Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce, and Science College, Ahmednagar (Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

National Education Policy (NEP)
Choice Based Credit System (CBCS)

Programme Skeleton and Syllabus of

M.Sc. Wine, Brewing and Alcohol Technology

Implemented from

Academic Year 2023-24

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Board of Studies in Wine, Brewing and Alcohol Technology

Sr. No.	Name	Designation
1.	Dr. Sanjay Tukaram Moharekar	Chairman
2.	Dr. Shubhangi Sanjay Moharekar	Member
3.	Dr. Sarika Rameshrao Deshmukh	Member
4.	Mr. Ashish Sadanand Wani	Member
5.	Prof. Syed S. Dastager	Vice-Chancellor Nominee
6.	Prof. Sanjay V. Patil	Academic Council Nominee
7.	Mr. Rajendra G. Chaure	Academic Council Nominee
8.	Mr. Manoj Madhukarrao Mukkirwar	Industry Expert
9.	Mr. Prasad Vinod Rajale	Alumni
10.	Ms. Dipali D. Giramkar	Member (co-opt)
11.	Ms. Supriya P Salve	Member (co-opt)

Prologue/ Introduction of the programme:

Wine Brewing and Alcohol Technology, being one of the youngest branch of Life Science, has expanded and established as applied science. Global and local focus has slowly shifted to not only current "Century of Knowledge" but also on to technology development and application in life sciences. Although, alcoholic beverages have traditionally been consumed throughout history with evidence dating back to Harappa civilization.

Beer: It is believed that Chinese brewed alcoholic beverage similar to beer. Sumerian peoples brewed alcoholic beverage similar to beer which became most popular. In the 13th century AD, beer finally started being produced commercially in Germany, England, and Austria. In the nineteenth century, beer was widely famous as the world's number one alcoholic beverage. In India breweries and microbreweries are emerging one after another in India. India will become beer industry hub in near future.

Wine: Although, wine has traditionally been consumed throughout history with evidence dating back to Harappa civilization, commercial wine production is a pretty recent phenomenon, with the first commercial grape wine plant being set up only in the 1980s. Since then, three major players – Chateau Indage, Grover Vineyards and Sula Vineyards – emerged in the domestic winemaking scene and the last few decades saw vineyards cropping up all overthe country. commercial production is a pretty recent phenomenon, with the first commercial grape wine plant being set up only in the 1980s. Since then, three major players – Chateau Indage, Grover Vineyards and Sula Vineyards – emerged in the domestic winemaking scene and the last few decades saw vineyards cropping up all over the country.

Then came the tide of globalization and India, bowing to WTO's demands, had to reduce tariffs on imported liquor with the consequence that the market was suddenly flooded with incredibly refined Italian and French wines of unmatched quality – much to the delight of the wine lovers and to the woe of the Indian winemakers. Coming back to the present times, finding a foothold in an arena that has been eternally dominated by European players (read: France, Italy, and Spain, in that order) has been quite an uphill task for Indian winemakers. However, the recent growth numbers – the wine market is currently growing at a rate of 25-30 per cent – have given them some cause to celebrate.

A larger market translates to more demand, which in turn means that Indian wines can, now, share a shelf with their French and Italian counterparts. Moreover, Indians wines are considerably cheaper than their Western counterparts; thus, enabling it to achieve a particular target audience of its own. Back home, statistics reveal that India's rich and prosperous are finally warming up to this delicious drink; India has alcoholic beverage market of roughly 1.2 million cases, while experts predict that consumption will grow at a CAGR of around 30% during 2009-2013. Lastly, right marketing strategies and increased awareness will go a long way to ensure that this historically significant drink finally conquers Indian hearts.

Programme Outcomes (POs)

After successfully completing this course, the student should be able to:

• Understand the basic knowledge and concepts of Wine/Beer/Alcohol and other related areas.

• Understand the ability to apply their knowledge for practical which they can conduct independently.

• Apply their knowledge in other advanced subject area like Energy Production Energy Conservation and Sustainable Development

• Learn the theoretical and practical exposure to the basic and the advanced fields of Wine/Beer/Alcohol technology.

Career Opportunities:

1. Government sector in India

• Agriculture departments

• Agriculture Institute

• Excise Department

• Bureau of Indian Standards

• Import Export Departments

2. International and national wine making plant

• Vineyard management and marketing services

• Research technician

• Technical assistant

• Winery/Brewery/Distillery laboratory technicians

• Wine/Beer/Alcohol marketing services

• Quality control in Wine/Beer/Alcohol industry

3. Self-employment

• Own winery/Microbrewery

• Winery/Microbrewery consultant

• Wine/Beer taster, Wine maker, Brewer

• **Eligibility:** Candidates applying for M.Sc. for wine technology should be B. Sc. In Wine Technology/ Post Graduate Diploma in Industrial Fermentation and Alcohol Technology/ B.Sc. in Bio-Technology Microbiology/ Chemistry/ Agriculture/ Botany/ Zoology/Agricultural Bio-Technology and B.E. /B. Tech. (Chemical Engineering/ Biotechnology/food).

Distribution of credits

Type of Courses	Total Credits	Credits/ Semester
Discipline-Specific Core Courses (DSC)	54	14 /12
Discipline Specific Elective Courses (DSE)	16	04
Research Methodology (RM)	04	Semester I only
On-Job Training/ Internship (OJT/I	04	Semester II only
Project (PR)	10	Semesters III and IV only
Total	88	22

Master of Science (M.Sc.) in Wine, Brewing and Alcohol Technology Course Distribution

Class	Semester	Subjects	Courses	DSC		DSE		RM/OJT/ Internship etc.		Project *	Total Credits
				T	P	T	P	T	P		
M. Sc. I	I	01	09	03	03	01	01	01*		00	22
M. Sc. I	II	01	09	03	03	01	01	00	01	00	22
M. Sc. II	III	01	07	02	02	01	01	00	00	01	22
M. Sc. II	IV	01	07	02	02	01	01	00	00	01	22

* RM: Theory and Practical credits in RM paper shall be decided by the Department. The final marks/grade point shall be calculated by considering theory and practical marks.

Master of Science (M. Sc.) in Wine, Brewing and Alcohol Technology Credit Distribution

Class	Semester	Subjects	Courses	DSC		DSE		RM/OJT/ Internship etc.		Project *	Total Credits
				T	P	T	P	T	P		
M. Sc. I	I	01	09	08	06	02	02	04*		00	22
M. Sc. I	II	01	09	08	06	02	02	00	04	00	22
Exit Option: PG Diploma											
M. Sc. II	III	01	07	08	06	02	02	00	00	04	22

M. Sc. II	IV	01	07	08	04	02	02	00	00	06	22
				32	**20**	**08**	**08**	**02**	**06**	**12**	**88**

Master of Science (M. Sc.) in Wine, Brewing and Alcohol Technology
Distribution of Courses

Class	Semester	Course and their credits in the bracket			
		DSC	DSE	RM/OJT/ Internship etc.	Project *
M. Sc. I	I	DSC -01 (03)	DSE -01 (02)	RM-01(04)	NA
M. Sc. I	I	DSC -02 (03)	DSE -02 (02)		
M. Sc. I	I	DSC -03 (02)			
M. Sc. I	I	DSC -04 (02)			
M. Sc. I	I	DSC -05 (02)			
M. Sc. I	I	DSC -06 (02)			
M. Sc. I	II	DSC -07 (03)	DSE -03 (02)	OJT-01 (04)	NA
M. Sc. I	II	DSC -08 (03)	DSE -04 (02)		
M. Sc. I	II	DSC -09 (02)			
M. Sc. I	II	DSC -10 (02)			
M. Sc. I	II	DSC -11 (02)			
M. Sc. I	II	DSC -12 (02)			
M. Sc. II	III	DSC -13 (04)	DSE -05 (02)	NA	PR-01(04)
M. Sc. II	III	DSC -14 (04)	DSE -06 (02)		
M. Sc. II	III	DSC -15 (03)			
M. Sc. II	III	DSC -16 (03)			
M. Sc. II	IV	DSC -17 (04)	DSE -05 (02)	NA	PR-02(06)
M. Sc. II	IV	DSC -18(04)	DSE -06 (02)		
M. Sc. II	IV	DSC -19 (02)			
M. Sc. II	IV	DSC -20 (02)			

