UNIVERSITY OF PUNE

SYLLABUS

T. Y. B. Sc. (WINE TECHNOLOGY)

w. e. f. June 2009

PROF. B. P. KAPADNIS

CHAIRMAN, SUBCOMMITTEE

BOS IN MICROBIOLOGY

T.Y. B. Sc. Wine Technology

	Course Code	Course Title	Work load/course (Hrs)	Marks Int	Ext.
Semester - III	WT-331	**Project 1.Viticulture**	48	10	40
	WT-332	**Basic Chemical Engg. Principles**	48	10	40
	WT-333	**Equipment & Utilities**	48	10	40
	WT-334	**Pre-& Post-fermentation Processing in Winery**	48	10	40
	WT-335	**Health benefits of wine**	48	10	40
	WT-336	**Byproducts and waste management**	48	10	40
Semester - IV	WT-341	**Project 2. Winery**	48	10	40
	WT-342	**Fruit and fortified wines**	48	10	40
	WT-343	**Wine defects, identification & rectification**	48	10	40
	WT-344	**Wine laws, Management & Taxation**	48	10	40
	WT-345	**Wine market & Marketing**	48	10	40
	WT-346	**Term paper & Seminar, 2 each, relevant to curriculum**	48	10	40
Practical Courses (Semester III and IV)		**WT-301**:**Sensory evaluation of wine**	96	20	80
		WT-302: **Microbiology & Wine making**	96	20	80
		WT-303 : **Practicals based on Chemical Engg.**	96	20	80

GENERAL INSTRUCTIONS

1. Distribution of Courses semester-wise:

Semester	Theory Courses	Practical Courses	Project/Term paper/Seminar
Semester - III	**WT-332, WT-333, WT-334, WT-335, WT-336**	**WT-301, WT-302, WT-303**	**WT-331 (Project 1: Viticulture establishment to be conducted in the vineyard)**
Semester - IV	**WT-442, WT-443, WT-444, WT-445,**	**WT-301, WT-302, WT-303**	**WT-341 (Project 2: Winery establishment to be conducted in the winery)** **WT- 446 (Term paper & Seminar, 2 each)**

2. Practical courses of Semesters - III & IV i.e. **WT – 301**, **WT-302**, and **WT-303** and **project** courses of Semester – III & IV i.e. **WT-331** and **WT-441** (**Dissertation)** and term papers and seminars of semester IV i.e. **WT-446** shall be examined by university appointed examiners for practicals, at the end of academic year i.e. in the month of April / May of the respective academic year..

3. Practicals for courses. **WT-301, WT-302** and **WT-303** will be conducted throughout the academic year and side by side students can carry out the dissertation work **in vineyard/winery** in respective semester.

4. The format for dissertation will be similar to the research thesis style; incorporating chapters on: Introduction, Materials and Methods, Results and Discussion and References / Bibliography. The dissertations will be submitted in a typewritten and bound form. Copy of each dissertation will be submitted to the respective department at the end of respective semester and the center will place them before the University practical examiners for assessment.

5. Each Laboratory course will occupy six hours / week.

6. Each **project work/dissertation** will occupy equivalent to one laboratory course i.e. 6 hours a week.

7. Dissertation will be compulsory to all students. Students will carry out dissertation work individually in respective semester in **vineyard/winery**.

8. Concerned department shall provide all required infrastructure to carry out dissertation work.

9. Every student will write two term papers/ review articles based on original and recently published scientific research papers and submit them to the dept. at the end of **semester IV**, in wire bound form.

10. Every student will give two seminars/ oral presentations in **IVth semester** , which will be evaluated by the faculty. Marks for the oral presentation will be incorporated in the internal assessment of **the course WT-446**.Final evaluation of the term papers and write-up of seminars submitted will be done by the University examiners for practical exam.

