

सावित्रीबाई फुले पुणे विद्यापीठ
SAVITRIBAI PHULE PUNE UNIVERSITY

(Formerly University of Pune)

NATIONAL EDUCATION POLICY (NEP) – 2020
COMPLIANT CURRICULUM

SYLLABUS BOOKLET

DOUBLE MINOR COURSE IN

FOOD, WINE & DAIRY TECHNOLOGY

Under the

BOARD OF STUDIES, BIOTECHNOLOGY (ENGINEERING)

With effect from

ACADEMIC YEAR 2026-27



- BUILD FOUNDATIONS IN FOOD, WINE & DAIRY
- EXPLORE INDUSTRY RELEVANT TECHNOLOGIES
- DEVELOP PRACTICAL SKILLS
- CONTRIBUTE TO A SUSTAINABLE FUTURE

BOARD OF STUDIES, BIOTECHNOLOGY (ENGINEERING)
FACULTY OF SCIENCE & TECHNOLOGY
SAVITRIBAI PHULE PUNE UNIVERSITY

Pune – 411007, Maharashtra, India
www.unipune.ac.in

Double Minor Course Proposed by the Biotechnology Board of Studies in B. Tech BIOTECHNOLOGY (UG – NEP Course)

Under

Savitribai Phule Pune University

DOUBLE MINOR IN FOOD, WINE & DAIRY TECHNOLOGY

Sr. No.	Course Code	Semester	Name of the course	Credits		
				Theory	Practical	Total
1.	D-FWD-301-BIO	Sem-V	Biology for Engineers	3	1	4
2.	D-FWD-351-BIO	Sem-VI	Food Technology	3	1	4
3.	D-FWD-401-BIO	Sem-VII	Wine Processing & Technology	3	1	4
4.	D-FWD-451-BIO	Sem-VIII	Dairy Science & Technology	3	1	4
5.	D-FWD-453-BIO	Sem-VIII	Minor Project		2	2
			Total	**12**	**6**	**18**

Offered to:

1. Instrumentation Engineering
2. Mechanical and Automobile Engineering
3. Mechatronics
4. Petroleum Engineering
5. Production and Industrial Engineering
6. Information Technology
7. Computer Engineering / Computer Science Engg
8. Electrical Engineering
9. Electronics and Telecommunication Engineering
10. Chemical & Petroleum Engineering
11. Robotics and Automation
12. Cyber Security
13. Artificial Intelligence and Machine Learning
14. Artificial Intelligence and Data Science
15. Biotechnology

Savitribai Phule Pune University
Double Minor Course (2024 Pattern)
NEP 2020 Compliant Curriculum Structure

Double Minor in Food, Wine & Dairy Technology

Course Code	Type of Course	Course Title	Teaching Scheme			Examination Scheme						Credit			
			L	T	P	CCE	ESE	TW	PR	OR	Total	L	T	P	Total
Semester - V															
D-FWD-301-BIO	Double Minor	Biology for Engineers	3			30	70				100	3			3
D-FWD-302-BIO	Double Minor	Biology for Engineers Lab			2			25		25	50			1	1
Semester – VI															
D-FWD-351-BIO	Double Minor	Food Technology	3			30	70				100	3			3
D-FWD-352-BIO	Double Minor	Food Technology Lab			2			25		25	50			1	1
Semester – VII															
D-FWD-401-BIO	Double Minor	Wine Processing & Technology	3			30	70				100	3			3
D-FWD-402-BIO	Double Minor	Wine Processing & Technology Lab			2			25		25	50			1	1
Semester - VIII															
D-FWD-451-BIO	Double Minor	Dairy Science & Technology	3			30	70				100	3			3
D-FWD-452-BIO	Double Minor	Dairy Science & Technology Lab			2			25		25	50			1	1
D-FWD-453-BIO	Double Minor	Minor Project			4			50		50	100			2	2
		Total	**12**		**12**	**120**	**280**	**150**		**150**	**700**	**12**		**6**	**18**

Savitribai Phule Pune University, Pune Double Minor B.Tech. Biotechnology (2024 Course) D-FWD-301-BIO: Biology for Engineers		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 3 Hours/Week	**03**	**CCE (Theory): 30 Marks ESE (Theory): 70 Marks Total: 100 Marks**

Prerequisite Courses, if any: Basic Biology and Fundamental Chemistry

Course Objectives:

1. To introduce fundamental biological principles relevant to engineering applications.
2. To examine the structure and functions of biomolecules and enzymes.
3. To explore microbial diversity, growth, and its relevance to biotechnology.
4. To explain fundamental concepts of genetics, molecular biology, and genetic variation.
5. To familiarize learners with basic biotechnological processes and bioprocessing systems.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Explain cellular organization, cell structures, and fundamental cellular processes.

CO2: Interpret structures and functions of major biomolecules and enzymes.

CO3: Distinguish microorganisms based on their characteristics and growth patterns.

CO4: Describe fundamental principles of genetics, molecular biology, & r DNA technology.

CO5: Summarize basic biotechnology, fermentation, bioreactors, & downstream processing principles.

Course Contents

Unit I	**Fundamentals of Biology and Cell Biology**	**(7 Hrs)**
Importance of biology in engineering, characteristics of living organisms, organization of life, prokaryotic and eukaryotic cells, cell structure and functions, cell organelles, plant and animal cells, cell membrane and transport, basic cellular processes		
Mapping of Course Outcomes for Unit I	CO1: Explain cellular organization, cell structures, and fundamental cellular processes.	
Unit II	**Biomolecules and Enzymes**	**(8 Hrs)**
Carbohydrates, proteins, lipids, nucleic acids, biological functions of biomolecules, structure and properties of carbohydrates, proteins and lipids, introduction to enzymes, enzyme classification, mechanism of enzyme action, factors affecting enzyme activity, enzyme inhibition, industrial applications of enzymes		
Mapping of Course Outcomes for Unit II	CO2: Interpret structures and functions of major biomolecules and enzymes.	

