Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B. Sc. Degree Course in

WINE, BREWING AND ALCOHOL TECHNOLOGY

Syllabus

(To be implemented from Academic Year 2019-20)

F.Y. B. Sc.
(Wine, Brewing & Alcohol Technology)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Preamble:

Wine 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, 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 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 area 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 a wine 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.

Introduction:

The syllabi till today had been sufficient to cater to the needs of students for building up their careers in industry and research. However, with the changing scenario at local and global level, we feel that the syllabus orientation should be altered to keep pace with developments in the education and industrial sector. The need of the hour is to design appropriate syllabi that emphasize on teaching of technological as well as the economical aspects of Wine, Alcohol and Brewing industry. Theory supplemented with extensive practical skill sets will help a graduate student to avail the opportunities in the applied fields (research, industry or institutions), without any additional training. Thus, the university / college itself will be developing the trained and skilled man-power.

Objectives to be achieved:

- To introduce the concepts in various allied subjects
- To enrich students' knowledge
- To help the students to build interdisciplinary approach
- To inculcate sense of scientific responsibilities and social and environment awareness

- To help students build-up a progressive and successful career

Eligibility: Candidates applying for B.Sc. Wine, Brewing And Alcohol Technology should be H.S.C. in science disciplines OR 10 +2 years diploma course in Agriculture or Diploma in Fruit Processing and Wine Technology or Horticulture.

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

Reservation and relaxation will be as per the Government rules.

Medium of Instruction: English

SPECIAL FEATURES
1. More stress will be given to this process development and scale-up system along with marketing. 2. Evaluation of waste for production of valuable products will be given prime importance 3. Energy Production and Conservation will be considered during the tenure of the courses. 4. Industry attached Educational system, is more feasible concept
Carrier Opportunity
1. Government sector in India
-Agriculture departments
-Agriculture Institute
-Excise Department
-Bureau of Indian Standards
-Import Export Departments
2. International and national Brewing, Wine and Alcohol Industry
-Vineyard management and marketing services
-Research techniques
-Technical assistance
-Winery laboratory technicians
-Wine marketing services
-Quality control in Brewing and wine industry.
3. Self employment
-own winery, Brewery
-winery consultant
-wine taster, wine maker

Course Structure:

- CGPA will be calculated based on core 132 credits only

- Each theory credit is equivalent to 15 clock hours of teaching(12hrs classroom+3hrs of tutorials-active learning method) and each practical credit is equivalent to 30 clock hours of teaching in a semester.
- For the purpose of computation of workload, the following mechanism may beadopted as per
- UGC guidelines:
  1 Credit = 1 Theory period of one-hour duration per week
  1 Credit = 1 Tutorial period of one-hour duration per week
  1 Credit = 1 Practical period of two-hour duration per week
- Each theory Lecture time for FY, SY, TY is of 1 hour = 60 min
- Each practical session time for FY is of 3 hour = 180 min
- Each practical session time for SY & TY is of 4 hour = 240 min

Award of Credits:

- Each course having 4 credits shall be evaluated out of 100 marks and student should secure at least 40 marks to earn full credits of that course.
- Each course having 2 credits shall be evaluated out of 50 marks and student should secure at least 20 marks to earn full credits of that course.
- GPA shall be calculated based on the marks obtained in the respective subject provided that student should have obtained credits for that course.

Evaluation Pattern:

- Each course carrying 100 marks shall be evaluated with Continuous Assessment(CA) and University Evaluation (UE) mechanism.
- Continuous assessment shall be of 30 marks while University Evaluation shall be of 70 marks. To pass in a course, a student has to secure minimum 40 marks provided that he should secure minimum 28 marks in University Evaluation (UE).
- Each course carrying 50 marks shall be evaluated with Continuous Assessment (CA) and University Evaluation (UE) mechanism.
- Continuous assessment shall be of 15 marks while University Evaluation shall be of 35 marks. To pass in a course, a student has to secure minimum 20 marks provided that he/she should
- secure minimum14 marks in University Evaluation (UE).
- For Internal examination minimum two tests per paper of which one has to bea written test 10 marks
- Methods of assessment for Internal exams: Seminars, Viva-voce, Projects,Surveys, Field visits, Tutorials, Assignment, Group Discussion, etc (on approval of the head of the centre)