11. Marking system will be as mentioned for I & II semesters of B Sc Wine Technology (Each theory course, project course and WT-446 (term paper/seminar) course is assigned 50 marks, out of which 10 marks for internal assessment; Each practical course is assigned 100 marks out of which 20 for internal assessment.
12. Each theory course, project course and term paper/ seminar course is equivalent to 48 lectures per semester. Each practical course is equivalent to 96 lectures.

T. Y. B. Sc. (WINE TECHNOLOGY) Curriculum

Semester III:

Project Course I -	WT-331	**Project 1.Viticulture**
Theory Course I -	WT-332	**Basic Chemical Engg. Principles**
Theory Course II -	WT-333	**Equipment & Utilities**
Theory Course III-	WT-334	**Pre-& Post-fermentation Processing in Winery**
Theory Course IV-	WT-335	**Health benefits of wine**
Theory Course V-	WT-336	**Byproducts and waste management**
Practical Course I	- WT-301	**Sensory evaluation of wine**
Practical Course II	- WT-302	**Microbiology & Wine making**
Practical Course III	-WT-303	**Practicals based on Chemical Engg.**

Semester IV:

Project Course II	- WT-441	**Project 2. Winery**
Theory Course VI	- WT-442	**Fruit and fortified wines**
Theory Course VII	- WT-443	**Wine defects, identification & rectification**
Theory Course VIII	-WT-444	**Wine laws, Management & Taxation**
Theory Course IX	-WT-445	**Wine market & Marketing**
Theory Course X	-WT-446	**Term paper & Seminar, 2 each, relevant to curriculum**
Practical Course I	- WT-301	**Sensory evaluation of wine**
Practical Course II	- WT-302	**Microbiology & Wine making**
Practical Course III	-WT-303	**Practicals based on Chemical Engg.**

WT-331: PROJECT 1.VITICULTURE ESTABLISHMENT (Each student is expected to carry out the project/dissertation work in the vineyard)

WT-332: BASIC CHEMICAL ENGINEERING PRINCIPLES

1. **Basic Fluid flow and fluid mechanics:**
   - 1.1 Properties of liquids: Density, Viscosity and stress in fluid flow
   - 1.2 Measurement of Viscosity: Capillary tube viscometer, Rotational viscometer, influence of temperature on viscosity, Properties of non-Newtonian liquids
   - 1.3 Handling systems for Newtonian liquids: Flow characteristics, Reynolds number, Laminar flow and turbulent flow.
   - 1.4 Mechanical Energy Balance: as a function of Potential and Kinetic Energy, pressure and frictional forces
   - 1.5 Pump Selection and Performance: Characteristic Diagrams of pumps, Net Positive suction head, computation of pump requirements
   - 1.6 Flow Measurement: Pitot tube, Orifice meter, Venturi meter, paddle flow meters, magnetic flow meters.
2. **Liquid filtration:**

   2.1Introduction to liquid filtration, filter media, classification of liquid filtration, formation of filter cake, Darcy Equation, Constant rate/ Constant pressure filtration, typical wine filtration conditions using dead-end filters, cross-flow filters, plate & frame filters, cartridge filters, membrane filters, ultrafiltration/microfiltration

   Sizing of filtration equipment.
3. **Heat Transfer and Thermal Processing:**
   - 3.1 Systems for heating and cooling of liquids: Plate heat exchanger, Tubular heat exchanger
   - 3.2 Thermal properties of foods; Specific heat, Thermal conductivity, Conductive heat transfer, convective heat transfer
   - 3.3 Thermal processing: Decimal Reduction time (D), Thermal resistance constant, thermal death time (F),
   - 3.4 Relationship between chemical Kinetics and Thermal processing Parameters: Decimal reduction time, rate constants k and Q_{10} Thermal resistance constant z, Activation energy E_a and their inter-relationship
4. **Energy for Wine Processing**
   - 4.1 Steam generation: Steam generation systems, Thermodynamics of phase change, steam tables, Steam utilization
   - 4.2 Electric Power utilization: Electrical terms and units, Ohms law, Electric circuits, electric motors, electrical controls,
5. **Refrigeration**
   - 5.1 Selection of Refrigerants, components of refrigeration system (Evaporator, Compressor, Condenser and expansion valve)
   - 5.2 Basic design of chilling systems, calculation of heat loads

