Savitribai Phule Pune University, Pune

Two Year M. Sc. Degree Program in

Wine, Brewing and Alcohol Technology

(Faculty of Science and Technology)

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

M. Sc. Wine, Brewing and Alcohol Technology

To be implemented from Academic Year 2023-2024

Title of the program: Master of Science (M. Sc.) (Wine, Brewing and Alcohol Technology) as per NEP 2020

I. Preamble:

The M.Sc. (Wine, Brewing, and Alcohol Technology) program at Savitribai Phule Pune University is a comprehensive and specialized degree program designed to cater to the growing demand for skilled professionals in the wine, brewing, and alcohol industry. This program is based on the recognition that Wine, Brewing, and Alcohol Technology is a rapidly evolving and dynamic field, requiring a deep understanding of the scientific, technological, and economic aspects of the industry.

Wine, Brewing, and Alcohol Technology is considered as one of the youngest branch of Science, focusing on the applied science and technological advancements involved in the production, processing, and quality control of wines and alcoholic beverages. The industry has witnessed remarkable growth and transformation, both globally and within India, with rising demand for high-quality wines, craft beers, and other alcoholic beverages.

The M.Sc. (Wine, Brewing, and Alcohol Technology) program is a response to this changing landscape, aiming to equip students with the necessary knowledge, skills, and expertise to excel in the industry. It is built on the foundation of scientific principles, technological advancements, and practical applications specific to the wine, brewing, and alcohol sectors.

The program emphasizes a multidisciplinary approach, integrating various fields such as viticulture, oenology, fermentation science, microbiology, chemistry, agriculture, and business management. This interdisciplinary perspective provides students with a comprehensive understanding of the entire value chain of the industry, from grape cultivation to the production and marketing of wines and alcoholic beverages.

The revised syllabi have been developed to keep pace with the industry's latest developments and trends. They incorporate theoretical knowledge, practical training, and industry exposure to ensure that graduates are well-prepared to meet the challenges of the wine, brewing, and alcohol industry.

The program emphasizes hands-on experience, laboratory-based learning, industry internships, and research projects to enhance students' skills and competencies.

Furthermore, the program promotes a sense of scientific responsibility, social awareness, and environmental consciousness among students. It emphasizes the importance of sustainable practices, waste utilization, energy conservation, and responsible consumption of alcoholic beverages. Graduates are equipped with the knowledge and ethical values necessary to contribute positively to society and the industry, ensuring the long-term sustainability of the wine, brewing, and alcohol sectors.

The M.Sc. (Wine, Brewing, and Alcohol Technology) program opens up diverse career opportunities for graduates. They can pursue roles in wineries, breweries, research and development organizations, quality control laboratories, marketing and sales departments, and government regulatory bodies related to the wine, brewing, and alcohol industries. Graduates may also explore entrepreneurial avenues, establishing their wineries, breweries, or consultancy services.

By offering a comprehensive curriculum, practical training, and industry-relevant skills, the M.Sc. (Wine, Brewing, and Alcohol Technology) program at Savitribai Phule Pune University aims to nurture a new generation of professionals who will contribute to the growth, innovation, and sustainability of the wine, brewing, and alcohol industry. The program's commitment to excellence, scientific rigour, and industry integration ensures that graduates are well-prepared to meet the demands and challenges of this dynamic and exciting field.

1. Introduction:

The M.Sc. (Wine, Brewing, and Alcohol Technology) program at Savitribai Phule Pune University is a specialized and comprehensive course designed to cater to the dynamic and evolving needs of the wine, brewing, and alcohol industry. This program stands as a testament to the growing significance of the wine and alcoholic beverage sector, which has witnessed remarkable advancements in technology, scientific research, and consumer preferences.

The wine, brewing, and alcohol industry has a rich history dating back to ancient times, and its significance has only grown with time. Wine, in particular, has transcended cultural boundaries and has been an integral part of social and religious practices in various civilizations. Today, the industry not only serves cultural and social purposes but also holds tremendous economic importance worldwide.

In recent years, there has been a substantial surge in the demand for wine and alcoholic beverages, driven by changing consumer preferences, globalization, and increasing disposable incomes. As a result, the industry is experiencing a paradigm shift, wherein cutting-edge technologies, innovative brewing techniques, and sustainability practices are at the forefront of its development. This shift necessitates a workforce that is well-equipped with the knowledge, skills, and expertise to navigate the complexities of the modern wine and brewing landscape.

The M.Sc. program in Wine, Brewing, and Alcohol Technology is designed to address these challenges and prepare a new generation of professionals capable of making meaningful contributions to the industry. Students enrolling in this program embark on a journey that delves into the intricate science and artistry of wine production, brewing methods, and the diverse world of alcoholic beverages.

The program's curriculum is thoughtfully crafted to provide students with an in-depth understanding of the various elements that contribute to the creation of high-quality wines and alcoholic beverages. It covers crucial topics such as viticulture, where students explore the cultivation of grapes, grape varieties, and vineyard management practices. In the study of oenology, students delve into winemaking techniques, fermentation processes, and the influences of different factors on the wine's flavour and aroma profiles.

Furthermore, the program places significant emphasis on brewing methods, where students learn about the intricacies of beer production, the brewing process, and the impact of different ingredients on the final product. This comprehensive approach enables students to gain a holistic understanding of the science behind winemaking and brewing, allowing them to make informed decisions in the industry.

As technology plays an increasingly vital role in modern industries, the program is committed to equipping students with cutting-edge knowledge and practical skills. Through laboratory sessions and field visits to vineyards and breweries, students receive hands-on training in state-of-the-art equipment, analytical techniques, and quality control procedures. They also explore the role of automation, data analytics, and modern technologies in optimizing production processes and maintaining consistent product quality.

Sustainability and environmental consciousness are integral components of the M.Sc. program in Wine, Brewing, and Alcohol Technology. Students are exposed to eco-friendly practices, waste management strategies, and energy conservation methods that contribute to the industry's sustainable growth. This emphasis on sustainability aligns with the global efforts to minimize the

ecological impact of industries, making graduates of this program environmentally responsible professionals.

In conclusion, the M.Sc. (Wine, Brewing, and Alcohol Technology) program at Savitribai Phule Pune University is a transformative educational endeavour that seeks to empower students with the knowledge, skills, and values to thrive in the fast-paced and ever-evolving world of wine, brewing, and alcohol technology. With a focus on modern science, technological advancements, and sustainability, this program nurtures a generation of professionals who can push the boundaries of innovation and contribute significantly to the flourishing wine and alcoholic beverage industry.

2. Objectives to be achieved:

- **In-depth Knowledge of Wine Technology:**

The program aims to provide students with a comprehensive understanding of Wine Technology, covering all aspects of wine production and winemaking. Students learn about viticulture, including grape varieties, vineyard practices, pest management, and harvesting techniques. They delve into the science of winemaking, studying fermentation processes, yeast and bacteria strains, wine additives, and maturation. The program also covers sensory evaluation, where students learn to assess wine quality based on taste, aroma, and appearance. The objective is to equip students with the expertise to produce high-quality wines and understand the factors influencing wine style and characteristics.

- **Brewing Techniques and Technology:**

The program emphasizes the art and science of brewing, focusing on beer production. Students explore the various brewing techniques, including mashing, lautering, boiling, and fermentation. They study the different types of beer, their ingredients, and the impact of brewing processes on beer flavour and aroma. Students gain insights into yeast strains, fermentation control, and the influence of temperature and pH on beer production. The objective is to provide students with a deep understanding of the brewing process, enabling them to create a wide range of beer styles and flavours.

- **Alcohol Technology and Distillation:**

In addition to wine and beer, the program covers the technology of alcoholic beverages, including spirits. Students learn about distillation processes, spirit production, and the factors affecting spirit flavour and quality. They study the various types of spirits, such as whiskey, vodka, rum, and brandy, and explore the impact of raw materials, fermentation, and ageing on spirit characteristics.

The objective is to equip students with knowledge and skills in distillation technology, enabling them to produce premium spirits and maintain consistency in quality.

- **Analytical Techniques in Beverage Technology:**

To ensure quality control and safety in the beverage industry, the program emphasizes analytical techniques. Students learn about chemical analysis methods, microbiological testing, and sensory evaluation procedures. They gain proficiency in using equipment such as spectrophotometers, gas chromatographs, and sensory evaluation tools. The objective is to enable students to perform quality checks, identify potential issues, and ensure compliance with industry standards.

- **Process Optimization and Innovation:**

The program encourages students to explore process optimization and innovation in wine, brewing, and alcohol technology. They study modern advancements in winemaking, brewing equipment, and fermentation control systems. Students learn about sustainable practices, waste utilization, and energy conservation in beverage production. The objective is to foster creativity and critical thinking, empowering students to develop new techniques, improve existing processes, and implement sustainable solutions in the industry.

- **Marketing and Business Strategies in Beverage Industry:**

Understanding the business aspects of the wine, brewing, and alcohol industry is crucial for graduates. The program covers marketing strategies, branding, and market analysis for alcoholic beverages. Students study consumer behaviour, distribution channels, pricing strategies, and the impact of marketing on beverage sales. The objective is to equip students with skills to create successful marketing campaigns, build strong brands, and make informed business decisions in the beverage industry.

- **Sensory Analysis and Consumer Preferences:**

Students are trained in sensory analysis techniques to evaluate wines, beers, and spirits. They learn how to assess the flavour, aroma, appearance, and mouthfeel of beverages. The program also covers consumer preferences and market trends in alcoholic beverages. The objective is to enable students to develop products that align with consumer tastes and preferences, ensuring success in the competitive beverage market.