Unit III	Microbiology and Microbial Growth	(7 Hrs)
Introduction to microbiology, classification of microorganisms, bacteria, fungi, yeast and viruses, microbial cell structure, beneficial and harmful microorganisms, microbial nutrition, microbial growth, microbial growth curve, factors affecting microbial growth, microbial contamination and control		
Mapping of Course Outcomes for Unit III	CO3: Distinguish microorganisms based on their characteristics and growth patterns.	
Unit IV	**Genetics and Molecular Biology**	**(7 Hrs)**
DNA and RNA structure and functions, genes and chromosomes, central dogma, mutations and genetic variation, introduction to recombinant DNA technology, applications of biotechnology		
Mapping of Course Outcomes for Unit IV	CO4: Describe fundamental principles of genetics, molecular biology, and rDNA technology.	
Unit V	**Basic Biotechnology and Bioprocessing**	**(7 Hrs)**
Introduction to biotechnology, industrial biotechnology, fermentation and its types, batch and continuous processes, basic fermentation parameters, inoculum and starter cultures, bioreactors and their basic components, sterilization and aseptic processing, downstream processing, case studies of bioprocessing		
Mapping of Course Outcomes for Unit V	CO5: Summarize basic biotechnology, fermentation, bioreactors, & downstream processing principles.	

Learning Resources

Text Books:

1. G. K. Suraishkumar, Biology for Engineers, Oxford University Press, 2018.
2. B. Mallick, Biology for Engineers, McGraw Hill, 2021.
3. U. Satyanarayana and U. Chakrapani, Biochemistry, 6th ed., Elsevier, 2021.
4. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 8th ed., Macmillan Learning, 2021.
5. L. A. Urry et al., Campbell Biology, 12th ed., Pearson, 2021.
6. J. M. Willey, L. M. Sherwood, and C. J. Woolverton, Prescott's Microbiology, 11th ed., McGraw Hill, 2020.

Reference Books:

1. S. B. Primrose and R. Twyman, Principles of Gene Manipulation and Genomics, 7th ed., Wiley-Blackwell, 2013.
2. G. Karp, J. Iwasa, and W. Marshall, Karp's Cell and Molecular Biology: Concepts and Experiments, 9th ed., Wiley, 2020.
3. P. F. Stanbury, A. Whitaker, and S. J. Hall, Principles of Fermentation Technology, 3rd ed., Elsevier, 2016.
4. P. M. Doran, Bioprocess Engineering Principles, 2nd ed., Academic Press, 2013.

eBooks/Online Resources:

1. OpenStax, Biology 2e.
   https://openstax.org/details/books/biology-2e
2. OpenStax, Microbiology.
   https://openstax.org/details/books/microbiology
3. Nature Education, Scitable
   https://www.nature.com/scitable/ebooks/#Featured_eBooks

MOOC / NPTEL Courses:

1. NPTEL – "Biology for Engineers and Other Non-Biologists"
   https://onlinecourses-archive.nptel.ac.in/noc18_bt23/preview
2. NPTEL – "Fundamentals of Biotechnology"
   https://www.nptel.ac.in/courses/102103045
3. NPTEL – "Industrial Biotechnology"
   https://www.nptel.ac.in/
4. NPTEL – "Bioengineering: An Interface with Biology and Medicine"
   https://www.nptel.ac.in/courses/102101068
5. Coursera – "Industrial Biotechnology" – University of Manchester
   https://www.coursera.org/learn/industrial-biotech
6. edX – "Principles of Biochemistry" – Harvard University
   https://www.edx.org/learn/biochemistry
7. Khan Academy – AP®/College Biology
   https://www.khanacademy.org/ap-biology/

Savitribai Phule Pune University, Pune Double Minor B.Tech. Biotechnology (2024 Course) D-FWD-302-BIO: Biology for Engineers Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 2 Hours/Week	**01**	**TW: 25 Marks** **OR: 25 Marks** **Total: 50 Marks**

Prerequisite Courses, if any: Basic Food Science and Fundamental Biology

Course Objectives:

1. To introduce fundamental concepts of cell biology and cellular organization.
2. To explain biomolecules, enzymology, and their biological significance.
3. To develop practical understanding of microbiology and microbial growth.
4. To introduce molecular biology techniques and DNA analysis.
5. To explain basic principles of biotechnology, bioprocessing, and fermentation.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Explain cellular structures, organization, and fundamental cellular processes.

CO2: Describe biomolecules, enzyme functions, and factors affecting enzyme activity.

CO3: Explain microbial characteristics, growth patterns, and basic microbiological techniques.

CO4: Describe DNA structure, isolation, analysis, and molecular biology techniques.

CO5: Explain biotechnology applications, fermentation processes, and basic bioprocess operations.

Course Contents

Suggested List of Laboratory Assignments: (Any 8)

Section 1: Cell Biology

1. Study of Prokaryotic cells.
2. Study of Eukaryotic cells.
3. Preparation of Model/Poster for Prokaryotic or Eukaryotic cells.

Section 2: Biomolecules and Enzymology

3. Qualitative Tests for Carbohydrates, Proteins and Lipids.
4. Estimation of Reducing Sugars by Benedict's Test.
5. Study of Enzyme Activity and Effect of Temperature on Enzyme Action.
6. Study of the Effect of pH on Enzyme Activity.