Programme Framework (Courses and Credits): M. Sc. Wine, Brewing and Alcohol Technology

Sr. No.	Year	Semester	Level	Course Type	Course Code	Title	Credits
1.	I	I	6.0	DSC-01	MS-WT111T	Microbiology of Wine, Beer and Alcohol	03
2.	I	I	6.0	DSC-02	MS-WT112T	Biochemistry of Wine, Beer and Alcohol	03
3.	I	I	6.0	DSC-03	MS-WT113T	Viticulture	02
4.	I	I	6.0	DSC-04	MS-WT114P	Practical's In Microbiology of Wine, Beer and Alcohol	02
5.	I	I	6.0	DSC-05	MS-WT115P	Practical's In Biochemistry of Wine, Beer and Alcohol	02
6.	I	I	6.0	DSC-06	MS-WT116P	Practical's In Viticulture	02
7.	I	I	6.0	DSE-01	MS-WT117T (A) MS-WT117T (B)	Bioprocess Engineering Or Environmental Science	02
8.	I	I	6.0	DSE-02	MS-WT118P (A) MS-WT118P (B)	Practical's In Bioprocess Engineering Or Practical's In Environmental Science	02
9.	I	I	6.0	RM-01	MS-WT119T/P	Research Methodology (Instrumentation)	04
10.	I	II	6.0	DSC-07	MS-WT121T	Applied Alcohol Technology	03
11.	I	II	6.0	DSC-08	MS-WT122T	Applied Brewing Technology	03
12.	I	II	6.0	DSC-09	MS-WT123T	Applied Oenology	02
13.	I	II	6.0	DSC-10	MS-WT124P	Practical's In Applied Alcohol Technology	02
14.	I	II	6.0	DSC-11	MS-WT125P	Practical's In Applied Brewing Technology	02
15.	I	II	6.0	DSC-12	MS-WT126P	Practical's In Applied Oenology	02
16.	I	II	6.0	DSE-03	MS-WT127T (A) MS-WT127T (B)	Chemical Engineering and Plant Management OR Biostatistics	02
17.	I	II	6.0	DSE-04	MS-WT128P (A) MS-WT128P (B)	Practical's In Chemical Engineering and Plant Management OR Practical's In Biostatistics	02
18.	I	II	6.0	OJT-01	MS-WT129P	--	04
19.	II	III	6.5	DSC-13	MS-WT231T	Advanced Alcohol Technology	04

20.	II	III	6.5	DSC-14	MS-WT232T	Advanced Brewing Technology	04
21.	II	III	6.5	DSC-15	MS-WT233P	Practical's In Advanced Alcohol Technology	03
22.	II	III	6.5	DSC-16	MS-WT234P	Practical's In Advanced Brewing Technology	03
23.	II	III	6.5	DSE-05	MS-WT235T (A) MS-WT235T (B)	Advanced Oenology OR Entrepreneurship And Business Management	02
24.	II	III	6.5	DSE-06	MS-WT236P (A) MS-WT236P (B)	Practical's In Advanced Oenology OR Practical's In Entrepreneurship And Business Management	02
25.	II	III	6.5	PR-01	MS-WT237P	Project	04
26.	II	IV	6.5	DSC-17	MS-WT241T	Sensory evaluation and Health Benefits of Alcoholic Beverages	04
27.	II	IV	6.5	DSC-18	MS-WT242T	Industrial Waste Treatment & Environmental Management	04
28.	II	IV	6.5	DSC-19	MS-WT243P	Practical's In Sensory evaluation and Health Benefits of Alcoholic Beverages	02
29.	II	IV	6.5	DSC-20	MS-WT244P	Practical's In Industrial Waste Treatment & Environmental Management	02
30.	II	IV	6.5	DSE-07	MS-WT245T (A) MS-WT245T (B)	Marketing And Regulatory Policies Of Alcoholic Beverages OR Biophysical And Biochemical Techniques	02
31.	II	IV	6.5	DSE-08	MS-WT246P	Practical's In Marketing And Regulatory Policies Of Alcoholic Beverages OR Practical's In Biophysical And Biochemical Techniques	02
32.	II	IV	6.5	PR-02	MS-WT247P	Project	06

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

Syllabus

M.Sc. Wine, Beer and Alcohol Technology

Title of the Course: Microbiology of Wine, Beer and Alcohol								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
DSC-01	MS-WT111T	03	00	03	45	30	70	**100**

Learning Objectives:

1. Classify microorganisms based on different criteria.
2. Study the structure of bacterial cells.
3. Learn techniques for isolating and controlling microorganisms.

Course Outcomes (Cos)

1. Students will learn the classification of microorganisms based on different criteria.
2. Students will study the structure of bacterial cell.
3. Students will learn the basic technique for isolation of bacteria and fungi.
4. Students will study the control of microorganisms through various technique.
5. Students will study about the morphology and characterization of yeast.
6. Students will learn the role and mechanism of antimicrobial agents.
7. Students will know industrially important microorganism and their culture collecting center

Detailed Syllabus:

Unit I: Classification of microorganisms and cell biology: (13)

Occurrence, types of microorganisms. Classification of microorganisms: Difference between prokaryotic and eukaryotic cells, types of bacteria, fungi, viruses, protozoa and algae. Classification of bacteria and fungi.

Detailed study of bacterial cell structures, cell wall, cell membrane, capsule, endospore, flagella, types of flagella, mechanism of flagellar movement

Nutrition: autotrophic, heterotrophic

Pure culture techniques- enrichment culture technique, design & preparation of media nutritional requirements ingredients of media, types of media.

Preservation of pure culture and their techniques, slant culture preservation, lyophilization

Unit II: Basic techniques in microbiology Sterilization & Disinfections (15)

Definition of sterilization, disinfections and other concept

Methods of Sterilization-Physical – Heat and Radiation, Mechanical- Filtration

Chemical- characteristics of ideal disinfectant, selection of chemical antimicrobial agents, phenol & phenolic compounds, alcohol, halogens, heavy metals & their compounds, detergents, aldehydes, gaseous & chemo sterilizers.

Unit III: Microbiology of yeast (12)

Definition, comparison with other microorganisms, yeast morphology and taxonomy, yeast cell structure and functions of various cellular components. Nutritional requirements of yeast, Aerobic and anaerobic metabolic pathways in yeast for sugar dissimilation, Isolation and maintenance of yeast, stoichiometry of alcohol production.

Unit IV: Growth and Contamination control in alcoholic fermentations (15)

Growth: Definition of growth, factor affecting the growth curve, measurement of growth, continuous culture, chemostat, turbidostat, synchronous growth.

Introduction to antibiotics, mechanism of various antibiotics, effect of microbial contaminants on alcoholic fermentations. Role of antimicrobial substances controlling contamination in alcoholic fermentation.

Unit V: Industrially important Microorganisms and culture collection center's (05)

Role of fungi and bacteria in various fermentations, Examples of various fermentations using Yeast with special reference to Glycerol, baker's yeast, etc.

Suggested Readings:

1. Stanier, Roger Y.; Doudoroff, Michael; and Adelberg, Edward A., Lloyd E. M., 1957, The Microbial World, USA, J. Chem. Educ., American Chemical Society and Division of Chemical Education, Inc.