- **Quality Control and Safety Standards:**

Maintaining quality and safety standards is of utmost importance in the beverage industry. The program emphasizes the implementation of quality control measures and adherence to safety

regulations. Students learn about hygiene practices, sanitation, and the prevention of contamination during production. The objective is to equip students with the knowledge and skills to ensure product safety and consistently high-quality beverages.

In conclusion, the M.Sc. (Wine, Brewing, and Alcohol Technology) program at Savitribai Phule Pune University focuses on providing students with comprehensive knowledge and practical skills in Wine, Brewing, and Alcohol Technology. The objectives emphasize the various aspects of beverage production, including wine technology, brewing techniques, alcohol technology, and the analytical and business aspects of the industry. Graduates are prepared to excel in diverse roles within the wine, brewing, and alcohol industry and contribute to its growth and innovation.

Special Features:

Emphasis on Process Development and Marketing: The program focuses on process development, scale-up systems, and marketing strategies. Students learn about the various stages of wine production, brewing techniques, product development, and effective marketing approaches to meet consumer demands and market trends. They acquire skills in process optimization, sensory analysis, product innovation, market research, branding, digital marketing, sales techniques, and distribution strategies. Emphasis is placed on understanding the evolving wine market dynamics, consumer preferences, and global wine trends.

Waste Utilization and Sustainability: The program highlights the evaluation and utilization of waste generated during the production process. Students learn about innovative methods to convert waste into valuable products, promoting sustainability and reducing environmental impact. They study waste treatment technologies, by-product valorization, sustainability certifications, and the circular economy principles in the wine and brewing industry. Students develop an understanding of the environmental and economic benefits of waste management and sustainable practices in the industry.

Energy Production and Conservation: The syllabi include a focus on energy production and conservation within the wine, brewing, and alcohol industries. Students explore energy-efficient practices, renewable energy sources, and strategies to minimize energy consumption in production processes. They learn about the energy demands of wineries, breweries, and distilleries, energy-efficient equipment and technologies, and the integration of renewable energy sources such as solar and wind power. The program emphasizes the importance of energy conservation and the reduction of greenhouse gas emissions in the wine industry.

Industry Integration and Internships: The program offers opportunities for industry integration and internships. Students have the chance to gain practical experience through internships at wineries, breweries, and related organizations. This exposure to real-world scenarios enhances their understanding of industry practices and cultivates professional networks. Internships provide students with an opportunity to apply their theoretical knowledge in a practical setting, develop professional skills, and gain insights into the daily operations of the wine and brewing industry.

Career opportunities:

- Winemaker: Winemakers are skilled professionals responsible for the overall winemaking process. They oversee the selection of grapes, fermentation, ageing, and blending to create wines with distinct flavours and characteristics. Winemakers use their expertise to control the fermentation process, adjust the sugar and acidity levels, and manage the maturation of wines. They play a crucial role in crafting wines that meet consumer preferences and maintain the quality and reputation of the winery.
- Viticulturist: Viticulturists are specialists in vineyard management and grape cultivation. They focus on the science and practice of growing grapes to optimize grape quality and yield. Viticulturists make informed decisions on planting, pruning, irrigation, pest control, and harvesting. They work closely with winemakers to ensure that the vineyard produces high-quality grapes, which are essential for producing excellent wines.
- Beverage Research and Development Specialist: Graduates can work in research and development departments of wineries, breweries, or distilleries. As research specialists, they conduct experiments to improve winemaking, brewing processes, and distillation techniques. They develop new product formulations, explore innovative technologies, and experiment with unique ingredients to create novel alcoholic beverages that resonate with consumer preferences.
- Beverage Product Manager: Beverage product managers oversee the development and launch of new alcoholic products. They conduct market research, analyze consumer trends, and identify opportunities for new product lines. Product managers collaborate with research and development teams to bring new wines, beers, and spirits to the market successfully.
- Wine and Beverage Journalist: Wine and beverage journalists work in media outlets, publishing houses, or online platforms. They write articles, reviews, and reports on various alcoholic beverages, covering tasting notes, industry trends, and regional wine and beer

events. Their expertise and knowledge help inform and educate the public about different alcoholic beverages.

- Beverage Chemist: Beverage chemists specialize in the analysis of alcoholic beverages. They use advanced laboratory techniques to determine the chemical composition, alcohol content, and stability of wines, beers, and spirits. Beverage chemists also work on product formulation, ensuring that alcoholic beverages meet safety and quality standards.
- Wine and Beverage Sales Representative: Sales representatives play a pivotal role in promoting and selling alcoholic beverages to distributors, retailers, and consumers. They build relationships with clients, negotiate sales deals, and provide product information to potential customers. Sales representatives are instrumental in expanding the market reach and visibility of alcoholic beverages.
- Wine and Beverage Tourism Specialist: Wine and beverage tourism specialists work in the hospitality and tourism industry, focusing on wine tours, tastings, and experiences. They manage winery and brewery tours, design tasting experiences, and organize events to attract visitors to wine regions and breweries.
- Beverage Supply Chain and Logistics Manager: Supply chain and logistics managers play a crucial role in the beverage industry. They oversee the transportation, distribution, and storage of alcoholic beverages to ensure efficient and timely delivery to consumers.
- Wine Production Manager: As a wine production manager, graduates oversee the entire winemaking process, from grape harvesting to bottling. They manage vineyards, ensure proper fermentation, monitor quality control, and coordinate packaging and labeling. Their role is crucial in maintaining consistency in wine quality and adhering to production schedules.
- Brew master: Brew masters are responsible for managing brewery operations and supervising the brewing process. They develop new beer recipes, experiment with brewing techniques, monitor fermentation, and control the beer's flavour and aroma. Brew masters play a key role in maintaining the quality and distinctiveness of the brewery's beer offerings.
- Alcohol Production Technologist: Graduates can work in alcohol production, which includes the distillation of spirits such as whiskey, vodka, rum, and brandy. Alcohol production technologists are involved in the entire distillation process, from raw material selection to final product quality control.

- Fermentation Technologist: Fermentation technologists work in the wine, beer, and alcohol industries. They specialize in fermentation science, optimizing yeast and microbial cultures to ensure efficient and consistent fermentation processes. They play a crucial role in enhancing the flavour profiles of wines, beers, and other fermented alcoholic beverages.
- Quality Control Specialist: Quality control specialists are responsible for testing and analyzing wine, beer, and spirit samples to ensure compliance with industry standards and product consistency. They use advanced analytical techniques to identify any deviations in product quality and implement corrective measures.
- Sensory Analyst: Sensory analysts evaluate the sensory attributes of wines, beers, and spirits to assess their quality and consumer appeal. They conduct sensory evaluations to identify flavour profiles, aromas, and appearance characteristics, providing valuable insights for product improvement and market positioning.
- Beverage Research Scientist: Graduates can work as beverage research scientists, conducting research on new alcoholic beverages, their health effects, and consumer preferences. They contribute to the development of innovative alcoholic products that meet market demands.
- Beverage Consultant: As a beverage consultant, graduates provide expertise to wineries, breweries, distilleries, or research institutions on process optimization, quality control, and product development. They may also offer advice on marketing strategies, market trends, and brand positioning for alcoholic beverages.
- Beverage Educator: Beverage educators work in educational institutions, training centres, or consultancy firms. They teach courses on wine, brewing, distillation, and alcohol technology, sharing their expertise with aspiring students and industry professionals.
- Wine and Spirits Sommelier: Wine and spirits sommeliers are experts in beverage tasting, food pairing, and customer service. They work in restaurants, hotels, or wine bars, recommending wine, beer, and spirit selections to customers based on their preferences and meal choices.
- Beverage Marketing and Sales: Opportunities exist in marketing and sales roles for wineries, breweries, and distilleries. Graduates can work in sales teams, brand management, digital marketing, or distribution channels, promoting and expanding the market reach of alcoholic beverages.
- Beverage Production Engineer: Beverage production engineers are involved in designing and optimizing the equipment and processes used in wine, brewing, and alcohol

production. They focus on improving efficiency, safety, and product quality in beverage manufacturing facilities.

- Beverage Supply Chain and Logistics Manager: Supply chain and logistics managers play a crucial role in the beverage industry. They oversee the transportation, distribution, and storage of alcoholic beverages to ensure efficient and timely delivery to consumers.

In conclusion, the M.Sc. (Wine, Brewing, and Alcohol Technology) program at Savitribai Phule Pune University offers diverse and promising career opportunities in Wine Brewing, Alcohol, and Beverage Technology. Graduates are equipped with the necessary knowledge and practical skills to excel in various roles within the wine, brewing, and alcohol industry, including Winemaker, Viticulturist, and various other positions related to research, quality control, marketing, and management. They contribute to the growth, innovation, and global recognition of the beverage industry.

3. Course Structure and assessment of credits:

I. Total credits:

A full master's degree course in science would be of 88 credits. One credit course of theory will be of one clock hour per week, running for 15 weeks and one credit for practical course will consist of 30 clock hours of laboratory exercises. There shall be four semesters and credits are distributed over 4 semesters. There will be 2 core compulsory theory courses (4 credits each), one core compulsory theory course (2 credits) and one core compulsory Practical course (4 credits). In addition to this, choice based optional paper means elective course is offered consisting of 2 theory credits course and allied 2 practical credit courses. There are also Research Methodology (RM), Internship/ On the Job training (O/T) and Research Project credits assigned to a particular semester.