Section 3: Microbiology and Microbial Growth

7. Gram Staining and Differentiation of Gram-Positive and Gram-Negative Bacteria.
8. Preparation and Sterilization of Microbiological Growth Media.

9. Study of the Effect of Temperature and pH on Microbial Growth.

Section 4: Molecular Biology and DNA Analysis

10. Isolation of Plasmid DNA from Bacterial Cells.
11. Separation and Analysis of DNA by Agarose Gel Electrophoresis.
12. Assessment of DNA Purity Using UV Absorbance Ratios.
13. Determination of the Absorption Maximum (lambda max) of DNA Using UV Spectrophotometry.

Section 5: Bioprocess Technology and Fermentation

14. Preparation and Sterilization of Fermentation Media and Preparation of Microbial Inoculum.
15. Batch Fermentation for the Production of an Alcohol or an Organic Acid.
16. Study of Sugar Utilization Before and After Fermentation and Measurement of pH Changes.
17. Demonstration of Fermenter/Bioreactor Components and Basic Bioprocess Parameters.

Learning Resources

Text Books:

1. G. K. Suraishkumar, Biology for Engineers, Oxford University Press, 2018.
2. B. Mallick, Biology for Engineers, McGraw Hill, 2021.
3. U. Satyanarayana and U. Chakrapani, Biochemistry, 6th ed., Elsevier, 2021.
4. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 8th ed., Macmillan Learning, 2021.
5. L. A. Urry et al., Campbell Biology, 12th ed., Pearson, 2021.
6. J. M. Willey, L. M. Sherwood, and C. J. Woolverton, Prescott's Microbiology, 11th ed., McGraw Hill, 2020.

Reference Books:

1. S. B. Primrose and R. Twyman, Principles of Gene Manipulation and Genomics, 7th ed., Wiley-Blackwell, 2013.
2. G. Karp, J. Iwasa, and W. Marshall, Karp's Cell and Molecular Biology: Concepts and Experiments, 9th ed., Wiley, 2020.
3. P. F. Stanbury, A. Whitaker, and S. J. Hall, Principles of Fermentation Technology, 3rd ed., Elsevier, 2016.
4. P. M. Doran, Bioprocess Engineering Principles, 2nd ed., Academic Press, 2013.

MOOC / NPTEL Courses:

1. NPTEL – “Biology for Engineers and Other Non-Biologists” https://onlinecourses-archive.nptel.ac.in/noc18_bt23/preview
2. NPTEL – “Fundamentals of Biotechnology” https://www.nptel.ac.in/courses/102103045
3. NPTEL – “Industrial Biotechnology” https://www.nptel.ac.in/
4. NPTEL – “Bioengineering: An Interface with Biology and Medicine”

https://www.nptel.ac.in/courses/102101068

5. Coursera – “Industrial Biotechnology” – University of Manchester
   https://www.coursera.org/learn/industrial-biotech
6. edX – “Principles of Biochemistry” – Harvard University
   https://www.edx.org/learn/biochemistry
7. Khan Academy – AP®/College Biology
   https://www.khanacademy.org/ap-biology/

Savitribai Phule Pune University, Pune Double Minor B.Tech. Biotechnology (2024 Course) D-FWD-351-BIO: Food Technology		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 3 Hours/Week	**03**	**CCE (Theory): 30 Marks ESE (Theory): 70 Marks Total: 100 Marks**

Prerequisite Courses, if any: Biology and Fundamental Chemistry

Course Objectives:

1. To introduce fundamental concepts of food science and food spoilage.
2. To examine principles and methods of food processing and preservation.
3. To explore microbial applications in food fermentation and biotechnology.
4. To explain essential concepts of food quality, safety, and management.
5. To familiarize learners with food waste management and emerging technologies.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Explain food properties, spoilage mechanisms, and factors affecting food quality.

CO2: Describe major food processing and preservation methods and applications.

CO3: Explain microbial roles in food fermentation and biotechnology applications.

CO4: Identify food quality, safety, regulatory, and shelf-life assessment principles.

CO5: Summarize food waste treatment, valorization, and emerging processing technologies.

Course Contents

Unit I	Introduction to Food Science	(9 Hrs)
Food industry and its scope, classification of foods, nutritional components of food, physical and chemical properties of food, sensory characteristics of food, water activity, pH, food spoilage, mechanisms and types of spoilage, factors affecting food spoilage, food spoilage microorganisms		
Mapping of Course Outcomes for Unit I	CO1: Explain food properties, spoilage mechanisms, and factors affecting food quality.	
Unit II	**Food Processing and Preservation**	**(9 Hrs)**
Preliminary processing, cleaning, sorting, grading, peeling, size reduction, thermal processing, blanching, pasteurization, sterilization, UHT treatment, refrigeration, freezing, drying and dehydration, canning, irradiation, microwave processing, high-pressure processing, food additives, packaging and storage		
Mapping of Course Outcomes for Unit II	CO2: Describe major food processing and preservation methods and applications.	

Unit III	Food Fermentation and Biotechnology	(9 Hrs)
Role of microorganisms in food production, food fermentation, starter cultures, fermented foods, microbial production of food ingredients, microbial enzymes in food processing, food flavour production, microbial production of oils and fats, solid-state fermentation, traditional fermented foods, probiotics and functional foods		
Mapping of Course Outcomes for Unit III	CO3: Explain microbial roles in food fermentation and biotechnology applications.	
Unit IV	**Food Quality and Safety**	**(9 Hrs)**
Food quality parameters, sensory evaluation, food adulteration, food contaminants, foodborne microorganisms, food safety, good manufacturing practices (GMP), HACCP, quality assurance, shelf-life evaluation, food safety management, FDA and FSSAI		
Mapping of Course Outcomes for Unit IV	CO4: Identify food quality, safety, regulatory, and shelf-life assessment principles.	
Unit V	**Food Processing Waste and Emerging Technologies**	**(9 Hrs)**
Classification and characterization of food industry waste, solid and liquid waste, physical, chemical and biological treatment, activated sludge process, anaerobic treatment, value addition of food waste, sustainable food processing, emerging food processing technologies, smart and active packaging		
Mapping of Course Outcomes for Unit V	CO5: Summarize food waste treatment, valorization, and emerging processing technologies.	

