Savitribai Phule Pune University

(Formerly University of Pune)

S.Y.B.Sc.
(Wine, Brewing and Alcohol Technology)

Three Year B. Sc. Degree Course in

Wine, Brewing and Alcohol Technology

Syllabus

(To be implemented from Academic Year 2019-20)

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 thewoe 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

Programme Outcomes

This programme intends to blend theoretical knowledge with practical learning skills with a view to prepare students for career in Wine, Brewing and Alcohol Technology.

- The students will be able to understand the contribution of various scientists in Wine Brewing and Alcohol Technology and scope of various branches.
- They will understand the concept of alcoholic beverage and different types of alcoholic beverage.
- Students will understand the basic concept of Yeast Technology, Fermentation Technology and Brewing Technology.
- Students will surely absorb knowledge about diverse basic production steps in wine and beer production.
- They will understand and explain various processes of chemical plant engineering and wine marketing.
- Students will be able to explain and describe importance of health benefits of wine by products and Waste Management.
- Students will understand the fundamental concept of Viticulture, Biochemistry and Sensory evaluation of Wine, Waste Management and Environmental Awareness etc.
- Students develop the skills to think independently, plan wine fortification technique and execute it in different fields of Wine Technology especially the Environment Sustainability.
- Students will acquire and demonstrate competency in laboratory techniques

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 FruitProcessing and Wine Technology or Horticulture.

Admissions will be given as per the selection procedure / policies adopted by the respective collegekeeping 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

SPECIALFEATURES 1. Morestresswillbegiventothisprocessdevelopmentandscale-upsystemalongwith marketing. 2. Evaluation of waste for production of valuable products will be given prime importance 3. EnergyProductionandConservationwillbeconsideredduringthetenureofthecourses. 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.Internationalandnational Brewing, Wine and Alcohol Industry
-Vineyard management and marketing services
-Research techniques
-Technical assistance
-Winery laboratory technicians
-Wine marketing services
-Quality controlling Brewing and wine industry.
3.Self employment
-own winery, Brewery
-winery consultant
-wine taster, winemaker

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 be adopted 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 50 min
- Each practical session time for FY is of 3 hour 15 mins. = 195 min
- Each practical session time for SY & TY is of 4 hour 20 mins. = 260 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 be a 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 course: S.Y.B. Sc. (Wine, Brewing and Alcohol Technology)

Structure of the Course

Semester: III

Theory and Practical

CourseCode	Course Title	Credits	Number of Hours	Marks
WBAT - 231	Yeast technology paper -I	2 Credits	30	50 (35 External+15 Internal)
WBAT - 232	Fermentation technology paper-I	2 Credits	30	50 (35 External+15 Internal)
WBAT - 233	Brewing technology -I	2 Credits	30	50 (35 External+15 Internal)
WBAT – 234	Alcohol technology -II	2 Credits	30	50 (35 External+15 Internal)
WBAT – 235	Biochemistry Paper -III	2 Credits	30	50 (35 External+15 Internal)
WBAT – 236	Vineyard technology paper -I	2 Credits	30	50 (35 External+15 Internal)
WBAT – 237	Environmental awareness	2 Credits	30	50 (35 External+15 Internal)
WBAT – 238	English communication	2Credits	30	50 (35 External+15 Internal)
WBAT – 239	Practical's course -I	2 Credits	14P	50 (35 External +15 Internal)
WBAT – 2310	Practical's course -II	2 Credits	14P	50 (35 External+15 Internal)
WBAT – 2311	Practical's course -III	2 Credits	14P	50 (35 External+15 Internal)
Total Credits (Theory+ Practical)		**22 Credits**		