WT333: WINERY EQUIPMENTS AND UTILITIES:

1. Utilities: **Water**– Various water sources, Hardness and need for softening, Water pressure requirements, Hot water needs & systems. **Electric supply** – Power supply requirement to run various equipments, Energy conservation using solar power for hot water, insulation. Decision on back-up power supply. **Air-conditioning, humidifiers, de-humidifiers**- Temperature and humidity levels - Barrel room, bottle storage areas, finished goods area, **Chilling system, Gas Supply**- carbon dioxide, nitrogen, oxygen, **Lighting, Catwalks and man ways, Computers.**

2. Equipments:

Process equipments: Functions, types, and uses of -Sorting tables, Receivers/ hoppers, Pneumatic press, De-stemmers and crushers, basket press, transfer pumps (centrifugal, piston, diaphragm, positive displacement, flexible impeller, rotary lobe, peristaltic), heat exchangers (Plate heat exchanger & Tube –in-tube exchanger), Tanks (stainless steel – open tops/ closed top, concrete, cooling with limpet coils/ dimpled jackets), temperature sensors, actuators, display and control panel, Hoses and fittings, special devices (Punch down devices, mixing devices, sprinklers, Venturi systems), Micro-oxygenation systems, Various filters & clarification equipment (Pressure-leaf, plate & frame, rotary drum vacuum, centrifuge, cross-flow filters) .

Cleaning, Hygiene and Sanitation equipments: Functions, types, and uses of -
CIP systems, Pressure cleaners, Spray nozzles, Air locks, Pest controllers, Bottling filtration systems, pest controllers

Material handling equipments: Functions, types, and uses of -
Pallet jacks, Forklifts, Man lifts, Barrel racks, Loading/Unloading bay/ platforms, Wine transfer pumps.

Packaging equipments: Functions, types, and uses of -
Bottling machines with specifics on rinsers, fillers, corking machines, screw cappers, labelling machines, carton packing machines

Special Lab equipments: Functions, types, and uses of -
Ebulliometer, Centrifuge, Dissolved oxygen meter, Torque tester, Oven/ Desiccator, Sampling devices, Thieves, Pressure checking equipment, Spectrophotometer.

Sparkling wine making equipments: Functions, types, and uses of -
Neck freezer, Disgorging and Dosage machines, Corking and wirehooding machine, Foiling and labelling machines, manual riddling racks, gyro-pallets.

References:

1. David Storm . 1997.Winery Utilities .
2. David Bird. 2005. Understanding Wine technology- Vol.1, Resources.
3. Roger B. Boulton, Vernon Singleton, Linda Bisson and Ralph Kunkee . Principles and Practices of Winemaking.

WT334 : PRE - & POST FERMENTATION PROCESSING IN WINERY:

1. Grapes sampling: Random berry sampling, whole cluster sampling, variations in sampling, maturity analysis –visual, sensory and chemical.

2. Grapes handling: Receiving fruit at winery, use of dry ice, use of carbon dioxide, bins & receiving hoppers, sorting of bad fruit, leaves, unwanted material, sorting table/ manual sorting.

3. Pressing/ Destemming: Sanitizing methods, cleaning the presses, hoses, tanks and all equipment. Deciding the press program, cycles of pressing, holding times and length of program.

4. Selection of yeasts & consumables: Selection of yeasts based on desired characters, turnover time, fermentation aids

5. Fermentation process: Settling & Racking off juice lees, Checking nitrogen content of juice, pre-fermentation analysis, Adjustments to juice/ must, Inoculation

6. Barrel fermentation/aging: Age of barrels to be used, composition of new, 1year old, 2 year old and neutral barrels, use of used white and red barrels, topping and maintaining SO2 in wine stored in barrels, racking from barrels.