Savitribai Phule Pune University, Pune

Credit Framework for Post Graduate (PG)

Level	Semester	Credits Related to Major		Research Methodology (RM)	Internship On Job Training (OJT)	Research Project (RP)	Total
		Major Core	Major Elective				
6.0	I	10(T) + 4(P)	2 (T) + 2 (T/P)	4	0	0	22
	II	10(T) + 4(P)	2 (T) + 2 (T/P)	0	4 (OJT)	0	22
Exit option: Award PG Diploma on completion of 44 Credits after Three Year UG Degree OR continue with PG second year							
6.5	III	10 (T) + 4 (P)	2 (T) + 2 (T/P)	0	0	4	22
	IV	8 (T) + 4 (P)	2 (T) + 2 (T/P)	0	0	6	22
Total 4 Years		54	16	4	4	10	88
2 Years-4 Sem. Award PG Degree on completion 88 credits after Three Year UG Degree or 1 Year-2 Sem PG Degree (44 credits) after Four Year UG Degree							

Notes:

Abbreviation: T – Theory, P – Practical

3. Wherever require the BOS can choose theory or practical course as per the need and within the given structure.
4. Each course should be designed with minimum 2 or maximum 4 credits.

II. Workload:

Each theory credit is equivalent to 15 clock hours of teaching (12 hrs classroom + 3 hrs of tutorials-active learning method) and each practical credit is equivalent to 30 clock hours of teaching in a semester.

1. For the purpose of computation of workload, the following mechanism may be adopted as per UGC guidelines:
   i) 1 Credit= 1 Theory period of one-hour duration per week
   ii) 1 Credit=1 Tutorial period of one-hour duration per week
   iii) 1 Credit=1 Practical period of two-hour duration per week
2. Each theory lecture time is of 1 hour=60 minutes
3. Each practical session time for Compulsory Practical Paper is of 8 hour=480 minutes
4. Each practical session time for Choice Based Practical Optional paper is of 4 hour = 240 minutes

III. M. Sc. First year in Wine, Brewing and Alcohol Technology - Semester I

Assessment of Credits:

WT: Wine Technology; CT: Core Compulsory Theory; CP: Compulsory Practical;

ET: Elective Theory; EP: Elective Practical; RMT: Research Methodology Theory; RMP: Research Methodology Practical

Components of Study	Course Code		Course Name	Credit	Assessment		
					IA	UE	Total
Core Compulsory Theory Papers	WT 511 MJ		Microbiology of Wine, Beer & Alcohol	4	30	70	100
	WT 512 MJ		Biochemistry of Wine, Beer & Alcohol	4	30	70	100
	WT 513 MJ		Vineyard Technology	2	15	35	50
Core Compulsory Practical paper	WT 514 MJP		Practicals based on WT 511 MJ Microbiology of Wine, Beer & Alcohol, WT 512 MJ Biochemistry of Wine, Beer & Alcohol and WT 513 MJ Vineyard Technology	4	30	70	100
Research Methodology Theory	WT 510 RM		Research Methodology	2	15	70	50
Research Methodology Practical	WT 510 RMP		Research Methodology Practical	2	15	35	50
Choice Based Optional Papers Elective/ Departmental Course **Any one group**	Group I	WT 515 MJ	Viticulture	2	15	35	50
		WT 515 MJP	Practicals Based on WT 515 MJ Viticulture	2	15	35	50
	OR						
	Group II	WT 516 MJ	Alcohol Technology	2	15	35	50
		WT 516 MJP	Practicals based on WT516 MJ Alcohol Technology	2	15	35	50
	OR						
	Group III	WT 517 MJ	Food Technology	2	15	35	50
		WT 518 MJ	Microbial Screening and strain improvement	2	15	35	50
	OR						
	Group IV	WT 519 MJ	Biochemical Engineering	2	15	35	50
		WT 519 MJP	Practicals based on WT 519 MJ Biochemical Engineering	2	15	35	50

IV. M. Sc. First year in Wine, Brewing and Alcohol Technology SemesterII

Assessment of Credits:

WT: Wine Technology; CT: Core Compulsory Theory; CP: Compulsory Practical;

ET: Elective Theory EP: Elective Practical; OJT- Internship/On job training

Course Type	Course Code		Course Name	Credit	Assessment		
					IA	UE	Total
Core Compulsory Theory Papers	WT 521 MJ		Enology-I	4	30	70	100
	WT522 MJ		Brewing Technology-I	4	30	70	100
	WT 523 MJ		Alcohol Technology-I	2	15	35	50
Core Compulsory Practical paper	WT 524 MJP		Practicals based on WT521 MJ Enology-I, WT522 MJ Brewing Technology-I and WT 523 MJ Alcohol Technology-I	4	30	70	100
Internship On job training	WT 520 OJT		Internship /On job training	4	30	70	100
Choice Based Optional Papers Elective / Departmental Course **Any one group**	Group I	WT 525 MJ	Brewing Microbiology	2	15	35	50
		WT 526 MJ	Green Technology	2	15	35	50
	OR						
	Group II	WT 527 MJ	Equipment in alcoholic Beverages	2	15	35	50
		WT 528 MJ	Fermentation Technology	2	15	35	50
	OR						
	Group III	WT 529 MJ	Plant Engineering	2	15	35	50
		WT 529 MJP	Practicals based on WT529 MJ Plant Engineering	2	15	35	50
	OR						
	Group IV	WT 530 MJ	Sensory Evaluation & serving of wine	2	15	35	50
		WT 530 MJP	Practicals based on WT 530 MJ Sensory Evaluation & serving of wine	2	15	35	50

V. Course Evaluation:

Each course will be evaluated for 25 marks per credit of which 30% will be based on continuous/ internal evaluation.

VI. Examination Results:

Results at the end of the semester will be declared using a grade point system as per the University rules.

VII. The GPA:

The formula for GPA will be based on weighted average. The final GPA will not be printed unless a student passes courses equivalent to minimum 80 credit hours. Total credit hours mean sum of credit hours of the courses which a student has passed.

VIII. Rules and University Guidelines:

All other rules will be as per the university guidelines for postgraduate courses under credit-based system.

IX. Important Note:

The above circular supersedes all previous circulars on the credit system being operated at SPPU.

5. General Instructions:

The post-graduate degree will be awarded to students who obtain a total 80 credits (20 average credits per semester). One credit will be equivalent to 15 clock hours of teacher-student contact per semester.

Assessment shall consist of

a) In-semester continuous assessment (30 % Marks)

b) End-semester assessment (70 % Marks)

The teacher concerned shall announce the units for which each in-semester assessment will take place. However, the end-semester assessment shall cover the entire syllabus prescribed for the course. An in-semester assessment of 30% marks should be continuous and at least two tests should be conducted for courses of 4 credits and a teacher must select a variety of procedures for examinations such as:

1. Written test (not more than one or two for each course)
2. Term paper
3. Journal/Lecture/Library notes
4. Seminar presentation
5. Short Quizzes
6. Assignments
7. Extension work
8. An open book test (with the respective subject teacher deciding what books are to be allowed for this purpose)
9. Mini research project by individual student or group of students

The concerned teacher in consultation with the Head of the PG Department shall decide the nature

of questions for the unit test.

Semester end examination for remaining 70% marks will be conducted by Savitribai Phule Pune University. The student has to obtain 40%marksin the combined examination of In-semester assessment and Semester-End assessmentwithaminimumpassingof30%inboththeseseparately.

To pass the degree course, a student shall have to get minimum aggregate 40% marks (E and above grade point scale) in each course. If a student misses an internal assessment examination, he/she will have a second chance with the permission of the principle in consultation with the concerned teacher. Such a second chance shall not be the right of the student.

Internal marks will not change. A student cannot repeat internal assessment. In case he/she wants to repeat internal assessment he/she can do so only by registering for the said course during the $2^{th}/3^{th}$semester on downwards upto 4^{th} semester.

Students who have failed semester-end exam may reappear for semester-end examination only twice in subsequent period. The students will be finally declared as failed if he/she does not pass all credits within a total period of four years. After that, such students will have to seek fresh admission rules prevailing at time.

A student cannot register for the third semester, if she/he fails to complete 50% credits of the total credits expected to be ordinarily completed within two semesters.

ThereshallbeRevaluationofanswerscriptsofsemesterexaminationbutnotofinternalassessment papers as per the Ordinance no. 134 A and B. While marks will be given for all examinations, they will be converted into grades. The semester end grade sheets will have only grades and final grade sheets and transcripts shall have grade points average and total percentage of marks (up to two decimal points). The final grade sheet will also indicate the PG center to which candidate belongs.

Each assessment/test will be evaluated in terms of grades. The grades for separate assignments and the final (semester-end) examination will be added together and then converted into grade and later a grade point average. Result will be declared for each semester and the final examination will give total grades and grade point average.

Reference: Savitribai Phule University's circular on "Rules and Regulation for PG Choice Based credit system for Science Programme of Affiliated Colleges", effective from June 2019 and further amendments.

M. Sc. Wine, Brewing and Alcohol Technology
Part I Semester I
WT 511 MJ Microbiology of Wine, Beer & Alcohol
Total: 4 Credits Workload: -15 hrs/credit
(Total Workload: 4 credits x15 hrs=60 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get..

1. Knowledge of the types of microbes, its cytology, staining techniques and role in alcohol, beer and wine industries.
2. Knowledge of the sterilization and disinfection principles and its use in alcohol, beer and wine industries.
3. Knowledge of the isolation of microbes and its growth in the laboratory using various types of media. Also growth pattern of microbes and its measurement.
4. Knowledge of the use of microbes in various fermentation industries.