2. Dr. C.B.Powar, Dr.H.F. Daginawala, 2010, General Microbiology, Vol. I, New Delhi Himalaya Publishing House

3. Pelcza M.J. Chan E.C.S. , 1982, Elements of Microbiology , International Edition, New York, McGraw-Hill Education

4. Casida L. E., 1968, Industrial microbiology, Wiley, the University of Michigan, United States.

Title of the Course: Biochemistry of Wine, Beer and Alcohol								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-02	MS-WT 112T	03	00	03	45	30	70	100

Learning Objectives:

1.Gain knowledge of biomolecules.

2.Understand different types of bonds

3.Learn about biochemistry of alcoholic fermentation & malolactic fermentation

Course Outcomes (Cos)

1. Students will learn different biomolecules with their structure and function.

2. Students will understand concept of biochemistry of alcoholic fermentation & malolactic fermentation

3. Students gain knowledge of different concepts like pH, pKa, buffer, enzyme activity etc.

Detailed Syllabus:

Unit I: Basic Biochemistry of living cells: (08)

Introduction to Biochemistry, Concept & scope of Biochemistry and its application.

Water : Types of bond, Covalent and non-covalent interactions in biomolecules with suitable example. Properties of water- osmosis and ionization of water, pH, pKa, titration curve, Concept of Buffers: Biological buffers

Unit II: Basic biomolecule (15)

Carbohydrates- classification with example, important carbohydrates for production of alcohol, beer and wine, glycolysis, fates of pyruvate.

Amino Acids: classification with example, structural classification of protein, amino acids and proteins in sugarcane juice and molasses

Lipids- classification with example.

Nucleic acid - DNA structure, RNA- types, structure and functions

Vitamins- Types, functions and sources

Unit III: Enzyme: (07)

Concept of active site, Enzyme Activity, factors influencing enzyme activity, enzyme substrate complex formation, enzyme inhibition and its types, enzyme regulation- allosteric enzyme, isoenzymes, Applications of enzymes in winery and brewery.

Unit IV: Biochemistry of alcoholic fermentation & Maloalcoholic Fermentation (15)

Pathways involved in alcoholic fermentation, Transport of carbohydrates in yeast. Inter relationship between sugar uptake during alcoholic fermentation (Pasteur and Crabtree Effect). Concept of Maloalcoholic fermentation and its effect on harmonious balance taste, various microorganisms used in Malolactic fermentation (MLF), beneficial and deleterious aspects of malic acid biodegradation. Production of biogenic amines & ethyl carbamate, usage & formation of Sulphur compound. Microbial formation & modification of flavor & off-flavor compounds in alcoholic beverages. Exoenzymes of alcoholic beverages microorganisms.

Suggested Readings/Material:

1. Nelson D.L.,2013, Lehninger principles of Biochemistry, 6th edition,USA, Macmillan publication
2. Voet D.& Voet J.G.,1999,Fundamentals of Biochemistry, John Wiley & Sons,Unites states
3. Nelson D.L.& Cox MM ,2008 , Lehninger principles of Biochemistry, 5 th edition,USA, W.H.Freeman and Compony

Title of the Course: Viticulture								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-03	MS-WT113T	02	00	02	30	15	35	50

Learning Objectives

1. To learn the historical aspects of grape vines and understand the physicochemical factors impacting vine growth and development.
2. To understand the techniques involved in grape vine propagation.
3. To learn the significance of grape vine training and pruning.
4. To study the common pests, diseases and their control methods associated with grapevine.
5. To learn the morphological, physiological, and biochemical changes occurring during berry maturation.

Course outcomes

1. Students will learn history and origin of grape vines and understand the physicochemical factors of the edaphic and aerial environment impacting vine growth and development
2. Students will learn the technique of grape vine propagation
3. Students will learn significance of grape vine training and pruning
4. Students will learn significance of biology and symptomatology of the most common pests and diseases of grapevines
5. Students will learn morphological, physiological and biochemical changes in berry during maturation

Detailed Syllabus:

Unit I: History and origin of grapes, Soil and climate for viticulture: (08)

Concept of centers of diversity,

History and origin of grape vines in India and world

Introduction to soil and its importance, Pedogenesis, Soil profile, Major types of soil,

Properties of Soil: Physical Chemical and Biological properties of soil

Relationship between grapevine and climatic factors

Introduction to climatic factors and its effect on different growth stages (dormant period, bud burst period, flowering, post setting and harvest period).

Unit II: Vineyard establishment: (08)

Site selection and its importance w.r.t. irrigation, climate, soil etc., Planting materials and propagation techniques used- Seed, Vegetative/Asexual- Cutting, layering, grafting,

budding, micropropagation

Vineyard design: Initial planning, roads, blocks, rows, spacing,

Planting and care of young grape vine: Planting methods, timing of planting, irrigation, fertigation, weed, pest, disease management and training of young vines,

Pruning: Significance of pruning, types and pruning procedure in different geographical areas.

Unit III: Weed, pest and disease management (10)

Weeds: Concept, types and its management

Pest: Mealybug, Moths, Phylloxera, Fruit flies, Thrips.

Fungal diseases: Downey mildew, Powdery mildew, Anthracnose, Botrytis rot.

Bacterial diseases: Pierce's disease, Crown gall

Viral diseases: Leaf-roll, Fanleaf degeneration

Unit IV: Berry development, pre and post-harvest management (04)

Muscadine and Euvitis species, Developmental stages of the grape, Berry structure, flavour and aroma compounds of the mature grape, phenolic compound in grape.

Harvesting: Maturity standards, harvesting periods, packing, Postharvest handling, processing, transportation and marketing

Suggested readings

1. Seattle: American Society for Enology and Viticulture
2. Phil Nicholas, Peter Magarey, Malcom Wachtel: Diseases and Pests
3. P.R. Dry & B.G. Coombe: Resources-Viticulture Volume-I
4. P.R. Dry & B.G. Coombe: 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 pest-management
10. Ralph E. Kunkee: Introduction to wine making-Viticulture and Enology-3.
11. Konig Helmut: Biology of microorganisms on grapes, in must and wine

Title of the Course: Practical's in Microbiology of Wine, Beer and Alcohol								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
DSC-04	MS-WT114P	00	02	02	60	15	35	**50**

Learning Objectives:

1. Demonstrate competence in preparing and sterilizing media for culturing microorganisms.
2. Perform accurate isolation and identification of microorganisms using appropriate techniques.
3. Apply slide culture technique effectively for the preparation and observation of yeast.

Course Outcomes (Cos)

1. Students will study to prepare and sterilize media.
2. Students will perform the isolation of microorganisms.
3. Students will learn the to prepare slide culture technique for yeast
4. Students will study bacteria by performing different staining technique.
5. Students will check practically the effect of antibiotic on microbial growth.

Detailed Syllabus:

1. Preparation of culture media and sterilization. (1)
2. Preparation of MGYP medium for growth and Identification of yeast. (2)
3. Isolation of microorganisms by four-quadrant method. (1)
4. Enumeration of microorganisms by using spread plate technique. (1)
5. Counting of microorganisms by pour plate method. (1)
6. Preparation of slide culture of yeast. (1)
7. To study types and composition of stain and preparation of stains and reagents. (1)
8. To study bacteria by monochrome staining technique. (1)
9. To study bacteria by Gram's staining technique. (1)
10. Effect of antibiotic on microbial growth. (2)

Title of the Course: Practical's in Biochemistry of Wine, Beer and Alcohol								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-05	MS-WT 115P	00	02	02	60	15	35	50

Learning Objectives:

1. Learn to perform methods for protein estimation
2. To study effect of different parameters on enzyme activity.
3. Learn to perform paper chromatography

Course Outcomes (Cos)

1. Students will learn different qualitative and quantitative tests for biomolecules.
2. Students will understand concept of chromatography, spectroscopy etc.
3. Students gain knowledge of enzyme activity, specific activity and effect of different parameters on enzyme activity.

