications in bioprocessing and industrial biotechnology.

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Describe and explain the structural components of a fermenter, including body construction, aeration/agitation systems, and control devices.
CO2	Demonstrate an understanding of sterilization methods and aseptic handling in fermentation processes.
CO3	Compare and contrast different types of fermenters such as batch, fed-batch, continuous, and solid-state systems, along with their applications.
CO4	Explain the roles of various utility systems (e.g., boilers, compressors, chilling units, water treatment) in supporting fermentation operations
CO5	Apply knowledge of fermenter design and operation to troubleshoot and optimize bioprocesses.

Credit no.	Unit/ topic details	No. of hours
I	**Unit I: Types of fermenters** 1.1. Fermenter configuration. 1.2. Types of Fermenter: - Stirred tank fermenter, Tubular fermenter, Fluidized bed fermenter, Solid state fermenter, Hollow Fiber Reactors, Concept of Bioreactor.	15
	Unit II: Utilities required for fermentation 2.1. Boilers, Compressors, Cooling towers, Refrigeration and air Conditioning, Chilling plants. 2.2. Water treatment plants.	
II	**Unit III: Parts of fermenters** 3.1. Body construction and temperature control. 3.2. Aeration and agitation: Aerator (sparger), Agitator (Impellers, baffles) 3.3. Achievement and maintenance of aseptic conditions: sterilization of fermenter, sterilization of air supply, sterilization of exhaust gas, addition of inoculum, nutrients and other supplements, sampling, feed ports, sensor probes, foam control, monitoring and control of various parameters 3.4. Piping and Valves. 3.5. Factors affecting design 3.6. Fermenter operation modes: (Single, dual, multiple, batch, fed-batch, continuous)	15

References -

1. Patel, A. H. (2008). *Industrial Microbiology*. Macmillan India Ltd.
2. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2008). *Principles of Fermentation Technology* (2nd ed.). Elsevier.
3. Mansi, E. M. T. E., & Bryce, C. F. A. (Eds.). (2007). *Fermentation Microbiology and Biotechnology* (2nd ed.). CRC Press.
4. Srivastava, M. L. (Year unknown). *Fermentation Technology*. Narosa Publishing House.
5. Singh, B. D. (2007). *Biotechnology* (3rd ed.). Kalyani Publishers.
6. Casida, L. E. (1968). *Industrial Microbiology*. Wiley Eastern Limited.
7. Vogel, H. C., & Todaro, C. L. (1997). Fermentation and Biochemical Engineering Handbook (2nd ed.). Norwich, NY: William Andrew Publishing.

Semester III
Major Core
WT- 203-MJP Laboratory techniques in Wine and Fermentation Technology

(Total Workload: 2 credits × 30 hrs = 60 hrs in a semester)

Course Objectives	
1	To provide hands-on training in the preparation and formulation of culture media for microbial fermentation processes.
2	Gain hands-on experience in conducting microbial fermentation and analyzing fermentation products such as acids, gases, and alcohol.
3	To develop skills for analyzing physical and chemical parameters of fermentation substrates such as grape juice and wine.
4	To train students in analytical techniques for assessing fruit and grain quality relevant to fermentation.
5	Use analytical instruments such as refractometers and hydrometers for quantitative estimations in winemaking.

Course Outcomes (COs) **On completion of the course, the students will be able to:**	
CO1	Prepare and formulate appropriate culture media for fermentation and microbial growth.
CO2	Analyze sugar fermentation processes, identifying acid and gas production in different conditions.
CO3	Measure pH and total acidity in grape juice, wine, and other fermentation substrates using standard techniques.
CO4	Analyze total soluble solids in juices and wines using refractometry and hydrometry methods.
CO5	Perform quality assessment of barley including sampling, grading, protein estimation, and moisture content analysis.

1 Practical credit = 30 hours	**1 Practical = 4.00 hours**

Expt.No.	Title	No. of Practical
1	Preparation of synthetic (SDY) and crude media (YEPD) for fermentation process.	**1**
2	Sugar fermentation test.	**1**
3	Effect of salt and sugar concentration on bacterial growth	**2**
4	Determination of thermal death time of yeast/bacteria (TDT).	**1**
5	Determination the pH of grape juice, wine-red wine & white wine	**1**
6	Determination of total acidity of juice (grape or any fruit)	**1**
7	Determination of total soluble solids of grape juice/wine/must by refractometry	**1**
8	Determination of soluble solids of grape juice/wine/must by hydrometry	**1**
9	Determination of pH of grape juice/wine.	**1**
10	Determination of volatile acidity, fixed acidity and titratable acidity in wine	**2**
11	Determination of reducing sugar by Rebelein method	**1**
12	Visit to Vineyard/ Winery	**2**
	Total	**15**

References –

1. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2021). Brock biology of microorganisms (16th ed.). Pearson.
2. Cappuccino, J. G., & Welsh, C. (2020). Microbiology: A laboratory manual (12th ed.). Pearson.
3. Amerine, M. A., & Ough, C. S. (1980). Methods for analysis of musts and wines. John Wiley & Sons.
4. Fleet, G. H. (Ed.). (1993). Wine microbiology and biotechnology. CRC Press.
5. Zoecklein, B. W., Fugelsang, K. C., Gump, B. H., & Nury, F. S. (1995). Wine analysis and production. Springer Science & Business Media.
6. Prescott, L. M., Harley, J. P., & Klein, D. A. (2020). Microbiology (11th ed.). McGraw-Hill Education.

Semester -III
WT-221-VSC Vineyard management
Total: 2 Credits Workload: 15hrs/credit
(Total Workload: 2 credits × 15 hrs = 30 hrs in semester)

Course Objectives	
1	Understand the fundamentals of soil science and its relevance to grapevine health and productivity
2	To impart knowledge on the physical and chemical properties of soil, soil colloids, and their influence on nutrient availability.
3	Learn the processes and principles involved in vineyard establishment and grapevine plantation.
4	Apply key concepts of canopy management to optimize grapevine health and fruit quality.
5	To introduce various trellising systems and pruning practices and analyze their impact on canopy microclimate and grape maturity.

Course Outcome After studying this course students will be able to	
CO1	Classify different types of soils and evaluate their suitability for grapevine cultivation
CO2	Analyze soil properties such as texture, structure, and colloid content and explain their impact on nutrient availability
CO3	Assess climatic influences on grapevine growth and select appropriate grape varieties and rootstocks for specific regions.
CO4	Explain the principles of canopy management and evaluate various trellising and training systems.
CO5	Identify different stages of grape development and interpret changes in grape morphology and composition during ripening.

