Savitribai Phule Pune University

(*Formerly University of Pune*)

Faculty of Science and Technology

Revised Syllabi for

M.Sc. (Wine, Brewing & Alcohol Technology) Part-II

NEP 2020

For Colleges

Affiliated to Savitribai Phule Pune University

To be implemented from Academic Year 2024-2025

Course Structure and assessment of credits:

1. **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.

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Credit Framework for Post Graduate (PG):

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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.

2. **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

Course Type	Course Code		Course Name	Credit	Assessment		
					IA	UE	Total
Core Compulsory Theory Paper	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		Practical's 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	Practical's based on WT 515 MJ	2	15	35	50
	OR						
	Group II	WT 516 MJ	Alcohol Technology	2	15	35	50
		WT 516 MJP	Practical's based on WT 516 MJ	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	Practical's based on WT 519 MJ	2	15	35	50

3. **M. Sc. First year in Wine, Brewing and Alcohol Technology Semester II 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 Paper	WT 521 MJ		Enology-I	4	30	70	100
	WT 522 MJ		Brewing Technology-I	4	30	70	100
	WT 523 MJ		Alcohol Technology-I	2	15	35	50
Core Compulsory Practical	WT 524 MJP		Practical's based on WT 521 MJ, WT 522 MJ, and WT 523 MJ	4	30	70	100
Internship	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	Practical's based on WT 529 MJ	2	15	35	50
	OR						
	Group IV	WT 530 MJ	Sensory Evaluation & Serving of Wine	2	15	35	50
		WT 530 MJP	Practical's based on WT 530 MJ	2	15	35	50

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

Assessment of Credits:

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

ET: Elective Theory; EP: Elective Practical; RP: Research Project

Course Type	Course Code		Course Name	Credit	Assessment		
					IA	UE	Total
Core Compulsory Theory Paper	WT 601 MJ		Enology – II	4	30	70	100
	WT 602 MJ		Brewing Technology- II	4	30	70	100
	WT 603 MJ		Alcohol Technology - II	2	15	35	50
Core Compulsory Practical	WT 604 MJP		Practical's based on WT 601 MJ, WT 602 MJ, WT 603 MJ	4	30	70	100
Research Project	WT 631 RP		Research Project	4	30	70	100
Choice Based Optional Papers Elective / Departmental Course **Any one group**	Group I	WT-610 MJ	Advance Marketing of Alcoholic Beverages	2	15	35	50
		WT 610 MJP	Practical's Based on WT 610 MJ Marketing of Alcoholic Beverages	2	15	35	50
	OR						
	Group II	WT 611 MJ	Food Safety, Standards and Regulations.	2	15	35	50
		WT 611 MJP	Practical's based on WT 611 MJ Food Safety, Standards and Regulations.	2	15	35	50
	OR						
	Group III	WT 612 MJ	Quality Control Aspects of Beverages	2	15	35	50
		WT 613 MJ	Beer Quality and Safety	2	15	35	50
	OR						
	Group IV	WT 614 MJ	Heritage Liquor	2	15	35	50
		WT 615 MJ	Policy Norms of Beverages	2	15	35	50

IV. M. Sc. Second year in Wine, Brewing and Alcohol Technology - Semester IV

Assessment of Credits:

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

ET: Elective Theory; EP: Elective Practical;

Course Type	Course Code		Course Name	Credit	Assessment		
					IA	UE	Total
Core Compulsory Theory Paper	WT 651 MJ		Industrial Waste Treatment and Environment Management	4	30	70	100
	WT 652 MJ		Business Management of Alcoholic Beverages	4	30	70	100
Core Compulsory Practical	WT 653 MJP		Practical's based on WT 651 MJ, WT 652 MJ	4	30	70	100
Choice Based Optional Papers Elective / Departmental Course **Any one group**	Group I	WT-660 MJ	Advance Enology - III	2	15	35	50
		WT 660 MJP	Practical Based on WT 660 MJ Advance Enology-III.	2	15	35	50
	OR						
	Group II	WT 661 MJ	Advanced Brewing Technology-III.	2	15	35	50
		WT 661 MJP	Practical's based on WT 661 MJ Advanced Brewing Technology-III.	2	15	35	50
	OR						
	Group III	WT 662 MJ	Advanced Alcohol Technology-III	2	15	35	50
		WT 662 MJP	Practical's based on WT 662 MJ Advanced Alcohol Technology	2	15	35	50
	OR						
	Group IV	WT 663 MJ	Packaging Techniques in Beverages	2	15	35	50
		WT 664 MJ	Chemical and Plant Engineering	2	15	35	50
In plant Training	In plant Training	WT 681 IT	In plant Training or Research Project	6	45	105	150

M. Sc. Wine, Brewing and Alcohol Technology Part II Semester III

WT-601-MJ Enology-II

Compulsory Theory Paper

Total:4CreditsWorkload: -15 hrs /credit

(Total Workload: -4 credits x15 hrs=60 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Define wine fortification
CO2	Understand role of various microbes in enology
CO3	Determine constituents of grape juice and wine
CO4	Illustrate development of wine parks
CO5	Evaluate quality of wine by sensory analysis
CO6	Understand the principles of wine tasting, including aroma, flavor, and mouth feel analysis.

WT-601-MJ Enology-II

Compulsory Theory Paper

Total: 4 Credits Workload: -15 hrs /credit

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

Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I:** **Role of various microbes in Enology:** 1. Yeast: Introduction, isolation & enumeration of wine yeast. 2. Different yeast species/strains used in winemaking Killer yeast –Killer phenomenon, Role of killer yeast in wine making 3. Concept of yeast autolysis, 4. Enological significance of yeast autolysis	3
	Lactic acids bacteria: 1. Introduction, isolation & taxonomy of LAB. 2. Characteristic of various wine related genera of LAB- Lactobacillus, Leuconostoc, Oenococcus, Pediococcus, and Weissella. 3. LAB and malolactic fermentation (MLF) - Deacidification by MLF conversion, Bacteriological stability following MLF, flavor Change from MLF. **Acetic acid bacteria:** 1. Introduction, isolation & taxonomy of AAB, 2. Acetic acid bacteria in grapes, must, fermentation.	4
	Microbiological spoilage of wine & its control: 1. Definition of microbiological spoilage, Origin of wine spoilage microorganism. 2. Spoilage by yeast, LAB, AAB& its control, Additional spoilage	8

	problems, Contamination control of wine, Untypical aged flavor, Heat, Accidental contamination.	
II	**UNIT II:** **Sensory Analysis and tasting of Wine:** 1. Selection of different types of glass, serving temperature. 2. Wine tasting- Smell of wine, taste & colour of wine, Factors affecting sensory analysis. 3. Sensory analysis profile of white, red and sparkling wine. 4. Matching wine with food such as sweet, sour, salty and spicy food with wine.	8
	Tasting Situation- **1.** Wine competition, trade tasting, wine appreciation and home tasting. **2.** Tasting exercise- Duo-tri test, blind testing, triangular test.	7
III	**UNIT III:** **Pre- tasting Organization-** Testing area, number of sample replicates, temperature, cork removal, decanting, dispensers, glasses, number of tasters.	8
	Concept of Wine Parks: 1. Concept of wine parks recent developments. 2. Wine parks & nodal agencies for establishment of Wine Park in India. 3. Status of wine parks in India with reference to case study. 4. Important wine zones in India.	7
IV	**UNIT IV:** **Fortified wines:** 1. Concept of fortification. 2. Quality standards for spirit used for fortification	4
	Specialized Techniques in Wine Production: Sherry Solera, Port, and Noble Rot Sweet Wines, Botrytized wine 1. Detailed study of sherry wine production - solera system 2. Detailed study of port wine production 3. Detailed study of sweet wine production from noble rot infected grapes 4. Botrytized wine	11

Suggested Reference Book :

1. Ribereau-Gayon, P., Dubourdieu, D., Donec he, B., &Lonvaud, A. (2006). *Handbook of Enology, Vol. I: The Microbiology of Wine and Vinification*. American Society for Enology and Viticulture.
2. Markides, A., & Gibson, R. (Eds.). *Australian Society of Viticulture and Enology*. Seattle: American Society for Enology and Viticulture.
3. Kunkee, R. E..*Introduction to Winemaking, Viticulture and Enology 3*.
4. Iland, P., & Gago, P. *Understanding Wine: Course Notes*.
5. Jackson, R. S. *Wine Science*.
6. Ribereau-Gayon, P., Dubourdieu, D., Maujean, A., & Glories, Y. (2006). *Handbook of Enology, Vol. 2: The Chemistry of Wine Stabilization and Treatments*.
7. Margalit, Y., & Crum, J. *Concepts on Wine Chemistry: The Wine Appreciation Guide.*

8. Vine, R. P., Harkness, E. M., & Linton, S. J.*Winemaking from Grape Growing to Marketplace*.
9. Iland, P., Bruer, N., Ewart, A., Markides, A., & Sitters, J. *Monitoring the Winemaking Process: From Grapes to Wine Techniques and Concepts*. Publisher Name.
10. Vine, R. P*Wine Appreciation*.
11. Zoecklein, B. W., Fugelsang, K., Gump, B. H., & Nury, F. S. (1999). *Wine Analysis and Production*.
12. Ough, C. S. (1992). *Winemaking Basics*.
13. Boulton, R. B. (1996). *Principles and Practices of Winemaking*.
14. Peynaud, E. (1984). *Knowing & Making Wine*.
15. Iland, P., & Gago, P. (1997). *Australian Wine: From the Grapes Vine to the Glass*.
16. Zoecklein, B. W. (1999). *Wine Analysis and Production*.

WT-602-MJ Brewing Technology-II
Compulsory Theory Paper
Total:4 Credits Workload: -15 hrs /credit
(Total Workload: -4 credits x 15 hrs= 60 hrs in semester)

Course outcomes Cos	
After studying the course learners will be able to	
CO1	Define the level of packaging
CO2	Describe the waste generation in beer making process
CO3	Demonstrate the process of beer making
CO4	Illustrate the factors affecting beer quality
CO5	Compare beer styles based on production techniques
CO6	Evaluate the quality and characteristics of brewing ingredients and their impact on the final product.