ATKT Rules:

- Minimum number of credits required to take admission to Second Year of B. Sc.: 31 [70%]
- Minimum number of credits required to take admission to Third Year of B.Sc.: 44 credits [100%] to be completed from F.Y.B.Sc and atleast 22 credits from S.Y. B.Sc
- Completion of Degree Course:
- A student who earns 140 credits, shall be considered to have completed the requirements of the B. Sc. degree program and CGPA will be calculated for such student

Title of the Course: F.Y.B.Sc. (Beer, Wine and Alcohol Technology)

Structure of the course:

Semester: I

Theory

Course Code	Course Title	Credits	Number of Hours	Marks
WT-101	Basic Microbiology Paper I	2 Credits	30	50 (35 External +15 Internal)
WT-102	Industrial Microbiology Paper I	2 Credits	30	50 (35 External +15 Internal)
WT-103	Introduction to Botany	2 Credits	30	50 (35 External +15 Internal)
WT-104	Plant Development and Anatomy	2 Credits	30	50 (35 External +15 Internal)
WT-105	Basic Biochemistry Paper I	2 Credits	30	50 (35 External +15 Internal)
WT-106	Metabolic Pathways Paper I	2 Credits	30	50 (35 External +15 Internal)
WT-107	Wine Technology	2 Credits	30	50 (35 External +15 Internal)
WT-108	Sensory Evaluation of wine paper-I	2 Credits	30	50 (35 External +15 Internal)

Practicals

WT-109	Practicals in Microbiology	1.5 Credits	10 P	50 (35 External +15Internal)
WT-110	Practicals in Botany	1.5 Credits	10 P	50 (35 External +15 Internal)
WT-111	Practicals in Biochemistry	1.5 Credits	10 P	50 (35 External +15 Internal)
WT-112	Practicals in Wine Technology	1.5 Credits	10 P	50 (35 External +15 Internal)
Total Credits (Theory + Practical)		**22 Credits**		

Title of course: F.Y.B. Sc (Beer, Wine and Alcohol Technology)

Structure of the Course

Semester : II

Theory

Course Code	Course Title	Credits	Number of Hours	Marks
WT-201	Basic Microbiology Paper II	2 Credits	30	50 (35 External +15 Internal)
WT-202	Industrial Microbiology Paper II	2 Credits	30	50 (35 External +15 Internal)
WT-203	Plant Physiology	2 Credits	30	50 (35 External +15 Internal)
WT-204	Applied Botany	2 Credits	30	50 (35 External +15 Internal)
WT-205	Basic Biochemistry Paper II	2 Credits	30	50 (35 External +15 Internal)
WT-206	Metabolic Pathways Paper II	2 Credits	30	50 (35 External +15 Internal)
WT-207	Introduction to Beer, Wine and Alcohol Technology	2 Credits	30	50 (35 External +15 Internal)
WT-208	Sensory evaluation of wine paper-II	2 Credits	30	50 (35 External +15 Internal)

Practicals

WT-209	Practicals in Microbiology	1.5 Credits	14 P	50 (35 External +15 Internal)
WT-210	Practicals in Botany	1.5 Credits	14 P	50 (35 External +15 Internal)
WT-211	Practicals in Biochemistry	1.5 Credits	14 P	50 (35 External +15 Internal)
WT-212	Practicals in Wine Technology	1.5 Credits	14 P	50 (35 External +15 Internal)
Total Credits (Theory + Practical)		**22 Credits**		

Title of course: S.Y.B. Sc (Beer, Wine and Alcohol Technology)