Learning Resources

Text Books:

1. N. N. Potter and J. H. Hotchkiss, Food Science, 5th ed., Springer, 1995.
2. P. J. Fellows, Food Processing Technology: Principles and Practice, 5th ed., Elsevier, 2022.
3. B. Sivasankar, Food Processing and Preservation, Prentice-Hall of India, 2023.
4. M. R. Adams and M. O. Moss, Food Microbiology, 4th ed., Royal Society of Chemistry, 2016.

Reference Books:

1. H.-D. Belitz, W. Grosch, and P. Schieberle, Food Chemistry, 4th ed., Springer, 2009.
2. M. P. Doyle, F. Diez-Gonzalez, and C. Hill, Eds., Food Microbiology: Fundamentals and Frontiers, 5th ed., ASM Press, 2019.
3. S. S. Nielsen, Nielsen's Food Analysis, 6th ed., Springer, 2024.
4. M. Shafiur Rahman, Ed., Handbook of Food Preservation, 3rd ed., CRC Press, 2020.
5. J. M. Jay, M. J. Loessner, and D. A. Golden, Modern Food Microbiology, 7th ed., Springer, 2005.

eBooks/Online Resources:

1. Food Safety and Standards Authority of India (FSSAI) – Food Safety Resources https://www.fssai.gov.in/

2. FSSAI – Food Safety Training and Certification (FoSTaC)
   https://fostac.fssai.gov.in/
3. Codex Alimentarius – FAO/WHO Food Standards
   https://www.fao.org/fao-who-codexalimentarius/
4. U.S. FDA – Food Safety and Applied Nutrition
   https://www.fda.gov/food
5. OpenStax – Biology 2e
   https://openstax.org/details/books/biology-2e

MOOC / NPTEL Courses:

1. NPTEL – Food Science and Technology, IIT Kharagpur
   https://www.nptel.ac.in/courses/126105548
2. NPTEL – Dairy and Food Process and Products Technology, IIT Kharagpur
   https://www.nptel.ac.in/courses/126105013
3. NPTEL – Food Microbiology for Safe and Sustainable Food Systems, IIT Kharagpur
   https://www.nptel.ac.in/courses/126105550
4. NPTEL – Impact of Flow of Fluids in Food Processing and Preservation, IIT Kharagpur
   https://www.nptel.ac.in/courses/126105549
5. NPTEL – Fundamentals of Food Process Engineering
   https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-ag02/
6. NPTEL – Novel Technologies for Food Processing and Shelf Life Extension
   https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar01/
7. Coursera – Food Science Courses and Specializations
   https://www.coursera.org/browse/life-sciences/food-science
8. edX – Food Science Courses
   https://www.edx.org/learn/food-science
9. FutureLearn – Food and Nutrition Courses
   https://www.futurelearn.com/subjects/healthcare-medicine-courses/nutrition

Savitribai Phule Pune University, Pune
Double Minor B.Tech. Biotechnology (2024 Course)
D-FWD-352-BIO: Food Technology Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 2 Hours/Week	01	TW: 25 Marks OR: 25 Marks Total: 50 Marks

Prerequisite Courses, if any: Basic Food Science and Fundamental Biology

Course Objectives:

6. To familiarize students with basic food quality and composition analysis.
7. To develop skills in physicochemical and nutritional food testing.
8. To demonstrate microbial, preservation, processing, and fermentation techniques.
9. To introduce methods for evaluating food quality and safety.
10. To provide practical exposure to food processing and industrial practices.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Determine physicochemical and nutritional parameters of food samples.
CO2: Perform basic microbiological and food preservation experiments safely.
CO3: Prepare dehydrated and fermented food products using suitable methods.
CO4: Evaluate food products for sensory quality, safety, and adulteration.
CO5: Demonstrate practical understanding of food processing through industrial exposure.

Course Contents

Suggested List of Laboratory Assignments: (Any 8)

Group A: Physicochemical and Nutritional Analysis

1. Determination of pH and Titratable Acidity of Food Samples
2. Qualitative Analysis of Carbohydrates, Proteins and Lipids in Food Samples
3. Determination of Moisture Content of Food Samples
4. Determination of Ash Content of Food Samples
5. Determination of Total Soluble Solids (TSS) in Fruit/Vegetable Samples
6. Determination of Enzyme Activity in Food Samples

Group B: **Food Microbiology, Spoilage and Preservation**

7. Study of Food Spoilage Microorganisms by Microscopic Examination
8. Study of Effect of Temperature on Food Spoilage
9. Demonstration of Pasteurization of Milk/Fruit Juice
10. Study of Effect of Different Preservation Methods on Food Samples

Group C: **Food Processing and Fermentation**

11. Preparation of a Dehydrated Food Product
12. Preparation of a Fermented Food Product
13. Demonstration of Yeast Fermentation and Measurement of CO_2 Production

Group D: **Food Quality, Safety and Industrial Exposure**

14. Sensory Evaluation of Food Products
15. Detection of Common Food Adulterants
16. Industrial / Field Visit

Learning Resources

Text Books:

1. S. S. Nielsen, Food Analysis, 5th ed., Springer, 2017.
2. R. P. Singh and D. R. Heldman, Introduction to Food Engineering, 5th ed., Academic Press, 2014.
3. P. J. Fellows, Food Processing Technology: Principles and Practice, 5th ed., Elsevier, 2022.