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	Introduction to Micro-organisms, classification and staining techniques: 1. Occurrence, types and importance of microbes: Difference between prokaryotic cell and eukaryotic cell, Types of microbes (bacteria, fungi, viruses, protozoa & algae), Industrial applications of bacteria & fungi 2. Stains and staining techniques - Definition of stain and dyes, types of stain, procedure and mechanism of monochrome staining, Gram staining and negative staining. 3. Bacterial cytology: Ultrastructure of bacterial cell, study of structure and functions of cell wall, cell membrane, capsule, endospore, flagella 4. Yeast Microbiology: Yeast morphology and taxonomy, Ultrastructure of yeast cell, Isolation of yeast, Glucophilic and fructophilic yeast, Nutritional requirements of yeast, Aerobic and anaerobic metabolic pathways in yeast for sugar dissimilation.	1	15
II	Sterilisation and Disinfection : 1. Sterilization, disinfection, antiseptic and antimicrobial agents, characteristics of ideal disinfectant 2. Physical Agents - High temp - moist heat & dry heat Radiations; Ionizing - (X-rays, gamma rays & cathode), Non-ionizing; UV rays, Filtration (Bacteriological filters and HEPA filters), Osmotic Pressure 3. Chemical agents – Phenol & phenolic compounds,	1	15

	detergents, aldehydes, gaseous agents, alcohol, heavy metals, halogens.		
III	Nutrition, cultivation and Growth of microbes: 1. Nutrition – Importance of nutrition, nutritional classification of microorganisms (autotrophic, heterotrophic & photosynthetic), Types of microbiological media - Synthetic, complex, selective, differential and enrichment culture media. 2. Cultivation of microbes - Techniques for isolation of microbes in pure form, Streak plate (Four quadrant & parallel line methods) 3. Introduction to microbial growth, Growth curve, Measurement of growth, continuous growth, Synchronous growth	1	15
IV	Industrially important fermented products: 1. Introduction to industrially important fermented products 2. Role of yeast in industrially important products, study of glycerol fermentation & production of baker's yeast. 3. Role of bacteria in the fermentation process, study of lactic acid & acetic acid fermentation processes. 4. Contamination control in alcoholic fermentations- Introduction to antibiotics, Mechanism of various antibiotics, Effect of microbial contaminants on alcoholic fermentations. Role of antimicrobial substances controlling contamination in alcoholic fermentation.	1	15

References

1. Seattle: American Society for Enology and Viticulture
2. Phil Nicholas, Peter Magarey, Malcom Wachtel: Diseases and Pests
3. P.R. Dry & B.G. CooWTe: Resources-Viticulture Volume-I
4. P.R. Dry & B.G. CooWTe: Practical-Viticulture Volume-II
5. John Kent & Richard Early: Pesticide applications in Vineyards
6. Robert E. White: Soil for fine wines
7. Andrew markides & Richard Gibson: Australian Society of Viticulture Enology
8. Donald L. Flaheherty, L. Peter Christensen, W. Thomas Lalini, James J. Marosis, Phil
9. Philips, Lloyd T. Wilson: Grape pest management
10. Prof. Ralph E. Kunkee: Introduction to wine Making-Viticulture andEnology-3.
11. Konig Helmut: Biology of microorganisms on grapes, in must and wine

WT 512 MJ: Biochemistry of wine, Beer & Alcohol

Total: 4 Credits Workload: -15 hrs/credit

(Total Workload: 4 credits x 15 hrs = 60 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Knowledge of the basic concepts of biochemistry.
2. Kowledge of the proteins, amino acids, lipids, their types and metabolism
3. Knowledge of the enzymes & vitamins, their kinetics and its use in in alcohol, beer and wine industries.
4. Knowledge of the biochemistry of alcoholic fermentation, basic pathways involved and biochemistry of secondary fermentation of wine.

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	Concept of Biochemistry: 1. Buffers, its types and importance 2. Principles of analytical, Techniques-Introduction to chromatography and spectrophotometer. 3. Bioenergetics-concept of free & energy, endothermic & exothermic reactions. 4. Photosynthesis: Definition, importance and mechanism, light reaction, Dark reactions and factors affecting the photosynthesis rate. 5. Carbohydrates – Definition and classification of carbohydrates with examples, structure of various carbohydrates. Functions of carbohydrates.	1	15
II	Structure & Functions of Biomolecules: 1. Proteins 2. Carbohydrates 3. Lipids 4. Nucleic acids	1	15
III	Enzymes & Vitamins: 1. Enzymes - Definition, classification, cofactor, co-enzymes mechanisms of enzyme action, applications of enzymes. 2. Enzyme Kinetics: M-M Kinetics, Effect of pH & temperature on Enzyme Kinetics. 3. Large scale production of Enzymes- Pectinase & Amylase 4. Industrial Application of enzymes 5. Vitamins- Definition, classification, biochemical & physiological functions	1	15

IV	Biochemistry of alcoholic fermentation: 1. Definition of alcoholic fermentation, pathways involved in alcoholic fermentation (anaerobic), Stoichiometry of alcohol fermentation 2. Pasteur-Crabtree effect 3. Malolactic Fermentation - Concept, biochemistry, strains involved in MLF, beneficial and deterious aspects of malic-acid biodegradation 4. Production of metabolites during wine production by bacteria and yeast. 5. Production of biogenic amines and ethyl carbamate. Usage & formation of Sulphur compound. Microbial formation &modification of flavor & off-flavor compounds in wine.	1	15

References

1. Keith Wilson (2005) Practical Biochemistry Biology Principles &Techniques
2. Deb A. C. (1999) Concepts of biochemistry (Theory &Practical)
3. Lehninger Albert L. (1984) Biochemistry
4. David L. Nelson & Michael M. (2005) Lehninger Principles of Biochemistry
5. Sadasivam S. & Manickam A. (2010) Biochemical Methods
6. Gurdeep P.Chaiwal& sham K. Anand (2007) Industrial methods of chemical Analysis
7. Deb A. C.(2004) Fundamentals of biochemistry
8.U Satyanarayana , U Chakrapani, Biochemistry 6th Edition
9.J. L. Jain , Sunjay Jain , Nitin Jain Fundamentals of Biochemistry ; S. Chand Publication

WT 513 MJ Vineyard Technology

Total: 2 Credits Workload: -15hrs /credit

(Total Workload: 2 credits x15 hrs=30hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Idea and information of the physical and chemical properties of soil used for cultivation of grapes, grapevine planting materials and its propagation.
2. Knowledge of the site selection for the cultivation of the grapes, irrigation climate & vegetative analysis
3. Information regarding selection of cuttings treatment and storage, propagation by layering propagation of grafted vines etc,
4. Vineyard establishment, Grapevine pests and diseases, Developmental stages of grapes and harvesting of grapes for wine production.

Credit	Credit Title & Contents	Number of Credits	Number of Hours
I	Soil and Grapevine planting materials and propagation: 1. Physical properties of soil: soil colour, texture, thickness of topsoil, soil water and topography: 2. Chemical properties of soil: soil pH nutrient, type of soil in Maharashtra 3. Site selection: Macroclimate, microclimate, What is site selection?, irrigation climate, soil, vegetative analysis 4. Grapevine propagation: Selection of cuttings treatment and storage, propagation by layering propagation of grafted vines: bench Grafting, budding.	1	15
II	Vineyard establishment, Grapevine pests and diseases, Developmental stages of grapes and Harvesting: 1. Vineyard design: Planting of rootings, care of young vines, training of young vines, pruning of grapevine. 2. Grapevine pest: Light brown Grape berry moths, Grape Mealybrigs, grape phylloxera Asian Lady Beetles 3. Fungal diseases: Downey mildew, Powdery mildew, Anthracnose, Botrytis rot 4. Bacterial diseases: Pierce's disease, Crown gall, Viral: Leaf roll 5. Developmental stages of grapes, chemical composition of grape juice 6. Harvesting methods of grape; Post harvest handling	1	15

References
1. Seattle: American Society for Enology and Viticulture

2. Phil Nicholas, Peter Magarey, Malcom Wachtel: Diseases and Pests
3. P.R. Dry & B.G. CooWTe: Resources-Viticulture Volume-I
4. P.R. Dry & B.G. CooWTe: Practical-Viticulture Volume-II
5. John Kent & Richard Early: Pesticide applications in Vineyards
6. Robert E. White: Soil for fine wines
7. Andrew markides& Richard Gibson: Australian Society of Viticulture Enology
8. Donald L.Flaheherty, L. Peter Christensen, W. Thomas Lalini, James J. Marosis, Phil A.
9. Philips, Lloyd T. Wilson: Grape pestmanagement
10. Prof. Ralph E. Kunkee: Introduction to wine making-Viticulture andEnology-3.

WT 514 MJP: Practical's based on WT 511 MJ, WT 512 MJ, WT 513 MJ
Compulsory Practical Paper
Total: 4 Credits Workload: 30hrs/credit
(Total Workload: 4 credits x 30 hrs =120 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Hands on experience of handling of microbes and microscopic observations etc.
2. Skills of Isolation and characterization of yeast, lactic acid bacteria and acetic acid bacteria from beverages samples.
3. Practical skills of Inoculum development of yeast & determination of exponential phase of growth and detection of sugars from raw materials used for alcohol fermentation.
4. Hands on experience of determination of Temperature, pH, water holding capacity of soil for grape cultivation, observations of downey mildew on infected leaves of grapevine, Grafting techniques used in vineyards and study of various harvesting techniques used in vineyards.