Credit	Unit/ topic details	Number of Hours
I	**Unit 1:Introduction to soil for quality grape production** 1.1The study of soil and its function; study of different soil in Maharashtra &India 1.2Principles of weathering of rocks and materials	**6**

	1.3Physical and chemical properties of soil 1.4Content of soil colloids and effect on nutrient availability	
	Unit 2: Study of vineyard establishment 2.1 History and origin of grape vines in India and world 2.2. Relationship of grapevine and climatic factors 2.3. Study of different wine grape varieties (clone) and root stock 2.4. Selection of grape(Wine grape)varieties for plantation 2.5 Method of plantation: Pit and Trenches 2.6 Care of young vine: Irrigation, Nutrients (fertilizers) 2.7 Weed control, giving shape and maintaining frame work of young grape vine	**9**
II	**Unit 3:Canopy management and nutrition of grapevine** 3.1 Definition and concept of canopy 3.2 Canopy microclimate: Canopy attenuation, solar radiation 3.3 To study training and pruning practices and its effect in canopy management 3.3 Study of different trellising system and its effect on grape maturity 3.4 Technique to be followed for canopy management 3.5 Description and composition of mature grape 3.6 Development stages of grape 3.7 Grape berry morphology 3.8 Changes in grape during maturation	**15**

References –

1. Nicholas, P., Magarey, P., & Wachtel, M. (1994). Diseases and pests.
2. Dry, P. R., & Coombe, B. G. (2004). Viticulture. Volume I: Resources.
3. Dry, P. R., & Coombe, B. G. (2004). Viticulture. Volume II: Practices.
4. Kent, J., & Early, R. (2007). Pesticide applications in vineyards. Land links Press.
5. White, R. E. (2003). Soils for fine wines. Oxford University Press.
6. Markides, A., & Gibson, R. (Eds.). (2000). Australian Society of Viticulture and Oenology: Technical review. ASVO.

Savitribai Phule Pune University (SPPU) Pune
S. Y. B. Sc. Wine, Brewing and Alcohol Technology
(Semester III/5.0)
WT- 231-FP FIELD PROJECT
(Total Workload: 2 credits × 30 hrs = 60 hrs in a semester)

Course Objectives	
1	To provide hands-on experience in real-world wine or alcohol production settings.
2	To understand the community and industry perspectives related to brewing, distillation, and alcohol regulation.
3	To enable students to apply theoretical knowledge to field-level challenges and opportunities.
4	To promote ethical, sustainable, and economically viable practices in alcohol technology.

Course Outcomes Upon completion of the course, students will be able to:	
CO 1	Students will be able to demonstrate an understanding of raw material selection, fermentation processes, and quality control methods used in wine, beer, and alcohol production industries.
CO 2	Students will apply microbiological, biochemical, and analytical techniques in solving practical problems during wine and alcohol production.
CO 3	Students will be able to design and conduct small-scale experiments or surveys related to fermentation, sensory evaluation, or raw material analysis.
CO 4	Students will demonstrate communication, reporting, teamwork, and professional ethics through participation in industrial training or collaborative fieldwork.

Component Details	
Total Workload	30 hours (Field visits, data collection, Project writing)
Field Work	Minimum 2 field visits or a single extended pr
Report Submission	Field Project Report (Mandatory)

Possible Field Areas:

- **Wine industry –** a) Fermentation and Microbiology
  b) Raw material analysis
  c) Product development
  d) Quality and Safety
  e) Bottling and ageing
  f) Sensory and QC

- **Brewing industry –** a) Raw material and malting
  b) Process Control
  c) Product innovation
  d) Sensory and QC
- **Distilled Alcohol industry –** a) Raw material utilization
  b) Fermentation and Distillation
  c) Quality Control
  d) Waste Management

Project Examples: [These are just for sample. Topics can be chosen depending up on local needs, gaps, infrastructural set up etc.]

- **Isolation of yeast and use for wine fermentation**
- **Grape maturity index and its effect on wine quality**
- **Quality analysis of barley and other raw materials for beer and alcohol production**
- **Effect of hop varieties on beer aroma and bitterness**
- **Detection of methanol and fusel oil**
- **Low sugar wine formulation for health conscious consumers**
- **Estimation of ethanol, acidity, total sugars and shelf life analysis**
- **Treatment of distillery spent wash**
- **Feasibility of biogas generation from distillery waste**

Teaching-Learning Methods:

- **Orientation lectures on project planning and safety.**
- **Field visits and guided sample collection.**
- **Data analysis workshops.**
- **Guidance sessions for report writing and presentation.**

Assessment Scheme:

Component	Marks
Field Participation	20%
Sample Collection and Lab Work	20%
Field Notes and Data Sheets	20%
Project Report (Written)	30%
Project Presentation	10%

(Oral/Poster)
Project Report Guidelines: • **Introduction (Problem statement, objectives)** • **Materials and Methods (Sample collection, techniques)** • **Results (Tables, figures)** • **Discussion (Interpretation, limitations)** • **Conclusion (Summary of findings)** • **References (At least 5 scientific references)**

Recommended Resources:

- "The Wine Microbiology" by Kenneth C. Fugelsang and Charles G. Edwards
  Covers: Yeast biology, malolactic fermentation, wine spoilage organisms
- OIV (International Organisation of Vine and Wine)
  Website: www.oiv.int
  Covers: International standards for wine analysis and practices
- "Brewing: Science and Practice" by Dennis Briggs et al.
  Covers: Raw materials, mashing, fermentation, beer styles, and packaging
- "The Alcohol Textbook: Alcohol Production" (5th Edition) by K. A. Jacques, T. P. Lyons, and D. R. Kelsall
  Covers: Industrial ethanol production, yeast strains, fermentation optimization
- BIS / FSSAI Standards for Alcoholic Beverages
  - Bureau of Indian Standards: https://www.bis.gov.in
  - FSSAI Regulations: https://www.fssai.gov.in
- "Brewing Yeast and Fermentation" by Boulton & Quain
  Covers: Yeast management and fermentation control in brewing
- Research articles related to Winery, Brewery and distilleries

Semester -III
WT - 241 MN: Yeast Culture technology

Total: 2 Credits Workload:15hrs/credit
(Total Workload: 2 credits × 15 hrs = 30 hrs in semester)

Course Objectives This course is designed for students from non-wine technology background	
1	Understand the morphology, cytology, and growth dynamics of various yeast strains, with a focus on Saccharomyces cerevisiae.
2	Explore the physiological and nutritional requirements for optimal yeast growth and reproduction in different media.
3	Analyze the industrial and commercial significance of yeast strains in wine fermentation and production.
4	Examine the microbial ecology of grapevines and the role of yeast in wine microbiology, including spoilage and preservation.
5	Evaluate the biochemical contributions of yeast through primary and secondary metabolite production and their screening methods.

Course Outcomes After studying this course students will be able to	
CO1	Describe morphological and cytological features of different yeast species, especially Saccharomyces cerevisiae.
CO2	Identify and apply appropriate methods for cultivating, maintaining, and preserving commercial yeast strains.
CO3	Differentiate various growth phases and types of yeast growth, and interpret their relevance in industrial processes.
CO4	Explain the microbial interactions and spoilage organisms associated with grapevines and wine fermentation.
CO5	Implement preventive measures during fermentation, curing, and storage to avoid microbial spoilage.

