

UNIVERSITY OF PUNE

**SYLLABUS FOR
S. Y. B. SC WINE TECHNOLOGY**

Submitted to BOS Microbiology

By

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Chairman

Sub Committee for S. Y. B. Sc.

Wine Technology Syllabus

August 11, 2008

COURSE STRUCTURE

NAME OF THE COURSE - B.SC. WINE TECHNOLOGY					
YEAR- SECOND YEAR					
	Code	Paper	Marks External	Marks Internal	Work Load
Semester - I	WT-211	Yeast Culture Technology- I	40	10	48
	WT-212	Vineyard Technology – I	40	10	48
	WT-213	Biochemistry – I	40	10	48
	WT-214	Fermentation – I	40	10	48
	WT-215	Fermentation – II	40	10	48
	WT-216	Wine Technology – I	40	10	48
Semester - II	WT-221	Yeast Culture Technology – II	40	10	48
	WT-222	Vineyard Technology – II	40	10	48
	WT-223	Biochemistry – II	40	10	48
	WT-224	Waste Treatment – I	40	10	48
	WT-225	Waste Treatment – II	40	10	48
	WT-226	Wine Technology - II	40	10	48
Practical Courses (Semester I and II)		Course – 1	80	20	96
		Course – II	80	20	96
		Course - III	80	20	96

Semester I	Lectures
<p>WT - 211: Yeast Culture Technology – I</p> <p>Importance of yeast strains in wine making Maintenance of yeast strains and preservation of strain characteristics Yeast culture techniques, stability of cultures and autolysis Normal micro flora and pathogens of grapevine Types of microbial spoilage of wine, Prevention of microbial spoilage of wine during fermentation, curing and storage of wine Primary, secondary and targeted screening of yeast strain.</p>	<p>(48)</p> <p>6 6 6 6 12 12</p>
<p>WT – 212: Vineyard Technology – I</p> <p>1. Introduction to Soil: Soil is a basic unit of life for quality grape production The study of soil and its function; study of different soils in Maharashtra and India. Principles of weathering of rocks and materials. Physical and Chemical properties of soil. Content of soil colloids and effect on nutrient availability.</p> <p>2. Study of vineyard establishment. History and origin of grape vines in India and world. Relationship of grapevine and climatic factors. Study of different wine grape varieties (clone) and rootstock. Selections of grape (wine grapes) varieties for plantation. Method of plantation: Pit and Trenches. Care of young vine: Irrigation, Nutrients (fertilizers). Weed control, giving shape and maintaining the frame work of young grape vine.</p> <p>3. Canopy management and Nutrition of grapevine Definition and concept of canopy. Canopy microclimate: canopy attenuation, solar radiation. To study Training and pruning practices and its effect in canopy management. Study of different trellising system and its effect on grape maturity Techniques to be followed for canopy management Availability of nutrients and influence on uptake, Study of macro and micro nutrients</p>	<p>(48)</p> <p>16</p> <p>16</p> <p>16</p>

<p>WT – 213: Biochemistry – I</p> <p>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, Electro-dialysis, Solvent extraction, De-colorization techniques involve in industry</p> <p>2. The metabolites produced in wine and microbiological stabilization of wine Production of acetic acid by yeast, Importance of skin contact, phenolic compounds, unsaturated fatty acids and sterols Biological degradation of malic acid</p> <p>3. Malolactic and Maloalcoholic Fermentation Maloalcoholic fermentation and its on harmonious balance taste Malolactic fermentation (MLF) beneficial and deleterious aspects of malic acid biodegradation The importance of pH, SO₂ and alcohol contents Effect of various strains of bacteria on MLF. Commercial aspects of MLF</p>	<p>(48)</p> <p>16</p> <p>16</p> <p>16</p>
<p>WT – 214: Fermentation – I</p> <p>1. Types of fermenters Fermenter configuration Batch fermenter, Continuous fermenter, Stirred tank fermenter, Tubular fermenter, Fluidized bed fermenter, Solid state fermenters, Hollow Fibre Reactors</p> <p>2. Parts of fermenters</p> <ol style="list-style-type: none"> a. Body construction and temperature control b. Aeration and agitation: Aerator (sparger), Agitator (Impellers, baffles) c. 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 d. Piping and Valves. <ol style="list-style-type: none"> a. Factors affecting design b. Fermenter operation modes: (Single, dual, multiple, batch, fed-batch, continuous) <p>3. Manufacture of Fermenter: Design calculations, Fabrication drawing, Fabrication and machining techniques, Assembly and testing, Repairs and maintenance</p>	<p>(48)</p> <p>12</p> <p>16</p> <p>8</p>