7. Malo-lactic fermentation: Natural vs. Inoculated fermentations, Selection of cultures, sulphur dioxide and alcohol levels.

8. Post fermentation racking: Deciding racking times, lees and wine character, fine lees vs. coarse lees, batonnage in barrels, racking from tanks and barrels

9. Blending, Fining and filtration: Sensory analysis of lots, classification and blending of lots, deciding fining requirements, over-fining. Turbidity of wine & need for filtration, coarse filtration, polish filtration, membrane filtration, unfiltered wines – pros and cons.

10. Packaging: choice of bottles, shape and colour, labels and capsules, screwcap vs. Cork, analysis at bottling

11. Bulk Wine & bottled wine storage: managing ullages/ headspace, Temperatures of bulk wine storage, bottled wine storage – stacking method, temperature, light and humidity. Carton Packaged wine storage in warehouse

References:

1. Roger B. Boulton, Vernon Singleton, Linda Bisson and Ralph Kunkee. Principles and Practices of Winemaking.

2. Bruce Zoecklein, Kenneth Fugelsang, Barry Gump and Fred Nury, 1995. Wine Analysis and Production.

3. P. Ribereau- Gayon, 2006. Handbook of Enology: Volume 2: Chemistry of Wine Stabilization and Treatments –, 2nd Edition.

4. David Bird. 2005. Understanding Wine technology-, Vol.1, Resources.
5. Emile Peynaud, 1984. Knowing and Making Wine –, 1st Edition .

6. Albert Julius Winkler, W. M. Kliewer, Lloyd A. Lider, James A. Cook,
. 1974 . General Viticulture,

WT335: CONTRIBUTION OF WINE TO HUMAN HEALTH

- French Paradox
- Emerging research on mealtime alcohol consumption
- Wine polyphenols as antioxidants and free radical scavengers
- Major wine antioxidants: Procyanidins (OPCs), salicylic acid, DHBs, epicatechin, gallic acid, quercetin and resveratrol
- Moderate alcohol consumption and associated health benefits: liver, lungs and heart health benefits, anti- ageing effects, reduced dementia, reduction in various causes of mortality, lower risks of strokes, ulcer and kidney stones.
- Role of wine antioxidants in preventing; cardiovascular diseases, cancer (prostrate, lung and ovarian cancer in women), anti-degenerative diseases (Parkinson's, Alzheimer's and Rheumatoid diseases) and anti- LDL.
- Synergism of alcohol and antioxidants in wine

References:

1. Catherine Cheze, Joseph Vercauteren, R. Verpoorte, (2001). Polyphenols, Wine and Health .
2. Red wine for your health – Andrea Schaffer

3. C. A. Crampton "Fermented Alcoholic Beverages, Malt Liquors, Wine, And Cider", Also available from Amazon: Fermented Beverage Production, Second Edition.

3. Bruce Zoecklein, Kenneth Fugelsang, Barry Gump and Fred Nury.(1995) Wine analysis and Production.

WT-336 : WINERY BYPRODUCTS AND WASTE MANAGEMENT

1.Byproducts from wine production

Grape seed oil
Grape seed tannins
Tartaric acid;
Salts, anthocyanins from peels
Methods of extraction and uses.
Rochelle salt and natural color,

Evaluation of products from winery wastes: Cattle feed

2.Waste management

Types of waste and their characteristics
Concept of 4R principle in Waste treatment
Physicochemical methods of treatment
Biological methods of treatment (aerobic and anaerobic)
Integrated approach to waste treatment

WT-341: PROJECT 2: WINERY ESTABLISHMENT (Each student is expected to carry out the project/dissertation work in the winery)

WT 342: FRUIT AND FORTIFIED WINES

Traditional and nontraditional fruits.

Harmonious blends of fruits with grape wine

The concept of fruit beer and alcoholic wine as compared to synthetic beverages.

Prospect of fruit wines: Banana and orange wine.

Propensity of wine making: Guava wine and strawberry wine.

Technology of sparkling wine production : Sparkling cider.