Credit	Unit/ topic details	Number of Hours
I	**Unit-1. Morphology, cytology and growth of yeast.** 1.1 Morphological features of different yeast strains. 1.2 Cytological feature of *S. cerevisiae*. 1.3 Nutritional requirement for yeast growth. 1.4 Commercial yeast culture –growth on solid media, liquid media. 1.5 Growth of yeast with growth phases. 1.6 Types of yeast growth- settling, flocculent and aggregate. 1.7 Importance of yeast strains in wine making. 1.8 Maintenance of yeast strains and preservation of strain characteristics. 1.9 Yeast autolysis.	**15**
II	**Unit 2: Wine Microbiology by Yeast** 2.1. Normal micro flora and pathogens of grapevine 2.2. Types of microbial spoilage of wine 2.3 Prevention of microbial spoilage of wine during fermentation 2.4 Curing and storage of wine 2.5. Primary, secondary and targeted screening of yeast strain. 2.6. Primary, secondary metabolites produced by yeast	**15**

References –

1. Casida LE. Industrial Microbiology. New Delhi: New Age International Publishers; 2005
2. Jackson, R. S. (2008). Wine Science: Principles and Applications (3rd ed.). Academic Press.
3. Patel AH. Industrial Microbiology. New Delhi: Macmillan Publication; 2008.
4. Stanbury PF, Whitaker A. Principles of Fermentation Technology. Oxford: Butterworth-Heinemann; 2008.
5. Singh BD. Biotechnology. New Delhi: New Age International; 2008.
6. Rose, A. H., & Harrison, J. S. (Eds.). (1991). The Yeasts: Yeast Cell Biology (Vol. 4). Academic Press.
7. Walker, G. M. (1998). Yeast Physiology and Biotechnology. John Wiley & Sons.

Semester III

WT-242 MNP: Laboratory techniques in Yeast Culture Technology-I

Total: 2 Credits Workload:30hrs/credit

(Total Workload: 2 credits × 30 hrs = 60 hrs in a semester) **1 Practical = 4.00 hours**

Course Objectives **This Course is designed to**	
1	Understand and apply various techniques for the preparation of nutrient media specific to microbial groups like yeast, lactic acid bacteria (LAB), and acetic acid bacteria (AAB).
2	Perform morphological identification of industrially significant microorganisms.
3	Isolate and identify wild yeast strains from natural substrates such as infected grapes or must.
4	Assess microbial response to environmental stresses including variations in pH, UV radiation exposure, and thermal death rate.
5	Develop an understanding of microbial resistance mechanisms against antifungal agents.

Course Outcome After studying this topic students will be able to.	
CO1	Prepare and differentiate nutrient media tailored for yeast, LAB, and AAB cultures.
CO2	Morphologically identify yeast and bacterial strains using microscopic and staining techniques.
CO3	Isolate wild yeast from natural substrates and characterize them through identification protocols.
CO4	Evaluate yeast metabolic activity such as hydrogen sulphide production and resistance to chemical agents like sulphur dioxide.
CO5	Measure microbial cell density accurately using turbidometry and interpret growth patterns.

Practical No.	Experiment Title	No. of Practicals
1	Preparation of Nutrient media for yeast, LAB & AAB	1
2	Morphological identification of yeast, LAB & AAB	3
3	Determination of cell density of yeast by McFarland method	1
4	Isolation of wild yeast from infected grapevine or must and its cultural and microscopic identification.	2
5	Determination of ability of yeast to form hydrogen sulphide	1
6	Determination of effect of $S0_2$ on yeast growth	1
7	Determination of antifungal sensitivity for yeast	1
8	Effect of pH on yeast growth.	1
9	Determination of the thermal death rate of the given organism (TDR).	1
10	Effect of U.V radiation on yeast.	1
11	Study of culture preservation methods.	2
	TOTAL	**15**

References:

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology And Biotechnology. New Age International, New Delhi, India
2. Smith H. and Brown A. (2023). Benson's Microbiological Applications, Laboratory Manual, 15th Edition. Mc Graw Hill.
3. Cappuccino J. G. and Welsh C. T. (2016). Microbiology: A Laboratory Manual. Pearson Education
4. Deshmukh A. M. (2007). Handbook of Media Stains Reagents Microbiology. Oxford Book Company
5. Garratt D. C. (2012). The Quantitative Analysis of Drugs: 3rd Edition. United Kingdom: Springer US

Semester III
OE-201- WT: Grains to beer
Open Elective

Total: 2 Credits Workload: 15hrs/credit
(Total Workload: 2 credits × 15 hrs = 30 hrs in semester)

Course Objectives This course is designed for students from non-wine technology background	
1	Provide historical context and technological development in the beer-making industry.
2	Develop understanding of the raw materials used in beer production, especially malted barley, water, hops, adjuncts, and yeast
3	Explain the biochemical and mechanical principles underlying key beer production processes such as milling, mashing, fermentation, and finishing.
4	Introduce students to the technical and quality aspects of beer production, including the use of equipment and process parameters.
5	Promote a systems-thinking approach by analyzing the full process flow diagram of beer manufacturing

Course Outcomes After studying this course students will be able to	
CO1	Describe the historical evolution and industrial advancements in beer making.
CO2	Identify and evaluate the role of various raw materials (malt, water, hops, yeast, adjuncts) in the brewing process.
CO3	Explain the steps involved in barley processing and malt production, including germination and kilning techniques.
CO4	Demonstrate understanding of key unit operations in brewing: milling, mashing, lautering, wort boiling, fermentation, and product recovery.
CO5	Assess the impact of process parameters on the final product's quality, including filtration, maturation, and storage conditions.

Credit	Unit/ topic details	Number of Hours
I	**Unit-1. History & Raw materials** 1.1-Historical background & development in Beer making 1.2- Barley (malt) processing & production of malt- controlled germination, Types of kiln & kilning process, types of malt. 1.3- Raw materials -Water, Grains, Hops, Adjuncts and Yeast 1.4- Process flow diagram.	**10**
II	**Unit-2. Sensory Evaluation of Beer** 2.1 Sensory evaluation and terminology 2.2 Types of beer –ale, lager, Pilsners, Stouts and Porters. 2.3 Basic taste of beer(bitterness, acidity, salt, sweetness and alcohol on tongue) 2.4 Human sensory organs and perception 2.5 Sensory Attributes of Beer – Appearance, Aroma, Mouth feel 2.6 Glassware Selection and Preparation for beer tasting. 2.7 Pouring Techniques of Beer. 2.8 Storage and Handling of Beer. 2.9 Types of sensory tests: discrimination, descriptive, hedonic 2.10 Common Off-Flavors and Defects in beer.	**20**

References –

1. Harnesey, T. S. (2003). A history of beer & brewing. Royal Society of Chemistry.
2. Deeds, S. (2013). Brewing engineering: Great beer through applied science. USA Publication.
3. Lewis, M. J., & Young, T. W. (2013). Brewing. Kluwer Academic/Plenum Publishers.
4. Palmer, J. J., & Kaminski, C. (2013). Water: A comprehensive guide for brewers. Brewers Publications.
5. White, C., & Zainasheff, J. (n.d.). Yeast: The practical guide to beer fermentation. Brewers Publications.
6. Mallett, J. (2014). Malt: A practical guide from field to brewhouse. Brewers Publications.
7. Hieronymus, S. (2012). Hops: The practical guide to aroma, bitterness, and the culture of hops. Brewers Publications.