<p>4. Utilities required for fermentation: Boilers, Compressors, Cooling towers, Refrigeration and air conditioning, Chilling plants, Water treatment plants</p>	<p>12</p>
<p>WT – 215: Fermentation – II</p> <p>1. Process Optimization:</p> <p>a. Types of inoculum</p> <p>b. Media Formulation</p> <p> 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</p> <p> ii) Media Optimization</p> <p> iii) Media Sterilization principles - Different Methods, Decimal Reduction Time</p> <p>2. Process parameters and their importance - Temperature, pH, O-R Potential, agitation, foam, pressure, dissolved oxygen, effect of prolonged anaerobiosis, exhaust gas analysis (N₂, CO, CO₂), etc., Yeast cell autolysis, Measurement and control of process parameters, computer applications in process controls.</p> <p>3. Immobilization of whole cells and enzymes: Concept, methods and applications</p>	<p>(48)</p> <p>20</p> <p>24</p> <p>4</p>
<p>WT – 216: Wine Technology – I</p> <p>1. Red wine – objectives.</p> <p>To Provide an overview of red wine varieties and styles.</p> <p>To Provide a brief overview of making of rose style wines.</p> <p>To Provide enough information to understand the red wine making process and to differentiate it from white wine making.</p> <p>To undertake sensory evaluation of a number of Australian red wine styles.</p> <p>Red grape varieties: Shiraz, Cabernet, Grenache, Pinot Noir, Merlot, etc.</p> <p>2.Red wine making process.</p> <p>Harvesting grapes – crushing.</p> <p>Skin + Juice + Seeds (must). Addition of active yeast.</p> <p>Fermentation option, time on skin, extraction method, temperature, type of yeast, barrel fermentation, post fermentation operations.</p> <p>Pump over operation : Adjustment of temperature and extraction of color.</p> <p>Pressing (free run or pressed fraction combined or kept separate or without MLF)-Clarification and stabilization cap management.</p> <p>Storage (ageing) – Bottling- maturation in bottle. Quality control.</p> <p>Study yeast used for red wine making according to style of wine making.</p>	<p>(48)</p> <p>12</p> <p>24</p>

<p>3. Influence of climate. Effect of temperature on wine quality. Effect of humidity on production of quality wine. Influence of package of practices on quality of wine. Effect of seasonal fluctuations on quality of wine. Managing wine grape garden under aberrant climate conditions.</p>	12
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Semester II	Lectures
<p>WT – 221: Yeast Culture technology – II</p> <p>Preparation of yeast starter cultures Phage contamination of yeast cultures Types of growth of yeast in wine Role of yeast in grape flavor development Aromatic substances and their transformation by yeasts Significance of yeast and bacterial enzymes in varietal characteristics of wine Controlling degree of anaerobiosis during alcoholic fermentation, Killer factors in fermentation</p>	<p>(48)</p> <p>4 4 4 8 12 12 4</p>
<p>WT – 222: Vineyard Technology – II</p> <p>1. Study of different propagation techniques 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 techniques</p> <p>2.The grape and its maturity Study of Phenology : Vegetative and reproduction cycle 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 Production of phenolic and aromatic compounds with respect to wine making style and wine varieties. Vintage planning- sampling and study of maturity.</p>	<p>(48)</p> <p>12</p> <p>12</p>