WT-602-MJ Brewing Technology-II Compulsory Theory Paper		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I: Yeast metabolism and brew house technology Pure Yeast Cultures** 1. Introduction to Yeast Metabolism 2. Strain Selection and Characteristics 3. Storage, Propagation, and Scale-Up of Yeast Cultures 4. Contamination Control in Yeast Cultures 5. Yeast Washing Techniques 6. Yeast Pitching and Cell Viability 7. Yeast Collection, Storage, and Shipping	4
	Brewhouse Technology: 1. Introduction to Brewhouse Technology 2. General Layout of the Brewhouse 3. Heat Transfer in the Brewhouse: Materials and Techniques 4. Raw Materials Intake and Storage 5. Foreign Object Removal in Raw Materials	2
	Milling: 1. Importance of Milling in Brewing 2. Types of Milling: Roll Mills, Conditioning, and Hammer Milling	2
	Mash Conversion and Separation 1. Purpose of mashing and Basic principles of Mash separation. 2. Mash Tuns,	3

	3. Mashing – systems, 4. The Mash conversion Vessel - Adjunct or Cereal Cookers, Mash Kettle, 5. Mash Acidification, 6. Mash separation systems – Lauter Tuns, strain mster, mash filters, membrane mash filters, The Nortek Mash filters	
	Wort Boiling – 1. Principles of Boiling, Types of Boiling, Objective, 2. Wort preventing, types of wort boiling systems, Energy recovery systems in the Brew house, Hop addition, 3. Work clarification – separation systems, wort cooling and Aeration, plate and frame Heat Exchangers	2
	Removal of cold break, cold sedimentation tank, anstellbottich, centrifugation, filtration, floatation, aeration, yeast addition, Brewhouse efficiency – brewhouse yield, Brewhouse capacity, Brewhouse cleaning.	2
II	**UNIT II: Control of brewing process Fermentation:** Wort Clarification, Aeration laboratory analyse, Pitching – Microbial examination, cell concentration and pitching, pitching process.	2
	Biochemical Aspects and Varieties of Fermentation in Brewing Metabolism & growth – biochemistry of fermentation, growth during fermentation, measurement of growth. Batch fermentations, Lager fermentation, fermentation vessels, characteristics of fermentation, Ale fermentation	3
	Advanced Fermentation Techniques and Factors Influencing Yeast Performance Laboratory analysis during fermentation, factors affecting fermentation, yeast strain and condition, pitching rate and yeast growth, temperature, oxygen, zinc, trub canny over, fermenter geometry, Related fermentations: High gravity fermentations, accelerated fermentations, High-pressure fermentations, Continuous fermentations, low caloric fermentation: - Definition production methods	5
	Non-alcoholic and low alcohol fermentation – Definitions, major deficiencies, production methods, Abnormal Fermentations – Symptoms causes – process variations, Wort nutrient deficiencies yeast changes	3
	Treatments, Beer transfers and yeast separation – yeast cropping consideration, method of cropping – centrifugation, Recovery of carbon dioxide – purity and collection strategies	2
III	**UNIT III:** **Packaging And Sanitation Aspects In Brewery Packaging Technology:** Levels of packaging, packaging materials, packaging and brewing industry, cost of packaging, glass bottles and bottling, bottle filling, PET bottles, cans, Kegs and Kegging, Pasteurization, Tunnel Pasteurization packaging line efficiency.	5
	Introduction to CIP. Sanitation and Pest Control:	5
	Types of pest encountered, integration of sanitation and pest control methods, possible points of contamination, insects control methods, insect monitoring method, safety	5
IV	**UNIT IV:** Brewery by - products and waste valorisation: Composition and feed value of major brewery by-products and competitive	5

	feeds, Brew house effluent, spent Hops and Trub.	
	Wet Brewers Grain Handling and Dewatering, Brewers Grain Drying, Brewers grain Feed Products. Brewer's yeast, Brewers condensed soluble, excess carbon dioxide, spent filter cake	5
	Malt analysis System of analysis of malt, Common analysis –Hot water extract, cold water extract, Moisture content, Diastatic power, Dextrinising units, Colour, Fermentable extract, Friability and homogeneity	5

Suggested Reference Book:

1. American Society of Brewing Chemists. *Methods of Analysis of American Society of Brewing Chemists*. 8th rev. USA: American Society of Brewing Chemists, 1996. ISBN 1-881696-01-4.
2. Arntzen, C.J., ed. *Encyclopedia of Agricultural Science, Vol. 1: A - D*. New York: Academic Press, 1994. ISBN Rs.18802.00 (630.3 ARNARN).
3. Birch, G.G. *Alcoholic Beverages*. London: Elsevier Applied Science Pub., 1985. ISBN Rs.369.20 (663.1 BIR).
4. Government of India. *Technical Excise Manual*. 663.16GOV.
5. Hardwick, W.A., ed. *Handbook of Brewing*. New York: Marcel Dekker, Inc., 1995. ISBN Rs.6181.50 (663.3 HARHAR).
6. Hough, J.S., Briggs, D.E., Stevens, R., Young, T.W. *Malting & Brewing Science, Vol. 2: Hopped Wort & Water*. London: Chapman & Hall, 1982. Rs.591.50 (663.3 HOU).
7. Pollock, J.R.A., ed. *Brewing Science, Vol. 1*. London: Academic Press, 1979. (663.3 POL).
8. Pollock, J.R.A., ed. *Brewing Science, Vol. 2*. London: Academic Press, 1981. (663.3 POL).
9. Prescott, S.C., Dunn, C.G. *Industrial Microbiology*. Jodhpur: Agrobios (India), 2002. ISBN 81-7754-149-8.
10. Priest, F.G. *Brewing Microbiology, 2nd ed.* UK: Chapman & Hall, 1996. ISBN 0412591502 (576 PRI).
11. Priest, Fergus G., Stewart, Graham G. *Handbook of Brewing*, 2nd ed. USA: CRC Press, Taylor & Francis Group, 2006. ISBN 0-8247-2657-x.
12. Harnesey, Tan S. *A History of Beer & Brewing*.
13. Deeds, Steven. *Brewing Engineering*.
14. Lewis, Michel J., Young, Tom W. *Brewing*.
15. Palmer, John. *Water: A Comprehensive Guide for Brewers*.
16. White, Chris, Zainasheff, Jamil. *Yeast: The Practical Guide to Beer Fermentation*.
17. Mallett, John. *Malt: A Practical Guide from Field to Brewhouse*.
18. Hieronymus, Stan. *Hops*.

WT-603-MJ Alcohol technology-II
Core Compulsory Theory Paper
Total: 2 Credits Workload: - 15 hrs /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	Define the maturation and aging of county and foreign liquor
CO2	Describe the rectified spirit, extra neutral alcohol and anhydrous alcohol
CO3	Illustrate the Indian & International standards of molasses and various alcohol
CO4	Categorize the manufacturing process of extra neutral alcohol and anhydrous alcohol
CO5	Compare the atmospheric and multipressure distillation
CO6	Gain knowledge of global and local regulations governing the production, labelling, and distribution of alcoholic beverages.

WT-603-MJ Alcohol technology-II		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I: Characteristics of Various alcohols, denaturation and by-products of alcohol and manufacturing of extra neutral alcohol** 1. Characteristics of various alcohols, denaturation, and by-products of alcohol. 2. Composition of Wash, RS, EQRS, ENA, EQENA, FA, AA and IS. Denaturation of spirit – Denaturating agents 3. Ware house practices – Excise Rules & Regulations. 4. Distillation – Atmospheric distillation process and its operation & maintenance, Specifications of plant and machinery	3
	By-Products and Production of Extra Neutral Alcohol in Alcohol Manufacture: By-products - CO2, fuel oil & yeast sludge.Manufacture of Extra Neutral Alcohol, Anhydrous alcohol/Fuel ethanol Process details, utilities requirement, specifications of ENA, quality aspect, specifications of plant and machinery	5
	Industrial Ethanol Production: Azeotropic Distillation and molecular sieve dehydration methods: 1. Azeotropic mixture commercial production of ethanol by azeotropic distillation. Distillation efficiency, 2. Effect of traces of entrainer (benzene, cyclohexane, monoethylene glycol) on fuel ethanol. Rules with examples,	5
II	**UNIT II: Reduction, blending and analytical aspects of alcoholic beverages** Reduction, blending and alcoholic beverages; Making of various Alcoholic beverages- Classification of beverages, liquor, country liquor manufacturing process**.** Production methods of Indian rice beer and other beverages like Pachwai, Bhaati Jaanz, Chhang, Raksi, Thensing, Bhagchang, Apong etc.	5

	Quality Assurance and Global Standards in IMFL Manufacturing: Quality control aspects. Global practices for manufacturing of IMFL.	3
	1. Maturation and aging: changes during maturation (spirit characters, aroma, flavor etc). Types of wood used for cask/barrel making. 2. Typical design of barrel.	3
	1. Role of excise department in alcoholic beverages industry. 2. Shelf life of alcoholic beverages.	1
	1. Analytical aspects of alcohol and alcoholic beverages. 2. Overview of IS and international standards of molasses, various alcohol and alcoholic beverages. 3. Proper sampling of spirit samples for analysis.	4
	1. Introduction to important Global organizations in all over the world involved in analysis of spirit and beverages. 2. Overview of distillery industry in India and world.	1

Suggested Reference Book :

1. Jacques, T. P. Lyons, D. R. Kelsall. *The Alcohol Textbook*. ISBN 978-1-4051-2497-3.
2. Rao, Satyanarayana. *Alcoholometry*. ISBN 978-8173714697.
3. Chatterjee, A.C. *Handbook of Fermentation & Distillation*. ISBN 978-8173716219.
4. Barron, H.C. *Distillation*. ISBN 978-0070052810.
5. *Technical Excise Manual*.
6. Paturao. *Byproducts of Sugar Industry*.

WT-604-MJP Practical based on WT 601 MJ, WT 602 MJ and WT 603 MJ

Core Compulsory Practical Paper

Total:4 Credits Workload: - 30 hrs /credit

(Total Workload: -4 credits x 30hours=120 hours in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Study properties of Wine, Indian-made foreign liquor, Spirits
CO2	Understand basic concepts of Indian-made foreign liquor, spirit
CO3	Determine chemical parameters of Indian-made foreign liquor, spirit
CO4	Illustrate methods of wine making from raw material other than grapes
CO5	Assess wine sensory analysis parameters
CO6	Understand maturation and aging processes in spirits production.