Structure of the Course

Semester : III

Theory

Course Code	Course Title	Credits	Number of Hours	Marks
WT-301	Yeast technology paper -I	2 Credits	30	50 (35 External +15 Internal)
WT-302	Fermentation technology paper-I	2 Credits	30	50 (35 External +15 Internal)
WT-303	Brewing technology -I	2 Credits	30	50 (35 External +15 Internal)
WT-304	Alcohol technology -II	2 Credits	30	50 (35 External +15 Internal)
WT-305	Biochemistry Paper -III	2 Credits	30	50 (35 External +15 Internal)
WT-306	Vineyard technology paper -I	2 Credits	30	50 (35 External +15 Internal)
WT-307	Environmental awareness	2 Credits	30	50 (35 External +15 Internal)
WT-308	English communication	2 Credits	30	50 (35 External +15 Internal)

Practicals

WT-309	Practical course -I	2 Credits	14 P	50 (35 External +15 Internal)
WT-310	Practical course -II	2 Credits	14 P	50 (35 External +15 Internal)
WT-311	Practical course -III	2 Credits	14 P	50 (35 External +15 Internal)
Total Credits (Theory + Practical)		**22 Credits**		

Title of course: S.Y.B. Sc (Beer, Wine and Alcohol Technology)

Structure of the Course

Semester : IV

Theory

Course Code	Course Title	Credits	Number of Hours	Marks
WT-401	Yeast technology paper-II	2 Credits	30	50 (35 External +15 Internal)
WT-402	Fermentation technology paper-II	2 Credits	30	50 (35 External +15 Internal)
WT-403	Wine technology -I	2 Credits	30	50 (35 External +15 Internal)
WT-404	Wine technology -II	2 Credits	30	50 (35 External +15 Internal)
WT-405	Waste treatment paper -I	2 Credits	30	50 (35 External +15 Internal)
WT-406	Vineyard technology paper-II	2 Credits	30	50 (35 External +15 Internal)
WT-407	Environmental awareness	2 Credits	30	50 (35 External +15 Internal)
WT-408	English communication	2 Credits	30	50 (35 External +15 Internal)

Practical's

WT-409	Practical course -I	2 Credits	14 P	50 (35 External +15 Internal)
WT-410	Practical course -II	2 Credits	14 P	50 (35 External +15 Internal)
WT-411	Practical course -III	2 Credits	14 P	50 (35 External +15 Internal)
Total Credits (Theory + Practical)		**22 Credits**		

Course Code :WT-301 Yeast technology paper-I (2 Credit course) Total Hours=30

Serial No.	Topics	No. of Hours

Unit -1	I yeast –Introduction, taxonomy & morphology and yeast cell structure and functions of various cellular components. ii.Importance of yeast strains in wine making iii. Maintenance of yeast strains and preservation of strain characteristics iv. Yeast culture techniques, stability of cultures and autolysis v .Normal micro flora and pathogens of grapevine vi. Types of microbial spoilage of wine, Prevention of microbial spoilage of wine during fermentation, curing and storage of wine vii. Primary, secondary and targeted screening of yeast strain. viii Primary, secondary metabolites produced by yeast	03 01 05 05 02 06 06 02

Course Code :WT-302 Fermentation technology paper-I (2 Credit course) Total Hours=30

Unit No.	Topics	No. of Hours
Unit -1.	**Types of fermenters:** i.Fermenter configuration ii.Types :- Batch fermenter, Continuous fermenter, Stirred tank fermenter, Tubular fermenter, Fluidized bed fermenter, Solid state fermenters, Hollow Fibre Reactors	08
Unit -2.	**Parts of fermenters:** i. Body construction and temperature control ii. Aeration and agitation: Aerator (sparger), Agitator (Impellers, baffles) iii. Achievement and maintenance of aseptic conditions: sterilization of fermenter, sterilization of air supply, sterilization of exhaust gas, addition of inoculum, nutrients and other supplements, sampling, feed ports, sensor probes, foam control, monitoring and control of various parameters iv. Piping and Valves. a. Factors affecting design b. Fermenter operation modes: (Single, dual, multiple, batch, fed-batch, continuous)	12
Unit –-3.	**Utilities required for fermentation:** Boilers, Compressors, Cooling towers, Refrigeration and air conditioning, Chilling plants, Water treatment plants	10