<p>3. Study of harvesting techniques and machinery Study of hand harvesting: advantages and disadvantages Study of machine harvesting: advantages and disadvantages Study of farm machines (e.g. tractors, power trailers, plough pumps, motors, etc.)</p> <p>4. Plant management program (PMP) Study of different disease and pest with respect to causal organism, scientific name and origin, symptoms, and control measures (Physical, chemical, 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 preventive measures</p>	<p style="text-align: right;">12</p> <p style="text-align: right;">12</p>
WT – 223: Biochemistry – II	
<p>1. Microbiological control of wine during storage Controlling the flora spoilage The fermentation and production of H₂S during wine fermentation Bacterial degradation of citric acid Tartaric acid and glycerol degradation 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 Phage contamination and abnormal fermentation</p> <p>3. Food Spoilage. Microbial Spoilage : Bacteria, yeast, mold Enzymatic spoilage Characteristics and storage conditions of food Mechanical Damage .</p> <p>4. Oak Biochemistry. Selection of oak barrel with respect to wine : French oak and American oak Barrel aging : oak components and extraction Oak alternatives and their chemistry with respect to Indian wine making</p>	<p style="text-align: right;">(48)</p> <p style="text-align: right;">24</p> <p style="text-align: right;">12</p> <p style="text-align: right;">12</p>
WT – 224: Waste Treatment – I	
<p>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</p>	<p style="text-align: right;">(48)</p> <p style="text-align: right;">12</p>

<p>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),</p>	12
<p>Chemical Unit Processes: Chemical precipitation, Adsorption (including biosorption), Disinfection (chlorine, ozone and Ultraviolet), Dechlorination</p>	12
<p>Biological Unit Processes: Aerobic, Anaerobic, Denitrification, Biosorption</p>	12
<p>WT – 225: Waste Treatment – II</p>	
Removal of phosphorus (biological and chemical)	6
Removal of toxic compounds and refractory organics	6
Removal of dissolved inorganic substances	6
Sludge treatment and disposal	6
In-situ bioremediation	6
Design principles and designing of ETPs	6
Troubleshooting	6
Environmental Impact Assessment	6
<p>WT – 226: Wine Technology – II</p>	
<p>1. Production of white wine.</p>	
White Wine objective.	10
White wine Varieties and style.	
The physiology of grape : Component, principal, location, fate, affecting wine composition and sensory correlation.	
Influence on viticulture practices.	
Study of yeast strains used in white wine making styles.	
<p>2. White wine making process.</p>	
Harvesting – crushing – pressing – juice – addition of active yeast	
Fermentation: Control of fermentation parameter option of fermentation techniques.	
Clarification and stabilization.	
Maturation and aging. Time – temperature relationship and traditional regimes for different classes of wine. Bulk maturation variables, chemistry and quality effect.	
Blending, bottle aging and post bulk operation. Rapid maturation and aging. Chilling, filtration using filter aid, bottling, corking, sealing	24

<p>3. Cooperage for wine making. A brief history of oak barrel making in world. imentation of particles in suspension Racking : role and technique Theory of protein fining Fining teachings, products used in fining Clarification treatment</p>	<p>14</p>
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<p>Semester I and II Practicals</p>	<p>Lectures</p>
<p>Course – I</p> <ol style="list-style-type: none"> 1. Isolation and purification of wine yeast from stock culture 2. Isolation and purification of yeast from flowers, fruits and berries 3. Measurement of growth of wine yeast, bacterial count, direct cell count and total viable count 4. Determination of viable count of yeast from the wort and wine 5. Inoculum development of yeast and determination of exponential phase of growth 6. Determination of proteolytic activity of yeast strain during fermentation 7. Strain development of yeast for tolerance to higher alcohol and SO₂ concentrations 8. Home made wine production: grape, jamoon, pomegranate or any other fruit 9. Microscopic observation of yeast during wine production 10. Determination of the course of fermentation and the rate of alcohol production 11. Whole cell immobilization of yeast. Determination of the sugar alcohol conversion coefficient in immobilized and free cell systems 12. Determination of the ability to produce acetic acid by yeast strain 13. Determination of the aptitude to form sulfite and sulfide (H₂S) by yeast strains 	<p>(96)</p>
<p>Course – II</p> <ol style="list-style-type: none"> 1. Collection of soil sample and determination of N,P,K. 2. Studies on fruit-bud differentiation by visual identifications. 3. Propagation techniques for grapes: budding and grafting 4. Pruning techniques for grape vine and harvesting technique for grapes 5. Preparation of solutions and mixtures: Bordeaux mixture, antibiotics and plant growth regulators 6. Study of morphology, anatomy and microscopic features of grape(Microscopy) 7. Determination of pH, total and volatile acidity of grapes 	<p>(96)</p>