WT-604-MJP Practical based on WT 601 MJ, WT 602 MJ and WT 603 MJ Core Compulsory Practical Paper		
Practical No.	**Credit Title & Contents**	**Number of Hours**
1	Determination of residue on evaporation of whisky sample.	**120**
2	Determination of ethyl alcohol content of whisky, brandy and spirit and wine by specific gravity method	
3	To determine the volatile acidity and methyl alcohol content of whisky	
4	Reduction of the spirit	
5	Blending of spirit	
6	Propagation of yeast in laboratory	
7	Isolation of lactic acid bacteria from wine	
8	Determination of acetic acid content of wine by HPLC/spectrophotometric technique	
9	Detection of microbial contamination in beer	
10	Determination of starch content in grain flour sample.	
11	Estimation of hop bitterness and colour of beer	
12	Quality control aspects of cap, label and bottles of IMFL (2 Practical's)	
13	Sensory evaluation of wine samples (white, red, sparkling)	
14	Alcohol production from corn/sorghum/sweet potato/molasses	
15	Alcohol estimation in wine and beer (by ebuliometer) or denistometer	
16	Determination of reducing sugar of wine by Lane and Eynon method	
18	Making of wine from other than grapes	

Suggested Reference Book :

1. Ribereau-Gayon, P., Dubourdieu, D., Doneche, B., Lonvaud, A. (Eds.). (2000). *Handbook of Enology, Vol. I. The Microbiology of Wine and Vinification*. Chichester: John Wiley & Sons.
2. American Society for Enology and Viticulture, Seattle.
3. Australian Society of Viticulture and Enology.. Andrew Markides, Richard Gibson.
4. Kunkee, R. E. *Introduction to Winemaking, Viticulture and Enology 3*..
5. Iland, P., Gago, P. *Understanding Wine - Course Notes*.
6. Jackson, R. S. *Wine Science*.
7. Ribereau-Gayon, P., Dubourdieu, D., Maujean, A., Glories, Y. (Eds.). (2000). *Handbook of Enology, Vol 2 - The Chemistry of Wine Stabilization and Treatments*. Chichester: John Wiley & Sons.
8. Margalit, Y., Crum, Jn*Concepts on Wine Chemistry - The Wine Appreciation Guide*..
9. Vine, R. P., Harkness, E. M., Linton, S. J..*Winemaking from Grape Growing to Marketplace*. Publisher not specified.
10. American Society of Brewing Chemists. (1996). *Methods of Analysis of the American Society of Brewing Chemists* (8th rev.). U.S.A.: American Society of Brewing Chemists. ISBN: 1-881696-01-4.
11. Arntzen, C. J. (Ed.). (1994). *Encyclopedia of Agricultural Science, Vol. 1: A - D*. New York: Academic Press. ISBN: (630.3 ARNARN).
12. Birch, G. G. (1985). *Alcoholic Beverages*. London: Elsevier Applied Science Publishers. ISBN: (663.1BIR).
13. Government of India. *Technical Excise Manual*. ISBN: (663.16GOV).
14. Hardwick, W. A. (Ed.). (1995). *Handbook of Brewing*. New York: Marcel Dekker, Inc. Price: Rs.6181.50. ISBN: (663.3 HARHAR).
15. Hough, J. S., Briggs, D. E., Stevens, R., Young, T. W. (1982). *Malting & Brewing Science, Vol. 2: Hopped Wort & Water*. London: Chapman & Hall. Price: Rs.591.50. ISBN: (663.3HOU).
16. Jacques, T. P., Lyons, T., Kelsall, D. R..*The Alcohol Textbook*.
17. Rao, S. *Alcoholometry*.
18. Chatterjee, A. C..*Handbook of Fermentation & Distillation*.
19. Barron, H. C..*Distillation*.
20. Paturao. *Byproducts of Sugar Industry*.

WT 631 RP: Research project
4 Credits

Course outcomes Cos	
After studying the course, learners will be able to	
CO1	Identify and model problems linked to the beverage industries
CO2	Develop technical, inter personal and communication skill
CO3	Apply theoretical aspects in practical situations by accomplishing the tasks with respect to social, cultural, global and environmental responsibility
CO4	Analyze the challenges and future potential of outcomes with respect to industrial issues
CO5	Evaluate the training/research experience in terms of their personal, educational and career perspective
CO6	Develop presentation skills to present the research outcomes

Research project (Individual/groups)

The Opportunity to analyze a particular industry based problem or topic in depth. Conduct a relevant lab or library- based study.
To provide a chance to improve fundamental research & analysis, skills & advance understanding of then processes involved in Wine technology, Brewing technology or Alcohol technology.
Student has to undertake an extended investigation in an advanced topic of relevance to their degree discipline or to their Sponsoring industrial partner.
The research project builds on the taught modules of the course. Students should analyses their results & present the same in the form of a dissertation that includes a review of previous research & set their work in context with critically argued discussion.
Students should contribute via seminars or posters or publication to the research activity of the host /work institution

WT-610-MJ Advance Marketing of Alcoholic Beverages
Group I Major Elective Theory
Total: 2 Credits Workload: - 15 hrs /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	Describe wine marketing principles
CO2	Understand basic wine marketing terminologies
CO3	Examine consumer beheviour and marketing strategies
CO4	Categorize marketing opportunities
CO5	Summarize financial management
CO6	Demonstrate strategic management skills in the context of alcoholic beverages.

WT-610-MJ Advance Marketing of Alcoholic Beverages Group I Major Elective Theory		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I:** **Overview of the Alcoholic Beverages Industry (World Scenario and Indian Scenario)** **1.** Historical perspective of Alcohol Industry 2. Market size and growth trends, Key players, and 3. Various Indian or International Alcohol Brands Study.	3
	UNIT II: **Consumer Behaviour in Alcoholic Beverages** 1. Basics of consumer buying behavior 2. Understanding consumer preferences 3. Factors influencing purchasing decisions 4. Segmentation and targeting of consumers, 5. Buyer decision process specific to alcoholic beverages	6
	UNIT III: **Extended Marketing Mix (7P's)** 1. Product Levels, Product Life Cycle (PLC), New Product Development Process	6

	2. Price - Pricing Objectives and Strategies, Psychological Pricing and Discounts 3. Place (Distribution) - Role of Distribution in Marketing, Types of Distribution Channels 4. Promotion - Advertising, Sales Promotion, Public Relations, Direct Marketing, Personal Selling 5. Promotion Mix Strategies, People - Importance of People in Services Marketing	
II	**UNIT IV:** **Advanced Elements of the Extended Marketing Mix:** Process - Role of Process in Service Delivery, Physical Evidence - Role of Physical Evidence in Customer Perception	**5**
	UNIT V: **Surrogate Marketing:** 1. Fundamentals of Surrogate Advertising. 2. Case study of any Wine/Beer/Alcohol brand Surrogate Advertising **International Marketing:** **1.** Fundamentals of International Markets and Marketing **2.** Types of international marketing: Export franchising, licensing, and joint venture	**10**

Suggested Reference Book :

1. Kotler, P., & Keller, K. L. (2016). *Marketing Management: Offers Insights into Strategic Marketing Decisions, Product Lifecycle Management, Pricing Strategies, and Promotion Mix Strategies.*
2. Wagner, P., Olsen, J., & Thach, L. (2011). *Wine Marketing and Sales.*
3. Moulton, K., & Lapsley, J. *Successful Wine Marketing.*
4. Varhncya, P. L., &Bhattachary, B. *International Marketing Management.*
5. Rothbaum, N. *The Business of Spirits: How Savvy Marketers, Innovative Distillers, and Entrepreneurs Changed How We Drink.*
6. Hawkins, D. I., Mothersbaugh, D. L., & Best, R. J. *Consumer Behavior: Building Marketing Strategy.*
7. Kotler, P., & Armstrong, G. *Principles of Marketing: A Classic Textbook that Covers All Aspects of Marketing, Including the Extended Marketing Mix (7 P's) and International Marketing.*
8. Keegan, W. J., & Green, M. C. *Global Marketing: Focuses on International Marketing Strategies, Including Export Strategies and International Market Dynamics.*
9. Brown, A. (Ed.). *Alcohol Advertising: A Global Legal Perspective: Covers Regulatory Frameworks and Ethical Considerations in Alcohol Marketing Across Various Countries.*

WT-610-MJP Practical on Advance Marketing of Alcoholic Beverages
Group I Major Elective Practical

Total: 2 Credits Workload: - 30 hrs /credit
(Total Workload: - 2 credits x30 hrs = 60 hrs in semester)

Course outcomes Cos	
After studying the course learners will be able to	
CO1	Identify advertising and promotion management aspects
CO2	Understand bottle labelling and packaging
CO3	Demonstrate e-commerce design and digital marketing
CO4	Illustrate industrial analysis report
CO5	Develop brand and label for alcoholic beverages
CO6	Assess regulatory compliance and ethical considerations in alcohol marketing.

WT-610-MJP Practical on Advance Marketing of Alcoholic Beverages Group I Major Elective Practical		
Practical No.	**Credit Title & Contents**	**Number of Hours**
1.	Market Analysis Project : (Wine/Beer/Alcohol Market of India)	**60 hours**
2.	Consumer Buying Behaviour Survey in Alcoholic Beverages	
3.	Develop Marketing Strategy for a New Alcoholic Beverage Brand	
4.	Design an E-commerce/Digital Marketing Program for Wine/Beer/Alcohol	
5.	Develop Brand Identity and Label Design – Practical Application	
6.	Bottle Labelling, Packaging, and Promotional Activities	
7.	Identify International Marketing Strategy	
8.	Identify Regulatory Compliance and Ethical Marketing	
9.	Design Business Product based on Extended Marketing Mix	
10.	Design Surrogate Advertising Plan for your Wine/Beer/ Alcohol Brand.	
11.	Seminar I	
12.	Seminar II	
13.	Presentation: Marketing Strategy Pitch for a New Product	
14.	Case Study of Prominent brands Analysis Report (Beer, Wine, Spirits)- Any	

	one	
15.	Visit to Winery/Brewery/Distillery: Hands-on Industry Experience	

Suggested Reference Book :

1. Wagner, P., Olsen, J., & Thach, L. Wine Marketing and Sales.
2. Hawkins, D. I., Mothersbaugh, D. L., & Best, R. J. Consumer Behavior: Building Marketing Strategy.
3. Kotler, P., & Keller, K. L. Marketing Management: Offers Insights into Strategic Marketing Decisions, Product Lifecycle Management, Pricing Strategies, and Promotion Mix Strategies.
4. Smith, R. Digital Marketing Strategies for Alcoholic Beverages.
5. Solomon, M. R. Consumer Behavior: Buying, Having, and Being.

WT-611-MJ Food Safety, standards and regulations
Group II Major Elective Theory
Total: 2 Credits Workload: - 15 hrs /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 the basic principles and concepts of food safety.
CO2	Identify common foodborne pathogens and their sources.
CO3	Explain food quality attributes and factors affecting food quality.
CO4	Understand national and international food standards and their significance.
CO5	Comply with food safety laws, regulations, and standards (e.g., FDA, EU regulations, Codex Alimentarius).
CO6	Implement and manage food safety management systems (e.g., HACCP)

WT-611-MJ Food Safety, Standards, and Regulations **Group II Major Elective Theory**		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**Unit-1:** **Introduction to Food Safety and food Microbiology:** 1. Overview of food safety principles. 2. Importance of food safety regulations. **3.** Historical perspectives on food borne illnesses.	3
	Microorganisms in food 1. Factors influencing microbial growth and survival. 2. Food borne pathogens and toxins.	5
	Types of food contaminants (physical, chemical, biological), Sources of contamination in food production and processing	5
	Hazard Analysis and Critical Control Points (HACCP) principles	2
II	**Unit-2: Food Safety Management Systems** 1. Overview of international food safety standards (ISO, Codex Alimentarius). 2. FDA and USDA regulations (for US-focused courses)	3
	1. Methods for food safety testing (microbiological, chemical, allergens). 2. Sampling techniques and interpretation of results 3. Role of food testing laboratories	5

	Good Manufacturing Practices (GMPs)	1
	Food Safety and Hygiene Practices: From Sanitation to Global Implications 1. Sanitation and hygiene practices 2. Cleaning and disinfection in food facilities 3. Food fraud and adulteration. 4. Novel food technologies and safety implications 5. Globalization and its impact on food safety	6

Suggested Reference Book:

1. Ronald Schmidt and Gary E. Rodrick, *Principles of Food Safety and Hygiene*.
2. *Food Control* and *Journal of Food Protection*, scientific journals.
3. Yasmine Motarjemi and Huub Lelieveld, *Food Safety Management: A Practical Guide for the Food Industry*.
4. Ronald Schmidt and Gary E. Rodrick (eds.), *Food Safety Handbook*.
5. Ian C. Shaw, *Food Safety: The Science of Keeping Food Safe*.
6. Debby Newslow, *Food Safety Management Programs: Applications, Best Practices, and Compliance*.
7. Marc C. Sanchez, *Food Law and Regulation for Non-Lawyers: A US Perspective*.
8. Neal D. Fortin, *Food Regulation: Law, Science, Policy, and Practice*.
9. Preston W. Blevins, *Food Safety Regulatory Compliance: Catalyst for a Lean and Sustainable Food Supply Chain*.
10. Rick Costanza, *Understanding Food Systems: Agriculture, Food Science, and Nutrition in the United States*.
11. Sara E. Mortimore and Carol Wallace, *HACCP: A Practical Approach*.
12. Jonathan W. Emord and Gregory Conko, *The Food Safety Modernization Act: A Comprehensive Overview of the Statute and Its Implementation*.