Reference Books:

1. S. Suzanne Nielsen, Food Analysis Laboratory Manual, 3rd ed., Springer, 2017.
2. M. P. Doyle, F. Diez-Gonzalez, and C. Hill, Eds., Food Microbiology: Fundamentals and Frontiers, 5th ed., ASM Press, 2019.
3. J. M. Jay, M. J. Loessner, and D. A. Golden, Modern Food Microbiology, 7th ed., Springer, 2005.

Virtual Labs:

1. Virtual Labs – Food Chemistry Lab
   https://fc-iitk.vlabs.ac.in/

MOOC / NPTEL Courses:

2. NPTEL – Food Science and Technology, IIT Kharagpur
   https://www.nptel.ac.in/courses/126105548
3. NPTEL – Dairy and Food Process and Products Technology, IIT Kharagpur
   https://www.nptel.ac.in/courses/126105013

Savitribai Phule Pune University, Pune Double Minor B.Tech. Biotechnology (2024 Course) D-FWD-401-BIO: Wine Processing & Technology		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 3 Hours/Week	**03**	**CCE (Theory): 30 Marks ESE (Theory): 70 Marks Total: 100 Marks**

Prerequisite Courses, if any: Biology, Microbiology and Fundamental Chemistry

Course Objectives:

1. To introduce principles of viticulture, grapes, and wine classification.
2. To explain wine production processes, equipment, and fermentation systems.
3. To examine wine chemistry, maturation, and quality-related transformations.
4. To familiarize students with wine quality assessment and regulatory standards.
5. To explore wine packaging, sustainability, and emerging industry practices.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Explain viticulture principles, grape composition, varieties, and wine classifications.

CO2: Describe wine production processes, equipment, fermentation systems, & processing operations.

CO3: Analyze wine fermentation, chemical composition, maturation, and stabilization processes.

CO4: Evaluate wine quality, sensory attributes, defects, and applicable regulatory standards.

CO5: Discuss wine packaging, storage, sustainability, and emerging industry technologies.

Course Contents

Unit I	Viticulture and Wine Science	(9 Hrs)
History and evolution of winemaking, major wine-producing regions, grapevine biology, grape composition, important grape varieties, factors affecting grape quality, grape maturity and harvesting, harvesting equipment and grape handling systems, wine classifications and types, red wine, white wine, rosé, sparkling and fortified wines.		
Mapping of Course Outcomes for Unit I	CO1: Explain viticulture principles, grape composition, varieties, and wine classifications.	
Unit II	**Wine Production Technology**	**(9 Hrs)**
Grape harvesting, grape reception units, crushers, destemmers and conveyors, must preparation, maceration tanks and presses, pressing, must clarification and treatment, wine yeast and starter cultures, yeast selection and inoculation, fermentation tanks and temperature-control systems, pumps and filtration systems, alcoholic fermentation, red/white winemaking process		
Mapping of Course Outcomes for Unit II	CO2: Describe wine production processes, equipment, fermentation systems, & processing operations.	

Unit III	Wine Fermentation, Chemistry and Maturation	(9 Hrs)
Wine microorganisms, alcoholic and malolactic fermentation, factors affecting fermentation, temperature and pH control, fermentation-derived metabolites: sugars, organic acids and alcohols, phenolic compounds and tannins, colour, flavour and aroma compounds, wine maturation, oak barrels and stainless-steel ageing tanks, barrel ageing, bottle ageing, clarification, stabilization		
Mapping of Course Outcomes for Unit III	CO3: Analyze wine fermentation, chemical composition, maturation, and stabilization processes.	
Unit IV	**Wine Quality Analysis and Regulations**	**(9 Hrs)**
Wine quality, sensory evaluation, wine tasting, aroma and flavour profiling, wine defects, off-flavours, physicochemical analysis, FSSAI regulations, alcoholic beverage standards, wine labelling requirements, State Excise regulations, OIV standards, Codex Alimentarius, international wine standards		
Mapping of Course Outcomes for Unit IV	CO4: Evaluate wine quality, sensory attributes, defects, and applicable regulatory standards.	
Unit V	**Wine Packaging, Sustainability and Industry**	**(9 Hrs)**
Wine bottling and packaging, bottle filling and corking/capping machines, labelling machines and packaging lines, packaging materials and closures, storage and cellar management, wine labelling, wine preservation, wine tourism, sustainability in viticulture and winemaking, by-product utilization, recent industry trends and emerging technologies		
Mapping of Course Outcomes for Unit V	CO5: Discuss wine packaging, storage, sustainability, and emerging industry technologies.	

Learning Resources

Text Books:

1. R. S. Jackson, Wine Science: Principles and Applications, 5th ed., Academic Press, 2020.
2. A. C. Noble and R. B. Boulton, Principles and Practices of Winemaking, Springer, 1995.
3. P. Ribéreau-Gayon, Y. Glories, A. Maujean, and D. Dubourdieu, Handbook of Enology, Volume 1: The Microbiology of Wine and Vinifications, 2nd ed., Wiley, 2006.
4. P. Ribéreau-Gayon, Y. Glories, A. Maujean, and D. Dubourdieu, Handbook of Enology, Volume 2: The Chemistry of Wine – Stabilization and Treatments, 2nd ed., Wiley, 2006.
5. B. G. Coombe and P. R. Dry, Viticulture, Winetitles, 2004.