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

Structure of the Course

Semester: IV

Theory and Practical

Course Code	Course Title	Credits	Number of Hours	Marks
WBAT – 241	Yeast technology paper-II	2Credits	30	50 (35External+15 Internal)
WBAT – 242	Fermentation technology paper-II	2Credits	30	50 (35External+15 Internal)
WBAT – 243	Wine technology -I	2Credits	30	50 (35External+15 Internal)
WBAT – 244	Wine technology -II	2Credits	30	50 (35External+15 Internal)
WBAT – 245	Waste treatment paper -I	2Credits	30	50 (35External+15 Internal)
WBAT – 246	Vineyard technology paper-II	2Credits	30	50 (35External+15 Internal)
WBAT – 247	Environmental awareness	2Credits	30	50 (35External+15 Internal)
WBAT – 248	English communication	2Credits	30	50 (35External+15 Internal)
WBAT – 249	Practical's course -I	2 Credits	14P	50 (35 External +15 Internal)
WBAT – 2410	Practical's course -II	2 Credits	14P	50 (35External+15 Internal)
WBAT – 2411	Practical's course -III	2 Credits	14P	50 (35External+15 Internal)
Total Credits (Theory+ Practical)		**22 Credits**		

S.Y.B. Sc. (Wine, Brewing and Alcohol Technology)

Equivalences for the New Courses (2019 Pattern) with Old Courses (2009 Pattern) Semester III

Old Course (2009 Pattern)		New Course (2019 Pattern)	
Course Number	**Course title**	**Course Number**	**Course title**
WT-211	Yeast culture technology -I	WBAT-231	Yeast technology paper-I
WT-214	Fermentation I	WBAT-232	Fermentation technology paper-I
WT-223	Biochemistry II	WBAT-233	Brewing technology -I
WT-225	Waste treatment II	WBAT-234	Alcohol technology -II
WT-213	Biochemistry I	WBAT-235	Biochemistry Paper III
WT-212	Vineyard technology I	WBAT-236	Vineyard technology paper-I
	Environmental awareness	WBAT-237	Environmental awareness
	English	WBAT-238	English communication
	Practical course -I	WBAT-239	Practical course -I
	Practical course -II	WBAT-2310	Practical course -II
	Practical course -III	WBAT-2311	Practical course -III

S.Y.B. Sc. (Wine, Brewing and Alcohol Technology)

Equivalences for the New Courses (2019 Pattern) with Old Courses (2009 Pattern) Semester IV

Old Course (2009 Pattern)		New Course (2019 Pattern)	
Course Number	**Course title**	**Course Number**	**Course title**
WT-221	Yeast culture technology -II	WBAT-241	Yeast technology paper-II
WT-215	Fermentation II	WBAT-242	Fermentation technology paper -II
WT-216	Wine technology -I	WBAT-243	Wine technology -I
WT-226	Wine technology -II	WBAT-244	Wine technology -II
WT-224	Waste treatment I	WBAT-245	Waste treatment paper -I
WT-222	Vineyard technology II	WBAT-246	Vineyard technology paper-II
	Environmental awareness	WBAT-247	Environmental awareness
	English	WBAT-248	English communication
	Practical course -I	WBAT-249	Practical course -I
	Practical course -II	WBAT-2410	Practical course -II
	Practical course -III	WBAT-2411	Practical course -III

WBAT-231: Yeast Technology Paper-I (2 Credit course) Total Hours = 30

Course Outcomes:

- Understand the yeast cell morphology, taxonomy and functions.
- Understand the importance of yeast strains in wine making.
- Acquire knowledge about various yeast strain preservation techniques.
- Gain knowledge about normal micro flora and pathogens of grape wine.
- Understand the concept of spoilage and their preventive measures in wine.
- Understand the primary and secondary metabolites produced by yeast.