8. Meilgaard M, Civille GV, Carr BT. Sensory Evaluation Techniques. 5th ed. CRC Press; 2015.

9. Meilgaard M, Dalgliesh CE, Clapperton JF. Beer Flavor Terminology. J Am Soc Brew Chem. 1979;37(1):47–52.
10. Bamforth CW. Flavor of Beer and Brewing. In: Sensory and Consumer Research in Food Product Design and Development. 2nd ed. Moskowitz HR, Beckley JH, Resurreccion AVA, eds. Wiley-Blackwell; 2012:439–453.
11. Jackson M. Michael Jackson's Beer Companion: The World's Great Beer Styles, Gastronomy, and Traditions. Running Press; 1993.
12. Lawless HT, Heymann H. Sensory Evaluation of Food: Principles and Practices. 2nd ed. Springer; 2010.
13. ASBC. Methods of Analysis, Beer-23: Flavor Stability. American Society of Brewing Chemists; 2011.

Savitribai Phule Pune University (SPPU), Pune
S. Y. B. Sc. Wine, brewing and alcohol technology Syllabus
(Semester III/5.0)
IKS 201-WT Indian Knowledge System and Wine, brewing and alcohol technology (2 credits)
(2 Credits: 60 working hours)

Course Objectives	
1	Understand the historical, cultural, and philosophical foundations of Indian Knowledge Systems (IKS) with respect to fermentation practices.
2	Explore and document traditional Indian fermented beverages, their preparation methods, and associated indigenous raw materials.
3	Analyze the scientific principles underlying traditional fermentation, distillation, and preservation methods used in ancient India.
4	To examine traditional fermentation vessels, environmental conditions, and monitoring techniques
5	To study traditional distillation, purification, and aging methods

Course Outcomes After studying this course students will able to	
CO 1	Explain the evolution and diversity of fermentation practices in ancient India based on Vedic, Ayurvedic, and regional texts.
CO 2	Identify and describe various traditional fermented beverages, raw materials, starter cultures, and indigenous fermentation vessels used in Indian communities.
CO 3	Evaluate the microbiological, nutritional, and environmental principles behind traditional Indian fermentation and distillation techniques.
CO 4	Demonstrate knowledge of traditional fermentation and distillation apparatus, environmental factors, and indigenous quality control methods.
CO 5	Describe and evaluate traditional distillation and storage practices

Credit	Title	Lectures
I	**1.Foundations of Indian Knowledge Systems in Fermentation** **1.1 Introduction to Indian Knowledge Systems** Definition and scope of Indian Knowledge Systems (IKS) Historical perspectives on fermentation in ancient India Vedic and Ayurvedic references to fermented beverages Regional diversity in traditional fermentation practices **1.2 Traditional Indian Fermented Beverages** **Soma and Sura**: Historical significance and preparation methods **Regional beverages**: Feni (Goa), Mahua (Tribal regions), Rice wine (Northeast) **Ayurvedic fermented preparations**: Arishta and Asava	15

	Domestic fermentation: Kanji, fermented rice preparations **1.3 Scientific Basis of Traditional Methods** Microbiological principles behind traditional practices Nutritional and therapeutic aspects of traditional fermented beverages Preservation techniques in ancient India	
II	**UNIT II: Traditional Knowledge Systems and Practices** **2.1: Indigenous Raw Materials and Selection (8 Hours)** **Grain Selection**: Traditional varieties of rice, millet, barley, and wheat **Fruit-based Materials**: Use of grapes, dates, coconut, and wild fruits **Floral Sources**: Mahua flowers, palm sap, and other botanical materials **2.2: Traditional Fermentation Sciences** **Indigenous Starter Cultures**: Preparation and maintenance of traditional yeasts **Fermentation Vessels**: Clay pots, wooden containers, and their significance **Environmental Factors**: Understanding of temperature, humidity, and timing **Natural Additives**: Use of herbs, spices, and plant extracts **Monitoring Techniques**: Traditional methods of assessing fermentation progress **2.3: Distillation and Processing Methods (8 Hours)** **Traditional Distillation Apparatus**: Design and operation of indigenous stills **Heat Sources and Control**: Use of biomass and temperature management **Purification Techniques**: Traditional filtering and clarification methods **Storage and Aging**: Traditional containers and maturation processes **Quality Control**: Indigenous methods of testing and standardization	15

Recommended Resources:

1. Capoor, K. (2017). Traditional Knowledge Systems in India. New Delhi: National Book Trust.
2. Achaya, K. T. (1994). Indian Food: A Historical Companion. Oxford University Press.
3. Ray, R. C., & Joshi, V. K. (Eds.). (2014). Fermented Foods: Past, Present and Future. CRC Press.
4. Singh, R. (2012). Traditional Fermentation Knowledge and Its Applications. ICAR-NBAIM.
5. Joseph, T. (2015). Tribal Ethnomedicine and Fermented Beverages. Deep Publications.
6. Recent journal articles on microbiological validation of traditional practices.

Semester IV
Major Core
WT-251 MJ- Advances in Beer and Alcohol Technology

Total: 2 Credits Workload: 15hrs/credit
(Total Workload: 2 credits × 15 hrs = 30 hrs in semester)

Course Objectives	
1	Understand the basic concepts, types, and industrial relevance of alcohol and alcoholic beverages
2	Learn the principles of starch processing, enzymatic reactions, and their applications in alcohol production.
3	Gain knowledge about raw materials used in brewing, including barley, malt, hops, adjuncts, and brewer's yeast.
4	Explore the biochemical and physical processes involved in fermentation and alcohol recovery.
5	Develop an appreciation of the historical, cultural, and economic significance of the global alcohol industry.

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Describe the classification, properties, and global significance of alcohol and alcoholic beverages.
CO2	Explain starch gelatinization and saccharification processes, and the role of enzymes in alcohol production.
CO3	Analyze factors affecting enzyme activity and apply calculations for alcohol yield and recovery.
CO4	Identify and evaluate brewing raw materials, including malt, hops, adjuncts, and yeast strains.
CO5	Illustrate the steps in malt and beer production and explain the functional role of each raw material.