WT-611-MJP Practical on Food Safety, standards and regulations
Group IIMajor Elective Practical
Total: 2 CreditsWorkload: - 30 hrs /credit
(Total Workload: - 2 credits x 30 hrs= 60 hrs in semester)

Course outcomes Cos	
After studying the course learners will be able to	
CO1	Explain the basic principles of food safety, including hazards, contamination routes, and preventive measures.
CO2	Apply knowledge of microbiological, chemical, and physical hazards in food safety management.
CO3	Demonstrate the ability to navigate and comply with regulatory requirements for food handling, storage, labelling, and distribution.
CO4	Implement GMPs and hygiene practices effectively to prevent contamination during food production, processing, and handling.
CO5	Develop and implement HACCP plans specific to food processes or products.
CO6	Monitor and maintain food quality throughout production and distribution processes.

WT-611-MJP Practical on Food Safety, standards and regulations Group II Major Elective Practical		
Practical No.	**Credit Title & Contents**	**Number of Hours**
1	Perform total plate count to determine microbial load in food samples.	60
2	Perform Most Probable Number (MPN) method to estimate coliform count.	
3	Demonstrate proper hand washing techniques to ensure cleanliness before handling food.	
4	Practice sanitizing surfaces and equipment regularly, following recommended protocols (e.g., using sanitizing solutions at appropriate concentrations).	
5	Create sample food labels that comply with local labelling regulations (e.g., listing ingredients, allergens, nutritional information).	
6	Discuss the importance of clear and accurate labelling to prevent allergen cross-contamination and ensure consumer safety.	

7	Develop and implement a HACCP plan for a specific food product or	

Suggested Reference Book:

1. Bhat, R., ed. Practical Food Safety: Contemporary Issues and Future Directions. Academic Press, 2016.
2. Lelieveld, H. L. M., Holah, J., and Zwietering, M. W. H., eds. Handbook of Hygiene Control in the Food Industry. Woodhead Publishing, 2016.
3. Nychas, G.-J. E., and Tassou, C. C. Practical Food Microbiology and Technology. CRC Press, 2012.
4. Dawson, P. L., and Golden, D. A. Food Safety: Theory and Practice. Wiley-Blackwell, 2009.
5. King, H. Food Safety Management: Implementing a Food Safety Program in a Food Retail Business. Academic Press, 2013.
6. Yiannas, F. Food Safety Culture: Creating a Behavior-Based Food Safety Management System. Springer, 2009.
7. Barba, F. J., and Bevilacqua, A., eds. Food Safety: Basic Concepts, Recent Issues, and Future Challenges. Springer, 2016.
8. Motarjemi, Y., and Lelieveld, H. Food Safety Management: A Practical Guide for the Food Industry. Academic Press, 2014.
9. Mortimore, S., and Wallace, C. Food Safety Management: Implementing an Effective Food Safety Management System. Wiley-Blackwell, 2013.
10. Food and Agriculture Organization (FAO). Food Quality and Safety Systems: A Training Manual on Food Hygiene and the Hazard Analysis and Critical Control Point (HACCP) System. FAO, 2006.

WT-612-MJ Quality control aspects of beverages

Group III Theory Paper

Total: 2 Credits Workload: - 15 hrs /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	Define and identify key quality parameters for various types of beverages.
CO2	Implement quality assurance procedures specific to beverage production and packaging.
CO3	Explain the importance of sensory evaluation in assessing beverage quality.
CO4	Apply analytical techniques (e.g., pH measurement, titrations, spectroscopy) to assess and monitor beverage quality.
CO5	Identify microbiological hazards and risks associated with beverage production.
CO6	Evaluate packaging materials and methods to ensure product integrity and prevent contamination.

WT-612-MJ Quality control aspects of beverages Group III Major Elective Theory Paper		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**Unit-1: Introduction to beverage quality, raw material and process** Definition and importance of quality control in beverage production Principles of quality assurance and quality control Regulatory requirements and standards –	5
	Selection criteria for raw materials (water, fruits, grains, etc.) Quality parameters for different ingredients (sugars, acids, preservatives)	5
	Beverage processing methods (thermal processing, fermentation, carbonation) Impact of processing on product quality (flavor, color, stability) Process control and monitoring (temperature, pressure, pH)	5
II	**Unit-2: Chemical Analysis, Sensory Evaluation, Packaging and Shelf-Life** Analytical techniques for assessing beverage quality (spectroscopy, chromatography) Methods for detecting contaminants (pesticides, heavy metals, mycotoxins)	3
	Principles of sensory analysis in beverage quality assessment Panel selection and training	4

	Descriptive analysis and consumer testing	
	Packaging materials and their impact on beverage quality Shelf-life determination and prediction models Packaging integrity testing	4
	Overview of various test of raw material and packaged product 1. Physical test of liquor (Glass particle/paper/dust particle/insects) 2. Chemical test (Oil/grease) 3. Microbiological tests (MPN test) 4. Caramel test for foam test, sludge settling test, sunlight test, pH, Alcohol resistant test	4

Suggested Reference Book :

1. Buglass, Alan J., ed. *Handbook of Alcoholic Beverages: Technical, Analytical and Nutritional Aspects*. Chichester, UK: John Wiley & Sons, 2011.
2. Chandan, Ramesh C., and Charles H. Hui, eds. *Beverage Quality and Safety*. San Diego, CA: Academic Press, 2019.
3. Hui, Y. H., and E. Özgül Evranuz. *Beverage Quality Control and Safety Management*. Boca Raton, FL: CRC Press, 2012.
4. Stone, Herbert, Joel L. Sidel, and Diane Labowsky. *Sensory Evaluation Practices*. 4th ed. San Diego, CA: Academic Press, 2012.
5. Tunick, Michael H., and Charles L. Barnes, eds. *Beverage Industry Microfiltration*. New York: Springer, 2008.
6. Tamime, Adnan Y., ed. *Analytical Methods for Food and Dairy Powders*. Chichester, UK: John Wiley & Sons, 2015.
7. Eßlinger, Hans Michael, ed. *Handbook of Brewing: Processes, Technology, Markets*. 2nd ed. Weinheim, Germany: Wiley-VCH, 2009.
8. Ashurst, Philip R., ed. *Handbook of Noncarbonated Beverages*. Boca Raton, FL: CRC Press, 2011.
9. Wilson, Ted, and Norman J. Temple, eds. *Beverage Impacts on Health and Nutrition*. Totowa, NJ: Humana Press, 2007.
10. Small, Robert W. *Beverage Basics: Understanding and Appreciating Wine, Beer, and Spirits*. New York: John Wiley Sons, 2010.

WT-613-MJ Beer Quality and safety
Group III Theory Paper
Total: 2 Credits Workload: - 15 hrs /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	Understanding the various methods used to monitor and control quality throughout the beer production process.
CO2	Learn how to conduct sensory evaluation and use analytical instrument to assess beer quality.
CO3	Develop skill in identifying and troubleshooting quality issues.
CO4	Learn about the importance of sanitation, hygiene, good manufacturing practices (GMP) in ensuring the safety of beer.
CO5	Gain the understanding of microbiological and chemical hazards that can affect beer safety.
CO6	Analyze how variations in raw materials impact the final beer product.

WT-613-MJ Beer Quality and safety Group III Theory Paper		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I: Quality of Beer** Introduction, physical properties of beer foam, beer foam components, foam structure, improving foam stability, foam assessment, beer colour and beer clarity.	8
	Flavour determinants in beer quality: Introduction, taste of beer, beer aroma and sensory assessment of beer	6
	Maintenance of beer quality: Introduction, beer flavor stability, foam stability, microbial contamination, and beer quality.	6
II	**Unit-2: Safety of Beer:** Nutritional aspects of beer: Beer components of nutritional value, metabolism of alcohol	4
	Risks to food safety,	2
	HACCP: Raw materials, microbiological safety, packaging, deliberate tampering, allergens.	4

Suggested Reference Book:

1. Denise Baxter and Paul S. Hughes, *Beer Quality, Safety and Nutritional Aspects* (Royal Society of Chemistry, 2001).
2. American Society of Brewing Chemists, *Methods of Analysis of the American Society of Brewing Chemists*, 8th rev. (American Society of Brewing Chemists, 1996), 1-881696-01-4.
3. Arntzen, C.J., ed., *Encyclopedia of Agricultural Science, Vol. 1: A — D* (Academic Press, 1994).
4. Birch, G.G., *Alcoholic Beverages* (Elsevier Applied Science Pub., 1985).
5. Government of India, *Technical Excise Manual*.
6. Hardwick, W.A., ed., *Handbook of Brewing* (Marcel Dekker, Inc., 1995).
7. Hough, J.S., Briggs, D.E., Stevens, R., and Young, T.W., *Malting & Brewing Science, Vol. 2: Hopped Wort & Water* (Chapman & Hall, 1982).
8. Pollock, J.R.A., ed., *Brewing Science*, *Vol. 1* (Academic Press, 1979).
9. Pollock, J.R.A., ed., *Brewing Science*, *Vol. 2* (Academic Press, 1981).
10. Prescott, S.C. & Dunn, C.G., *Industrial Microbiology* (Agrobios (India), 2002), 81-7754-149-8.

WT-614-MJ Heritage Liquor
Group IVMajor Elective Theory Paper
Total: 2 Credits Workload: - 15 hrs /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	Explain the historical significance of heritage liquors within their cultural contexts.
CO2	Analyze the impact of local traditions, ingredients, and production techniques on the development of heritage liquors.
CO3	Describe traditional and modern production techniques used in the making of heritage liquors.
CO4	Implement quality control measures to ensure consistency and adherence to traditional standards in heritage liquor production.
CO5	Compare distillation, aging, and blending methods specific to different types of heritage liquors.
CO6	Analyse the historical origins and cultural significance of various heritage liquors (e.g., Scotch whisky, tequila, baijiu).