Detailed Syllabus:

1. Preparation of buffers of desired pH, Molarity, Normality. (1)
2. Qualitative test for carbohydrate, lipid and protein (1)
3. Paper chromatography of amino acid/ sugar (1)
4. Thin layer chromatography of pigments (1)
5. Determination of reducing sugar by DNSA method. (1)
6. Estimation of protein by Bradford method. (1)
7. Estimation of protein by Lowry method. (1)
8. Estimation of activity and specific activity of amylase. (2)
9. Effect of temperature and pH on enzyme activity. (2)
10. Estimation of tannins in red wine (1)

Suggested Readings/Material:

1.Sadasivam S. & Manickam A.,2010, Biochemical Methods, 3 rd edition, New age international publication,New Delhi

2.Keith W. 2005, Practical Biochemistry Biology Principles &Techniques, USA

Title of the Course: Practical's in Viticulture								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-06	MS-WT116P	00	02	02	60	15	35	50

Learning objectives

1. To acquire knowledge and skills in conducting soil analysis.
2. To gain practical experience in applying different techniques of grape vine propagation.
3. To explore the morphology, structure and nutritional requirements of grape vines.
4. To understand the significance of training and pruning for vineyard management and grape production.
5. To gain knowledge about the biology, life cycles, and symptoms of the common pests and diseases of grapevines.

Course Outcomes (COs):

1. Students will learn basic techniques of soil analysis
2. Students will practice the techniques of grape vine propagation
3. Students will study the morphology of grape vine and nutritional requirement of grapevine
4. Students will practically learn grape vine training and pruning
5. Students will learn significance in biology and symptomatology of the most common pests and diseases of grapevines
6. Students will practically study morphological, physiological and biochemical changes during berry maturation

Detailed syllabus:

1. To study collection and preservation of soil sample and analysis of physical parameters of soil: colour, particle size and water holding capacity of soil sample (1)
2. To determine soil pH, conductivity and total alkalinity of the soil sample (1)
3. To determine chlorides and sulphates of the soil sample (1)
4. To determine organic matter content of the soil sample (1)
5. To determine Nitrogen in the given soil/petiole (plant) sample (1)
6. To study of morphology of grapevine and anatomical features of stem (1)
7. To study grapevine propagation techniques (cutting, grafting and budding) (1)
8. To study pruning technique of grapevine (1)

9. To study major pests of grapevine (1)
10. To study bacterial, fungal and viral disease of grapevine (1)
11. To study Stages of grape berry development (1)
12. Visit to vineyard and submission of a report (1)

Suggested readings

1. Seattle: American Society for Enology and Viticulture
2. Phil Nicholas, Peter Magarey, Malcom Wachtel: Diseases and Pests
3. P.R. Dry & B.G. Coombe: Resources-Viticulture Volume-I
4. P.R. Dry & B.G. Coombe: 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 pest-management
10. Ralph E. Kunkee: Introduction to wine making-Viticulture and Enology-3.
11. Konig Helmut: Biology of microorganisms on grapes, in must and wine

Title of the Course: Bioprocess Engineering								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSE-01	MS-WT117T (A)	02	00	02	30	15	35	50

Learning Objectives:

1. Understand and apply the principles of fermenter design and operation.
2. Demonstrate knowledge and proficiency in the principles and methods of sterilization.
3. Develop the skills to successfully cultivate and transfer inoculum for industrial fermentation.
4. Analyze and optimize fermentation media composition using appropriate techniques to enhance fermentation efficiency.

Course Outcomes (COs):

1. Students shall become aware of fermentation.
2. Students should be able to gain in-depth understanding of fermenter, types of fermenter and its parts.
3. Students should be able to known about the media preparation, inoculum development and media optimization.

Detailed Syllabus:

Unit I: Fermenter and its sterilization **(15)**

Scope and importance of fermentation, configuration of fermenter, types of fermenters: batch fermenter, continuous, stirred tank, tubular fermenter, fluidized bed fermenter, bed fermenter, solid state fermenter, hollow fiber fermenter

Parts of fermenters: Body construction and temperature control, aeration and agitation: aerator (sparger), agitator (impellers, baffles)

Sterilization: introduction, media sterilization, design of batch and continuous sterilization processes, sterilization of fermenter, filter sterilization

Unit II: Inoculum development and media preparation **(15)**

Development of inoculum for industrial fermentation, criteria for transfer of inoculums, development of inoculums for yeast, bacterial processes, and mycelial processes

Production of media, characteristics of ideal production media.

Raw materials: saccharine material, starchy material, cellulosic hydrocarbon and vegetable oils, nitrogenous material.

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. Media optimization-Classical method, Plackett-Burman method.

Suggested reading:

1. Stanbury, P. F., Whittaker, A. and Hall, S., (2016) Principles of Fermentation technology, Springer, Third edition

2. Atkinson, (2014) Handbook of Bioreactors,Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.

3. Casida, L. E., (2019), Industrial Microbiology, New age International, New Delhi, Second Edition.

4. A.H. Patel. (2011), Industrial Microbiology, Macmillan India Ltd., Second Edition.

5. Crueger, W. and Crueger, A. (2005) A Text Book of Industrial Biotechnology.

Title of the Course: Environmental Science								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSE-01	MS-WT117T (B)	02	00	02	30	15	35	50

Learning objectives

1. To study basics of bioenergy resources and their exploitation and impact on environment.
2. To learn about different threats to environment, climate change and its global scenario.
3. To know about the biotechnological approach for waste management.
4. To know different rules and laws for regulation of environment monitoring in india and globe.

Course Outcomes:

1. The student will understand threats to the environment, its causes and consequences.
2. The student will be able to evaluate the potential of biodegradation of pollutants by microorganisms.
3. Students will understand the phenomenon of bioremediation, phytoremediation for the decontamination of soil and water, wetlands.
4. Students will learn about national/international environmental laws and policies.

Detailed Syllabus:

Unit I: Threats to Environment **(10)**

Global and regional threats to the environment

Composition of Air, chemical composition of atmosphere, air pollution-causes, greenhouse gases, greenhouse effect, global warming and its effect on agriculture

Water Pollution-sources and its effect on environment

Soil pollution causes and its effect

Carbon foot prints and carbon sequestration

Unit II: Biotechnology in Remediation **(10)**

Introduction to bioremediation, advantages, limitations and applications, Types of bioremediation and factors affecting, bio-stimulation, bio-augmentation, Ex-situ and In-situ methods of bioremediation, phytoremediation

Waste water treatment plant- physical, chemical and biological unit operations/processes overview, activated sludge process, trickling filters, oxidation ponds

Unit III: Environmental Laws and Policies (10)

International: In the view of global concerns, objectives of laws/regulations and its importance, Stockholm conference, the Montreal protocol, Rio conference, United Nations Framework Convention on Climate Change (UNFCC) and Kyoto protocol

National: Environmental policy and overview of laws, anti-pollution Acts: Their important objectives, environmental Impact Assessment (EIA)-Introduction, Objectives, Classification, Guidelines.