Credit	Unit/ topic details	Number of Hours
I	**Unit 1 -Basic Concept in Alcohol technology :** 1.1. Introduction to Alcohol -Nomenclature, classification, Physical and chemical properties of Alcohol. 1.2. History and evolution of alcohol production. 1.3. Global alcohol industry overview and economic significance. 1.4. Types of alcoholic beverages and their characteristics. **Unit 2- Starch processing and role of Enzymes in distillery-** 2.1 Starch-Introduction to starch (types of starch molecules, structure), Gelatinization process, Saccharification process - Saccharification process with malt and Saccharification process by acids. 2.2 Enzyme Activity-Effect of temperature and pH on the activity of the enzyme. 2.3 Enzymes used in distilleries. 2.4 Calculation of efficiency and recovery in alcohol production.	**15**
II	**Unit I –Handling of Brewing Raw Material** 1.1 Barley- cultivation, growth, & climatic conditions, harvest and storage. 1.2-Barley (malt) processing & production of malt- controlled germination, kilning process. 1.3 Malt- Chemical composition of Malt, types of malt, Diastatic power in malt. 1.4-Hops (*Himulus lupulus*)-Cultivation, role in beer making, hop products. 1.5-Adjuncts -Types and role of Adjuncts. 1.6 Brewer's yeast - Different yeast strains used in brewing.	**15**

References:

1. Harnesey, T. S. (2003). A history of beer & brewing. Royal Society of Chemistry.
2. Deeds, S. (2013). Brewing engineering: Great beer through applied science. USA Publication.
3. Lewis, M. J., & Young, T. W. (2013). Brewing. Kluwer Academic/Plenum Publishers.
4. Palmer, J. J., & Kaminski, C. (2013). Water: A comprehensive guide for brewers. Brewers Publications.
5. White, C., & Zainasheff, J. (n.d.). Yeast: The practical guide to beer fermentation. Brewers Publications.
6. Mallett, J. (2014). Malt: A practical guide from field to brewhouse. Brewers Publications.

7. Hieronymus, S. (2012). Hops: The practical guide to aroma, bitterness, and the culture of hops. Brewers Publications.
8. Morrison, R. T., & Boyd, R. N. (2011). Organic Chemistry (7th ed.). Pearson Education..
9. Lea, A. G. H., & Piggott, J. R. (Eds.). (2003). Fermented Beverage Production (2nd ed.). Springer.
10. Bamforth, C. W. (2005). Food, Fermentation and Micro-organisms. Blackwell Publishing.For: Historical aspects and evolution of alcohol production.
11. OECD. (2014). Global Alcohol Market Trends and Impacts. Organisation for Economic Co-operation and Development.
12. Shukla, B. D., & Ghosh, T. K. (2010). Industrial Alcohol Technology: Production and Uses. IBDC Publishers

Semester IV
Major Core
WT-252 MJ- Fermentation Technology

Total: 2 Credits Workload:15hrs/credit
(Total Workload: 2 credits × 15 hrs = 30 hrs in semester)

Course Objectives	
1	Understand the principles and methods of media formulation, optimization, and sterilization for microbial fermentation.
2	Gain insight into the role and preparation of inoculums and their significance in the fermentation process.
3	Analyze the composition of fermentation media with an emphasis on grape juice and its suitability for wine production.
4	Learn and evaluate the critical process parameters that affect microbial fermentation and their measurement and control techniques.
5	Familiarize with various products of microbial fermentation including organic acids, amino acids, oriental fermented foods, and fruit-based alcoholic beverages.

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Design and optimize fermentation media including selection of appropriate carbon, nitrogen sources, vitamins, minerals, and buffering systems.
CO2	Evaluate the composition of grape juice for its efficiency as a fermentation medium in wine production.
CO3	Explain media sterilization methods and calculate parameters such as Decimal Reduction Time (D-value).
CO4	Apply techniques for measuring and controlling key process parameters in microbial fermentation.
CO5	Outline the production processes of various fermented products such as oriental foods, organic acids, amino acids, and fruit-based alcoholic beverages.

Credit no.	Unit/ topic details	No. of hours
I	**Unit-I: Process Optimization:** 1.1 Types of inoculum. 1.2 Media Formulation for Yeast - crude (YEPD)and synthetic media (SDA) 1.3 Composition of grape juice as fermentation medium with respect to: Source of 'C', 'N', Amino acids, vitamins, minerals, pH, water, Buffering Capacity etc. 1.4 Additives used in wine fermentation. 1.5 Media Sterilization principles - Different Methods, Decimal Reduction Time	**7**
	Unit-II: Process parameters and their importance: 2.1 Temperature, pH, agitation, foam, pressure, dissolved oxygen, effect of prolonged anaerobiosis , exhaust gas analysis (N2, CO, CO2), etc. 2.2 Yeast cell autolysis, Measurement and control of process parameters. 2.3 Computer applications in process controls.	**8**
II	**Unit-III: General outline of fermentation products** 3.1 Fermented foods- Idli and Pakhala Bhata. 3.2 Production of organic acids- citric acid and acetic acid. 3.3 Production of amino acids- Alanine and Aspartic acid. 3.4 Fruit based alcoholic beverages- Cider, Perry, Cherry wine, Kirsch, Pineapple wine and Mango wine.	**15**

References -

1. Patel, A. H. (2008). *Industrial Microbiology*. Macmillan India Ltd.
2. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2008). *Principles of Fermentation Technology* (2nd ed.). Elsevier.
3. Mansi, E. M. T. E., & Bryce, C. F. A. (Eds.). (2007). *Fermentation Microbiology and Biotechnology* (2nd ed.). CRC Press.
4. Srivastava, M. L. (Year unknown). *Fermentation Technology*. Narosa Publishing House.
5. Singh, B. D. (2007). *Biotechnology* (3rd ed.). Kalyani Publishers.
6. Casida, L. E. (1968). *Industrial Microbiology*. Wiley Eastern Limited.
7. Vogel, H. C., & Todaro, C. L. (1997). Fermentation and Biochemical Engineering Handbook (2nd ed.). Norwich, NY: William Andrew Publishing

Semester IV
Major Practical core
WT-253 MJP - Laboratory techniques in Beer, Alcohol and Fermentation Technology

(Total Workload: 2 credits × 30 hrs = 60 hrs in a semester) **1 Practical = 4.00 hours**

Course Objectives	
1	Understand the basics of microbial activity in alcoholic fermentation.
2	Gain practical skills in determining sugar concentration and specific gravity in molasses.
3	Learn techniques to estimate alcohol content and fermentation by-products.
4	Acquire analytical skills for assessing acids, fusel oils, and alcohol content in spirits.
5	Develop industrial insight through field visits to distilleries or breweries.

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Examine and interpret microbial presence in fermented wash using microscopy.
CO2	Measure °Brix and specific gravity to evaluate fermentation potential of molasses.
CO3	Estimate residual sugars, alcohol, and volatile acids in fermented molasses broth.
CO4	Determine alcohol content and acidity in spirits using hydrometer, pyknometer, and specific gravity methods.
CO5	Prepare and submit a report based on an industrial visit, demonstrating practical understanding of alcohol production.