WT-614-MJ Heritage Liquor Group IV Major Elective Theory Paper		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I: Introduction and Global Diversity of Heritage Liquors** 1. Definition and significance of traditional and heritage liquors 2. Historical evolution and cultural importance 3. Economic and social impact of heritage liquors	5
	Overview of heritage liquors from different regions Geographical indications and cultural heritage protection	5
II	**Unit-II: Raw Materials and Production Techniques, Chemistry and Biochemistry of Heritage Liquors** Selection and sourcing of raw materials and impact of raw materials and production techniques on flavor profiles Production methods of Indian rice beer and other beverages like Pachwai, Bhaati Jaanz, Chhang, Raksi, Thensing, Bhagchang, Apong etc. Production process of Mahua spirit and cashew apple to pheni Traditional fermentation and distillation methods	10
	Chemical composition of traditional beverages and its sensory characteristics	5
	Biochemical processes during fermentation and aging	5

Suggested Reference Book :

1. Broom, Dave. *The World Atlas of Whisky: New Edition*.
2. Broom, Dave. *Rum: The Manual*.
3. Owens, Bill, and Alan Dikty. *The Art of Distilling Whiskey and Other Spirits: An Enthusiast's Guide to the Artisan Distilling of Potent Potables*.
4. Valenzuela-Zapata, Ana G., and Gary Paul Nabhan. *Tequila: A Natural and Cultural History*.
5. Janzen, Emma. *Mezcal: The History, Craft & Cocktails of the World's Ultimate Artisanal Spirit*.
6. Knoll, Aaron. *Gin: The Art and Craft of the Artisan Revival*.
7. Abou-Ganim, Tony. *Vodka Distilled: The Modern Mixologist on Vodka and Vodka Cocktails*.
8. Jarrard, Kyle. *Cognac: The Seductive Saga of the World's Most Coveted Spirit*.
9. Buxton, Ian, and Paul S. Hughes (eds.). *The Science and Commerce of Whisky*.
10. Minnick, Fred. *Bourbon: The Rise, Fall, and Rebirth of an American Whiskey*.
11. MacLean, Charles. *Scotch Whisky: A Liquid History*.
12. Ashcraft, Brian, and Idzuhiko Ueda. *Japanese Whisky: The Ultimate Guide to the World's Most Desirable Spirit*.

WT-615-MJ Policy norms of beverages
Group IVMajor Elective Theory Paper
Total: 2 Credits Workload: - 15 hrs /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	Explain the local, national, and international regulatory frameworks governing the beverage industry.
CO2	Analyze the impact of regulatory policies on beverage production, distribution, marketing, and consumption.
CO3	Analyze current beverage policies and their implications for public health, safety, and economic development.
CO4	Assess the role of beverage policies in promoting public health and safety, including measures to reduce alcohol-related harm and ensure product quality.
CO5	Explore policies and practices aimed at promoting sustainable beverage production, packaging, and waste management.
CO6	Implement strategies to minimize environmental impact throughout the beverage supply chain.

WT-615-MJ Policy norms of beverages Group IVMajor Elective Theory Paper		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I: Introduction to Beverage Policy, National and Regional Regulatory Frameworks** Definition and scope of beverage policy Importance of regulatory frameworks in beverage industries Historical evolution of beverage regulation	3
	Regulatory authorities and their roles Legislation governing beverage production, labeling, and marketing Differences in regulatory approaches across region	2
	Regulatory Compliance and Quality Assurance, Public Health 1. Policies and Beverage Consumption, Environmental and Sustainability policies. 2. Standards and guidelines for beverage safety and quality	3
	1. Compliance requirements for ingredients, additives, and contaminants. 2. Labeling regulations (nutritional information, health claims, allergens). 3. Impact of beverages on public health (e.g., alcohol, sugary drinks)	2
	1. Policies promoting healthy beverage choices (e.g., sugar taxes, alcohol advertising restrictions). 2. Role of government interventions and public awareness campaigns	3

	1. Sustainability challenges in beverage production (e.g., water use, packaging waste). 2. Environmental regulations and sustainability certifications (e.g., organic, fair trade). 3. Case studies on sustainable beverage brands and practices	2
II	Introduction to structure of Excise Department Introduction to excise rules and regulations of molasses, alcohol, Cl, IMFL and other beverages. Food Safety and Standards (Alcoholic Beverages) Regulations, 2018 Distilled Alcoholic Beverages Wine and other Fermented Beverages Beer Specific Labeling Requirements for Alcoholic Beverages **Requirements for Low Alcoholic Beverages other than wine and beer** **Online services offered by State Excise Department:** Citizen services: Premises registration, Temporary/One day function license, One year & lifelong permissions-Cl, IMFL and others. Handling of alcoholic beverages law. Excise duty on molasses, alcohol, CL & IMFL Transport license and regulations of molasses and spirit from one state to other state Transport license and regulations of molasses and spirit –Import and export policies	15

Suggested Reference Book :

1. Anderson, P., Baumberg, B., & Reynolds, A. J. (Eds.). (2013). *Alcohol and Public Policy: Evidence and Issues*. London: Routledge.
2. Casswell, S., et al. (Eds.). (2010). *Global Alcohol Policy and the Public Good*. Oxford: Oxford University Press.
3. Erickson, P., & Gruenewald, P. J. (Eds.). (2013). *Regulating Alcohol around the World: Policy Cocktails*. Oxford: Oxford University Press.
4. Hastings, G., & Roux, D. (Eds.). (2009). *Policy Options and Models for Promoting Safe Beverage Consumption*. Basingstoke: Palgrave Macmillan.
5. Voon, T., et al. (Eds.). (2014). *Regulating Tobacco, Alcohol and Unhealthy Foods: The Legal Issues*. Abingdon: Routledge.

M. Sc. Wine, Brewing & Alcohol Part II

Semester IV

WT-651-MJ Industrial Waste Treatment and Environmental Management

Compulsory Theory Paper
Total: 4 Credits; Workload: -15 hrs /credit
(Total Workload: -4 credits x 15 hrs=60 hrs in semester)

Course outcomes COs	
After studying the course, learners will be able to	
CO1	Identify different types of industrial wastes (e.g., solid, liquid, hazardous) and their sources across various industrial sectors.
CO2	Explain the characteristics and composition of industrial wastes, including their potential environmental impacts
CO3	Develop strategies for waste minimization, resource recovery, and pollution prevention in industrial processes.
CO4	Implement cleaner production techniques and technologies to reduce waste generation and environmental impact.
CO5	Design comprehensive waste management plans that include collection, transportation, treatment, and disposal of industrial waste.
CO6	Evaluate and select appropriate disposal methods, including landfilling, incineration, and secure containment.

WT-651-MJ Industrial Waste Treatment and Environmental Management		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I: Biological treatment fundamentals** 1. Characteristics of distillery effluents & CPCB norms for disposal. 1. Waste treatment methods- Types & Selection Criteria, 2. Aeration principles & types of system	5
	Composting – 1. Microbial aspects & silent features, Economics consideration in composting process. 2. Incineration – Theoretical, considerations, types, incineration systems in practice. 3. Microbiology & Conversion process in anaerobic fermentation, Kinetics of methane fermentation. Energy generation and types of anaerobic system. Type of secondary treatment system.	**10**
II	**UNIT II: Winery & brewery sanitization and waste disposal regulations** Winery sanitization- The Importance of Cleaning and Sanitation in the Winery,	8

	Basic Cleaning, Water Quality, The Solution: Cleaning Compounds, Cleaning Equipment, Sanitizing and Sanitizers, Sterilizing and Sterilizers,	
	Hardware: Tanks, Pumps, Hops, Walls, Floors, Ceilings, Drains, Solid and Liquid Waste Disposal	4
	Government Regulations, Safety, OSHA, EPA, DNR, MSDS, Sanitation Plan	3
III	**UNIT III: Waste water disposal systems in industries and air pollution** Waste Beer, solid waste materials, wastewater disposal and treatments. Sludge treatment, Disposal and Utilization, Land application of Brewery Effluents	5
	Production of single cell protein from Brewery Effluents.	2
	Air pollution: Air pollution control principles &equipments Effects of air pollution on human beings, plants & animals; Global effects- Green house effects, Ozone depletion, heat island, dust storms. Air quality sampling & monitoring: Stack sampling, Instruments & methods of analysis of SO_2, CO_2 etc.	2
	Environmental Audit, Disposal of effluent & soil fertility, Environmental laws, Case studies	6
IV	**UNIT IV: Water conservation in distilleries** Requirement of total water for process and non-process in typical 30 KLPD molasses and grain based distillery. Scope for water recycles of various streams for process. Cost economics of saving of water in distillery with typical case study. Importance of water conservation in distilleries.	3
	Concept of 3R System CREP norms, Define Zero liquid discharge (ZLD), Existing effluent treatment technologies for achieving ZLD in molasses and grain based distilleries as approved by Ministry of Environment & Forest and Climate Change (MoEF& CC) and Central Pollution Control Board.	4
	Importance of environmental clearance, Consent to establishment and consent to operate, Characteristics of spent wash generated in molasses based distilleries and whole stillage generated in grain based distilleries,	4
	Various polluted and non-polluted waste generated in distilleries; Its quantity and mode of disposal (solid/liquid/gas), Technologies for treatment of low strength waste generated in distilleries, Condensate polishing unit (CPU), Reverse osmosis; Environment norms for disposal of effluent on land	4

Suggested Reference Books :

1. Brock, T.D. *Biology of Microorganisms*.
2. Ramalho, R.S. *Introduction of Waste Water Treatment*.
3. Edwards, C.A., and Veeresu, G.U. *Soil Biology & Ecology in India*. Bangalore: University of Agricultural Sciences, 1978.
4. Trivedi, R.K. *Environmental and Industrial Pollution Control. Vol. I*.
5. Ministry of Environment & Forest, Govt. of India. *Technical EIA Guidance Manual for Distilleries*. September 2009.
6. Central Pollution Control Board, Ministry of Environment & Forest. *Management of Distillery Wastewater*. September 2001.

WT-652-MJ Business Management of Alcoholic Beverages
Compulsory Theory Paper
Total: 4 Credits Workload: - 15 hrs /credit
(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)

Course outcomes COs	
After studying the course, learners will be able to	
CO1	Apply management principles and practices specific to the alcoholic beverages industry.
CO2	Analyse operational aspects including production management, quality assurance, and innovation in alcoholic beverages.
CO3	Evaluate financial management techniques and their application within the alcohol industry.
CO4	Assess organizational behaviour and its impact on business management in the context of alcoholic beverages.
CO5	Assess market opportunities and create competitive strategies.
CO6	Optimize business processes to improve efficiency and productivity.