Course Code :WT-303 Brewing technology-I (2 Credit course) Total Hours=30

Unit No.	Topics	No of Hour

Unit 1	i. How Different Beer Styles are Created – 1.Ingredients –Water, Fermentable Carbohydrates, Hops, Yeast 2. Processing- 1. Equipment configuration and design Grain milling, Mashing, Lautering, Boiling — type and length. Temperature of fermentation., Time of maturation, Filtration, 3. Packaging 4. Marketing 5. Culture ii. Origins of Style, Methods Used to Define Brewers Association's Beer Style Guidelines iii. The Beer Styles –Ales ,lagers etc	**08**
Unit 2	**Outline of brewing :** Outline of the Brewing Steps- Malts, Adjuncts ,brewing liquor, milling, mashing, Wort separation, Wort boiling, Trub removal, Wort cooling/aeration , Yeast handling, Yeast pitching, Fermentation , Yeast removal, Aging, Clarification, Packaging , Warehousing and distribution	**15**
Unit 3	**Malting technology :** i. Barley and Malt: - Barley – Structure and function: the husk the pericarp, testa, Aleurone Layer, Starchy Endosperm, The Embryo. ii. Malt Production: Drying, Storage, and Handling, steeping, Germination, Kilning and Malt Quality, Malt varieties	**07**

Course Code :WT-304 Alcohol technology -I (2 Credit course) Total Hours=30

Unit No.	Topics	No of Hours

Unit 1	**Unit-1 Introduction to distillery.** 1.1- Role of wine technologist in distillery-Scope & functions of technical person in distillery 1.2- Process flow diagram of distillery- 1.3 - Raw materials used in alcohol production- Sugar containing; starch containing and cellulosic raw materials. 1.4- Stoichometry- Calculation of theoretical yield from single glucose unit 1.5- Beverage alcohol products-Pot and continuous distillate products for making maturation & white sprits	**08**
Unit 2	**Unit-2.Fermentation :** 2.1- Yeast propagation under plant conditions in molasses and starch based distillery, characteristics of distillers yeast. 2.2- Conventional batch process for distillery. 2.3- Calculation of efficiency and recovery in alcohol production.	**06**
Unit 3	**Unit-3 Starch processing and role of Enzymes in distillery-** 3.1- Starch-Introduction to starch (types of starch molecules,structure), Saccharification process 3.2- Enzymes- Introduction and working of enzyme (Lock and key analogy), Enzymes used in distilleries (α-amylase and amyloglucosidase) 3.3- Enzyme Activity-Effect of temperature and pH on the activity of the enzyme. 3.4- Enzyme handling and storage	**10**
Unit 4	**Molasses handling :** 4.1-Overview of Molasses composition, grades, storage and cost 4.2-Molasses dilution practices adopted and design of diluter. 4.3 Preclarification of molasses advantages and drawback 4.4 Molasses sterilization/pasteurization.	**06**

Course Code :WT-305 Biochemistry paper-III (2 Credit course) Total Hours=30

Unit No.	Topics	No. of Hours
Unit-1	**General methods for extraction and purification of metabolites from fermentation broth:** Separation of microbial cells and protein impurities Filtration and centrifugation, Crystallization, Ion exchange, Electrodialysis,	08

	Solvent extraction, De-colorization techniques involve in industry	
Unit-2	**The metabolites produced in wine and microbiological stabilization of wine** i. Production of acetic acid by yeast, ii. Importance of skin contact -phenolic compounds, unsaturated fatty acids and sterols iii.Biological degradation of malic acid	08
Unit-3	**Microbiological control of wine during storage** i.Controlling the flora spoilage ii. The fermentation and production of H_2S during wine fermentation iii. Bacterial degradation of citric acid ,Tartaric acid and glycerol degradation iv. Methodology for the microbiological stabilization of must and wine, Technique used to determine a wine's propensity to develop turbidity Identification of sediment in wine	14