1 Practical credit = 30 hours	**1 Practical = 4.00 hours**

Expt.No.	Title	No. of Practical's
1	Microscopic observation of alcoholic fermented wash	**1**
2	Determination of ^{0}Brix, specific gravity of the molasses.	**1**
3	Estimation of residual sugar in molasses fermented broth	**1**
4	Estimation of alcohol content in molasses fermented broth	**1**
5	Estimation of volatile acids in molasses fermented broth	**1**
6	Fusel oil determination in spirit sample.	**1**
7	Determination of total, fixed and volatile acidity rectified spirit	**2**
8	Determination alcohol content of given spirit by hydrometer method	**1**
9	Determination alcohol content of given spirit by Pyknometer method	**1**
10	Potassium permanganate test for the quality of spirit.	**1**
11	Visit to brewery and distillery (report)	**3**
	Total	**15**

References:

1. Vogel, A. I., & Furniss, B. S. (1996). Vogel's textbook of practical organic chemistry (5th ed.). Longman Scientific & Technical..
2. AOAC International. (2019). Official methods of analysis of AOAC International (21st ed.). AOAC International.
3. Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). Modern food microbiology (7th ed.). Springer Science+Business Media.
4. Prescott, L. M., Harley, J. P., & Klein, D. A. (2002). Microbiology (5th ed.). McGraw-Hill.
5. Barnett, J. A., Payne, R. W., & Yarrow, D. (2000). Yeasts: Characteristics and identification (3rd ed.). Cambridge University Press.
6. Amerine, M. A., & Ough, C. S. (1980). Methods for analysis of musts and wines. John Wiley & Sons.
7. Chakraverty, A., Mujumdar, A. S., Ramaswamy, H. S., & Hosahalli, R. (2003). Handbook of postharvest technology: Cereals, fruits, vegetables, tea, and spices. Marcel Dekker.

Semester -IV
WT -271-VSC: Laboratory techniques in Vineyard management

Total: 2 Credits Workload:15hrs/credit
(Total Workload: 2 credits × 30 hrs = 60 hrs in a semester) **1 Practical = 4.00 hours**

Course Objectives	
1	Understand the physical and chemical properties of vineyard soils.
2	Identify major grapevine varieties and recognize common vineyard weeds.
3	Learn the use and function of tools and equipment in vineyard operations.
4	Study the morphological and anatomical structures of grapevine and berries.
5	Understand viticultural practices including pruning, training, and diagnosis of diseases and deficiencies.

Course Outcome After Studying this course students will be able to	
CO1	Measure soil parameters like water holding capacity, temperature, pH, and test soil using kits.
CO2.	Identify and describe common grapevine varieties and vineyard weeds.
CO3	Operate basic vineyard equipment and perform pruning and training techniques.
CO4	Examine stem, berry, and leaf anatomy and recognize symptoms of diseases like Powdery and Downy mildew.
CO5	Prepare a report based on vineyard field visits, demonstrating understanding of vineyard management.

Expt No.	Topics	No. of Practicals
1	Determination of water holding capacity of the soil	1
2	Determination of temperature and pH of the soil	1
3	Study of different grapevine varieties	1
4	Determination of soil by using soil testing kit.	1
5	Study different equipment and their uses in Vineyard	1
6	Study the morphology of weeds occur in vineyard	1
7	Demonstration of training and pruning techniques in vineyard	1
8	Demonstration of nutrient deficiency in grapevine.	1
9	Study the stem anatomy of grape vine.	1
10	Study the morphology, anatomy and microscopic features of matured berry.	1
11	Study the morphological and anatomical structure of infected vine leaf by Powdery mildew and Downy mildew.	2
12	Field visit to Vineyard (Visit report)	3
	Total	**15**

References:

1. Nicholas, P., Magarey, P., & Wachtel, M. (1994). Diseases and pests.
2. Dry, P. R., & Coombe, B. G. (2004). Viticulture. Volume I: Resources.
3. Dry, P. R., & Coombe, B. G. (2004). Viticulture. Volume II: Practices.
4. Kent, J., & Early, R. (2007). Pesticide applications in vineyards. Land links Press.
5. White, R. E. (2003). Soils for fine wines. Oxford University Press.
6. Brady, N. C., & Weil, R. R. (2016). The Nature and Properties of Soils (15th ed.). Pearson.
7. Christensen, L. P. (Ed.). (2003). Raisin Production Manual. University of California Agriculture and Natural Resources.
8. Winkler, A. J., Cook, J. A., Kliewer, W. M., & Lider, L. A. (1974). General Viticulture. University of California Pre

Savitribai Phule Pune University (SPPU), Pune
S. Y. B. Sc. Wine, Brewing and Alcohol Technology Syllabus
(Semester IV/5.5)
WT- 232 -CEP – COMMUNITY ENGAGEMENT PROGRAM
2 credits [30 Hrs.] [Field activities + planning + reporting]

Course Objectives	
1	o expose students to real-world community practices in traditional and local alcohol production.
2	o engage communities in safe, sustainable, and legal practices in wine brewing and alcohol use.
3	instill social responsibility and ethical perspectives in students as future alcohol technologists.
4	support grassroots entrepreneurship and technology transfer to rural and semi-urban communities.
5	To bridge the gap between classroom learning and real-world community problems.

Course Outcomes Upon completion of the course, students will be able to:	
CO 1	Understand community perceptions, practices, and challenges related to alcohol production. Develop small-scale, sustainable brewing models suitable for local deployment.
CO 2	Communicate scientific brewing methods in an accessible way to community members.
CO 3	Promote responsible alcohol use and public health awareness in rural communities.
CO 4	Collaborate effectively with local stakeholders to co-create knowledge and solutions.

ComponentDetails
Core Components: **1. Orientation & Planning (6 hours)** Importance of science outreach and WBAT in community health. Training in communication skills, ethics, and safety. Team formation and selection of target community/topic. **2.Community Engagement Activities (12–15 hours)**

Objective: Promote moderate and responsible drinking habits

Activities:

Awareness rallies and seminars in villages/towns
Distribution of pamphlets in local languages on effects of excessive alcohol
Invite doctors or counselors to talk about alcohol misuse
Promote legal drinking age awareness

Demonstrations (using posters, models, videos, or hands-on activities).
Distribution of pamphlets/info graphics created by students.
Interaction with schools, self-help groups, farmers, or healthcare workers.

Documentation & Reflection (6–8 hours)

Maintain logbooks or field diaries.
Collect community feedback and summarize outcomes.
Final group report submission.
Oral/poster presentation of experiences and impact.

Evaluation Scheme:

Component	Marks
Participation and Attendance	20
Community Interaction Quality	20
Educational Material Developed	20
Report and Presentation	30
Reflection and Teamwork	10
Total	100

Suggested sample Community Topics:

Legal Drinking Age in India: State-wise Variations – Educate on the minimum legal drinking age in different states.
Penalties for Underage Drinking and Drunk Driving – Explain the consequences under the Motor Vehicles Act and Excise Act.
About Responsible Drinking – Promote moderation, social etiquette, and health impact awareness.
Public Drinking: What the Law Says – Explain restrictions on drinking in public spaces and penalties.
Awareness on Drunken Driving and Road Safety – Legal blood alcohol limits and implications of violations.