Serial No.	Topics	No. of Hours
I	Unit 1	03
	i. Yeast –Introduction, taxonomy& morphology and yeast cell structure and	
II	functions of various cellular components.	01
III	ii. Importance of yeast strains in wine making.	05
IV	iii. Maintenance of yeast strains and preservation of strain characteristics.	05
V	iv. Yeast culture techniques, stability of cultures and autolysis	02
	Unit 2	06
VI	v. Normal micro flora and pathogens of grapevine	
VII	vi. Types of microbial spoilage of wine, Prevention of microbial spoilage of	06
VIII	wine during fermentation, curing and storage of wine	02
	vii. Primary, secondary and targeted screening of yeast strain.	
	viii Primary, secondary metabolites produced by yeast	

Reference books–

1. Patel, A.H. (2008). Industrial Microbiology. MaCmillan Publication, New Dehli.
2. Stanbuzy,Peter & Whitaker, A. (2008). Principal of Fermentation Technology. ButterworthHeinemann.
3. Casida L.E. (2005). Industrial Microbiology. New age International Publishers.
4. Srivastava, M.L. Fermentation Technology.
5. Singh, B.D. (2008). Biotechnology. New age International.

WBAT-232: Fermentation Technology Paper-I (2 Credit course) Total Hours = 30

Course Outcomes:

- Understand the types of fermenters and fermenter configuration
- Acquire knowledge about the parts of fermenter, their body construction and temperature control.
- Understand the concept of sterilization process.
- Gain knowledge about how to maintain aseptic conditions during fermentation process.
- Understand the fermenter operation modes.
- Acquire knowledge about the utilities required for fermentation.

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 Fiber 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

Reference books

1. Patel, A.H. (2008). Industrial Microbiology. MaCmillan Publication, New Dehli.
2. Stanbuzy,Peter & Whitaker, A. (2008). Principal of Fermentation Technology. ButterworthHeinemann.
3. Casida L.E. (2005). Industrial Microbiology. New age International Publishers.
4. Srivastava, M.L. Fermentation Technology.
5. Singh, B.D. (2008). Biotechnology. New age International.

WBAT-233: Brewing Technology-I (2 Credit course) Total Hours = 30

Course Outcomes:

- Understand how different beer styles are created.
- Understand the fundamentals of various brewing production steps.
- Acquire knowledge about the structure and function of barley and malt.
- Understand the culture characteristics which are used in brewing technology.
- Gain knowledge about malt production process.
- Understand diverse beer style produced in world

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 etc 3. 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**

Reference Books

1. Harnesey, Tan S.(2003). A History of Beer & Brewing. Royal Society of chemistry.
2. Steven, Deeds. (2013). Brewing Engineering : Great Beer Through Applied Science.USA Publication.
3. lewis, Michel j. & Young, Tom.W.(2013). Brewing. Kluwer Academic/ Plenum Publisher, New york.
4. John, J Palmer & Colin. Kaminski. (2013). Water : a comprehensive guide for brewers. Brewers Publications.
5. white ,Chris & Zaianshef, jamil. Yeast : the practical guide to beer fermentation.
6. Mallett , John. (2014). Malt : a practical guide from field to brewouse. Brewers Publications.
7. Hieronymus, Stan. (2012). Hops: the practical guide to aroma, bitterness and the culture of hops. Brewers Publications.

WBAT-234: Alcohol Technology -II (2 Credit course) Total Hours = 30

Course Outcomes:

- Understand various alcoholic product produced by distillation in distillery
- Familiarize with molasses handling, sterilization/pasteurization in distillery.
- Understand the conventional batch process for distillery in fermentation.
- Understand the basic and application of enzyme in alcohol production
- Understand the saccharification process.

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. Preclarification of molasses advantages and drawback Molasses sterilization/pasteurization.	**06**

WBAT-235: Biochemistry paper-III (2 Credit course) Total Hours=30

Course Outcomes:

- Understand the concept of extraction and purification of metabolites from fermented broth.
- Understand the biological degradation of malic acid.
- Understand the methodology for the microbiological stabilization of must and wine.
- Understand the controlling of microbial flora and spoilage.
- To acquire knowledge about fermentation and production of H_2S during wine fermentation.
- Understand the technique which used to determine a wine's propensity to develop turbidity and identification of sediment in wine.
- Understand bacterial degradation of citric acid, tartaric acid and glycerol.