WT-652-MJ Business Management of Alcoholic Beverages Compulsory Theory Paper		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**Unit 1: Introduction to Business Management in Alcoholic Beverages** 1. Management principles and practices. 2. Business communication and soft skills development. 3. Economic environment and entrepreneurial development	15
II	**Unit 2: Operational Aspects in Alcoholic Beverages** 1. Process management: Production organization, capacity planning and technology integration. 2. Production management: Personnel management, cost control, and automation. 3. Quality assurance and compliance: ISO standards, hygiene, and wastewater management. 4. Product development and innovation in alcoholic beverages	15
III	**Unit 3: Financial Management in the Alcohol Industry** 1. Financial management fundamentals. 2. Financial analysis techniques: Ratio analysis, cost-volume-profit analysis. 3. Financial control and management information systems. 4. Investment analysis and capital budgeting in the alcohol sector	15

IV	**Unit 4: Organisation business management** 1. Organizational Behavior. 2. Individual behavior in organizations. 3. Group dynamics and team building. 4. Leadership styles and theories	15

Suggested Reference Book :

- Kotler, P., & Keller, K. L. (Year). *Marketing management: Global edition.* Publisher.
- Wagner, P., Olsen, J., & Thach, L. (Year). *Wine marketing and sales.* Publisher.
- Brown, A. (Ed.). (Year). *Alcohol advertising: A global legal perspective.* Publisher.
- Keegan, W. J., & Green, M. C. (Year). *Global marketing.* Publisher.
- Various industry reports, case studies, and academic articles relevant to the course content.

WT-653-MJP Practical based on WT 651 MJ, WT 652 MJ

Total: 4 Credits Workload: - 30 hrs /credit

(Total Workload: - 4 credits x 30 hrs = 120 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	To identify various types of industrial wastes, including their sources, composition and potential environmental impacts.
CO2	Demonstrate proficiency in techniques for sampling, analyzing, and characterizing industrial waste.
CO3	Gain hands-on experience with physical, chemical and biological methods for treating industrial waste.
CO4	Design, operate and troubleshoot various industrial waste treatment systems, such as filtration, sedimentation, flotation and biological treatment units.
CO5	Understand management principles and practices applicable to the alcoholic beverages industry.
CO6	Analyse the economic environment and its impact on entrepreneurial development in the alcohol sector.

WT-653-MJP Practical based on WT 651 MJ, WT 652 MJ		
No	**Credit Title & Contents**	**Number of hours**
1	To estimate the alkalinity of given water sample	**120**
2	Estimation of suspended solids, total suspended solids and volatile solids of spentwash or press mud cake	
3	Determination of TSS of given water sample	
4	Determination of BOD	
5	Determination of COD	
6	Enumeration of coliform from water sample by MPN method	
7	Estimation of phosphate from given water sample	
8	Conduct a case study analysis on a successful brewery or distillery, focusing on the application of management principles and practices.	
9	Business Communication Workshop :Conduct mock scenarios to improve communication skills among team members in an alcoholic beverage business context.	
10	Formulate a new product development plan for an existing alcoholic beverage brand, focusing on innovation strategies to capture market	

	demand.	
11	Conduct a SWOT analysis for a selected alcoholic beverage company to identify its management principles and practices.	
12	Analyse case studies on organizational behaviour issues in alcoholic beverage companies and propose strategies for improvement.	
13	Design a wastewater management system for a distillery, considering environmental sustainability and regulatory requirements.	
14	Role-play scenarios to demonstrate different leadership styles in managing a team within a wine production company.	
15	Formulate a strategy for product development and innovation in craft beer, focusing on consumer trends.	
16	Develop a hygiene management plan for a brewery to ensure compliance with industry standards.	
17	Create a personnel management plan outlining roles, responsibilities, and training needs for a brewery.	

Suggested Reference Book :

1. Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery. McGraw-Hill Education.
2. Henze, M., et al. (2008). Biological Wastewater Treatment: Principles, Modelling and Design. IWA Publishing.
3. Diaz, L. F., de Bertoldi, M., & Bidlingmaier, W. (Eds.). (2007). Compost Science and Technology. Elsevier Science.
4. Hargreaves, J. C., &Adl, M. S. (2008). Soil Biota, Nutrient Cycling and Farming Systems. Springer.
5. Smith, M. R., & Misra, R. V. (2016). Anaerobic Microbiology: A Practical Approach. CRC Press.
6. Speece, R. E. (1996). Anaerobic Biotechnology for Industrial Wastewaters. Archae Press.
7. Waterhouse, A. L., & Sacks, G. L. (Eds.). (2013). Understanding Wine Chemistry. John Wiley & Sons.
8. Jackson, R. S. (2008). Wine Science: Principles and Applications. Academic Press.
9. Cooper, C. D., & Alley, F. C. (2002). Air Pollution Control: A Design Approach. Waveland Press.
10. Heinsohn, R. J., & Kabel, R. L. (2002). Industrial Ventilation: A Manual of Recommended Practice. American Conference of Governmental Industrial Hygienists.
11. Environmental Protection Agency (EPA). (2014). Water Conservation in Breweries and Distilleries: Best Practices Guide. EPA.
12. Robbins, S. P., Coulter, M., & De Cenzo, D. A. (2017). Fundamentals of Management: Management Myths Debunked! Pearson.
13. Stoner, J. A. F., Freeman, R. E., & Gilbert, D. R. (2019). Management (8th ed.). Pearson Education Limited.
14. Guffey, M. E., & Loewy, D. (2020). Essentials of Business Communication (12th ed.). Cengage Learning.
15. Murphy, H., & Hildebrandt, H. W. (2012). Effective Business Communication (7th ed.). McGraw-Hill Education.
16. Oakland, J. S., & Tanner, S. J. (2007). TQM: Text with Cases (3rd ed.). Butterworth-Heinemann.
17. Wagner, S. M., & Bode, C. (2008). ISO Standards for Quality Management. Springer.
18. Forsyth, D. R. (2018). Group Dynamics (7th ed.). Cengage Learning.
19. Huczynski, A., & Buchanan, D. (2017). Organizational Behaviour (9th ed.). Pearson Education Limited.
20. Northouse, P. G. (2018). Leadership: Theory and Practice (8th ed.). SAGE Publications.

WT-660-MJ Advance Enology - III
Group I Theory Paper
Total: 2 Credits Workload: - 15 hrs /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	Describe clarification & stability of wine
CO2	Understand maturation and ageing of wine
CO3	Illustrate the concept of blending and bottling
CO4	Select suitable practical technique to solve wine defects
CO5	Evaluate wine quality on the basis of maturation and ageing
CO6	Implement stabilization techniques to prevent precipitation of tartrates and protein hazes during storage and bottling.

WT-660-MJ Advance Enology - III Group I Major Elective Theory		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**Unit-I: Post fermentation treatments of wines:** Concept of clarification & stability of wine Study of various clarification & stabilization techniques – cold stabilization, filtration, Racking, ion exchange, electrophoresis, fining etc	7
	Tartrate stability –detailed concept, methodology for estimating cold stability & its control	2
	Protein stability –detailed concept, methodology for estimating protein stability & its control Metallic casse – ferric casse, cupric case	3
	Fining – Principle of fining, aim of fining, detailed study of various fining agents used in enology, effect of over fining.	3
II	**Unit-II: Maturation, aging and bottling Operations:** Maturation and aging of wine, Objectives of maturation. Containers/cooperages for maturation. Factors affecting maturation of wine. Chemical reactions occurring during wine ageing.	4
	Extraction of phenolic compounds from Oak. Bulk Wine & bottled wine storage: Managing ullages headspace, Temperatures of bulk wine storage, bottled wine storage – stacking method, temperature, light and humidity Blending and bottling of wine: Reasons/necessity for blending of wines. Various precautions/rules taken in to consideration during blending of wine.	3

	Various bottling operations -Quality control, bottling room, dedusting and rinsing of bottles, filling, cork insertion, labelling, capsulation and foiling etc. Physicochemical properties of cork, Production of wine stoppers.	5
	Wine Defects/ Wine faults/ Cork taints: Oxidation: acetaldehyde, acetic acid, ethyl acetate Sulfur compounds: Sulfur oxides, hydrogen sulfide, mercaptans, dimethyl Sulfide Study of various practical techniques to solve defects during processing –phenolic wine harsh and drying tannins, deacidification, acidification, dealing with stuck fermentation	3

Suggested Reference Book :

1. Jackson, D., & Schuster, D. *The Production of Grapes & Wine in Cool Climates*.
2. American Society for Enology& Viticulture. *50th Anniversary Annual Meeting, June 19-23, 2000, Washington State Convention & Trade Center, Seattle, Washington*.
3. Ough, C. S., & Amerine, M. A. *Methods for Analysis of Musts & Wines* (2nd ed.).
4. Bird, D. *Understanding Wine Technology*.
5. Gautier, B. *Practical Aspects of Wine Filtration*.
6. Belt, T. E. *Better Wines from Concentrates*.
7. Wagner, P., Olsen, J., & Thach, L. *Wine Marketing & Sales: Success Strategies for a Saturated Market*.
8. Sbrocco, L. *Wine for Women.*
9. Ribereau-Gayon, P., Dubourdieu, D., Doneche, B., &Lonvaud, A. *Handbook of Enology,Vol. I: The Microbiology of Wine and Vinification*.
10. American Society for Enology& Viticulture. *Proceedings of the Annual Meeting*.
11. Markides, A., & Gibson, R. *Australian Society of Viticulture &Enology*.
12. Kunkee, R. A. *Introduction to Winemaking: Viticulture and Enology*.
13. Iland, P., & Gago, P. *Understanding Wine Course Notes*.
14. Jackson, R. S. *Wine Science*.
15. Ribereau-Gayon, P., Dubourdieu, D., Maujean, A., & Glories, Y. *Handbook of Enology, Vol. 2: The Chemistry of Wine Stabilization and Treatments*.
16. Margalit, Y., & Cram, J. *Concepts of Wine Chemistry: The Wine Appreciation Guide*.
17. Vine, R. P., Harkness, E. M., & Linton, S. J. *Winemaking from Grape Growing to Marketplace*.
18. Iland, P., Bruer, N., Ewart, A., Markides, A., & Sitters, J. *Monitoring the Winemaking Process: From Grapes to Wine Techniques and Concepts*.
19. Vine, R. P. *Wine Appreciation*.

WT-660-MJP Practical on Advance Enology
Group I Major Elective Practical
Total: 2 Credits Workload: - 30 hrs /credit
(Total Workload: - 2 credits x 30 hrs = 60 hrs in semester)

Course outcomes Cos	
After studying the course learners will be able to	
CO1	Identify new techniques in wine production
CO2	Understand pre-operations of wine bottling
CO3	Demonstrate filtration and bottling of wine
CO4	Assess wine based on fining agents
CO5	Evaluate quality control aspects of packaging materials
CO6	Calculate and apply adjustments to alcohol content, acidity levels, and residual sugar to achieve target wine specifications.