Advertising and Promotion Restrictions – Laws regarding alcohol advertisements and surrogate marketing. Excise License Requirements for Wine, Beer, and Liquor Production – Discuss types of licenses: manufacturer, wholesale, retail. Difference between Legal and Illicit Alcohol Production – Highlight legal compliance, health risks of spurious liquor.
Teaching Methods: Brief lectures on outreach and science communication Group mentoring and progress checks Field visits and direct community interaction Use of vernacular language for communication is encouraged
Activity Outcomes [Fieldwork Report Components] (per group of 2 – 3 students / pair) Activity plan + photos Public awareness materials (pamphlets/posters) Community feedback (optional) Final group report + presentation

Recommended Resources:

1. Government of India. (Various years). State Excise Policies. State Excise Departments Websites (e.g., Maharashtra, Karnataka, and Goa).
2. Food Safety and Standards Authority of India (FSSAI). (2021). Food Safety and Standards (Alcoholic Beverages) Regulations.
3. Bureau of Indian Standards (BIS). (2020). Indian Standards for Alcoholic Beverages.
4. Central Pollution Control Board (CPCB). (2016). Guidelines for Waste Management in Distillery Industries.
5. Ministry of Environment, Forest and Climate Change (MoEFCC). (2006). EIA Notification and Amendments.
6. National Crime Records Bureau (NCRB). (2022). Reports on Road Accidents and Alcohol-Related Offenses.
7. World Health Organization (WHO). (2018). Global Status Report on Alcohol and Health.
8. Indian Council of Medical Research (ICMR). (2019). Alcohol Consumption and Public Health in India.
9. National Institute of Public Cooperation and Child Development (NIPCCD). Reports on Community Health and Substance Abuse.
10. Excise Manual for Licensing and Regulation of Distilleries, Breweries and Wineries – State Excise Departments.
11. CREP Guidelines. (2003). Charter on Corporate Responsibility for Environmental Protection. Ministry of Environment and Forests, Government of India.

12. UNDP India. (2015). Reports on Local Governance and Community Participation in Rural Development.
13. Legal texts such as the Indian Penal Code (IPC), Motor Vehicles Act, and Prohibition Acts (state-specific).

Semester -IV
WT -291-MN: Advances in Yeast Culture Technology

Total: 2 Credits Workload: 15hrs/credit
(Total Workload: 2 credits × 15 hrs = 30 hrs in semester)

Course Objectives	
1	To understand the techniques for yeast culture preparation, maintenance, and inoculum development.
2	To study sugar and nitrogen metabolism during alcoholic fermentation by yeast.
3	To analyze environmental and biological factors affecting yeast fermentation, including temperature and anaerobiosis.
4	To explore the role of yeast in wine fermentation, aroma development, and varietal characteristics.
5	To recognize and manage fermentation issues like phage contamination, killer factors, and stuck/sluggish fermentation.

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Demonstrate yeast culturing techniques including starter preparation, maintenance, and inoculum development.
CO2	Explain yeast metabolism of sugars and nitrogen, and its effect on fermentation dynamics.
CO3	Evaluate the impact of temperature, oxygen levels, and killer factors on yeast activity during fermentation.
CO4	Describe the roles of various yeast strains in wine production and their contribution to flavor and aroma.
CO5	Identify fermentation problems such as phage attack, acetic acid formation, and stuck fermentations, and suggest remedies.

Credit no.	Unit/ topic details	No. of hours
I	**Unit 1 – Yeast Culturing** 1.1 Preparation of starter culture. 1.2 Maintenance of yeast culture 1.3 Inoculum preparation 1.4 Phage contamination of yeast cultures. **Unit-2. The metabolism of sugars and nitrogen by yeast**. 2.1 The alcoholic fermentation. 2.2 Glucophilic and fructophilic yeast. 2.3 Effect of temperature on growth of yeast and wine fermentation. 2.4 Use of nitrogen compound and synthesis of amino acids. 2.5 Controlling degree of anaerobiosis during alcoholic fermentation 2.6 Killer factors in fermentation.	**6** **9**
II	**Unit-3 Role of Yeast in wine** 3.1 Life Cycle 3.2 Techniques applicable to yeast strain development 3.3 Baker's yeast 3.4 Brewer's yeast 3.5 Types of growth of yeast in wine. 3.6 Role of yeast in grape flavor development. 3.7 Aromatic substances and their transformation by yeasts. 3.8 Significance of yeast and bacterial enzymes in varietal characteristics of wine. 3.9 Sluggish and stuck fermentation. 3.10 Production of acetic acid by yeast during wine fermentation.	**15**

References:

1. Prescott, L. M., Harley, J. P., & Klein, D. A. (2005). Microbiology (6th ed.). McGraw-Hill.
2. Boulton, R., Singleton, V. L., Bisson, L. F., & Kunkee, R. E. (1999). Principles and practices of winemaking. Springer.

3. Ribéreau-Gayon, P., Dubourdieu, D., Donèche, B., & Lonvaud, A. (2006). Handbook of enology, volume 1: The microbiology of wine and vinifications (2nd ed.). John Wiley & Sons.
4. Rose, A. H., & Harrison, J. S. (1987). The yeasts: Volume 2. Yeast physiology and biotechnology. Academic Press.
5. Fleet, G. H. (2003). Yeast interactions and wine flavor. International Journal of Food Microbiology, 86(1–2), 11–22.
6. Barnett, J. A., Payne, R. W., & Yarrow, D. (2000). Yeasts: Characteristics and identification (3rd ed.). Cambridge University Press.
7. Casida LE. Industrial Microbiology. New Delhi: New Age International Publishers; 2005
8. Jackson, R. S. (2008). Wine Science: Principles and Applications (3rd ed.). Academic Press.
9. Patel AH. Industrial Microbiology. New Delhi: Macmillan Publication; 2008.

Semester IV

WT-292 MNP Laboratory techniques in yeast culture technology-II

Total: 2 Credits Workload: 30hrs/credit

(Total Workload: 2 credits × 30 hrs = 60 hrs in semester)**1 Practical = 4.00 hours**

Course Objectives	
1	Learn and apply staining, culturing, and microscopic techniques in yeast biology.
2	Evaluate the effect of ethanol and other environmental factors on yeast and microbial populations.
3	Quantify yeast growth using direct and indirect methods.
4	Develop practical skills in handling fermenting samples and preparing inoculum.
5	Assess yeast metabolic activity, including acid and sugar fermentation capabilities.

Course Outcome After studying this course students will be able to	
CO1	Evaluate how ethanol affects the microbial flora of the skin and understand implications for hygiene and fermentation environments.
CO2	Demonstrate the ability to distinguish live and dead yeast cells using vital staining techniques.
CO3	Isolate and identify indigenous microbial populations associated with grape berries and leaves.
CO4	Conduct direct cell counts to assess yeast biomass in fermentation samples.
CO5	Compare the fermentation profiles of yeast and bacteria on various sugars and interpret gas and acid production results.