Reference Books:

1. R. Boulton, V. Singleton, L. Bisson, and R. Kunkee, Principles and Practices of Winemaking, Springer, 1996.
2. A. L. Waterhouse, G. L. Sacks, and D. W. Jeffery, Understanding Wine Chemistry, Wiley, 2016.
3. R. S. Jackson, Wine Tasting: A Professional Handbook, 4th ed., Academic Press, 2017.
4. K. C. Fugelsang and C. G. Edwards, Wine Microbiology: Practical Applications and Procedures, 2nd ed., Springer, 2007.
5. M. A. Amerine and C. S. Ough, Methods for Analysis of Musts and Wines, Wiley, 1980.

eBooks/Online Resources:

1. ICAR–National Research Centre for Grapes – Grape Production and Research Resources
   https://www.nrcgrapes.in/
2. FSSAI – Food Safety and Standards (Alcoholic Beverages) Regulations
   https://www.fssai.gov.in/
3. APEDA – Agricultural and Processed Food Products Export Development Authority
   https://apeda.gov.in/
4. OIV – International Organisation of Vine and Wine: Standards and Technical Documents
   https://www.oiv.int/what-we-do/standards
5. UC Davis – Viticulture and Enology Resources
   https://wineserver.ucdavis.edu/

MOOC / NPTEL Courses:

1. Coursera – " Wine Tasting: Sensory Techniques for Wine Analysis Specialization"
   https://www.coursera.org/learn/wine
2. Udemy – “A Comprehensive Guide to Wine-Making”
   https://www.udemy.com/course/wine-making-in-india/
3. Udemy – “Techniques for Growing Grapes and Producing Wine”
   https://www.udemy.com/course/techniques-for-growing-grapes-and-producing-wine/
4. Udemy – “Mastering Sustainable Viticulture and Winemaking”
   https://www.udemy.com/course/mastering-sustainable-viticulture-and-winemaking/
5. Udemy – “Foundations of Viticulture: Understanding How Wine is Grown”
   https://www.udemy.com/course/viticulture/
6. Udemy – “Wine in 9: The Complete Wine Tasting Course”
   https://www.udemy.com/topic/wine/

Savitribai Phule Pune University, Pune
Double Minor B.Tech. Biotechnology (2024 Course)
D-FWD-402-BIO: Wine Processing & Technology Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 2 Hours/Week	01	TW: 25 Marks OR: 50 Marks Total: 75 Marks

Prerequisite Courses, if any: Wine Technology and Fundamental Microbiology

Course Objectives:

1. To develop practical skills in grape and must preparation techniques.
2. To demonstrate wine yeast handling and fermentation processes.
3. To perform basic analytical and processing techniques for wine.
4. To assess wine quality through sensory and defect evaluation.
5. To provide practical exposure to winery operations and industrial practices.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Identify grape varieties and perform basic grape juice analysis.
CO2: Demonstrate wine yeast handling and controlled fermentation techniques.
CO3: Determine important chemical parameters and perform wine processing operations.
CO4: Assess wine quality through sensory evaluation and defect identification.
CO5: Relate laboratory practices with commercial winery operations and processes.

Course Contents

Suggested List of Laboratory Assignments: (Any 8)

Group A: Grape Varieties and Must Preparation

1. Study of Different Grape Varieties Used in Winemaking
2. Determination of TSS and pH of Grape Juice
3. Determination of Titratable Acidity of Grape Juice
4. Preparation of Grape Must for Wine Production
5. Demonstration of Grape Crushing, Destemming and Pressing

Group B: Wine Yeast and Fermentation

6. Isolation/Observation of Wine Yeast and Study of Its Characteristics
7. Demonstration of Alcoholic Fermentation Using Wine Yeast
8. Study of Effect of Temperature and pH on Wine Fermentation

Group C: Wine Analysis and Processing

9. Determination of Alcohol Content in Wine
10. Determination of Residual Sugar in Wine
11. Determination of Titratable Acidity in Wine
12. Determination of Sulphur Dioxide in Wine
13. Study of Wine Clarification and Stabilization

Group D: Wine Quality and Industrial Exposure

14. Sensory Evaluation and Wine Tasting
15. Identification of Common Wine Defects and Off-Flavours
16. Industrial Visit / Field Visit

Learning Resources

Text Books:

1. B. W. Zoecklein et al., Wine Analysis and Production. Chapman & Hall.
2. M. A. Amerine and C. S. Ough, Methods for Analysis of Musts and Wines. Wiley.

Reference Books:

1. P. Iland et al., Techniques for Chemical Analysis and Stability Tests of Grape Juice and Wine.
2. K. C. Fugelsang and C. G. Edwards, Wine Microbiology: Practical Applications and Procedures. Springer.
3. R. B. Boulton et al., Principles and Practices of Winemaking. Springer.

MOOC / NPTEL Courses:

1. Coursera – Wine Tasting: Sensory Techniques for Wine Analysis (University of California, Davis) https://www.coursera.org/learn/wine
2. Udemy – A Comprehensive Guide to Wine-Making. https://www.udemy.com/course/wine-making-in-india/
3. Udemy – Making Homemade Wine: A Step-by-Step Guide. https://www.udemy.com/course/making-homemade-wine-a-step-by-step-guide/

Savitribai Phule Pune University, Pune Double Minor B.Tech. Biotechnology (2024 Course) D-FWD-451-BIO: Dairy Science & Technology		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 3 Hours/Week	**03**	**CCE (Theory): 30 Marks ESE (Theory): 70 Marks Total: 100 Marks**

Prerequisite Courses, if any: Basic Biology, Microbiology and Fundamental Chemistry

Course Objectives:

1. To introduce milk composition, chemistry, nutrition, and hygienic production practices.
2. To explain principles and methods of milk processing technologies.
3. To examine dairy product manufacturing and fermentation processes.
4. To familiarize students with dairy microbiology, quality, and safety.
5. To explore dairy equipment, packaging, waste management, and sustainability.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Explain milk composition, properties, nutritional value, and hygienic production practices.