Credit Title & Contents	Number of Credits	Number of Hours
1. Safety measurement, basic learning techniques in microbiology & Biochemistry laboratory. 2. Isolation and Characterization of yeast. 3. Isolation and Characterization of LAB. 4. Isolation and Characterization of AAB. 5. Study of Bacterial motility by Hanging Drop Method. 6. Basic staining techniques: i) Monochrome Staining ii) Negative Staining iii) Gram staining iv) Calcofluor White 7. Inoculum development of yeast & determination of exponential phase of growth. 8. Detection of sugars (Benedict's & Fehling's) 9. Determination of starch of grain 10. Titration of strong acid with strong base & Titration of weak acid with strong base 11. Detection of reducing sugars by DNSA/ Lane & Eynon method. 12. Demonstration of Gas Chromatography 13. Determination of Temperature, pH, water holding capacity of soil sample. 14. Study of Downey mildew on infected leaves of grape vine 15. Grafting techniques used in vineyards 16. Study of various harvesting techniques used in vineyards 17. Estimation of protein content by Biuret method	4	120

Research Methodology

Compulsory Theory Paper

Total: 2 Credits Workload :-15hrs/credit

(Total Workload:-2 credits x 15 hrs =30 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Understand research terminology
CO2	Describe quantitative, qualitative and mixed methods approaches to research
CO3	Identify the components of a literature review process
CO4	Analyze and interpret the research
CO5	Apply ethical principles of research in preparation of scientific documents

WT 510 RM- Research Methodology **CompulsoryTheory Paper** **Total: 2 Credits Workload :-15hrs/credit** **(Total Workload:-2 credits x 15 hrs =30 hrs in semester)**		
Credit	**Credit Title and Contents**	**Number of Lectures**
I	**1.** History of research. **2.** Research concept: Definition, Characteristics, Objectives, Utility **3.** Types of Research: Descriptive vs. Analytical Research; Applied vs. Fundamental Research; Quantitative vs. Qualitative Research; Conceptual vs. Empirical Research 4. Problem Identification & Formulation: Formulating the research problem, Defining the research problem, Origin of the research problem 5. Literature Review: Purpose of the literature review, Types of information and sources, Primary and secondary sources **6.** Research Objectives **7.** Research design: Types of research design (descriptive research design, correlational research design, experimental research design, explanatory research design) 8. Research methods: Quantitative research, Qualitative research, Experimental research, and mixed methods approaches, Data Analysis and Interpretation, Sample collection and processing techniques (Water, soil, air and medical)	15

	9. Citation: Methods, Bibliography, citation rules **10.** Current trends in Research: Mono-disciplinary Research, Trans-disciplinary Research, Inter-disciplinary Research, Threats and Challenges to Good Research	
II	1. Data Presentation: Presentation skills, formal scientific presentation skills; Preparing power point presentation, Presenting the work, Scientific poster preparation 2. Research report writing: Purpose of the writing, Types and Formats of scientific reports, scientific writing skills, Significance of communicating science, ethical issues, Copy rights and plagiarism, Components of a research paper 3. Preparation of Project Proposal – Time frame and work plan – Budget and Justification	15

WT 510 RMP: Research Methodology **Compulsory Practical Paper** **Total: 2 Credits Workload :-30hrs/credit** **(Total Workload:-2 credits x 30 hrs =60 hrs in semester)**		
Credit	**Title and Contents**	**Number of hours**
	Seminar presentations, group activities, and scientific writing sessions based on above theory course. These will include but not limited to- 1. Use of search engines for scientific data mining 2. Use of reference management tools 3. Preparing power point presentation 4. Statistical data analysis using software 5. Presenting a research article 6. Writing an abstract for a research paper 7. Preparing a graphical abstract using software 8. Writing a concept note for research project 9. Scientific poster preparation & presentation 10. Writing a scientific news article or a science blog 11. Preparing and scientoon **12.** Participating in group discussions, conferences, symposia etc.	**60**

WT 515 MJ: Viticulture
Group I Major Elective Theory

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

Course outcomes (Cos)

By studding this course learners will be able to get

1. Knowledge of the soil management for grape cultivation, the role of soil in root growth, soil moisture, soil air, soil temperature, organic matter and biological factor; Climate: Light, Temperature, Air, Rainfall, Humidity, carbon dioxide and effect of climate at different growth stages etc.
2. Knowledge of the planting material used for grape cultivation, sanitary selection, disease elimination, genetic selection etc.
3. Knowledge of the development stages of grapes, its harvesting and post-harvest management of grapes used for wine production.
4. Information and idea of the biotechnological tools to access genetic purity and diversity, Applications of genetically control mechanism in grapes development and development of grape varieties resistant to various biotic and abiotic stresses.

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	Soil management & planting: 1. Soil management: The role of soil in root growth, soil moisture, soil air, soil temperature, organic matter and biological factors (climate, light, temperature, air, rainfall, humidity, carbon dioxide) and effect of climate at different growth stages (dormant period, bud burst period, flowering, post setting and harvest period) 2. Planting material: Introduction, sanitary selection, disease elimination, genetic selection	1	15
II	Developmental stages of grapes, Harvesting, Post-Harvest management & Scenario of grapes: 1. Differences between Muscadine grapes & Evatis species, Berry structure, Development stages of the grape, flavour and aroma compounds of the mature grape, phenolic compound in grape. 2. Harvesting operation, mechanical harvesting and drying of grapes: Maturity standard, harvesting periods, packing. 3. Postharvest handling, processing, transportation and marketing; Leading grape and wine countries in the world, Grape production scenario of India and major states in India, statistical data of grape production in global and Indian scenario 4. Biotechnological tools to access genetic purity and diversity. Applications of genetically control mechanism in grapes	1	15

	development. Development of grape varieties resistant to various biotic and abiotic stresses.		

References

1. Phil Nicholas, Peter Magarey, Malcom Wachtel: Diseases and Pests
2. P.R. Dry & B.G. CooWTe: Resources-Viticulture Volume-I
3. P.R. Dry & B.G. CooWTe: Practical-Viticulture Volume-II
4. John Kent & Richard Early: Pesticide applications in Vineyards
5. Robert E. White: Soil for fine wines
6. Andrew Markides & Richard Gibson: Australian Society of Viticulture Enology
7. Donald L. Flaheherty, L. Peter Christensen, W. Thomas Lalini, James J. Marosis, Phil A.
8. Philips, Lloyd T. Wilson: Grape pest management

WT 515 MJP : Practicals based on WT 515 MJ: Viticulture
Group I Major Elective Practical
Total: 2 Credits Workload: 15hrs./credit
(Total Workload: 2 credits x 30 hrs. = 60 hrs. in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Hands on experience of study the anatomical features of grapevine stem & study the pruning techniques of grapevine.
2. Hands on experience of technique of "T" budding for propagation of grape plant and to test the soil sample for presence of chlorides, alkalinity or acidity of soil sample for grape cultivation.
3. Hands on experience of determination of Brix and pH of grape juice and to study different disorders of grape fruit.
4. Pracical experience to study of different grapevine pests and their control measures and to test the soil sample for presences of sulphate as well as to study different nutrient deficiencies and their effect on grapevine

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	1. Determination of anatomical features of grapevine stem. 2. Pruning techniques of grapevine. 3. The technique of "T" budding for propagation of grape plant. 4. Test the soil sample for presence of chlorides, iron, Calcium carbonates. 5. Determination of the alkalinity or acidity and Electric conductivity of soil sample	1	30
II	1. Determination of Brix and pH of grape juice 2. Study different disorders of grape fruit (any three) 3. Study of different grapevine pests and their control measures 4. Test the soil sample for presences of sulphates and phosphates by suitable method 5. Study of different nutrient deficiencies and their effect on grapevine	1	30

WT 516 MJ : Alcohol Technology-I
Group II Major Elective Theory

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

Course outcomes (Cos)

By studding this course learners will be able to get

1. Overview of molasses composition, grades, storage and cost.& details of molasses weighing system used in distillery.
2. Knowledge of the BH Molasses, sugar syrup & sugarcane juice used for alcohol fermentation & its composition and use for alcohol fermentation. Also they get information about molasses dilution practices adopted and design of diluter, quality of dilution water used in distillery. Also they get information about Pre-Clarification of molasses advantages &drawback.
3. Knowledge of the Classification of alcohols, Important chemical reactions of alcohol, Scenario of ethanol blending programme in India, Current status of ethanol blending programme.
4. Knowledge regarding alcohol based chemicals.

Credit	Credit Title & Contents	Number of Credits	Number of Hours
I	Raw material for alcoholic fermentation and its manufacturing 1. Introduction to first and second generation of ethanol. 2. Introduction to various feedstock for alcohol fermentation-grain, sweet sorghum, sugar beet, rice, maize, bajara, wheat, dates & cashew apple. 3. Overview of Molasses composition, grades, storage and cost.& Details of molasses weighing system. 4. BH Molasses,sugar syrup & sugarcane juice composition and use for alcohol fermentation. 5. Molasses dilution practices adopted and design of diluter, quality of dilution water used; Quality of water and molasses dilution practices. Pre-Clarification of molasses advantages &drawback..	1	15
II	Chemistry of alcohol: 1. Definition of Alcohol. Physical and chemical properties of alcohol 2. Classification of alcohols, Important chemical reactions of alcohol 3. Production of alcohol by synthetic method, Uses of Alcohol. 4. Scenario of ethanol blending programme in India, Current status of ethanol blending programme. Requirement of ethanol in India for 15 and 20% ethanol blending in petrol 5. Alcohol based chemicals: Detail study of reactions involved,	1	15

	manufacturing process, uses, list of manufacturers- Acetaldehyde, Acetic acid, Acetic-Anhydride, Butanol, Ethyl acetate, Butyl acetate, acetone, Ethyl ether, Diethyl oxalate.		

References
1. The Alcohol Textbook –W.M.Inledew.
2. Handbook of Alcohol beverages - by AlanBuglass.
3. HandbookofFermentationandDistillation–A.C.Chatterjee.
4. Distillation Engineering handbook by Parthasarathi30hattopadhyay
5. Malt whisky – by Charles MacLean
6. Distiiledspiritsproduction, technology, innovation–byJ.H.Bryce,J.R.Piggott

WT 516 MJP: Practicals based on WT 516 MJ: Alcohol Technology-I
Group II Major Elective Practical
Total: 2 Credits Workload: 15hrs./credit
(Total Workload: -2 credits x 30hrs. = 30hrs.insemester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Hands on experience of determination of ethanol content of spirit sample by oxidation method and determination of fermentation efficiency of yeast growing on molasses medium.
2. Skills of determination of various parameters of rectified spirit
3. Hands on experience of testing of spirit for good quality.
4. Information of selection of spirit for liquor industry by analyzing various parameters.