Suggested readings:

1. Environmental Science (2011) S C Santra, New Central Book Agency
2. Ecology and Environment (2011) P D Sharma,
3. Agenda 21: Guidelines for Stakeholders Patwardhan & Gunale, Pune.
4. Air Pollution (2004) HVN Rao and M N Rao Tata McGraw-Hill, , New Delhi
5. Air Pollution Engineering Manual (2000) Wayne T Davis (editor), Air and Waste Management Association, Wiley Interscience,, New Jersey
6. Bioremediation (1994) Baker, K.H and Herson, D.S.Mc Graw Hill, Inc. New York
7. Biotreatment of Industrial & Hazardous Waste (1993) M.V.Levin and Gealt, M.A McGraw Hill. Inc, New York
8. Ecology and environmental biology (2011) Saha T K Books & Allied (p) Ltd, Delhi
9. Environment Problems & Solutions (2001) Asthana & Asthana S. Chand Limited, New Delhi

Title of the Course: Practicals in Bioprocess Engineering								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSE-2	MS-WT118P (A)	00	02	02	60	15	35	50

Course Learning Objectives:

1. Students will understand the components and functions of a fermenter.
2. Students will gain practical skills in preparing media for fermentation, developing inoculum cultures.
3. Students will acquire knowledge and practical experience in optimizing fermentation media.
4. Students will develop practical understanding of the screening and isolation process for yeast or enzyme-producing organisms from natural sources.

Course Outcomes (COs):

1. Students shall become aware of fermenter and its parts.
2. Students will practically learn about the media preparation, inoculum development
3. and media optimization.
4. Students will practically understand how to screen and isolate the yeast or enzyme
5. producer organism from the natural sources.

Detailed Syllabus:

1. Preparation and sterilization of growth medium – nutrient agar and broth, PDA and PDB, YEPD, etc. (1)
2. Study of various parts and working of lab scale fermenter (1)
3. Screening and isolation of different yeast species from natural sources (2)
4. Screening and isolation of enzyme producer organism from the natural sources. (2)
5. Development of inoculums for bacteria, yeast and mycelial fungi (1)
6. Medium optimization for laboratory scale production. (2)
7. Lab scale production, recovery of any product by fermentation method. (2)
8. Visit to a fermentation industry (1)

Suggested reading:

1. Stanbury, P. F., Whittaker, A. and Hall, S., (2016) Principles of Fermentation technology, Springer, Third edition

2. Atkinson, (2014) Handbook of Bioreactors, Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.

3. Casida, L. E., (2019), Industrial Microbiology, New age International, New Delhi, Sec. Ed.

4. A.H. Patel. (2011), Industrial Microbiology, Macmillan India Ltd., Second Edition.

5. Crueger, W. and Crueger, A. (2005) A Text Book of Industrial Biotechnology.

Title of the Course: Practical's in Environmental Science								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSE-02	MS-WT118P (B)	00	02	02	60	15	35	50

Learning objectives

1. To gain practical experience in conducting experiments to assess the toxic effects of pollutants on biological systems.
2. To learn and apply the techniques of isolating microorganisms capable of degrading pollutants from polluted environments.
3. To acquire the knowledge and practical skills required to analyze water quality parameters.
4. To Execute Biodegradation of Pollutants using Plants or Microbes
5. To implement practical experiments to carry out biodegradation of pollutants.

Course Outcomes (COs):

1. Students will practically validate toxic effects of pollutants on biological system
2. Students will isolate the pollutant degrading microorganism from polluted environments.
3. Students will analyze/practically validate water quality parameters.
4. Students will practically execute biodegradation of pollutants using plant or microbes.

Detailed Syllabus:

1. Genotoxicity assay on polluted water- onion root tip and pollen germination assay. (2)
2. Isolation of microorganisms from different habitats/niches and enumeration of its bioremediation potential (2)
3. Qualitative estimation of biodegradation of pesticide/insecticide/fungicide. (2)
5. Estimation of total suspended solids (TSS) of waste water (1)
6. Determination of dissolved oxygen (DO) concentration of water sample (1)
7. Determination of chemical oxygen demand (COD) of sewage sample. (1)
8. Determination of biological oxygen demand (BOD) of sewage sample (1)
9. Review on EIA case study. (1)
10. Visit to waste water treatment plant (1)

Title of the Course: Research Methodology (Instrumentation)								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
RM-01	MS-WT119T/P	02	02	04	30 + 60	30	70	**100**

Learning Objectives:

1. Understand the principles and applications of distillation in the context of distilleries.
2. Gain knowledge of heat transfer fundamentals, different types of heat exchangers, and their design principles used distillery industry.
3. Familiarize with pressure measurement instrumentation.
4. Develop an understanding of flow measurement concepts of different types of flow meters.

Course Outcomes (COs):

1. Students will be able to accomplish basic design and optimization of process components and systems.
2. Students will learn use of different fluid flow measuring devices.
3. Students will be able to apply equations and principles to analyze pipe flow problems

Detailed Syllabus:

Unit I: Fundamentals of distilleries **(06)**

Fundamentals of distilleries, principles of distillation, vapour liquid equilibrium, boiling point curve/diagram.

Heat transfer fundamentals, types of heat exchanger, design of heat exchange equipments and their application to distillery industry

Unit II: Pressure measurement **(06)**

Introduction pressure measurement to instrumentation, important terms associated with instruments such as range, span, accuracy, error, resolution, reproducibility, repeatability, and sensitivity

Various pressure units and their conversion

Pressure transducers such as barometer, manometers, bourdon tube, diaphragm, bellows, capsule, strain gauges for pressure measurement.

Unit III: Flow measurement **(08)**

Basic terms such as total flow, volumetric flow, Mass flow, types of flow

Flow transducers such as orifice plate, pitot tube, venturi meter, variable area flow meter, magnetic flowmeter, vortex flowmeter, ultrasonic flowmeter, turbine flowmeter, displacement flowmeter.

Unit IV: Temperature measurement **(05)**

Various scales and conversion

Expansion thermometers, thermocouples, Resistance temperature detector, Thermistors and pyrometers.

Unit V: Level measurement **(05)**

Direct methods such as gauge glass method, float method, magnetic level indicator, magnetic level switches, indirect methods such as hydrostatic method, radiation method, ultrasonic method and capacitance method

Practical Syllabus:

1. Measurement of specific gravity (must, molasses, sugar syrups, wort, beer, wine etc.) using specific gravity bottle (1)
2. Measurement of viscosity of liquids using Oswald's viscometer (1)
3. Calibration of Bimetallic Thermometer (1)
4. Estimation of thermal death coefficient k for normal wine contaminants (2)
5. Determine the coefficient discharge using Orifice meter/pitot tube (1)
6. Determine the coefficient discharge using Venturi meter/magnetic flowmeter (1)
7. Determination of the heat transfer coefficient for plate type heat exchanger (1)
8. Determination of the heat transfer coefficient for Shell/Tube heat exchanger (1)
9. To study Rayleigh equation and study simple distillation (2)
10. Visit to winery/brewery /distillery to study CIP process, Orifice meter, pitot tube, Venturi meter and magnetic flowmeter and heat exchangers (1)

Suggested Readings:

1. Chaiwal, Gurdeep P.& Anand, Sham- Industrial Methods of chemical Analysis, Analytical instruments
2. Gurdeep & Anand, Sham (2007)- Industrial methods of chemical Analysis .
3. Mccabe, Warren L. , Smith, Julian C. & Harriott, Peter- Unit operations of chemical engineering.
4. Richardson, J. F. & Peacock, D. G. Coulson & richardson's - Chemical engineering, vol.
5. L. Victor, Streeter and E. Benjamin Wylie, (1985), Fluid Mechanics, Tata McGraw Hill.

6. M. Franck White, (2017), Fluid Mechanics, Tata McGraw Hill.

7. K. Subramanya, (2001), Theory and Applications of Fluid Mechanics, Tata McGraw Hill.

8. R. K. Rajput, A text book of Fluid Mechanics and Hydraulic Machines, S. chand Technical

Title of the Course: Applied Alcohol Technology								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-07	MS-WT 121T	03	00	03	45	30	70	100

Learning Objectives

1. To study history of alcohol technology.
2. To know different fermentation types for alcohol production.
3. To study role and applications of alcohol in pharmaceuticals and environment.