CO2: Describe major milk processing methods, equipment, and processing operations.

CO3: Explain manufacturing principles of fermented and processed dairy products.

CO4: Assess dairy quality, microbiological safety, adulteration, and regulatory requirements.

CO5: Discuss dairy equipment, packaging, sustainability, and waste management practices.

Course Contents

Unit I	**Milk Science and Dairy Chemistry**	**(9 Hrs)**
Dairy industry overview, composition and nutritional value of milk, physical and chemical properties, milk proteins and casein, milk fat and lactose, minerals and colloidal nature of milk, factors affecting milk composition, raw milk collection, sampling, transportation and hygienic milk production		
Mapping of Course Outcomes for Unit I	CO1: Explain milk composition, properties, nutritional value, and hygienic production practices.	
Unit II	**Milk Processing Technology**	**(9 Hrs)**
Milk reception and quality assessment, filtration and clarification, cooling, separation, standardization, homogenization, pasteurization, sterilization and UHT processing, evaporation and concentration, membrane processing, microfiltration, ultrafiltration and reverse osmosis, spray drying, processing of toned, double-toned, standardized and flavoured milk		
Mapping of Course Outcomes for Unit II	CO2: Describe major milk processing methods, equipment, and processing operations.	

Unit III	Dairy Products and Fermentation Technology	(9 Hrs)
Starter cultures and lactic acid bacteria, dairy fermentation, fermented and probiotic milk products, cream and butter, buttermilk, paneer, cheese manufacture, coagulation and curd formation, cheese ripening and maturation, ice cream and frozen desserts, condensed milk, milk powder		
Mapping of Course Outcomes for Unit III	CO3: Explain manufacturing principles of fermented and processed dairy products.	
Unit IV	**Dairy Quality, Microbiology and Safety**	**(9 Hrs)**
Microflora of milk, beneficial, spoilage and pathogenic microorganisms, microbial defects, milk quality parameters, pH and acidity, fat, protein, total solids and SNF, milk adulteration, microbial quality assessment, shelf-life evaluation, food safety, GMP, HACCP, quality assurance and dairy standards		
Mapping of Course Outcomes for Unit IV	CO4: Assess dairy quality, microbiological safety, adulteration, and regulatory requirements.	
Unit V	**Dairy Engineering, Packaging and Sustainability**	**(9 Hrs)**
Dairy processing equipment, heat exchangers, homogenizers, separators, evaporators and spray dryers, refrigeration and cold chain, Clean-in-Place (CIP), packaging materials and methods, storage and transportation, dairy waste management, waste treatment and by-product utilization, water and energy management, sustainable dairy processing, emerging dairy technologies		
Mapping of Course Outcomes for Unit V	CO5: Discuss dairy equipment, packaging, sustainability, and waste management practices.	

Learning Resources

Text Books:

1. P. Walstra, J. T. M. Wouters, and T. J. Geurts, Dairy Science and Technology, 2nd ed. CRC Press, 2006.
2. S. S. De, Outlines of Dairy Technology. Oxford University Press, 1980.
3. R. K. Robinson, Ed., Modern Dairy Technology, Volume 1: Advances in Milk Processing, 2nd ed. Chapman & Hall, 1994.

Reference Books:

1. A. Y. Tamime, Ed., Milk Processing and Quality Management. Wiley-Blackwell, 2009.
2. Y. H. Hui, Ed., Handbook of Dairy Foods and Nutrition, 3rd ed. CRC Press, 2006.

eBooks/Online Resources:

1. Food Safety and Standards Authority of India (FSSAI), Food Safety and Standards Regulations. https://www.fssai.gov.in/
2. National Dairy Development Board (NDDB), Dairy Development Resources. https://www.nddb.coop/

MOOC / NPTEL Courses:

1. NPTEL – Dairy and Food Process and Products Technology (IIT Kharagpur)
   https://nptel.ac.in/courses/126105013
2. Coursera – Dairy Production and Management
   https://www.coursera.org/learn/dairy-production
3. Coursera – Discovering Dairy: What's in Your Milk?
   https://www.coursera.org/learn/discovering-dairy-whats-in-your-milk
4. Udemy – Cheesemaking for Beginners: From Milk to Homemade Cheese
   https://www.udemy.com/course/from-milk-to-magic-the-transformative-power-of-cheesemaking/
5. Udemy – Membrane Technology in Juice and Milk Industry
   https://www.udemy.com/course/membrane-technology-in-juice-and-milk-industry/

Savitribai Phule Pune University, Pune
Double Minor B.Tech. Biotechnology (2024 Course)
D-FWD-452-BIO: Dairy Science & Technology Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 2 Hours/Week	01	TW: 25 Marks OR: 50 Marks Total: 75 Marks

Prerequisite Courses, if any: Basic Dairy Technology and Fundamental Microbiology

Course Objectives:

1. To develop practical skills in milk composition and quality analysis.
2. To demonstrate basic milk safety, processing, and preservation techniques.
3. To develop hands-on skills in dairy product preparation.
4. To assess dairy products using quality and shelf-life parameters.
5. To provide practical exposure to dairy packaging and industrial operations.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Determine major physicochemical and compositional parameters of milk.
CO2: Perform basic milk safety, processing, and preservation techniques.
CO3: Prepare dairy products using appropriate processing and fermentation methods.
CO4: Evaluate dairy products for quality, packaging, and shelf-life characteristics.
CO5: Relate laboratory practices to commercial dairy processing operations.