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	1. Determination of ethanol content of spirit sample by oxidation method. 2. Determination of fermentation efficiency of yeast growing on molasses medium. 3. Determination of total acidity of rectified spirit. (ISI method) 4. Determination of volatile acidity of rectified spirit (ISI method) 5. Determination of aldehyde content of Rectified Spirit (AOAC Method)	1	30
II	1. Determination of ester content of Rectified Spirit (AOAC Method) 2. Determination of fuel oil content in spirit sample 3. Determination of furfural content in spirit sample. 4. Potassium permanganate test for finding the quality of spirit. 5. Industrial Visit	1	30

References
1. The Alcohol Textbook –W.M.Inledew. 2. Handbook of Alcohol beverages - by AlanBuglass. 3. HandbookofFermentationandDistillation–A.C.Chatterjee. 4. Distillation Engineering handbook by Parthasarathi31hattopadhyay 5. Malt whisky – by Charles MacLean 6. Distiiledspiritsproduction, technology, innovation–byJ.H.Bryce,J.R.Piggott

WT 517 MJ Food Technology
Group III Major Elective Theory

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

Course outcomes (Cos)

By studding this course learners will be able to get

1. Classifications and composition of fruits, vegetables and spices.
2. Food additives used in food industries.
3. Theory of food spoilage
4. Effect of spoilage & microbes in fermented food.

Credit	Credit Title & Contents	Number of Credits	Number of Hours
I	Introduction to Food: 1. Scope of food science & Technology 2. Functions of food. 3. Classifications and composition of fruits, vegetables and spices. 4. Food additives-Preservatives, colouring agents, flavour enhancer, anti-oxidants, artificial sweetener, stabilizer, maturing.	1	15
II	Food Microbiology & Food health: 1. Food spoilage-effect of spoilage & microbes in fermented food. 2. Food adulteration & food poison. 3. Technology of wheat, rice, millet &pulses	1	15

References

1. Sumati R. Mudambi, Rajagopal M.V.; Fundamentals of food & nutrition, New Age International Publisher.
2. Potter NN, Hotckiss J.H. Food Science CBS Publishers and Distributors.
3. S. Manany, NS Swamy Food facts and Principles. New Age International Publishers.
4. Murano, Peter S Understanding food sciences and Technology, Thomson.
5. Banwart GJ (1989) Basic Food Microbiology AV1 Publisher.
6. JRN Taylor in Enclyopedia of Grain Science, 2004 Vijayakhader, Textbook of food science & technology ICAR.
7. B Sreelekshmi, Food Science

WT 518 MJ: Microbial Screening & Strain improvement
Group III Major Elective Theory
Total:2 Credits Workload: -30hrs/credit
(Total Workload: -2 credits x15hrs = 30 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Knowledge regarding primary & secondary screening of microbes.
2. Information about the detection & assay of fermentation products.
3. Knowledge of strain improvements and its techniques
4. Knowledge of Improved yeast strains used in alcoholic beverages.

Credit	Credit Title & Contents	Number of Credits	Number of Hours
I	Screening& Assay: 1. Primary & Secondary Screening 2. Detection & assay of fermentation products – physical, chemical assay & biological assay 3. Standard cultures, culture collection centres. 4. Objectives of culture collection centres.	1	15
II	Strain Improvements: 1. Strain improvements and its need-isolation of mutants by modification of permeability, feedback inhibitor, auxotrophic mutants, resistant mutant for secondary metabolites. 2. Genetic Engineering-general outline. (Host cells & vectors), molecular tools of genetic engineering, basic techniques in genetic engineering, nucleic acid blotting technique 3. Improved yeast strains used in alcoholic beverages.	1	15

References

1. L.E. Casida, JR; Industral Microbiology; New Age International Publisher's.

2. P.E. Stanbury, A. Whitaker & S. J. Hall, Principles of Fermentation Technology, 2nd Ediion.

3. U. Satyanarayana, U. Chakrapani, Biotechnology, Uppala. Author Publisher interlinks.

WT 519 MJ: Biochemical Engineering
Group IV Major Elective Theory

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

Course outcomes (Cos)

By studding this course learners will be able to get

1. Microbial cell growth kinetics
2. Stoichiometry and Stoichiometry of microbial growth and product formation
3. Techniques used for recovery and purification of products:
4. Finishing steps for purification of product

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	Microbial cell growth kinetics and stoichiometry: 1. Batch growth, Quantifying growth kinetics, Growth of cells in continuous culture 2. Stoichiometry of microbial growth and product formation – Introduction, Stoichiometric calculations, Theoretical predictions of yield coefficients	1	15
II	Recovery and purification of products: 1. Separation of insoluble products (Filtration, Centrifugation, Coagulation & flocculation) 2. Cell disruption (Mechanical & non mechanical methods) 3. Separation of soluble products (Liquid liquid extraction, Aqueous two phase extraction, Precipitation& Adsorption) Finishing steps for purification (Crystallization & drying)	1	15

References
Bioprocess engineering Basic Concepts-Michael L. Shuner & Fikret Kargi, Second Edition

WT 519 MJP: Practicals Based on WT 519 MJ Biochemical Engineering
Group IV Major Elective Practical

Total: 2 Credits Workload: 30 hrs/credit
(Total Workload:-2 credits X 30 hrs = 60 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Hands on experience of I solation of the intracellular enzyme
2. Hands on experience of isolation of extracellular enzyme
3. Hands on experience of evaluation of acetic acid by HPLC
4. Hands on experience of Separation of fermentation broth by membrane filtration

Credit Title & Contents	Number of Credits	Number of hours
1. Isolation of the intracellular enzyme (Isolation & purification of Enzymes) 2. Isolation of the extracellular enzyme (Isolation & purification of Enzymes) 3. Demonstration of control of pH and foam during fermentation	1	30
1. Demonstration of fermentation of acetic acid and citric acid 2. Evaluation of acetic acid by HPLC 3.Separation of fermentation broth by membrane filtration	1	30

References
Bioprocess engineering Basic Concepts-Michael L. Shuner & Fikret Kargi, Second Edition

M. Sc. Wine, Brewing and Alcohol Technology
Part I Semester II
WT 521 MJ Enology-I
Compulsory Theory Paper

Total: 4 Credits Workload: 15 hrs /credit3

(Total Workload: 4 credits 15 hrs = 60 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Knowledge of history of wine, classification and nutritional aspects of wine.
2. Knowledge of principal constituents of grape juice & wine
3. Knowledge of production of red and white wine from grapes.
4. knowledge of Oak & Cooperage

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	History and classification of wine: 1. Introduction: History of wine making, present international and national status of wine production, commercial aspect of wine production. 2. Classification of wine- table wines, sparkling wine, dessert wines, aperitif wine. 3. Nutritional and health aspects of wine -Chemical contents of grapes and wine in relation to nutrition 4. Contribution of Antioxidant with respect to human health, List of diseases cured by wine. 5. Comparison of Red, white and sparkling wine at nutritional point of view. 6. Overview of world and Indian wine scenario: - Major wine producing countries in the world. 7. The current and future wine prospectus in India New concept of wine production: organic, biodynamic wine, Ice wine, etc.	1	15
II	Principal constituents of grape juice & wine: 1. Principal constituents of grape- sugar, acid, mineral, polyphenols, flavour components, proteins. 2. Principal constituents of wine, alcohols, acids, volatile acidity, reducing sugar, glycerol, aldehydes &ketones. 3. Overview of white wine & red wine grape varieties. 4. Overview of sparkling wine varieties and styles.	1	15
III	Production of wine: 1. Detailed Red wine production stages - harvesting to bottling 2. Detailed White wine production stages - harvesting to bottling 3. Sparkling wine production stages - Traditional method,	1	15

	transfer		
IV	Oak & Cooperage: 1. Oak species, Barrel production, Chemical constituents of oak, In barrel fermentation, Advantages & disadvantages of oak 2. Bottle & other container Glass bottles, Bag in container	1	15

References

1) Pascal Ribereau , (2000) Hand book of enology volume–I

2) Ron s. Jockson (2000) Wine science principles practices &perception

3) Brue W. Zoecklein, Kenneth Fugelsang, Barry H. Gump Fred S. Nury

(1999) Wine Analysis and production

4) C. S. Ough (1992) Wine making Basics

5) Roger B.Boulton (1996) Principles and practices of winemaking

6) Emile Peynalld (1984) Knowing &making wine

7) Patrice Iland& Peter Gago (1997) Australian wine from the grasp vine to the glass

8) Brue W. Zoecklein (1999) Wine Analysis and production

WT 522 MJ: Brewing Technology-I
Compulsory Theory Paper
Total: 4 Credits Workload:-15 hrs /credit
(Total Workload:- 4 credits x 15 hrs = 60 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. knowledge of history, classification and various styles of beer.

2. knowledge of overview of basic raw materials used for brewing process.

3. knowledge of use of barley and malt for brewing process.

4. knowledge of use of hops and yeast for brewing process.