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, Solvent extraction, De-colorization techniques involve in industry	08
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

References book for biochemistry:

1. Keith Wilson. (2005). Practical Biochemistry Biology Principles &Techniques. Cambridge university press.
2. Deb,A. C.(1999). Concepts of biochemistry : theory & practical. Book &Allied Publication.
3. Lehninger, Albert L.(1984). Biochemistry. Kalyani Publishers.
4. Nelson, David L. & Michael, M.(2005). Lehninger principles of Biochemistry. W.H. Freeman & Company
5. Sadasivam,S. & Manickam, A.(2010). Biochemical Methods. New age International Publications.
6. Chaiwal, Gurdeep P. & Anand, Sham K. (2007). Industrial methods of chemical Analysis. Himalaya publishing house.
7. Deb,A. C.(2004).Fundamentals of biochemistry. New Central Bank Agency.

WBAT-236: Vineyard technology paper-I (2 Credit course) Total Hours = 30

Course Outcomes:

- Understand the basic concept of Pedology.
- Understand the relationship between grape wine and climatic factors.
- To acquire knowledge about the selection of grape varieties for plantation and its various method of plantation.
- To acquire knowledge about canopy management and their techniques.
- Understand the concept of macro and micronutrients.
- Understand the principles of weathering of rocks and materials.

Unit No.	Topics	No. of Hours
Unit -1.	**1.Introduction to soil: Soil is a basic unit of life for quality grape production** 1.1The study of soil and its function; study of different soil in Maharashtra &India 1.2Principles of weathering of rocks and materials 1.3Physical and chemical properties of soil 1.4Content 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 3.3 Study of different trellising system and its effect on grape maturity 3.4 Technique to be followed for canopy management 3.5 Availability of nutrients and influence on uptake, Study of macro and micronutrients	10

Reference

01. (2000).Proceeding American society for Enology and viticulture. American Society of Enology & viticulture.
02. Phil, Nicholas, Peter, Magarey & Malcom, Wachtel (2003). Diseases and pests Grape production series. Winetitiles.
03. Dry, P.R. & Coombe, B.G. (2005). Viticulture Vol.1 Resources. Winetitiles.
04. Dry, P.R. & Coombe, B.G. (2006). Viticulture vol. 2 practices. Winetitiles.
05. John, Kent & Richard, Early (2003). Pesticide applications inVineyards. Charles stuart university.
06. White, Robert E. (2003). Soil for fine wines. Oxford university press.
07. Andrew, Markides & Richard, Gibson. Australian Society of Viticulture & Enology.
08. Flaheherty, Donald L., Peter, Christensen L., Thomas, Lalini W., Marosis,James J., Philips, Phil A.& Wilson, Lloyd T. Grape pest management.
09. Kunkee, Ralph E. Introduction to wine making : viticulture and enology-3.
10. Helmut , Konig. Biology of microorganisms on grapes : in must and wine.

WBAT-239: Practical's course –I (2 Credit Course)

Conduct any 12 practical's.

Sr No	Experiment Title	No. of Practical's
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	1
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 ofsulphur-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

WBAT-2310: Practical's course –II (2 Credit Course)
Conduct any 12 practical's.

Sr No	Experiment Title	No. of Practical's
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

WBAT-2311: Practical's course –III (2 Credit Course)
Conduct any 12 Practical's.

Sr No	Experiment Title	No. of Practical's
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	1
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, Brewing and Alcohol technology

Semester –IV

WBAT-241: Yeast Technology Paper-II (2 Credit course) Total Hours = 30

Course Outcomes:

- Understand the preparation of yeast starter cultures.
- Understand the concept of killer factors in fermentation.
- Understand the importance of yeast in grape flavor development.
- To gain knowledge about role of bacterial enzyme in varietal characteristic of wine.
- Understand the controlling degree in alcoholic fermentation.
- Understand aromatic substances and their transformation by yeast

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

Reference books–

1. Patel, A.H. (2008). Industrial Microbiology. MaCmillan Publication, New Dehli.
2. Stanbuzy,Peter & Whitaker, A. (2008). Principal of Fermentation Technology. Butterworth Heinemann.
3. Casida L.E. (2005). Industrial Microbiology. New age International Publishers.
4. Srivastava, M.L. Fermentation Technology.
5. Singh, B.D. (2008). Biotechnology. New age International.