Expt. no.	Title	No. of Practicals
1	Effect of ethanol on skin microflora.	**1**
2	Vital staining of yeast.	**1**
3	Study growth characteristic of yeast on solid and liquid media.	**1**
4	Inoculum development of yeast and determination of exponential phase of growth	**2**
5	Microscopic observation of yeast during all stages of wine production	**1**
6	Determination of viable count of yeast from fermenting wine sample by Neubauer's chamber	**1**
7	Preparation of slide culture technique.	**1**
8	Study of normal flora of grape berry and leaf.	2
9	Measurement of growth of wine yeast on media (Direct cell count)	1
10	Study the effect of alcohol concentration on yeast growth	1
11	Determination of ability to produce acetic acid by yeast.	1
12	Sugar fermentation test (glucose, fructose & sucrose) for yeast.	2
	Total	**15**

References:

1. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2022). Brock Biology of Microorganisms (16th ed.). Pearson.
2. Atlas, R. M. (2010). Handbook of Microbiological Media (4th ed.). CRC Press.
3. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of Fermentation Technology (3rd ed.). Elsevier.
4. Campbell, M. K., & Farrell, S. O. (2018). Biochemistry (9th ed.). Cengage.
5. Rose, A. H., & Harrison, J. S. (Eds.). (1991). The Yeasts: Physiology and Biotechnology. Academic Press.
6. Collins, C. H., & Lyne, P. M. (2004). Microbiological Methods (8th ed.). Butterworth-Heinemann.
7. Fleet, G. H. (2003). Yeasts in winemaking. In Wine Microbiology and Biotechnology.

Semester IV

OE-251 WT - Laboratory techniques in Grains to beer

Total: 2 Credits Workload:30hrs/credit

(Total Workload: 2 credits × 30 hrs = 60 hrs in semester)**1 Practical = 4.00 hours**

Course Objectives	
1	Understand basic taste thresholds (sweet, acid, bitter) and their interactions.
2	Develop sensory evaluation skills for beer using standardized methods.
3	Learn to identify aroma profiles and off-flavors in beer.
4	Gain knowledge of glassware types and their importance in sensory assessment.
5	Understand the sampling and physical testing of raw materials like barley and malt.

Course Outcome After studying this course students will be able to	
CO1	Detect and evaluate thresholds of sweet, acid, and bitter tastes.
CO2	Analyze taste interactions in multi-component solutions (sweet, acid, bitter).
CO3	Identify beer aroma characteristics using the beer aroma wheel.
CO4	Conduct sensory evaluation of beer and recognize off odors.
CO5	Perform sampling and physical quality tests of barley and malt used in brewing.

Expt. no.	Title	No. of Practicals
1	Study threshold detection of sweet taste.	**1**
2	Study threshold detection of acid taste.	**1**
3	Study threshold detection of Bitter taste.	**1**
4	Interaction of sweet and acid taste	**1**
5	Interaction of sweet, acid and bitter taste.	**1**
6	Study of aroma wheel of beer.	**1**
7	Determination of Types of glasses.	**1**
8	Sensory evaluation of beer.	**1**
9	Identification of off odors in beer.	**1**
10	Sampling of barley.	**2**
11	Physical tests of malt.	**1**
12	Visit to brewery and submission of the report	**3**
	Total	**15**

References :

1. Lawless, H. T., & Heymann, H. (2010). *Sensory evaluation of food: Principles and practices* (2nd ed.). Springer.
2. Meilgaard, M. C., Civille, G. V., & Carr, B. T. (2016). *Sensory evaluation techniques* (5th ed.). CRC Press.
3. Bamforth, C. W. (2003). *Beer: Tap into the art and science of brewing* (2nd ed.). Oxford University Press.
4. Jackson, R. S. (2009). *Wine tasting: A professional handbook* (2nd ed.). Academic Press.
5. European Brewery Convention (EBC). (1998). *Analytica-EBC*. Fachverlag Hans Carl.
6. Briggs, D. E., Hough, J. S., Stevens, R., & Young, T. W. (2004). *Malting and brewing science: Volume 1 – Malt and sweet wort* (2nd ed.). Springer.
7. American Society of Brewing Chemists (ASBC). (2011). *Methods of analysis*. ASBC

Semester IV

SEC-251 WT - Techniques in Horticulture

Total: 2 Credits Workload: 30hrs/credit

(Total Workload: 2 credits × 30 hrs = 60 hrs in semester)**1 Practical = 4.00 hours**

Course Objectives	
1	To introduce basic garden tools and their uses in horticultural operations.
2	To impart knowledge of horticultural crops and propagation methods.
3	To provide hands-on training in nursery bed preparation and vegetative propagation.
4	To teach pruning, training, and potting practices for fruit and ornamental plants.
5	To expose students to field practices through visits to nurseries, vineyards, and orchards.

Course Outcome After studying this course students will be able to	
CO1	Identify and handle common garden tools and horticultural crops.
CO2	Prepare nursery beds and demonstrate various propagation techniques like cutting, layering, grafting, and budding.
CO3	Apply propagation through specialized vegetative structures effectively.
CO4	Perform pruning, training, potting, and fertilizer application in horticultural settings.
CO5	Prepare field visit reports and describe real-world nursery and vineyard operations.

Expt. no.	Title	No. of Practicals
1	Study of Garden Tools	**1**
2	Study of Horticultural crops	**1**
3	Preparation of Seed bed/Nursery bed	**1**
4	Study on propagation by Cuttings	**1**
5	Study on propagation by Layering	**1**
6	Study on propagation by Grafting	**1**
7	Study on propagation by Budding	**1**
8	Propagation through specialized Vegetative structures	**1**
9	Training and pruning of fruit plants	**1**
10	Preparation of potting mixture	**1**
11	Chemical and biological Fertilizer application in vineyard.	**2**
12	Visit to commercial nurseries/orchard / vineyard.	**3**
	Total	**15**

References:

1. Adams, C. R., Bamford, K. M., & Early, M. P. (2013). *Principles of horticulture* (5th ed.). Routledge.
2. Hartmann, H. T., Kester, D. E., Davies, F. T., & Geneve, R. L. (2011). *Plant propagation: Principles and practices* (8th ed.). Prentice Hall.
3. Bose, T. K., Mitra, S. K., & Sadhu, M. K. (1991). *Propagation of tropical and subtropical horticultural crops*. Naya Prokash.
4. Singh, J. (2005). *Basic horticulture*. Kalyani Publishers.
5. Sharma, R. R. (2002). *Fertigation in fruit crops*. International Book Distributing Co.
6. Chadha, K. L. (Ed.). (2001). *Handbook of horticulture* (2nd ed.). Indian Council of Agricultural Research (ICAR).
7. Indian Council of Agricultural Research. (2016). *Practical manual: Fundamentals of horticulture*.