Course Code :WT-306 Vineyard technology paper-I (2 Credit course)Total Hours=30

Unit No.	Topics	No. of Hours
Unit -1.	**1.Introduction to soil: Soil is a basic unit of life for quality grape production** 1.1.The study of soil and its function; study of different soil in Maharashtra &India 1.2. Principles of weathering of rocks and materials 1.3. Physical and chemical properties of soil 1.4. Content of soil colloids and effect on nutrient availability	10
Unit -2.	**2. Study of vineyard establishment** 2.1. History and origin of grape vines in India and world 2.2.Relationship of grapevine and climatic factors 2.3. Study of different wine grape varieties (clone) and root stock 2.4.Selection of grape(Wine grape)varieties for plantation 2.5. Method of plantation: Pit and Trenches 2.6. Care of young vine: Irrigation, Nutrients (fertilizers) 2.7.Weed control, giving shape and maintaining frame work of young grape vine	10
Unit -3.	**3. Canopy management and nutrition of grapevine** 3.1.Definition and concept of canopy 3.2. Canopy microclimate: Canopy attenuation, solar radiation 3.3.To study training and pruning practices and its effect in canopy management 3.4. Study of different trellising system and its effect on grape maturity 3.5. Technique to be followed for canopy management 3.6. Availability of nutrients and influence on uptake, Study of macro and micronutrients	10

Course Code - WT 309 : Practical's course -I (1.5 Credit Course)Total conduct any 14 practical's.

Sr No	Experiment Title	No. of Practical

1	Study of effectiveness of hand washing.	1
2	Preparation of Nutrient media and Morphological identification of yeast	1
3	Preparation of Nutrient media and Morphological identification of LAB & AAB	2
4	Determination of cell density of given microorganism by Turbidiometry method	1
5	Isolation of yeast from infected grape or must and its identification.	1
6	Determination of aptitude of yeast to form hydrogen sulphide	1
7	Experiment for resistance development of yeast strain for higher concentration of sulphur-di-oxide. or To study the effect of S02 on yeast growth	1
8	Determination of sensitivity of yeast to antibiotic streptomycin.	1
9	Effect of variable pH on yeast growth.	1
10	To determine the thermal death rate of the given organism (TDR).	1
11	Determination of thermal death time of the given organism (TDT).	1
12	To study the effect of U.V radiations on Microbial growth	1
13	Case study-culture preservation methods.	1
14	Bacterial motility by swimming growth method.	1

Course Code - WT 310: Practical's course -II (1.5 Credit Course)Total practical's -14

Sr No	Experiment Title	No. of Practic
1	To know the technique of collecting and preserving representative sample of soil	1
2	To determine the particle size of the soil sample	1
3	To determine the water holding capacity of the given soil sample	1
4	To determine the temperature and pH of the soil sample	1
5	To know the conductivity of the soil sample by using specific apparatus	1
6	To determine calcium and magnesium contents of the given soil sample	1
7	To determine Phosphorus and Nitrogen in the given soil sample	1
8	To determined alkalinity, Chlorides and Sulphates contents in the soil sample	1
9	To study grape varieties suitable for propagation in a favourable climatic conditions	1
10	To study method of plantation, irrigation and supply of nutrients for the grape plants	1
11	To observe and study the morphology of weeds occur in vine yard	1
12.	To study training and pruning techniques in vineyard for canopy management	1
13	. To study and observe nutrient deficiency in grape plant	1
14	Field visit to nearby Vine Yard and submission of a report	1

Course Code - WT 311: Practical's course -III (1.5 Credit Course)Totally conduct any 14 practical's