WBAT-242: Fermentation Technology Paper-II (2 Credit course) Total Hours = 30

Course Outcomes:

- Understand the principles of media sterilization
- Understand the concept of media formulation.
- To gain knowledge about the types of inoculums.
- To acquire knowledge of microbial production of organic and amino acids.
- Understand the autolysis of yeast cell.
- Understand the concept of media optimization.

Unit No.	Topics	No of Hours
Unit -1.	**Process Optimization:** a. Types of inoculums. 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 outline 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

Reference books

1. Patel, A.H. (2008). Industrial Microbiology. MaCmillan Publication, New Dehli.
2. Stanbuzy,Peter & Whitaker, A. (2008). Principal of Fermentation Technology. ButterworthHeinemann.
3. Casida L.E. (2005). Industrial Microbiology. New age International Publishers.
4. Srivastava, M.L. Fermentation Technology.
5. Singh, B.D. (2008). Biotechnology. New age International.

WBAT-243: Wine Technology -I (2 Credit Course) Total Hours = 30

Course Outcomes:

- To acquire knowledge about various grape varieties used in production of different red wine styles
- Comparative studies on basic production step of white and red wine
- Understand pre-fermentation production step in red wine making
- Understand the study of different yeast strain used for red wine making.
- Understand post fermentation production step in red wine making
- Understand the effect of temperature on grape maturation.
- To acquire knowledge about how to control wine quality.

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

References

1) Gayon, P. Ribereallll , Denis, Dubardieu, B. & Doneche, Aline Lonvalld . (2000). Hand book of enology volume–I. John Wiley 7 Sons, ltd.
2) Jockson , Ron S. (2000). Wine science principles practices & perception. Academic press.
3) Zoecklein, Brue W., Fugelsang, Kenneth, Gump, Barry H. & Nury, Fred S. (1999).Wine Analysis and production. Kluwer Academic/Plenum Publication.
4) . Ough, C. S. (1992). Wine making Basics. The Howorth press, Inc.
5) Boulton , Roger B. (1996). Principles and practices of winemaking. Sptinger sciencet Business Media.Inc.
6) Peynalld, Emile. (1984). Knowing & making wine. John wiley & sons.
7) Iland , Patrice & Gago, Peter .(1997). Australian wine from the grasp vine to the glass. Patrick Iland wine Promotion.

WBAT-244: Wine Technology –II (2 Credit course) Total Hours = 30

Course Outcomes:

- To acquire knowledge about various grape varieties and yeast strain used in white wine production
- Understand pre fermentation production step in white wine making
- To gain knowledge about sweet wine, sparkling wine and fortified wine production.
- To acquire knowledge about bottling like corking, sealing adjustment of sulfur dioxide
- Understand post fermentation production step in white wine making
- Understand the chemical composition of grape juice.

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

References

1) Gayon, P. Riberealll , Denis, Dubardieu, B. & Doneche, Aline Lonvalld . (2000). Hand book of enology volume–I. John Wiley 7 Sons, ltd.
2) Jockson , Ron S. (2000). Wine science principles practices & perception. Academic press.
3) Zoecklein, Brue W., Fugelsang, Kenneth, Gump, Barry H. & Nury, Fred S. (1999).Wine Analysis and production. Kluwer Academic/Plenum Publication.
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7) Iland , Patrice & Gago, Peter .(1997). Australian wine from the grasp vine to the glass. Patrick Iland wine Promotion.

WBAT-245: Waste Treatment Paper-I (2 Credit course) Total Hours = 30

Course Outcomes:

- To gain knowledge about waste water treatment plant design.
- Understand the concept of fermentation industry waste.
- Understand the types of waste, waste water treatment objectives and regulation.
- Understand physical, chemical and biological process to treat waste water
- Understand the sludge treatment and disposal.
- Understand the concept of waste water composition and studies their characteristic.