8. Determination of total soluble solids of grape by hand refractometer 9. Determination of reducing sugar of grape juice by Fehling method 10. Determination of total carbohydrates by Anthrone method. 11. Estimation of proteins, tannins, ethanol, anthocyanins and metals (copper and iron) from grapes and wine 12. Analysis of wine components as per IS specifications by IS 7585:1995 13. Determination of total and volatile acids of the grape / wort / wine IS 7585:1995 14. Determination of volatile acidity from wine by anion exchange column method	
Course – III 1. Analytical tests for identification of wine sediments: Potassium bi-tartrate, calcium tartarate, copper casse, yeast and bacteria cells 2. Wine fermentation: standardization of yeast inoculum and nutrient medium for wine production 3. Sensory assessment of berry Identification of pests and diseases of grapes 4. Selection of pesticides, timing, safe and efficient use 5. Identification of wine grape variety and rootstock by visual observations. 6. Berry sampling, methods and prediction of harvest date 7. Study of point quadrat method for canopy management. 8. Study of fruitful bud for determination of pruning method 9. Preparation of vineyard score card and evaluation of vineyard. 10. Comparison of total and volatile acidity of grape, wort, and wine 11. Detection of phage contamination in wine 12. Periodic estimation of alcohol from must and wine and graphical representation 13. Comparison of natural fermentation and fermentation with commercial yeast strain	(96)

References for Vineyard Technology I and II

Sr. No.	Author	Title	Edition	Year	Publisher and address
1.	P.R. Day and B.G. Coombe	Viticulture Vol 1 and 2	II nd	2005	Winetitles Publisher.
2.	P.Ribereau-Gayon, D. Dubourdieu, A. Lonvaud	Handbook of Enology Vol 1 and 2	I st	1998	Wiley Publishers
3.	Ministry Of agriculture and Fisheries ,New Zealand	Sunlight into Wine	I st	1991	Winetitles Publisher.
4.	Jacques Rousseau	Winegrape berry sensory assessment in Australia	I	2004	Winetitles Publisher

References For Wine Technology I And II

Sr. No.	Author	Title	Edition	Year	Publisher and address.
1.	Boltan R.B. et al	Principle and Practices of Winemaking		1996	Chapman & Hill
2.	Glaudio Delfini & J.V. Formica	Wine Microbiology Science & Technology		2001	L'artistica S-avigliano, Itali)
3.	R.B. Bolton, Singleton V.L. and Bison L.V.	Principle and Practices of Winemaking.		1996	Chapman and Hall.
4.		Home Winemaking		2001	Washington State University, Pullman, Washington.
5.	V.S.Rao	Principles of Weed Science.		1994	Oxford and IBH Publishing Co.Pvt.Ltd.
6.	Patrick Iland and Peter Gago	Australian Wine from the vine to the glass.		1997	Patrick Iland Wine promotions Adelaide, South Australia.
7.	James Halliday and Hough Johnson.	The art and science of Wine.			

References For Fermentation and Fermentation technology

Sr. No.	Author	Title	Editi on	Year	Publisher and address
1.	Casida L.E. (Jr.)	Industrial Microbiology		1989	Willey Eastern Limited
2.	Claudio-Delfini and Josepn v. Formica	Wine Microbiology Science and Technology		2001	L'artistica Svigano S.r.l.
3.	Yamadak <i>et al</i>	The Microbial Production of Amino acids		1972	Jhon Wiley & Sons, New York
4.	Ribereau- Gayon <i>et al</i>	Hand Book Of Enology		1999	Jhon Wiley & Sons, New York

References for Biochemistry I and II

Sr. No.	Author	Title	Edition	Year	Publisher and address
1.	Sadasivam S. and Manickam A.	Biochemical Methods	II nd	1996	New Age international Publisher.
2.	George Charalambous St.Louis, Missouri	Handbook of Food and Beverage Stability	I st	1986	Academic Press, INC. Harcourt Brace Javannovich, Publishers
3.	Joshi V.K. and Ashok Pandey.	Biotechnology Food fermentation.	I st	1999	Educational Publisher and Distributors, New Delhi.
4.	Casida L.E. (Jr.)	Industrial Microbiology		1989	Willey Eastern Limited
5.	Prescott S.C. and Dunn C.G.	Industrial Microbiology		1959	McGraw Hill Book Co. Inc. New York
6.	Kertesz Z.I.	The Pectic Substances		1957	Inter Science Publisher, New York)
7.	Yair Margalit	Concept in wine chemistry	II nd	1997	The Wine Appreciation Guide, San Francisco