Sr No	Experiment Title	No. of Practical'
1	Determination of total, fixed and volatile acidity rectified sprit.	1
2	Fusel oil determination in sprit sample.	1
3	To conduct potassium permanganate test for finding the quality of spirit	
4	Determination alcohol content of given spirit by hydrometer method	1
5	Determination alcohol content of given spirit by specific gravity method.	1
6	Reduction and blending of sprit	1
7	Sampling & grading of barley	1
8	Estimation of protein content of barley by suitable method	1
9	To determine the ^{0}Brix, specific gravity of the molasses.	1
10	To determine the pH of the molasses and wort	1
11	To determine the reducing sugars in the given molasses sample	1
12	Microscopic observation of alcoholic fermented wash	1
13.	Estimation of residual sugar in molasses fermented broth	1
14	Estimation of alcohol content in molasses fermented broth	1
15	Estimation of volatile acids in molasses fermented broth	1
16	Visit to brewery or distillery and submission of the report	1

S.Y.B.Sc Wine technology Semester -IV

Course Code :WT-401 Yeast technology paper-II (2 Credit course) Total Hours=30

Unit No.	Topics	No of Hours
Unit -1.	i.. Preparation of yeast starter cultures ii. Phage contamination of yeast cultures iii. Controlling degree of anaerobiosis during alcoholic fermentation, iv. Killer factors in fermentation	12
Unit -2.	i.. Types of growth of yeast in wine ii. Role of yeast in grape flavor development iii. Aromatic substances and their transformation by yeasts iv. Significance of yeast and bacterial enzymes in varietal characteristics of wine	18

Course Code :WT-402 Fermentation technology paper-II (2 Credit course) Total Hours=30

Unit No.	Topics	No of Hours
Unit -1.	**Process Optimization:** a. Types of inoculum b. Media Formulation i) Composition of grape juice as fermentation medium with respect to: Source of 'C', 'N', Amino acids, vitamins, minerals, pH, water, Buffering capacity, Additives used in wine fermentation ii) Media Optimization iii) Media Sterilization principles - Different Methods, Decimal Reduction Time	10
Unit -2.	**Process parameters and their importance:** Temperature, pH, agitation, foam, pressure, dissolved oxygen, effect of prolonged anaerobiosis, exhaust gas analysis (N_2, CO, CO_2), etc., ii. Yeast cell autolysis, Measurement and control of process parameters, computer applications in process controls.	12
Unit -3.	**Products of fermentation. General out line only** i.Oriental fermented foods. ii.The microbial production of organic acids iii. The microbial production of amino acids iv.Fruit based alcoholic beverages	08

Course Code :WT-403 Wine technology -I (2 Credit course) Total Hours=30

Unit No.	Topics	No. of Hours
Unit 1	**Red wine – objectives:** i. To Provide an overview of red wine varieties and styles. ii.To Provide a brief overview of making of rose style wines. iii.To Provide enough information to understand the red wine making process and to differentiate it from white wine making. iv. Effect of temperature on grape maturation v. Effect of seasonal fluctuations on quality of grape.	12
Unit 2	**Red wine making process:** i. Harvesting grapes & crushing. ii. Skin + Juice + Seeds (must preparation) & extraction methods iii. Maceration , Fermentation option, type of yeast, Addition of active yeast. cap management iv.Pump over operation : Adjustment of temperature and extraction of color. v. Pressing (free run or pressed fraction combined or kept separate or without MLF)- vi. Malolactic fermentation, Clarification and stabilization. v. barrel Ageing & maturation in bottle , Quality control & bottling. vi. Study of different yeast strain used for red wine making .	18

Course Code :WT-404 Wine technology –II (2 Credit course) Total Hours=30

Unit No.	Topics	No. of Hours
Unit 1	**Production of white wine:** i. White wine Varieties and style. ii. Chemical composition of grape juice. iii.Study of yeast strains used in white wine making styles.	05
Unit 2	**White wine making process:** i. Harvesting ,crushing ,pressing ,juice adjustments ,addition of active yeast ii.Fermentation: Control of fermentation parameter ,option of fermentation iii.Post feremtation treatments – Racking ,Clarification and stabilization, Maturation and aging ,Blending, Chilling, filtration using filter aid, v.bottling- corking, sealing,adjustment of sulfur dioxide before bottling the wine.	15
Unit 3	**Other wine making process :** i. Basic Outline of sweet wine production. ii. Basic Outline of sparkling wine production. iii. Basic Outline of fortified wine production.	10