Concept of fortification, different styles of fortified wine (Late harvest style, port style wine)

Methods of increasing berry sugar. *Botrytis* cinerea affected desert wines.

Useful and harmful effect of *Botrytis cinerea*

Addition of Brandy alcohol or liquor in wine

Preparation of wine from grapes with high sugar levels without Botrytis influences.

Wines made by addition of juice concentrate to a dry white wine.

Retention of portion of grape sugar in wine.

3. Evaluation of winery for sustainable production.

Most of the fruits are seasonal and perishable, wines from grape: Soft or hard as per consumer demand wines from traditional fruits: pomegranate, orange or any other fruit of choice, wine from non-traditional fruits: Jamoon, cashew nut; nonalcoholic beverages from fruits: Concept of nonalcoholic fruit wine. Carbonated fruit beverages as alternative for the synthetic drinks.

WT 343: WINE DEFECTS: IDENTIFICATION AND RECTIFICATION

1. Oxidation : acetaldehyde, acetic acid, ethylacetate
2. Sulfur compounds: sulfur oxides, hydrogen sulfide, mercaptans, dimethyl sulfide
3. Environmental : cork traint, heat damage, light strike, lady bird taint
4. Microbial : Brettanomyces (Dekkera). Geosmin, Lactic acid bacteria (bitterness taint, diacetyl, geranium taint, mannitor, ropiness), Mousiness, Refermentation
5. Acids in wine : volatile acidity (acetic acid), tartaric, malic, citric, lactic and succinic.
6. Wine aging factors and influences: with some little or no aging potential, bottle and dumbphase aging
7. Study of various practical techniques to solve defects during processing – phenolic wines, reduced wines, harsh and drying tannins, deacidification, acidification, dealing with stuck fermentation.
8. Understanding grape aroma flavour characteristics.
9. Additives allowed in making wine: Study of compounds and levels listed by OIV, AWRI, BIS.

References:

1. Ultimate Wine Tasting Kit: Wine Spectator,2004, 1st edition.
2. Handbook of Enology vol. 2, Chemistry of Wine Stabilization and Treatment- P. Ribereau- Gayon,2006, 2nd edition
3. Oxford Companion to Wine – Jancis Robinson, 3rd edition
4. Wine Grape Varieties- George Kerridge, Alan Antchliff, 1999.

WT-344: WINE LAWS, MANAGEMENT & TAXATION

Introduction, and Historical background:

Federal wine laws:

State wine laws: laws that govern the distribution of wine, selling of wine, state taxation of wine, shipping of wine by producers and consumers.

State distribution laws: Suppliers (wineries) that produce the wine, brokers, companies, and individuals that represent the winery and sell its product for a commission., Distributors, companies that purchase large amounts of wine in cases from suppliers and store it in their own warehouses while they sell it to retailers by the case or by the bottle, retailers, either on-premise (restaurants and bars) or off-premise (wine shops and grocery stores), who sell wine directly to consumers.

State Laws governing Wine sales:

State laws governing taxation of wine:

State laws governing shipping

Patents and secret process:

The patent: Concept of patent, composition of patent, subject matter and characteristics of patent. Protection of right of inventor; infringement, cost of patent. Product and process patent.

WT345: WINE MARKET AND MARKETING:

1. Understanding Marketing
2. The Global Wine market – Leading producers and regions, Top markets
3. Principles, logistics, and strategies of wine marketing and sales
4. Understanding the market and finding a niche, and developing a successful plan.
5. Case studies of real world examples from both wine and business experts
6. Indian wine market – Study of facts and figures

References:

1. Marketing Management, Philip Kotler, 13th edition
2. World's Wine Markets – Kym Anderson, 2004, 1st edition
3. Successful Wine Marketing – James Lapsley, Kirbey Moulton, 2001, 1st Edition
4. Wine Marketing and Sales – Liz Thach, Janeen Olson 7 Paul Wagner, 2008
5. Wine Marketing – Michael Hall, 2006, 1st Edition