WT-660-MJP Practical on Advance Enology
Group I Major Elective Practical
Total: 2 Credits Workload: - 30 hrs /credit
(Total Workload: - 2 credits x 30 hrs = 60 hrs in semester)

No	**Credit Title & Contents**	**Number of hours**
1.	Determination of methanol content of wine.	**60**
2.	Pre operations of wine bottling –Details of quality measures	
3.	Demonstration of filtration of wine	
4.	Demonstration of bottling of wine	
5.	Assess and conduct fining trials of i. Bentonite on wine. ii. PVPP on wine. iii. Gelatin on wine. iv. Egg albumen/egg white on wine.	
6.	Conduct protein stability in wine	
7.	Conduct cold stability test for tartrate stability in wine	
8.	Detect iron haze & copper haze in given wine sample	
9.	Determine SO2 of given wine by aspiration method.	
10.	Perform oxidative test for red wine.	

11.	Determine microbiological stability test of given wine sample	
12.	Determine carbon dioxide content of given wine sample	
13.	Quality control aspects of packaging materials of wine bottles	
14.	Assess and conduct blending trial of wine.	
15.	New techniques in wine production world: A case study	

Suggested Reference Book:

1. Ough, C. S., and M. A. Amerine. *Methods for Analysis of Musts & Wines*. 2nd ed.
2. Gautier, Bernard. *Practical Aspects of Wine Filtration*.
3. Belt, T. Edwin. *Better Wines from Concentrates*.
4. Wagner, Paul, Janeen Olsen, and Liz Thach. *Wine Marketing & Sales: Success Strategies for a Saturated Market*.
5. Sbrocco, Leslie. *Wine for Women*.
6. Ribereau-Gayon, P., D. Dubourdieu, B. Doneche, and A. Lonvaud. *Handbook of Enology, Vol. I: The Microbiology of Wine and Vinification*.
7. American Society for Enology & Viticulture. *Proceedings of the Annual Meeting*.
8. Markides, Andrew, and Richard Gibson. *Australian Society of Viticulture &Enology*.
9. Kunkee, Ralf A. *Introduction to Winemaking: Viticulture and Enology*.
10. Iland, Patric, and Peter Gago. *Understanding Wine Course Notes*.
11. Jackson, Ron S. *Wine Science*.
12. Ribereau-Gayon, P., D. Dubourdieu, A. Maujean, and Y. Glories. *Handbook of Enology, Vol. 2: The Chemistry of Wine Stabilization and Treatments*.
13. Margalit, Yair, and James Cram. *Concepts of Wine Chemistry: The Wine Appreciation Guide*.
14. Vine, Richard P., Ellen M. Harkness, and Salley J. Linton. *Winemaking from Grape Growing to Marketplace*.
15. Iland, Patric, Nick Bruer, Andrew Ewart, Andrew Markides, and John Sitters. *Monitoring the Winemaking Process: From Grapes to Wine Techniques and Concepts*.
16. Vine, Richard P. *Wine Appreciation*.

WT-661-MJ Advance Brewing Technology-III
Group II Major Elective Theory
Total: 2 Credits Workload: - 15 hrs /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	Describe contamination control method in beer making process
CO2	Explain beer stability
CO3	Illustrate different packaging methods of beer
CO4	Outline entire beer making process from aging to finishing
CO5	Compare home brewing and micro brewing
CO6	Experiment with alternative brewing methods (e.g., souring, barrel aging, dry hopping) to create unique beer styles and flavors.

WT-661-MJ Advance Brewing Technology-III Group II Major Elective Theory		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I : Beer types and their special features** 1. Beers Produced by top & bottom Fermentation, 2. Special features of top fermentation, 3. Physiological differences between top fermenting yeast & Bottom fermenting yeast. 4. Yeast Viability tests, Yeast Vitality test. Measures of cellular activity, 5. Fluorometric Vitality test, Saccharomyces wild yeast, Non-Saccharomyces Wild yeasts, Biofilms, Controlling contamination.	5
	Aging and Finishing: **1.** Introduction, Objectives of Aging and Finishing, component processes flavor maturation: - Impart flavor compounds Diacetyl and 2, 3-pentanedione, sulfur compounds, non-volatile flavor maturation, yeast autolysis Lagering and secondary fermentation (Kransening). **2.** Historical Lagering Practice, Krausening, lagering without secondary fermentation, addition of modified Hop extracts. **3. Beer Recovery**: Economics, Quality of recovered beer. Clarification: - Gravity sedimentation, finings, filtration, filters, sterile filtration. Stabilization:	10

	4. Beer Stability: Biological and Non-biological Instability. Biological Instability, Non biological stability: Physical stability, Flavor stability foam stability, Gushing, light stability, Flavor stability, Biological stability, Physical stability, **5. Carbonation:** - Basics of beer carbonation, modern carbonation, Standardization.	
II	**UNIT II : Bottling/canning the beer** 1. Advantages & disadvantages of glass bottles, Glass Bottle Production, Shape Color, Surface coating, Scuffing, 2. Bottle after coating filling & cleaning of returnable glass bottles, Factors Which influence bottle washing, 3. Design of Bottle washing Machine, Single end, Double end washing Machines, Cleaning & Maintenance Work on Bottle Washing Machine Control of filling process, 4. Closing the Bottles, pasteurizing in bottles, Labeling& foiling the bottles, PET.	8
	1. Bottles, plastic screw cap closures, Filling of wooden barrels & Casks. Secondary contaminants, beer dispensing. **2.** Micro/Pub brewing Micro Brewers, Hobby brewers, making your own malt. Pub breweries. Plant & Process diagram of pub breweries. **3.** The concept of home brewing, The details of home brewing, availability of raw materials kit and basic equipments, Precaution and quality measures for home brewing, **4.** Home brew maturation, Fermentation & Maturation cellar, Dispense equipment. Energy Supplies, Legal Regulations.	7

Suggested Reference Book :

1. American Society of Brewing Chemists. *Methods of Analysis of American Society of Brewing Chemists*. 8th rev. U.S.A: American Society of Brewing Chemists, 1996.
2. Arntzen, C. J., ed. *Encyclopedia of Agricultural Science, Vol. 1: A - D*. New York: Academic Press, 1994.
3. Birch, G. G. *Alcoholic Beverages*. London: Elsevier Applied Science Pub., 1985.
4. Government of India. *Technical Excise Manual*. Jodhpur: Agrobios (India), 2002. ISBN 81-7754-149-8.
5. Hardwick, W. A., ed. *Handbook of Brewing*. New York: Marcel Dekker, Inc., 1995.
6. Hough, J. S., Briggs, D. E., Stevens, R., Young, T. W. *Malting & Brewing Science, Vol. 2: Hopped Wort & Water*. London: Chapman & Hall, 1982.
7. Pollock, J. R. A., ed. *Brewing Science, Vol. 1*. London: Academic Press, 1979.
8. Pollock, J. R. A., ed. *Brewing Science, Vol. 2*. London: Academic Press, 1981.
9. Prescott, S. C., Dunn, C. G. *Industrial Microbiology*. Jodhpur: Agrobios (India), 2002.

ISBN 81-7754-149-8.

10. Priest, F. G. *Brewing Microbiology*, 2nd ed. U.K.: Chapman & Hall, 1996. ISBN 0412591502.
11. Priest, Fergus G., Stewart, Graham G. *Handbook of Brewing*, 2nd ed. U.S.A.: CRC Press, Taylor & Francis Group, 2006.
12. Harnesey, Tan S. *A History of Beer & Brewing*.
13. Deeds, Steven. *Brewing Engineering*.
14. Lewis, Michel J., Young, Tom W. *Brewing*.
15. Palmer, John. *Water: A Comprehensive Guide for Brewers*.
16. White, Chris, Zainasheff, Jamil. *Yeast: The Practical Guide to Beer Fermentation*.
17. Mallett, John. *Malt: A Practical Guide from Field to Brewhouse*.
18. Hieronymus, Stan. *Hops*.

WT-661-MJP Practical on Advance Brewing Technology
Group II Major Elective Practical
Total: 2 Credits Workload: - 30 hrs /credit
(Total Workload: - 2 credits x 30 hrs = 60 hrs in semester)

Course outcomes COs	
After studying the course learners will be able to	
CO1	Describe raw material and beer product parameters
CO2	Understand culture media requirement for isolation of bacteria from beer
CO3	Determine physical parameters of raw material and product in beer production
CO4	Analyze sugar and alcohol content of beer
CO5	Evaluate compositional analysis method for raw material of beer production
CO6	Evaluate the microbial profile of beer.

WT-661-MJP Practical on Advance Brewing Technology		
No	**Credit Title & Contents**	**Number of hours**
1	Germination test of barley by suitable method	**60**
2	Estimation of moisture content of malt	
3	Estimation of total acidity of beer	
4	Estimation of free amino nitrogen of wort.	
5	Estimate color,bitterness of wort	
6	Estimation of reducing sugar of beer	
7	Estimation of alcohol content of beer	
8	Estimation of protein content of wort by suitable method	
9	Differential staining of wort and beer	
10	Starch Conversion Test for mash or wort	
11	General culture media for isolation of bacteria from beer	
12	Differential culture media for isolation of bacteria from beer	
13	Estimation of yeast solids by total dry weight method	
14	Sensory evaluation of beer	

Suggested Reference Book :

1. Pollock, J.R.A., ed. *Brewing Science, Vol. 2*. London: Academic Press, 1981. (663.3POL)
2. Prescott, S.C. & Dunn, C.G. *Industrial Microbiology*. Jodhpur: Agrobios (India), 2002. ISBN 81-7754-149-8.
3. Priest, F.G. *Brewing Microbiology*, 2nd ed. U.K.: Chapman & Hall, 1996. ISBN 0412591502. (576PRI)
4. Priest, Fergus G., Stewart, Graham G. *Handbook of Brewing*, 2nd ed. U.S.A.: CRC Press, Taylor & Francis Group, 2006.
5. Harnesey, Tan S. *A History of Beer & Brewing*.
6. Deeds, Steven. *Brewing Engineering*.
7. Lewis, Michel J., Young, Tom W. *Brewing*.
8. Palmer, John. *Water: A Comprehensive Guide for Brewers*.
9. White, Chris, Zainasheff, Jamil. *Yeast: The Practical Guide to Beer Fermentation*.
10. Mallett, John. *Malt: A Practical Guide from Field to Brewhouse*.