Course Code :WT-405 Waste treatment paper-I (2 Credit course) Total Hours=30

Unit No.	Topics	No of Hours
Unit-1	**Fermentation industry waste:** Wastewater composition, Waste water characterization studies, Types of wastes (Solids, Liquids, Gases, Mixtures), Wastewater treatment objectives and regulations, Wastewater Treatment Plant Design	10
Unit-2	**Physical Unit Operations:** Flow measurement, Screening, Flow equalization, Mixing, Sedimentation, Accelerated gravity separation, Flotation, Granular medium filtration, Gas transfer, Volatilization and gas stripping of Volatile Organic compounds (VOCs), **Chemical Unit Processes**: Chemical precipitation, Adsorption (including biosorption), Disinfection (chlorine, ozone and Ultraviolet), Dechlorination **Biological Unit Processes:** Aerobic, Anaerobic, Denitrification. Sludge treatment and disposal	20

Course Code :WT-406 Vineyard technology paper-II (2 Credit course) Total Hours=30

Unit No.	Topics	No. of Hours
Unit -1.	**1. Study of propagation technique** 1.1. Collection and storage of cuttings 1.2. Propagation of own rooted vines in India 1.3. Propagation of grafted vines in India 1.4. Study of bench grafting technique 1.5. Study of budding technique	06
Unit -2.	**2. The grape and its maturity** 2.1.Study of phenology: Vegetative and reproductive cycle 2.2.Description and composition of mature grape 2.3. Development stages of grape 2.4. Grape berry morphology 2.5. Changes in grape during maturation 2.6. Evaluation of organic acids, minerals and nitrogen and origin, 2.7.Production of phenolic and aromatic compounds with respect to wine making style and wine varieties 2.8. Vintage planning-sampling and study of maturity	07
Unit -3.	**3. Study of harvesting techniques and machinery** 3.1.Study of hand harvesting: advantages and disadvantages 3.2. Study of machine harvesting: advantages and disadvantages 3.3. Study of farm machine (e.g. tractors, power trailers, plough pumps, motors, etc.)	02
Unit – 4.	**4. Plant management program (PMP)** 4.1. Study of different diseases and pest with respect to causal organism, Scientific name and origin, symptoms and control measures (Physical, Chemical and Biological, IPM) 4.2. Study of different disorders like pink berry, water berry, short berry, Chicken and hen etc 4.3. Study of different nutrient deficiency and control measures, precautionary and preventative measures.	15

Course Code - WT 409 : Practical's course -I (1.5 Credit Course) Totally conduct any 14 practical's

Sr.No	Experiment Title	No. of Practical's
1	Evaluation of alcohol as skin detergent	1
2	Visualization of yeast by vital staining.	1
3	Inoculums development of yeast and determination of exponential phase of growth	1
4	Microscopic observation of yeast during all stages of wine production	1
5	Determination of viable count of yeast from fermenting wine sample by Neubars chamber	1
6	Preparation of slide culture method	1
7	Study of normal flora of grape berry and leaf.	1
8	Measurement of growth of wine yeast(Direct cell count)	1
9	To study the effect of alcohol concentration on yeast growth	1
10	Log sheet of fermentation and its graphical representation	1
11	Isolation of bacteria (E.Coli) from wastewater, Perform confirmed test for coliform bacteria & biochemical identification by IMViC test	3
12	Fermentation waste and their utilization for the production of value added product:	1
13	Determination of ability to produce acetic acid by yeast strain.	1
14	checking efficiency of disinfectant with phenol coefficient technique	1