Course outcomes (CO's)

1. Students will understand various industrial methods of alcohol production.
2. Students will understand application of alcohol in pharmaceutical and energy sector.
3. Students will develop knowledge entrepreneurship related to alcohol
4. Students will learn about sustainable approach of alcohol production.
5. Students will gain knowledge about emerging technologies in alcohol production.

Detailed Syllabus-

Unit 1: Historical overview and significance of alcohol production **(02)**

Overview of different types of alcohol and their applications in industries

Unit II: Alcohol Fermentation And Distillation Technologies: **(12)**

Principles and mechanisms of fermentation and distillation

Analysis of different fermentation techniques (batch, continuous, solid-state, etc.)

Analysis of different distillation methods (pot still, column still, etc.)

Case studies: Comparing fermentation methods in different alcohol production processes

Case studies: Examining the impact of distillation techniques on alcohol quality

Unit III: Applications of Alcohol in Pharmaceuticals and Healthcare Products: **(12)**

Alcohol's role as a solvent and active ingredient in pharmaceuticals

Alcohol-based sanitizers and antiseptics

Case studies: Exploring alcohol's applications in the healthcare industry

Applications of Alcohol in Chemical Synthesis:

Alcohol as a solvent and reactant in chemical reactions

Industrial applications of alcohol in organic synthesis

Case studies: Examining alcohol's role in industrial chemical processes

Applications of Alcohol in Biofuels and Renewable Energy

Alcohol as a fuel source and its use in biofuel production

Alcohol-based renewable energy technologies

Case studies: Analyzing the potential of alcohol as a sustainable energy source

Unit IV: Alcohol Technology Innovations: (08)

Emerging technologies in alcohol production

Biotechnological advances in fermentation and distillation

Case studies: Exploring innovative approaches in alcohol technology

Environmental and Sustainability Considerations:

Environmental impact of alcohol production and consumption

Sustainable practices in alcohol manufacturing

Case studies: Assessing the environmental footprint of alcohol technology

Unit V: Entrepreneurship and Business Perspectives (11)

Opportunities and challenges in the alcohol industry

Business models for alcohol production and distribution

Marketing and branding strategies for alcoholic products

Case studies: Analyzing successful alcohol business ventures; Kingfisher, McDowell's No. 1, Officer's Choice, Royal Stag, Signature, Bagpiper Bacardi (Rum), Johnnie Walker (Scotch Whisky) ,Smirnoff (Vodka), Jack Daniel's , (Whiskey)Hennessy (Cognac), Absolut (Vodka)

Suggested Reading:

1. "Alcohol Textbook" by K. A. Jacques, T. P. Lyons, and D. R. Kelsall
2. "Alcohol Fuel: A Guide to Making and Using Ethanol as a Renewable Fuel" by Richard Freudenberger
3. "Alcohol Can Be a Gas!: Fueling an Ethanol Revolution for the 21st Century" by David Blume
4. "Industrial Alcohol Technology Handbook" by NPCS Board of Consultants & Engineers
5. "Fermentation and Biochemical Engineering Handbook: Principles, Process Design, and Equipment" by Henry C. Vogel and Celeste M. Todaro
6. "Distillation: Principles and Practices" by Johann G. Stichlmair
7. "Chemical Process Equipment - Selection and Design" by James R. Couper, W. Roy Penney, James R. Fair, and Stanley M. Walas

8. "Pharmaceutical Biotechnology: Fundamentals and Applications" by Daan J. A. Crommelin, Robert D. Sindelar, Bernd Meibohm
9. "Handbook of Pharmaceutical Excipients" by Paul J. Sheskey, Walter G. Cook, and Marian E. Quinn
10. "Chemical Process Industries" by Shreve's and George T. Austin
11. "Biofuels Engineering Process Technology" by Caye M. Drapcho, Nhuan P. Nghiem, and Terry H. Walker
12. "Introduction to Bioenergy" by Sergio Capareda
13. "Cleaner Combustion and Sustainable World" edited by Samir El-Sharoud
14. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
15. "Alcohol and the Environment" edited by Michael D. Goldsmith
16. "Sustainable Ethanol: Biofuels, Biorefineries, Cellulosic Biomass, Flex-Fuel Vehicles, and Sustainable Farming for Energy Independence" by Jeffrey Goettemoeller and Adrian Goettemoeller
17. "Sustainable Alcohol Production: A Handbook of Energy Efficiency and Renewable Energy Processes" edited by Adalberto Pessoa Jr.
18. "The Craft of Stone Brewing Co.: Liquid Lore, Epic Recipes, and Unabashed Arrogance" by Greg Koch and Steve Wagner
19. "The Wine Bible" by Karen MacNeil
20. "Distilled: From absinthe & brandy to vodka & whisky, the world's finest artisan spirits unearthed, explained & enjoyed" by Neil Ridley and Joel Harrison

Title of the Course: Applied Brewing Technology								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-08	MS-WT 122T	03	00	03	45	30	70	100

Learning objectives

1. To study about history of beer.
2. To study different beer styles.
3. To know about raw materials for beer production.
4. To study methodology of beer production.

Course outcomes (CO's)

1. Students will understand methods of beer production.
2. Students will understand history of beer.
3. Students will develop knowledge of different beer styles.
4. Students will learn about raw materials for beer production.
5. Students will gain knowledge about emerging technologies in beer production.

Detail Syllabus:

Unit I: History and overview of industrial brewing (13)

Introduction, brewing in an agrarian world, the eighteenth century, porter, the first industrial beer: mechanization and measurement. The nineteenth century: porter vs ale, the rush to bottom fermentation, science and practice. The twentieth century: beer and society, temperature and prohibition. Consumer choice fewer & bigger: the path to globalization, science applied & technology transformed. 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.

Beer origin, classification and beer styles

Beer origin, classification and beer styles, their origins and classification-introduction: creation of different styles of beer and factors involved- ingredients: water, fermentable carbohydrates, hops, yeast, processing: equipment configuration, milling, mashing, lautering, boiling time, fermentation temperature, maturation time, filtration, packaging, marketing, cultural origins of style, analytical and sensor variables, beer style guidelines, analysis, tasting &, brewing beer.

The beer styles-ales: British origin, Irish origin, German origin, Belgian and French origin, lager beer: European- Germanic origin, North American origin, other origin.

Unit II: Basic raw materials of brewing – Water (12)

Basic raw materials of brewing-water: brewery water consumption, brewery water categories, water hardness, water alkalinity and pH, effect of ions in water, inorganic constituents and organic constituents of water, water quality reports parameter – primary standards, secondary standards & aesthetic standards, chemical characterization of water types, summary of the influences of various ions during beer production

Unit III: Basic raw materials of brewing – Barley and malt (12)

Barley and Malt: -barley–structure and function: husk, pericarp, testa, aleurone layer, starchy endosperm, the embryo.

Malt production: drying, storage, and handling, steeping, germination, kilning and malt quality, malt varieties

Unit IV: Basic raw materials of brewing – Hops (08)

Hops-classification, hop variety, cultivation and harvesting, chemistry, whole hops, hop resins-soft and hard resins, hop oils, hop storage, bittering value, bitter flavor and foam – role of α-acids, typical chemical profile in presence and absence of hops. Factors affecting on hop addition in brewing process. Hops usage – choice of hop product, hop utilization, calculation of hop additions.Adjuncts- concept, role of adjuncts in brewing, various examples of adjuncts**.**

Suggested readings -

1. American Society of Brewing Chemists, U.S.A.: 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. N. York, Academic Press, 1994. 3. Birch,G.G.: Alcoholic beverages. London, Elsevier Applied Science Pub.1985.
3. Government of India. Technical Excise Manual. --(663.16GOV)
4. Hardwick,W.A.,ed.: Handbook of brewing. N. York, Marcel Dekker,Inc.,1995.(663.3 HARHAR)
5. Hough,J.S.,Briggs,D.E.,Stevens,R.,Young,T.W.: Malting & brewing science, vol. 2 : hopped wort & water. London, Champman & Hall, 1982.
6. Pollock, J.R.A., and ed.: Brewing science vol. 1.London, Academic Press, 1979,

7. Pollock, J.R.A., and ed.: Brewing science, vol. 2. London, Academic Press, 1981.
8. Prescott, S.C. & Dunn, C.G.: Industrial microbiology. Jodhpur. Agrobios (India), 2002. 81-7754-149-10.
9. Priest, F.G.: Brewing microbiology, 2nd ed.. (1996) U.K. Chapman & Hall, 1996.
10. Priest, Fergus G.; & Stewart, Graham G.: Handbook of brewing. (2nd) U.S.A. CRC Press, Taylor & Francis Group, 2006.