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	History and overview of Industrial Brewing: 1. Introduction, Brewing in an Agrarian World, The Nineteenth Century, the Twentieth Century 2. An overview of Brewing: Introduction, outline of the Brewing steps, Malting, Milling and Adjunct Use, Mashing, Wort separation, Wort boiling, Trub removal, Wort cooling/Aeration, Yeast handling, Yeast pitching, Fermentation, Yeast removal, Aging, Clarification, packaging and warehouse practices. 3. Beer origin, classification and beer styles : 4. Their origins and classification-Introduction: How different styles are created, Factors involved in styles of Beer, Ingredients: Water, fermentable carbohydrates, Hops yeast. 5. Processing: Equipment configuration, milling, mashing Lautering, Boiling time, Fermentation Temperature, Maturation time, filtration, Packaging, Marketing, Cultural 6. Various important Beer Styles and Beer style guidelines. 7. Chemical composition of beer.	1	15
II	Basic raw materials of brewing water: 1. Brewery water consumption Brewery water categories water hardness, water alkalinity & pH effect of ions in water 2. Inorganic and organic impurities of water 3.Water quality reports parameter – primary standards, Secondary standards & aesthetic standards. 4. Chemical characterization of water types 5. Summary of the influences of various ions during beer production	1	15
III	Basic raw materials of brewing – Hops and Adjuncts: 1. Hop classification, hop cultivation, hop harvesting 2. Hops chemistry -Hops- Hop chemistry, whole Hops, Hop Resins, Soft Resins, Hard Resins, Hop oils 3. Hop products – Benefits of hops products, classification of hops	1	15

	product 4. Hops usage - Choice of Hop Product, Hop Utilization, Calculation of Hop Additions 5. Adjuncts: concept, role of adjuncts in brewing, various example of adjuncts		
IV	Basic raw materials of brewing – Barley and malt yeast: 1. Barley and Malt - Barley–Structure and function: the husk the pericarp, testa, Aleurone Layer, Starchy Endosperm, The Embryo 2. Malt Production: Drying, Storage, and Handling, steeping, Germination, Kilning and Malt Quality, Malt varieties Yeast 3. Brewer yeast, Commercial brewery propagation, yeast handling, yeast collection	1	15

References
1. A History of Beer & Brewing by Tan S. Harnesey.
2. Brewing engineering by Stevendeeds.
3. Brewing by Michel j. lewis, tom w.young
4. Water a comprehensive guide for brewers by Johnpalmer
5. Yeast the practical guide to beer fermentation by Chris white with Jamilzaiansheff

WT 523 MJ: Alcohol Technology-II
Compulsory Theory Paper

Total : 2 Credits Workload: -15 hrs /credit

(Total Workload : 2 credits, 15 hrs =30 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Knowledge of yeast maintenance in distillery industry
2. Knowledge of propagation of yeast in distillery
3. Details of alcohol fermentation
4. Batch fermentation process of alcohol fermentation and its control

Credit	Credit Title & Contents	Number of Credits	Number of Hours
I	Yeast maintenance and propagation in distillery: 1. Design of yeast vessels, material of construction and its maintenance. 2. Propagation practices of yeast adopted under plant conditions. Measurement of number of yeast cells/yeast count etc. Use of Baker's yeast. Active Dry yeast and yeast Acidification / pre-treatment practices. 3. Pre-fermentation practices adopted for yeast propagation prior to inoculation to main fermenter. Prefermenter & its material of construction, its maintenance. Use of sterile air/sparging system in Pre-fermenter.	1	15
II	Details of alcoholic fermentation: 1. Definitions of various terms related to alcoholic fermentation, Pathways involved in yeast during aerobic growth and anaerobic mode of alcohol fermentation. Formation of glycerol and other by products during fermentation. How to minimize the rate of glycerol formation? Overview of major contaminating agents and its effect on quality of alcohol. 2. Process of Batch fermentation, factor influencing efficiency of fermentation, characteristics of Batch Fermentation Process, Control over fermentation operation, contamination, control, material of construction of fermenters, maintenance of fermenter and operational conditions on plant scale. 3. Efficiency of Fermentation and Attenuation data calculations – Related examples and solutions. 4. Alcoholmetry – proof spirit (British and USA) over proof, under proof, specific gravity of alcohol strength of alcohol in terms of concentration –related examples and solution. 5. Prevention of losses of alcohol during fermentation, post – fermentation practices/scrubbing etc. Post clarification of fermented wash; advantages and disadvantages.	1	15

	6. Opportunities & challenges for syrup fermentation, sugarcane juice/sugarcane syrup to ethanol fermentation. 7. Guidelines for use of sugarcane juice or sugarcane syrup for ethanol fermentation by DFPD.		

References
1. The Alcohol Textbook –W.M.Inledew.
2. Handbook of Alcohol beverages - by AlanBuglass.
3. HandbookofFermentationandDistillation–A.C.Chatterjee.
4. Distillation Engineering handbook by Parthasarathi Chattopadhyay
5. Malt whisky - by Charlesmaclean
6. Distiiledspiritsproduction,technology,innovation–byJ.H.Bryce,J.R.Piggott

WT 524 MJP Practicals based on WT 521 MJ, WT 522 MJ, WT 523 MJ
Compulsory Practical Paper

Total: 4 Credits Workload: 15 hrs/credit
(Total Workload: 4 credits x 30 hrs = 120 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Determination of pH, total acidity, Volatile acidity of wine & must.

2. Determination of free & total Sulphur dioxide of wine, soluble solids of grape juice& wine by refractometry & hydrometry.

3. Preparation of sample of barley for chemical analysis. & determination of Moisture & Extract content of barley.

4. Determination of ethanol content of spirit sample, fermentation efficiency of yeast growing on molasses medium

Credit Title & Contents	Number of Credits	Number of hours
1. Determination of pH and total acidity, Volatile acidity of wine & must. 2. Determination of free & total Sulphur dioxide ofwine. 3. Study of total soluble solids of grape juice& wine by refractometry & hydrometry. 4. Determination of moisture content of cork. 5. Determination of total reducing sugar of wine. 6. Preparation of wine from grapes. 7. Sampling, grading& germination of barley. 8. Preparation of sample of barley for chemical analysis. & Determination of Moisture & Extract content of barley. 9. Determination of Specific Gravity & Extract of wort. 10. Determination of Reducing sugar content& Fermentable saccharides of wort. 11. Sampling & physical tests of malt. 12. Determination of moisture& extract content of malt 13. Determination of ethanol content of spirit sample by oxidation method 14. Determination of fermentation efficiency of yeast growing on molasses medium. 15. Determination of total & fixed volatile acidity of rectified spirit (ISI method)	4	120

WT 525 MJ: Brewing Microbiology
Group I Major Elective Theory

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

Course outcomes (Cos)

By studding this course learners will be able to get

1. Knowledge of microflora of barely & malt
2. Knowledge of Gram positive and Gram negative bacteria involved in brewing process.
3. Knowledge of wild yeast involved in brewing process.
4. Knowledge of rapid detection of microbial spoilage

Credit	Credit Title & Contents	Number of Credits	Number of Hours
I	1. The microflora of barely & malt: The microflora of barely & malt, Effects of microorganisms on malting & Effects of the microflora on beer & distilled spirit, Health Hazards, Assessment of mould contamination. 2. Gram-positive brewery bacteria: Introduction, Lactic acid bacteria, *Lactobacillus*, *Pediococcus*, *Leuconostoc*, Homofermentative cocci, *Micrococcus* & *Staphylococcus*, Endospore forming bacteria, Identification of genera of Gram Positive Bacteria of brewery origin. 3. Gram-negative spoilage bacteria: Acetic acid bacteria, Enterobacteriaccae, *Zymomonas*, Anaerobic Gram-negative rods, Megsphaera, Miscellaneous non-fermentative bacteria, Detection, Enumeration & isolation.	1	15
II	1. Wild yeast in brewing: Detection of wild yeasts, Identification of wild yeasts, and Effects of wild yeasts in the brewery, Elimination of wild yeasts. 2. Rapid detection of microbial spoilage: Impedimetric techniques (Conductance, capacitance), Microcalorimetry, Turbidometry, Flow cytometry, Microcolony method, direct epifluorescence filter technique.	1	15

References

1. A History of Beer & Brewing by Tan S.Harnesey.
2. Brewing engineering by Stevendeeds.
3. Brewing by Michel j. lewis, tom w.young
4. Water a comprehensive guide for brewers by Johnpalmer
5. Yeast the practical guide to beer fermentation by chris white with jamilzaiansheff
6. Malt a practical guide from field to brewhouse by johnmallett
7. Hops by stan Hieronymus

WT 526 MJ : Green Technology
Group I Major Elective Theory

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

Course outcomes (Cos)

By studding this course learners will be able to get

1. knowledge of green chemistry and technology
2. knowledge of role of industry, Industrial ecology, role of industrial ecology in green technology
3. knowledge of Concept of biorefinery, Concept of circular economy, and formation of biochemicals
4. knowledge of Waste to wealth Production of Bio CNG, Biocompost, Hydrogen, etc.