WT-346: TERM PAPERS AND SEMINARS, TWO EACH RELEVANT TO CURRICULUM

WT301: SENSORY EVALUATION OF WINE

- The organization of wine evaluation: the space, equipment, temperature, order of serving the wines
- Wine evaluators selection based on their capacities and motivation and their fundamental education for sensory evaluation and scoring
- Sensory testing: sensory thresholds, acquaintance with the basic tastes, recognition of basic tastes, classification based on taste, smell, clarity and color, sight, touch, feeling and memory.
- Expression of senses perception (vocabulary); the types and methods of evaluation
- Performing and methods of sensory assessment (pair, three-angel, duo-trio test, the differentiation test, ranking test hedonic rating test and description analysis).
- The sensory evaluation by aroma wheel (varietal aroma, flavour and wood ageing)
- Analysis of substances responsible for astringency, bitterness and color of the wine.
- The influence of major technological properties during grape processing, wine making and nursing (grape maturation, maceration, changes before, during and after alcoholic and/or malolactic fermentation, wine maturation and blending)
- The study of sensory quality along with the wine origin and differentiation between the "technological wines" and "terroir wines" (geographical origin, wine sort, vintage, crop load, agro- ampelo techniques, technological maturity, harvest, etc.)
- Basics of wine and food pairing bases on sweetness, acidity, texture, tannin levels, oiliness and spice characteristics.

References:

Lawless, H.T. and Heymann, H. (1998) Sensory Evaluation of Food: Principles and Practices. (Chapman and Hall: New York).

Meilgaard, M., Civille, G.V. and Carr, B.T. (2007) Sensory evaluation techniques. (CRC Press Inc.: Boca Raton).

Stone, H. and Sidel, J.L. (2004) Sensory Evaluation Practices. (Elsevier Academic Press Inc: San Diego, CA.

S. Ranganna, (2001) Hand Book of Analysis and quality control for fruits and vegetables, , 2nd edition

J. Patric Handerson Dellie Rex (2002) Wine: Sensory evaluation : How the senses respond to wine.

Taste of Wine- Emile Peynaud, 1989,1st edition

Wine aroma wheel- Ann C. Noble, 1990 1st edition.

WT302: MICROBIOLOGY AND WINE MAKING

1. Grapes and wine microorganisms: Yeasts (fermentation and wine spoilage), lactic acid and acetic acid bacteria filamentous fungal pathogens like *Aspergillus, Botrytis Penicillium:* Introduction, taxonomy, nutritional requirements, metabolism

2. Microbial ecology during vinification: natural flora of grapes and other fruits, interactions of microorganisms, host-pathogen interaction

3. Microbial and biochemical profiling of wine fermentation

4. Wine spoilage: spoilage organisms, microorganisms from winery equipments, spoilage during fermentation and post-fermentation

5. Quality control parameters for wine fermentation

Practicals:

1. Phase Contrast Microscopy
2. Different isolation and selective media for microorganisms
3. Estimation of population density
4. Identification of wine spoilage organisms: phenotypic, biochemical and molecular methods
5. Microbial profiling of wine

WT303: PRACTICALS BASED ON CHEMICAL ENGINEERING.

1. Measurement of properties of liquids (must, wine, sugar syrups etc) using Specific gravity bottle, Brix hydrometer, hand held refractometer
2. Measurement of viscosity of liquids using Capillary tube viscometer, Rotational viscometer
3. Measurement of flow of liquids using rotameters, Pitot tube, Orifice meter, Venturi meter, paddle flow meters, vortex flow meters, magnetic flow meters etc.
4. Filtration of liquids through cake filters, Estimation of flux as a function of ΔP, area, etc calculation of values of α and β in the Darcy equation.
5. Calculation of heat load, chilling plant specifications etc, using a laboratory Plate heat exchanger/ shell & tube heat exchanger
6. Estimation of thermal death coefficient *k* for normal wine contaminants
7. Practical calculation of refrigeration loads for wine storage