WT-662-MJ AdvanceAlcohol technology-III
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	
After studying the course, learners will be able to	
CO1	Describe various types of continuous fermentation process
CO2	Describe method of alcohol analysis
CO3	Illustrate process of alcoholic beverages and their sensory analysis
CO4	Outline process of alcohol production from non-molasses sources
CO5	Evaluate quality aspects of alcohol using MPR distillation
CO6	Evaluate the quality of spirit using various sophisticated tools

WT-662-MJ Advance Alcohol technology-III Group III Major Elective Theory		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I : Fed batch/Continuous fermentation** 1. Theoretical aspects of continuous fermentation, various types of continuous fermentation systems, continuous Vs Batch Fermentation Systems. 2. Single Fermentation Continuous System (Biostil), Process Details with floe diagrams, Operational aspects, details of plant & machinery. 3. Merits & demerits of the technology, Cascade continuous Fermentation system,, 4. Process details with flow diagram, operational aspects, details of plant & machinery, merits and demerits of technology, 5. Yeast Flocculation Continuous Fermentation System (Encillium - NCL), Process details with flow diagram, operational aspects, details of plant & machinery, 6. Merits & Demerits of technology, Evaluation of Continuous fermentation Technologies. 7. Dry & wet gauging of tanks. 8. Contamination control with special reference to continuous fermentation process.	7

	Alcohol from non-molasses sources, manufacture of malt alcohol and cost of production of alcohol 1. Characterization of various non-molasses sources for alcohol production. 2. Process details of alcohol production from Corn, Sweet Sorghum, Tapioca, Sugarcane Juice and others, Quality aspects of alcohol from non- molasses sources, Production of alcohol from non-molasses sources in the existing molasses based distillery. 3. Manufacture of liquors-Rum, Whisky, Gin, Vodka, brandy, Cachaca, Taquilla etc. & bottling, packing of liquors. Reduction & blending of spirit. Blending and sensory analysis of various spirit and liquors. 4. Details of production of malt alcohol. International scenario of alcohol production and potential for import and export. Typical cost of production of alcohol. 5. Pot distillation, Difference between pot distillation and conventional distillation.	8
II	**UNIT-II:** **1.** Multi pressure distillation and Molecular sieve dehydration system, Importance of Spectroscopic and chromatographic techniques in alcohol industries **2.** Mechanism, flow diagram and concepts behind Molecular sieve and MPR distillation. The quality aspects of spirit using MPR distillation.	3
	1. Introduction to various spectroscopic and chromatographic techniques useful for alcohol industry. **2.** Role of AAS, GC-MS, GC, HPLC, HPTLC, and other sophisticated instruments in analysis of molasses, fermented wash, RS, ENA, AA, SDS, beer, wine and various beverages.	12

Suggested Reference Book :

1. Jacques, T. P., Lyons, P., & Kelsall, D. R. *The Alcohol Textbook.*
2. Rao, Satyanarayana. *Alcoholometry*.
3. Chatterjee, A. C. *Handbook of Fermentation & Distillation*.
4. Barron, H. C. *Distillation.*
5. Government of India. *Technical Excise Manual*.
6. Paturao. *Byproducts of Sugar Industry*

WT-662-MJP Practical on Advance Alcohol Technology
Group III Major Elective Practical

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

Course outcomes Cos	
After studying the course learners will be able to	
CO1	Identify properties of molasses
CO2	Understand properties of molasses fermented broth
CO3	Determine reducing sugars in molasses
CO4	Estimate alcohol content in molasses fermented broth
CO5	Compare different standard methods for analysis of molasses
CO6	Ability to perform basic quality control tests on raw materials and final alcohol products, including measurement of alcohol content, purity, and detection of impurities.

WT-662-MJP Practical on Advance Alcohol Technology Group III Major Elective Practical		
No	**Credit Title & Contents**	**Number of hours**
1	Conduct lab trails of molasses/starch based fermentation	**60**
2	Estimation of acidity in molasses fermented broth	
3	Estimation of residual sugar in molasses fermented broth	
4	Estimation of alcohol content of in molasses fermented broth	
5	Estimation of volatile acids in molasses fermented broth	
6	Determination of sludge content of molasses	
7	Determination of calcium content of molasses	
8	Microscopic observation of alcoholic fermented wash	
9	Estimation of caramel content of molasses	
10	Determination of mesophilic bacteria of molasses	
11	Determination of yeast & molds of molasses	
12	Determination of thermophilic bacteria of molasses	
13	Determination of lactic acid bacteria of molasses	

Suggested Reference Book :

1. Jacques, T. P., Lyons, P., & Kelsall, D. R. *The Alcohol Textbook*.
2. Rao, Satyanarayana. *Alcoholometry*.
3. Chatterjee, A. C. *Handbook of Fermentation & Distillation*.
4. Barron, H. C. *Distillation*.
5. Government of India. *Technical Excise Manual*.
6. Paturao. *Byproducts of the Sugar Industry*

WT-663-MJ Packaging Techniques in beverages
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	
After studying the course, learners will be able to	
CO1	Explain the properties and suitability of different packaging materials (e.g., glass, plastic, metal, paperboard) for various types of beverages.
CO2	Demonstrate knowledge of advanced packaging technologies and machinery used in the beverage industry.
CO3	Evaluate innovative packaging solutions (e.g., smart packaging, sustainable materials) to meet market demands and regulatory requirements
CO4	Conduct testing and evaluation of packaging materials and finished products to ensure compliance with regulatory requirements and consumer safety.
CO5	Develop innovative packaging solutions to enhance beverage shelf life, consumer convenience, and market differentiation.
CO6	Understand and comply with local and international regulations governing beverage packaging, including labeling requirements, material restrictions, and hygiene standards.

WT-663-MJ Packaging Techniques in beverages Group IV Major Elective Theory		
Credit	**Credit Title & Contents**	**Number of Lectures**
I	**UNIT I: Introduction to Beverage Packaging, Packaging Materials and Packaging Design Principles** 1. Overview of the beverage industry: types of beverages (carbonated, non-carbonated, alcoholic, non-alcoholic). 2. Importance of packaging: preservation, marketing, consumer appeal, regulatory compliance.	5
	Types of packaging materials: 1. Glass, plastic, metal, paperboard, and their suitability for different beverages. 2. Properties of packaging materials: barrier properties, mechanical strength, sustainability aspects	5
	Factors influencing packaging design: 1. Branding, shelf appeal, functionality, sustainability. 2. Economics and consumer convenience in beverage packaging.	5
II	**UNIT – II: Packaging Regulations and Standards, Environmental Impact, Advanced Packaging Techniques, Packaging Testing and Quality Control**	4

	1. Global and regional regulations governing beverage packaging: labeling requirements, environmental considerations, safety standards. 2. Life cycle assessment (LCA) of beverage packaging: carbon footprint, recycling, biodegradability.	
	Sustainable packaging solutions: 1. Innovations in eco-friendly materials, packaging reduction strategies. 2. Overview of beverage packaging lines: filling, capping, labeling, and sealing machines.	3
	Automation and Robotics in Packaging: Advances in efficiency and quality control.	2
	Aseptic packaging: 1. Principles and applications in beverage industry. 2. Testing methods for packaging materials: mechanical tests, permeability testing, sensory evaluation.	3
	Quality assurance in Packaging: Batch testing, defect analysis, compliance with specifications.	3

Suggested Reference Book :

1. Piggott, W. J. *Beverage Packaging: A Practical Guide*.
2. Sugg, T. J., & Shorter, A. J. (Eds.). *Beverage Packaging Materials and Processes*.
3. Nelson, P. E. (Ed.). *Handbook of Beverage Packaging*.
4. Emblem, A. *Packaging Technology: Fundamentals, Materials and Processes*.
5. Garetto, P. R., & Whited, A. E. (Eds.). *Sustainable Beverage Packaging*.
6. Almenar, E. S., &Lagaron, M. A. (Eds.). *Packaging for Noncarbonated Beverages*.
7. Twede, D. *Packaging Beverage: Trends and Innovation*.
8. Phillips, C. A. *Beverage Packaging*.
9. Hale, A. G. (Ed.). *Handbook of Green Chemistry and Technology in Beverages*.
10. Yam, K. L. (Ed.). *Food and Beverage Packaging Technology*.

WT-664-MJ Chemical and Plant 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	
After studying the course learners will be able to	
CO1	Describe the concept of separation techniques
CO2	Understand the different types of heat exchange equipments with their applications
CO3	Determine the number of plates in distillation system based on vapor liquid equilibrium
CO4	Illustrate the pumps and their applications
CO5	Evaluate the concepts of industrial instrumentation and automation
CO6	Understand the different types of pumps with their applications

WT-664-MJ Chemical and Plant Engineering
Group IV Major Elective Theory
Total: 2 Credits Workload: - 15 hrs /credit
(Total Workload: - 2 credits x 15 hrs = 30 hrs in semester)

Credit	**Credit Title & Contents**	**Number of Lectures**
I	**Separation techniques** Separation techniques like sedimentation, filtration & centrifugation: basic principles &equipment. Membrane separations & their applications. Distillation: Calculation of number of plates using McCabe Thiele method. Design of distillation column. Humidification: Psychometric Heating, cooling, , dehumidification, mixing of air streams, Drying of cereals and food as psychometric process.	10
II	**Heat transfer** Conduction, convection, thermal resistance and heat flux, Types of heat exchangers, Nucleate boiling curves, calculation of boiling heat flux, Vapor compression, Heat efficiency, Heat transfer through flat and curved surfaces and effects of insulation and its efficiency.	10
II	**Fluid mechanics** Fluid flow fundamentals. Laminar and turbulent flow. Bernoulliz theorem and its applications, Friction factor pump selection and applications. Fluid static, fluid dynamics, flow measurement, pipe/duct flow. Frictional pressure losses in pipe/duct, flow pumps/fans, cavitations.	10

Suggested Reference Book :

1. Treybal, R. E. *Mass Transfer Operations*.
2. Ghosal, S., & Sanyal, S. *Introduction to Chemical Engineering*.

3. McCabbe, W. L., & Smith, J. C. *Unit Operations of Chemical Engineering*.
4. Kern, D. Q. *Process Heat Transfer*.
5. Shinskey, F. G. *Process Control Systems*.
6. Johnson, C. D. *Process Control Instrumentation Technology*.
7. Andrew, W. G., & Williams, H. B. *Applied Instrumentation in the Process Industries*.

WT 681 IT Short term research project OR In plant Training: 6 Credits

Short term research project (Individual/groups) OR In plant training in industry

Course outcomes Cos	
After studying the course, learners will be able to	
CO1	Identify and model problems linked to the industry
CO2	Develop technical, inter personal and communication skill
CO3	Apply theoretical aspects in practical situations by accomplishing the tasks with respect to social, cultural, global and environmental responsibility
CO4	Analyze the challenges and future potential of outcomes with respect to industrial issues
CO5	Evaluate the training/research experience in terms of their personal, educational and career perspective
CO6	Develop presentation skills to present the research / training outcomes

The Opportunity to analyze a particular industry based problem or topic in depth. Conduct a relevant lab or library- based study.

To provide a chance to improve fundamental research & analysis, skills & advance understanding of then processes involved in Wine technology, Brewing technology or Alcohol technology.

Student has to undertake an extended investigation in an advanced topic of relevance to their degree discipline or to their Sponsoring industrial partner.

The research project builds on the taught modules of the course.

Students should analyses their results & present the same in the form of a dissertation that includes a review of previous research & set their work in context with critically argued discussion.

Students should contribute via seminars or posters or publication to the research activity of the host /work institution