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	Introduction to green chemistry and technology: 1. Twelve principles of green chemistry, Green technology-definition importance, factors affecting green technology 2. Role of industry, Industrial ecology, role of industrial ecology in green technology, Introduction to Government policies for green product formation	1	15
II	Green product formation: 1. Concept of biorefinery, Concept of circular economy, Formation of biochemicals-Fermented product formation of Ethanol, Lactic acid, Poly hydroxyl alkanoates, Hydrogen & Butanol 2. Waste to wealth Production of Bio CNG, Biocompost, Hydrogen, etc.	1	15

References
1.Green chemistry : An introductory text-3 rd Edition, Mike Lancaster, Royal Societyof Chemistry
2. New Trends in Green Chemistry-V K Ahluwalia, M Kidwai, Kluwer AcademicPublishers

WT 527 MJ: Equipment in alcoholic beverages
Group II Major Elective Theory
Total:2Credits Workload :-15 hrs. /credit

(Total Workload :-2 creditsx 15hrs.= 30hrs.insemester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. knowledge of Required utilities services & industrial equipments used in alcohol industries
2. Information of functions and uses of each equipments
3. Winery & brewery Sanitization
4. Special Lab equipment's used in alcohol industries

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	Required utilities services & industrial equipments: 1. Water– Various water sources, Hardness and need for softening, Water pressure requirements, Hot water needs & systems. 2. Electric supply – Power supply requirement to run various equipment's, air-conditioning, humidifiers, dehumidifiers, Chilling system. 3. Study the functions and uses of each equipments - Sorting tables, receivers/ hoppers, pneumatic press, de-stemmers and crushers, basket press. Heat exchangers -plate heat exchanger & tube –in-tube exchanger. Study of tanks used in wine and beer-. Temperature sensors, actuators, display and control panel, hoses and fittings, micro-oxygenation systems, various filters and clarification equipment used in winery as well as in brewery.	1	15
II	Winery & brewery Sanitization: 1. Functions, types, and uses of - CIP systems, sanitization, pressure cleaners, spray nozzles, air locks, pest controllers, bottling, filtration systems, pest controllers 2. Special Lab equipment's: Functions, types, and uses of - ebulliometer, centrifuge, dissolved oxygen meter, torque tester, colorimeter, oven/ dessicator, sampling devices, pressure checking equipment, spectrophotometer ,bottling machines, fillers, corking machines, screw cappers, labelling machines	1	15

References
1. Buglass, Alan J. - Handbook of alcoholic beverages technical, analytical and nutritional aspects vol.1 & 2
2. David, Bird-Understanding wine technology- Vol.1, Resources
3. David, Storm- Winery utilities: planning, design and operation

4. Liptak, Bela G.-Analytical instruments
5. Roger, B. Boulton, and Vernon Singleton- Principles and practices of winemaking
8. Voet D. and Voet J. G. (2011). Biochemistry. United Kingdom: Wiley

WT-528 MJ : Fermentation Technology
Group II Major Elective Theory

Total: 2 Credits Workload: 15 hrs. /credit

(Total Workload: 2 credits x 15hrs. = 30 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Scope and importance of fermentation and types of fermenters
2. Sterilization process used in fermentation
3. Development of Inoculum for industrial fermentation
4. Details of production media fomulation

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	Introduction to Fermentation: 1. Scope and importance of fermentation 2. Types of Fermentation-Batch, Continuous & Fed-Batch 3. Types of fermenter: Batch fermenter, Continuous, Stirred tank, Tubular 4. Fermenter, Fluidised bed fermenter, Bed fermenter, Solid state fermenter, Hollow fibre fermenter 5. Introduction to online to control of fermentation process 6. Sterilization: Introduction, Media Sterilization, Design of batch fermentation 7. Sterilization processes, Sterilization of fermenter, Filter sterilization.	1	15
II	Development of Inoculum for industrial fermentation & Production media: 1. Criteria for transfer of inoculum Development of inoculum for yeast processes Development of inoculum for bacterial processes Development of inoculum for mycelia processes 2. Production media-characteristics of ideal production media 3. Raw materials: Saccharine material, Starchy material, Cellulosic Hydrocarbon and vegetable oils, Nitrogenous material 4. Composition of grape juice as fermentation on medium with respect To source 'C', 'N', Amino acid, Vitamins, Minerals, pH, Water, Buffering capacity, Additives used in wine fermentation. 5. Media Optimization.	1	15

References
1. Industrial Microbiology- A. H. Patel (2008) 2. Principal of Fermentation Technology- Peter stanbuzy, A. Whitaker(2008) 3. Fermentation Microbiology & Biotechnology – Dr. Mansi & Prof. Chalie Bryce 4. Fermentation Technology- M. L. Srivastava 5. Biotechnology –B. D. Singh 6. Industrial Microbiology- L. E. Casida

WT 529 MJ : Plant Engineering
Group III Major Elective Theory
Total: 2 Credits Workload: 15 hrs/credit
(Total Workload : 2 credits x 15 hrs= 30 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Mass, Material and steam balance, Process design development and General design considerations
2. Computer-aided design, Optimum design and design strategy
3. project economics
4. Cost and asset accounting, Cost estimation, Interest and investment costs, Taxes and insurance.

Credit	Credit Title & Contents	Number of Credits	Number of Hours
I	Plant Engineering: Mass, Material and steam balance, Process design development, General design considerations, Computer-aided design, Optimum design and design strategy, Materials selection and equipment fabrication	1	15
II	Project economics: Cost and asset accounting, Cost estimation, Interest and investment costs, Taxes and insurance, Depreciation, Profitability, Alternative investments, and replacements.	1	15

Reference Books:

1. Plant Design and Economics for Chemical Engineers-Max S. Peter, Klaus D. Timmerhaus.
2. Process Engineering and Plant Design: The Complete Industrial Picture -Siddhartha Mukherjee

WT 529 MJP: Practicals based on WT 529 MJ Plant Engineering
Group III Major Elective Practical

Total: 2 Credits Workload : 15 hrs./credit
(Total Workload: 2 credits x 30 hrs = 60 hrs in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Measurement of properties of liquids using various tools
2. Students may get hands on experience of calibration of various equipments and its importance
3. Determination of the heat transfer coefficient for Shell and Tube heat Exchanger
4. Calibration of various equipments used in industries

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	1. Measurement of properties of liquids (must, wort, molasses, wine, sugar syrups etc.) using Specific gravity bottle, ^{0}Brix hydrometer, handheld Refractometer 2.Calibration of Bimetallic Thermometer OR RTD based temperature indicator 3. Calibration of pH meter 4. Practical calculation of refrigeration loads for wine storage 5.Determination of the heat transfer coefficient for plate type heat exchanger (Demonstration)	1	30
II	1. Determination of the heat transfer coefficient for Shell and Tube heat Exchanger (Demonstration) 2. Calibration of conductivity meter 3. To study the characteristics of simple distillation. 4. To calibrate pressure gauge and vacuum gauge using dead weight tester andplot its output response curve.	1	30

Reference Books:

1. Plant Design and Economics for Chemical Engineers-Max S. Peter, Klaus D. Timmerhaus.
2. Process Engineering and Plant Design: The Complete Industrial Picture -Siddhartha Mukherjee

WT 530 MJ: Sensory Evaluation & Serving of wine
Group IV Major Elective Theory

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

Course outcomes (Cos)

By studding this course learners will be able to get

Sensory Evaluation & Serving of wine
2. Threshold of sweetness, acid taste & bitterness
3. Scoring wine and wine evaluation under different conditions
4. Wine aroma –Primary,Secondary&Tertiary and wine serving principles.

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	Sensory Evaluation & Serving of wine: 1. Definition& terminology 2. The basic tastes of wine: bitterness, acidity, salt, sweetness, and alcohol on the tongue. 3. Sensory perception -study of tongue anatomy with reference to sensory response. 4. Factors influencing taste perception. 5. Threshold of sweetness, acid taste & bitterness 6. Pre- tasting organization – testing area, number of samples replicates, temperature, cork removal, decanting, dispensers, glasses, number of tasters. 7. Study of effervescence, ISO standard glass, Tears.	1	15
II	Scoring wine and wine evaluation under different conditions. 1. Intorudction to tasting sheet: table wine 2. Introduction to tasting sheet: sparkling wine 3. Introduction to aroma wheel: 4. To study the effect of pH on wine 5. Effect of age on wine 6. Effect of temperature on wine 7. Evaluation of sense of feel 8. Aroma wheel for wine evaluation 9. Scoring of wine using different sheet 10. Serving wine with food 11. Wine aroma –Primary,Secondary&Tertiary	1	15

References
1.Ronald S. Jackson (2002) Wine Testing a professional handbook 2.Ron s. Jockson (2000) Wine science principles practices & perception 3.Vine, Richard p (1997) Wine Appreciation 4.Emile Peynavd (1997) The taste of wine 5.Brue W. Zoecklein, Kenneth Fugelsang, Barry H. Gump Fred S. Nury (1999) Wine Analysis and production 6.C. S. Ough (1992) Wine making Basics 7.Roger B.Boulton (1996) Principles and practices of wine making 8.Emile Peynalld (1984) Knowing & making wine.

WT 530 MJP: Practicals based on WT 530 MJ Sensory Evaluation & serving of wine
Group IV Major Elective Practical

Total: 2 Credits Workload : 15hrs. /credit
(Total Workload: 2 credits x 30 hrs. = 60 hrs. in semester)

Course outcomes (Cos)

By studding this course learners will be able to get

1. Experience of Study the detection threshold of sweetness & acid taste
2. Experience of study the detection threshold of bitterness
3. Experience of Study the taste threshold by Difference test; triangle test
4. Experience of Scoring of wine using different tasting sheet.

Credit	Credit Title & Contents	Number of Credits	Number of hours
I	1. Study the detection threshold of sweetness 2.Study the detection threshold of acid taste 3.Study the detection threshold of bitterness 4.Study the Interaction of sweet and acid taste	1	30
II	1.Study the taste threshold by Difference test; triangle test 2. Study the effect of pH& age of wine 3. Study the influence of temperature on wine 4. Scoring of wine using different tasting sheet.	1	30

References

1.Ronald S. Jackson (2002) Wine Testing a professional handbook
2.Ron s. Jockson (2000) Wine science principles practices & perception
3.Vine, Richard p (1997) Wine Appreciation
4.Emile Peynavd (1997) The taste of wine
5.Brue W. Zoecklein, Kenneth Fugelsang, Barry H. Gump Fred S. Nury (1999) Wine Analysis and production
6.C. S. Ough (1992) Wine making Basics
7.Roger B.Boulton (1996) Principles and practices of wine making
8.Emile Peynalld (1984) Knowing & making wine.