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

References

1. Henze M, Springer, 2010.Waste water treatment. Publisher Springer, Edn. 3.Pg.430.
2. 02.Rao, M. N, & Datta, A. K. 2017.Waste water Treatment. Publisher Oxford & Lbh. Edn3.
3. Marcos Von Sperling, 2007.Biological Waste Water Treatment, IWA publisher, London, Vol. 6 , P. 237.
4. Lzrali,S & Mathai, P.K. 2005. Waste Water Sludge Processing, P. 368.
5. Dilek Sanin, F, Aarne Vesilind & William Wade Clarkson. 2011.Sludge Engineering: The Treatment and Disposal of waste water sludges.

WBAT-246: Vineyard Technology Paper-II (2 Credit course) Total Hours = 30

Course Outcomes:

- Understand the harvesting techniques and machinery.
- To acquire knowledge about propagation technique.
- Understand the bench grafting and budding technique.
- Understand the reproductive and vegetative cycle of grapes.
- Understand the evaluation of organic acids, minerals and nitrogen and their origin.
- Understand the development stages of grape.

Unit No.	Topics	No. of Hours
Unit -1.	**1. Study of propagation technique** Collection and storage of cuttings Propagation of own rooted vines in India Propagation of grafted vines in India Study of bench grafting technique Study of budding technique	06
Unit -2.	**2. The grape and its maturity** Study of phenology: Vegetative and reproductive cycle 2.2.Description and composition of mature grape Development stages of grape Grape berry morphology Changes in grape during maturation Evaluation of organic acids, minerals and nitrogen and origin, Production of phenolic and aromatic compounds with respect to wine making style and wine varieties Vintage planning-sampling and study of maturity	07
Unit -3.	**3. Study of harvesting techniques and machinery** Study of hand harvesting: advantages and disadvantages Study of machine harvesting: advantages and disadvantages Study of farm machine (e.g. tractors, power trailers, plough pumps, motors,etc.)	02

Unit – 4.	**4. Plant management program (PMP)** Study of different diseases and pest with respect to causal organism, Scientificname and origin, symptoms and control measures (Physical, Chemical and Biological, IPM) Study of different disorders like pink berry, water berry, short berry, Chicken and hen etc Study of different nutrient deficiency and control measures, precautionary and preventative measures.	15

Reference

10. (2000).Proceeding American society for Enology and viticulture. American Society of Enology & viticulture.
11. Phil, Nicholas, Peter, Magarey & Malcom, Wachtel (2003). Diseases and pests Grape production series. Winetitiles.
12. Dry, P.R. & Coombe, B.G. (2005). Viticulture Vol.1 Resources. Winetitiles.
13. Dry, P.R. & Coombe, B.G. (2006). Viticulture vol. 2 practices. Winetitiles.
14. John, Kent & Richard, Early (2003). Pesticide applications inVineyards. Charles stuart university.
15. White, Robert E. (2003). Soil for fine wines. Oxford university press.
16. Andrew, Markides & Richard, Gibson. Australian Society of Viticulture & Enology.
17. Flaheherty, Donald L., Peter, Christensen L., Thomas, Lalini W., Marosis,James J., Philips, Phil A.& Wilson, Lloyd T. Grape pest management.
18. Kunkee, Ralph E. Introduction to wine making : viticulture and enology-3.

10. Helmut , Konig. Biology of microorganisms on grapes : in must and wine.

WBAT-249: Practical's course –I (2 Credit Course)
Conduct any 12 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 Neubarschamber	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 coliformbacteria& 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

WBAT-2410: Practical's course –II (2 Credit Course)
Conduct any 12 Practical's

Sr No	Experiment Title	No. of Practical's
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 ofgrape	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 andMagnesium 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
16	Determination of BOD of given sample(winery/distillery/brewing waste)	1
17	Determination of COD of given sample(winery/distillery/brewing waste)	1
18	Perform decolouring of waste using microorganism	1

WBAT-2411: Practical's course –III (2 Credit Course)
Conduct any 12 Practical's

Sr. No	Experiment Title	No. of Practical's
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