Course Code - WT 410 : Practical's course -II (1.5 Credit Course)Total conduct any 14 practical's

Sr No	Experiment Title	No. of Practical'
1	To learn the techniques of Stem cuttings and its propagation	1
2	To learn the technique of "Whip" grafting for propagation of grape plants	1
3	To learn the "tongue" grafting for propagation of grape plant	2
4	To know the technique of "T" budding for propagation of grape plant	1
5	To study and observe the anatomy of the stem of grape plant	1
6	To study the morphology, anatomy and microscopic features of a matured berry of grape	1
7	To study and learn harvesting techniques of matured grape fruits	1
8	To study the morphological and anatomical structure of infected part of Powdery mildew of grape leaf	1
9	To study the morphological and anatomical structure of infected part of Downey	1
10	To study the morphological and anatomical structure of infected part of Anthrancnose of grape leaf	1
11	To observe and study the different disorders like pink berry, water berry, short berry, of grape fruits	1
12.	To study and observe nutrient deficiency symptoms of Nitrogen, Phosphorus and Magnesium in grape plants	1
13	To study different equipment and implements used in Vineyard	1
14	To study the morphological characters of wine verities of grape berries	1
15	A field visit to nearby winery and submission of the report	1

Course Code - WT 411: Practical's course -III (1.5 Credit Course)Total practical's -14

Sr. No	Experiment Title	No. of Practicals
1	Determination of pH of juice (grape or any fruit)	1
2	Determine the total acidity of juice (grape or any fruit)	1
3	Study the total soluble solids of grape juice/wine/must by refractometry	1
4	Study the total soluble solids of grape juice/wine/must by hydrometry	1
5	Determination of pH of wine red wine & white wine	1
6	Determination of sulphur-di-oxide by ripper method.	1
7	Determination of reducing sugar by Lane and Eynon method	1
8	Innovative idea or concept in wine production world: A case study	1
9	Determination of volatile acidity, fixed acidity and tiratable acidity in wine	2
10	Conduct heat stability test for protein stability in wine	1
11	Alcohol estimation in wine	1
12.	Sensory evaluation of sparkling wines	1
13	Sensory evaluation of dessert wines	1

Reference books for yeast technology and fermentation technology –

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

References book for biochemistry:

1. Keith Wilson (2005) Practical Biochemistry Biology Principles &Techniques
2. Deb A. C.(1999) Concepts of biochemistry (Theory &Practical)
3. Lehninger Albert L.(1984)Biochemistry
4. David L. Nelson & Michael M.(2005) Lehninger principles ofBiochemistry
5. Sadasivam S. & Manickam A.(2010) BiochemicalMethods
6. Gurdeep P.Chaiwal& sham K. Anand (2007) Industrial methods of chemicalAnalysis
7. Deb A. C.(2004) Fundamentals of biochemistry

Reference Books for vineyard techology:

01. Seattle: American Society for Enology andViticulture
02. Phil Nicholas, Peter Magarey, Malcom Wachtel: Diseases andPests
03. P.R. Dry & B.G. Coombe: Resources-ViticultureVolume-I
04. P.R. Dry & B.G. Coombe: Practical-ViticultureVolume-II
05. John Kent & Richard Early: Pesticide applications inVineyards
06. Robert E. White: Soil for finewines
07. Andrew markides& Richard Gibson: Australian Society of Viticulture&Enology
08. Donald L.Flaheherty, L. Peter Christensen, W. Thomas Lalini, James J. Marosis, Phil A. Philips, Lloyd T. Wilson: Grape pestmanagement
09. Prof. Ralph E. Kunkee: Introduction to wine making-Viticulture andEnology-3.
10. Konig Helmut: Biology of microorganisms on grapes, in must and wine

Reference Books alcohol technology:

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

Reference Books for brewing technology:

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

Recommended Textbooks and References for Wine technology:

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 makingBasics

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

6) Emile Peynalld (1984) Knowing & makingwine

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