Course Contents

Suggested List of Laboratory Assignments: (Any 8)

Group A: Milk Composition and Quality Assessment

1. Physicochemical Analysis of Milk
2. Estimation of Fat Content in Milk
3. Estimation of Protein Content in Milk
4. Assessment of Total Solids and SNF in Milk

Group B: **Milk Safety, Processing and Preservation**

5. Screening of Common Adulterants in Milk
6. Microbiological Quality Assessment of Milk
7. Demonstration of Milk Pasteurization
8. Effect of Homogenization on Milk Properties

Group C: **Dairy Product Processing and Quality Evaluation**

9. Yogurt Manufacturing Using Starter Culture
10. Paneer Manufacturing and Quality Evaluation
11. Butter Churning and Quality Assessment
12. Ice Cream Processing and Quality Evaluation
13. Production and Evaluation of a Fermented Dairy Product

Group D: **Dairy Packaging, Shelf-Life and Industrial Exposure**

14. Evaluation of Dairy Packaging Materials
15. Shelf-Life Assessment of a Dairy Product Under Different Storage Conditions
16. Industrial / Field Visit

Learning Resources

Text Books:

1. P. Walstra, J. T. M. Wouters, and T. J. Geurts, Dairy Science and Technology, 2nd ed. CRC Press, 2006.
2. S. S. De, Outlines of Dairy Technology. Oxford University Press, 1980.
3. A. Y. Tamime and R. K. Robinson, Yoghurt: Science and Technology, 2nd ed. Woodhead Publishing, 1999.

Reference Books:

1. R. K. Robinson, Ed., Modern Dairy Technology, Volume 1: Advances in Milk Processing, 2nd ed. Chapman & Hall, 1994.
2. A. Y. Tamime, Ed., Milk Processing and Quality Management. Wiley-Blackwell, 2009.
3. H. H. Hussain, Dairy Microbiology and Quality Assurance.

MOOC / NPTEL Courses:

1. NPTEL – Dairy and Food Process and Products Technology (IIT Kharagpur)
   https://nptel.ac.in/courses/126105013

Savitribai Phule Pune University, Pune Double Minor B.Tech. Biotechnology (2024 Course) D-FWD-453-BIO: Minor Project		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 4 Hours/Week	**02**	**TW: 50 Marks** **OR: 50 Marks** **Total: 100 Marks**

Prerequisite Courses, if any: Basic Biology, Mathematics and Fundamental Chemistry

Course Objectives:

1. Apply knowledge of food, wine, and dairy technology to solve practical problems.
2. Develop problem-solving and critical-thinking skills through project-based learning.
3. Design and execute projects using appropriate experimental, analytical, or computational methods.
4. Develop teamwork, project management, technical documentation, and communication skills.

Course Outcomes: On completion of the course, learner will be able to,

CO1: Identify and formulate problems related to food, wine, and dairy technology.

CO2: Plan and execute projects using appropriate methods and tools.

CO3: Analyze project data and evaluate the outcomes.

CO4: Present project findings through technical reports, presentations, and demonstrations.

Course Contents

The Minor Project is an integral component of the Double Minor in Food, Wine & Dairy Technology. It provides students with practical exposure to food processing, food quality and safety, fermentation, wine processing, dairy technology, and related interdisciplinary applications. Students are expected to identify a relevant problem and develop a practical solution through experimentation, product development, data analysis, process improvement, or prototype development.

Nature of the Minor Project

1. The project shall preferably be application-oriented and multidisciplinary.
2. Projects may involve product development, laboratory experiments, quality analysis, fermentation studies, process improvement, computational analysis, or prototype development.
3. Projects should produce a demonstrable outcome and should not be limited to a literature survey.
4. The project should be carried out individually or in a group of 2-3 students.

Suggested Project Themes

Suggested Project Themes

A. Food Technology

- Food product development and preservation
- Food quality and safety assessment
- Food packaging and shelf-life studies
- Food waste utilization and value addition
- Food processing equipment and automation, such as soup-making machines and automated milk dispensing systems (Milk ATM).

B. Wine Processing & Technology

- Fermentation studies and process optimization
- Wine yeast and fermentation monitoring
- Grape juice quality analysis
- Utilization of winemaking by-products

C. Dairy Science & Technology

- Milk quality assessment and adulteration detection
- Development of dairy products
- Fermented dairy products and shelf-life studies
- Dairy waste management and by-product utilization

D. Interdisciplinary Projects

- Sensor-based monitoring of food processing
- Data analysis for food quality assessment
- Low-cost tools for food safety and quality monitoring
- Sustainable processing and packaging solutions
- Software-based applications for food, wine, and dairy industries

Project Guidelines

1. Students shall identify a relevant problem and prepare a project proposal in consultation with their project guide.
2. The project shall include appropriate planning, implementation, testing, and evaluation.
3. Students shall maintain a project diary documenting progress, activities, and observations.
4. Projects involving laboratory work must follow appropriate safety, hygiene, and waste-disposal practices.
5. Students shall ensure proper acknowledgement of sources and maintain academic integrity.
6. The final project shall be presented through a technical report, presentation, demonstration, and oral examination.

Project Deliverables

1. Project proposal and problem statement
2. Brief literature review
3. Project methodology and work plan
4. Experimental work, analysis, prototype, or developed product, as applicable
5. Results and discussion
6. Final project report
7. Project presentation and demonstration
8. Project diary or progress record

The final report should include the objectives, literature review, methodology, results and discussion, conclusion, future scope, and references.