Title of the Course: Applied Oenology								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	**Total**
DSC-09	MS-WT 123T	02	00	02	30	15	35	**50**

Learning objectives:

1. To overview wine producing countries worldwide
2. To learn classification and health aspects of wine
3. To study detailed procedure of wine making
4. To understand wine fermentation parameters

Course Outcomes (Cos):

1. Students will learn the scope of oenology.
2. Students will study the classification and therapeutic values of wine.
3. Students will study the different red and white grape varieties along with its composition used in oenology.
4. Students will study the pre fermentation processes.
5. Students will learn the monitoring and controlling of wine fermentation parameters.

Detailed Syllabus:

Unit I: Introduction and classification of wine (08)

Introduction to Oenology. Major wine producing countries in the world. Present international and national status of wine production, commercial aspect of wine production. Overview of world and Indian wine scenario. The current and future wine prospectus in India. New concept of wine production: organic, biodynamic wine, Ice wine, Amber wine etc. Classification of wine- table wines, sparkling wine, dessert wines, aperitif wine, pop wine.

Unit II: Grape varieties, composition and Pre-fermentation treatments (08)

White wine grapes varieties, Red wine grape varieties. Principal constituents of grape juice and Wine: Water, carbohydrates (Sugar), acid, Nitrogen containing compounds, mineral salts, phenolic compounds and related phenol-tannins, Anthocyanin's, some important functional and chemical groups in grapes. Must preparation, must adjustments, Clarification of grape juice and commercial enzymes and yeast used in wine making.

Unit III: Wine Production (08)

Detailed Red wine production and its styles - harvesting to bottling Detailed White wine production and its styles -harvesting to bottling Sparkling wine production stages -traditional method, transfer process method, Tank method and Carbonation

Unit IV: Monitoring and controlling of wine fermentation parameters (06)

Monitoring cell number and viability of yeasts during wine fermentation, controlling microbial growth during wine production, effect of pH, temperature, CO_2, amount of sugar on fermentation rate. Role of sulphur-di-oxide in vinification Preservation of wine- sulphur dioxide, dimethyl dicarbonate, sorbic acid & benzoic acid

Suggested Readings/Material:

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. Brue W. Zoecklein (1999) Wine Analysis andproduction
8. Handbook of Enology, Vol. I. The Microbiology of Wine and Vinification- P. Ribereau-Gayon, D. Dubourdieu, B. Doneche, A. Lonvaud.
9. American Society for Enology and Viticulture- Seattle.
10. Introduction to winemaking, Viticulture and Enology 3- Prof. Ralph E. Kunkee.
11. Understanding wine- Course notes- Patrick IIand, Peter Gago.
12. Wine science- Ron S. Jackson.
13. Handbook of Enology, Vol 2- The chemistry of wine stabilization and treatments P. Ribereau – Gayon, D. Dubourdieu, A. Maujean, Y. Glories.
14. Concepts on wine chemistry- the wine appreciation guide- Yair Margalit, James Crum.
15. Wine making from grape growing to marketplace- Richard P. Vine, Ellen M.Harkness, Salley J. Linton.
16. Monitoring the wine making process from grapes to win techniques and Concepts Patrick Iland, Nick Bruer, Andrew Ewart, Andrew Markides, John Sitters.
17. Wine appreciation- Richard P. Vine.

20.Boltan R. B. (1996) Principles and practice of winemaking, Chapman and Hall.

Title of the Course: Practical's in Applied Alcohol technology								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-10	MS-WT 124P	00	02	02	60	15	35	50

Learning objectives

1. To study different materials for alcohol production.
2. To know various methods of alcohol estimation.
3. To study chemical analysis of alcohol and raw materials for alcohol.

Course Outcomes (COs):

1. Learn the types of substrate for alcohol production.
2. To study the various techniques of alcohol determination
3. Learn the estimation of various non-alcoholic entities present in spirit.
4. Understand the effect of alcohol on viability yeast.

Detailed Syllabus:

1. To study types of raw materials and substrate for alcohol production. (1)
2. Production of alcohol from molasses. (2)
3. Determination of fermentation efficiency of yeast (in molasses medium) (1)
4. Extraction of starch and estimation of total sugar by Anthrone method (1)
5. Production of alcohol using starch. (1)
6. Determination of alcohol content in given product. (2)

(a) Specific gravity method (b) Alcoholometer (c) Colorimeter

7. Determination of aldehyde content of spirit. (1)
9. Determination of ester content of spirit. (1)
10. To study the effect of alcohol concentration on yeast growth. (2)

Title of the Course: Practicals in Applied Brewing Technology								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-11	MS-WT 125P	00	02	02	60	15	35	50

Learning Objectives

1. To study different types of barley and cereal grains for beer production.
2. To know about different processes for beer production.
3. To study the different analysis methods of beer components.

Course Outcomes (COs):

1. Students should be known the structure of barley/cereal grains.
2. Students will practically understand how to prepare malt.
3. Students will practically learn about the chemical analysis of barley/cereal grains/malt.
4. Students will practically understand the chemical analysis of wort.

Detailed Syllabus:

1. Study of different types of cereal grains and its grading used in preparation of beer (1)
2. Determination of moisture content of barley/ cereal grains. (1)
3. Study of structure of barley/ cereal grains. (1)
4. Chemical analysis of barley/ cereal grains. (1)
5. Study of germination of barley and its analysis. (2)
6. Preparation of malt and chemical analysis of prepared malt. (2)
7. Extraction of wort and determination of its specific gravity. (1)
8. Determination of reducing sugar content of wort. (1)
9. Determination of fermentable saccharides of wort. (1)
10. Determination of pH &temperature; acidity of wort. (1)

Title of the Course: Practicals in Applied Oenology								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
DSC-12	MS-WT126P	00	02	02	60	15	35	**50**

Learning Objectives:

1. To obtain knowledge about instruments used in wine making
2. To study types of wine worldwide
3. To learn wine making
4. To study different wine parameter

Course Outcomes (Cos)

1. Students will study the instruments used in Oenology laboratory.
2. Students will learn the types of wine.
3. Students will learn to estimate sugar from grape juice.
4. Students will learn to determine different components from wine.
5. Students will study the wine preparation technique.

Detailed Syllabus:

1. Study of instruments used in oenology laboratory and its calibration (1)
2. Estimation of sugar from grape juice (1)
3. Must preparation and juice clarification (1)
4. Determination of total antioxidant content of wine (1)
5. Determination of total tannin content of wine (1)
6. Preparation of red wine (1)
7. Preparation of white wine (1)
8. Determination of alcohol content of wine by Ebulliometer (1)
9. Determination of pH and total acidity of wine (1)
10. Determination of volatile acidity of wine (1)
11. Determination of free and total sulphur dioxide of wine (1)
12. Visit to a wine industry and report submission along with photo documentation (1)

Title of the Course: Chemical Engineering and Plant Management								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
DSE-3	MS-WT127T (A)	02	00	02	30	15	35	**50**

Learning Objectives:

1. To understand/gain knowledge of the principles and equipment used in sedimentation, filtration, and centrifugation etc.
2. To familiarize students with pumps and their applications.
3. To develop knowledge in fluid mechanics: Gain a strong understanding of energy balances, fluid statics, and fluid dynamics.
4. To learn distillation column design and psychometric processes.

Course Outcomes (COs):

a. Students will get an ability to accomplish basic design and optimization of process components and systems of beverage industry.
b. Students will get chance to improve fundamental research & analysis, skills & advance understanding of then processes involved in wine production,
c. Students will get chance to improve fundamental research & analysis, skills & advance understanding of then processes involved in brewing technology.
d. Students will get chance to improve fundamental research & analysis, skills & advance understanding of then processes involved in Alcohol technology.

Detailed Syllabus:

Unit I: Mass balance and Separation techniques: (07)

Single and multiple unit processes, Reactive systems, Purge systems, Recycle, Bypass systems. Separation techniques like sedimentation, filtration & centrifugation: basic principles & equipment's.

Unit II: Pumps and their applications: (08)

Pumps and their applications, characteristic curves, types of pumps, (maintenance of pumps and operation). Use of compressed air for process industry, compressor and its working principles. Friction factor pump selection and applications.

Unit III: Fluid Mechanics (08)

Energy balances specific and latent heat, Enthalpy, Entropy, Internal energy heat and work, Open and closed systems, Thermodynamic diagrams, power and refrigeration. Fluid static, fluid dynamics, pipe/duct flow. Frictional pressure losses in pipe/duct, flow pumps/fans.

Unit IV: Design of distillation column **(07)**

Calculation of number of plates using McCabe Thiele method. Design of distillation column.

Psychometric Heating, cooling, humidification, dehumidification, mixing of air streams, drying of cereals and food as psychometric process.

Suggested reading:

1. Mass Transfer Operations – Robert E. Treybal
2. Introduction to Chemical Engineering – Ghosal & Sanyal
3. Unit Operations of Chemical Engineering – Warren L. McCabbe, Julian C. Smith
4. Process Heat Transfer- D. Q. Kern
5. Process control systems by F.G. Shinskey
6. Process Control Instrumentation Technology by C. D. Johnson.
7. Applied Instrumentation in the Process Industries by W.G. Andrew and H.B. Williams

Title of the Course: Biostatistics								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSE-3	MS-WT127T (B)	02	00	02	30	15	35	50

Learning Objectives:

1. To understand the concept of biostatistics
2. To summarize and categorize the statistical data
3. To use specific statistical test to specific data
4. To learn the interpretation of results and its application in biological sciences

Course Outcomes (COs)

1. Students will understand the importance of statistics in Biological sciences.
2. Students will learn to summarize and categorize statistical data.
3. Students will apply appropriate statistical tests on different types of data.
4. Students will learn the interpretation of results and its application in biological systems.

Detailed Syllabus:

Unit I: **(06)**

Introduction to Statistics: Measures of central tendency – mean, mode, median and their properties

Measures of dispersion – variance, standard deviation, coefficient of variance

Symmetry and skewness, measures of skewness, kurtosis

Sampling and sampling distributions – concept of sample and population, statistic, methods of sampling, standard error

Unit II: **(09)**

Correlation and regression

Bivariate correlation, positive correlation, negative correlation

Measures of correlation – Scatter diagram, Karl-Pearson's coefficient of correlation, Spearman's rank correlation coefficient

Regression – Equations of regression lines using least square method, regression estimate and its standard error

Unit III: **(06)**

Experimental Statistics - Design of experiments

Principles of design – randomization, replication, local control, treatment group and control group

Guidelines for designing the experiments, size of plot, number of replications

Completely randomized design (CDR), randomized block design (RBD)

Unit IV: **(09)**

Testing of hypothesis and analysis of variance

Hypothesis, statistical hypothesis, critical region, level of significance, p-value, normal distribution

T-test: t-test for mean, equality of two means, paired t-test, unpaired t-test

chi-square test: chi square test for goodness of fit, independence of attributes,

Analysis of variance table (ANOVA)

Introduction to statistical analysis software- e.g. SPSS

Suggested Readings:

1. Billingsley, P. (1986). Probability and Measure. New York: Wiley.
2. Rosner, B. (2000). Fundamentals of Biostatistics. Boston, MA: Duxbury Press.
3. Daniel, W. W. (1987). Biostatistics, a Foundation for Analysis in the Health Sciences. New York: Wiley.
4. Sunderrao P.S. and Richards J. An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India.
5. Campbell R.C. Statistics for Biologists, Cambridge University Press, Cambridge.

Title of the Course: Practical's in Chemical Engineering and Plant Management								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
DSE-4	MS-WT128P (A)	00	02	02	30	15	35	**50**

Learning Objectives:

1. Foster curiosity and a sense of adventure by engaging in individual tasks within an industrial learning environment.
2. Utilize in-plant training as a valuable opportunity for students to acquire practical skills and knowledge through active participation.
3. Provide students with constructive feedback on their performance to facilitate their professional growth and development.
4. Promote students' overall professional development in commercial practice to equip them with the necessary skills and abilities to thrive in a competitive global environment.

Course Outcomes (COs):

1. Course will develop enthusiasm to explore new things by participating in individual tasks available in outside industrial learning environment.
2. Students In plant training is a great learning opportunity for students to acquires skills from participating in such activities.
3. Students will get feedback on their performance so that they can grow professionally.
4. Students Overall professional development of Commercial Practice is the need of the day for enabling them to sustain in competitive global environment.

Detailed Syllabus:

It provide a chance to improve fundamental research & analysis, skills & advance understanding of then processes involved in Wine technology, Brewing technology or Alcohol technology. During in-plant training, students are usually placed within industrial organizations or companies where they can observe and actively engage in various aspects of the industry's operations. This can include tasks such as shadowing professionals, assisting with projects, participating in production processes, conducting research and development activities, or learning about specific functions like marketing, logistics or quality control.

In plant Training should be for the period of minimum two weeks. In plant training is typically conducted within industries (Distillery/Brewing, etc.) to provide hands-on experience and practical knowledge (instruments like heat exchanger, filters, bottling,

column distillation, quality control, etc.) to students or individuals who are pursing education or training in a specific field. After Training Student should submit the training report along with training certificate (training duration should be mention) of concern host /work institution. Evaluation will be carried out on the basis of in plant training report and viva.

Title of the Course: Practicals in Biostatistics								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSE-4	MS-WT128P (B)	00	02	02	60	15	35	50

Learning Objectives

1. To understand and calculate measures of central tendencies
2. To collect the primary and secondary data for analysis
3. To calculate kurtosis, skewness and correlation for data sets.
4. To learn the application of various statistical tests to given data

Course Outcomes (COs)

1. Students will understand the measures of central tendencies and their applications.
2. Students will able to collect the data relating to dependent and independent variable/variables.
3. Students will able to calculate kurtosis, skewness and correlation from different data sets.
4. Students can apply hypothesis testing via some of the statistical distributions.

Detailed Syllabus:

1	Measurement of central tendency (mean, mode and median)	(1)
2	Measure of variance, standard deviation, coefficient of variance and standard error	(1)
3	Measures of skewness and measures of Kurtosis	(1)
4.	Determination of Karl-Pearson's/ Spearman's rank coefficient of correlation from the given data.	(2)
5	Determination of regression lines and calculation of correlation coefficient – grouped and ungrouped data.	(2)
6	Drawing a simple random sample with the help of table of random numbers.	(1)
7	Chi-square test for goodness of fit and independent attributes	(1)
8	Analysis of variance on the given data (ANOVA)	(2)
9	Hypothesis testing of data using t test.	(1)