Savitribai Phule Pune University

(Formerly University of Pune)

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

Three-Year B. Sc. Degree Course inWine,

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:

Beer, Wine and Alcohol Technology, being one of the youngest branch of Life Science, has expanded and established as applied science. Global and local focus has slowly shifted to not only current "Century of Knowledge" but also on to technology development and application in life sciences. Although, 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 manpower.

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 student's build-up a progressive and successful career

Programme Outcomes (UG)

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. for 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 weightage will be given to the 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

Career 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 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 and 15 min = 195 min
- Each practical session time for SY & TY is of 4 hour and 20 min = 280 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 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.: 22
- Minimum number of credits required to take admission to Third Year of B.Sc.: 44
- 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 (Wine, Brewing and Alcohol Technology)

Structure of the course: Semester: I

Theory

Course Code	Course Title	Credits	Number of Hours	Marks
WBAT - 111	Basic Microbiology Paper I	2 Credits	30	50 (35 External +15 Internal)
WBAT - 112	Industrial Microbiology Paper I	2 Credits	30	50 (35 External +15 Internal)
WBAT - 113	Introduction to Botany	2 Credits	30	50 (35 External +15 Internal)
WBAT - 114	Plant Development and Anatomy	2 Credits	30	50 (35 External +15 Internal)
WBAT - 115	Basic Biochemistry Paper I	2 Credits	30	50 (35 External +15 Internal)
WBAT - 116	Metabolic Pathways Paper I	2 Credits	30	50 (35 External +15 Internal)
WBAT - 117	Wine Technology	2 Credits	30	50 (35 External +15 Internal)
WBAT - 118	Sensory Evaluation of winepaper I	2 Credits	30	50 (35 External +15 Internal)
WBAT - 119	Practicals in Microbiology	1.5 Credits	14 P	50 (35 External +15Internal)
WBAT - 1110	Practicals in Botany	1.5 Credits	14 P	50 (35 External +15 Internal)
WBAT - 1111	Practicals in Biochemistry	1.5 Credits	14 P	50 (35 External +15 Internal)
WBAT – 1112	Practicals in Wine Technology	1.5 Credits	14 P	50 (35 External +15 Internal)
Total Credits (Theory + Practical)		**22 Credits**		

Title of the Course:

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

Structure of the course: Semester: II

Theory

CourseCode	Course Title	Credits	Number of Hours	Marks
WBAT - 121	Basic Microbiology Paper II	2 Credits	30	50 (35 External +15 Internal)
WBAT - 122	Industrial Microbiology Paper II	2 Credits	30	50 (35 External +15 Internal)
WBAT - 123	Plant Physiology	2 Credits	30	50 (35 External +15 Internal)
WBAT - 124	Applied Botany	2 Credits	30	50 (35 External +15 Internal)
WBAT - 125	Basic Biochemistry Paper II	2 Credits	30	50 (35 External +15 Internal)
WBAT - 126	Metabolic Pathways Paper II	2 Credits	30	50 (35 External +15 Internal)
WBAT - 127	Introduction to Beer, Wine and Alcohol Technology	2 Credits	30	50 (35 External +15 Internal)
WBAT – 128	Sensory evaluation of winepaper-II	2 Credits	30	50 (35 External +15 Internal)
WBAT - 129	Practicals in Microbiology	1.5 Credits	14 P	50 (35 External +15 Internal)
WBAT -1210	Practicals in Botany	1.5 Credits	14 P	50 (35 External +15 Internal)
WBAT - 1211	Practicals in Biochemistry	1.5 Credits	14 P	50 (35 External +15 Internal)
WBAT – 1212	Practicals in Wine Technology	1.5 Credits	14 P	50 (35 External +15 Internal)
Total Credits (Theory + Practical)		**22 Credits**		

F.Y.B. Sc: Wine, Brewing and Alcohol Technology

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

Semester I

Old Course (2009 Pattern)		**New Course (2019 pattern)**	
Course Number	**Course title**	**Course Number**	**Course title**
WT-101	Paper 1 Microbiology	WBAT-111	Basic Microbiology Paper I
WT-102	Paper 2 Microbiology	WBAT-112	Industrial Microbiology PaperI
WT-104	Paper 1 Botany	WBAT- 113	Introduction to Botany
WT-105	Paper 2 Botany	WBAT-114	Plant Development and Anatomy
WT-107	Paper 1 Biochemistry	WBAT-115	Basic Biochemistry Paper I
WT-108	Paper 2Biochemistry	WBAT-116	Metabolic Pathways Paper I
WT-110	Paper 1Wine Technology	WBAT-117	Wine Technology
WT-111	Paper 2Wine Technology	WBAT-118	Sensory Evaluation of wine paper-I
WT-103	Microbiology Practical	WBAT-119	Practicals in Microbiology
WT-106	Botany Practical	WBAT-1110	Practicals in Botany
WT-109	Biochemistry Practical	WBAT-1111	Practicals in Biochemistry
WT-112	Wine Technology Practical	WBAT-1112	Practicals in Wine Technology

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

Semester II

Old course (2009 pattern)		**New course (2019 pattern)**	
Course Code	**Course name**	**Course Code**	**Course name**
WT-101	Paper 1Microbiology	WBAT-121	Basic Microbiology Paper II
WT-102	Paper 2 Microbiology	WBAT-122	Industrial Microbiology Paper II
WT-104	Paper 1 Botany	WBAT-123	Plant Physiology
WT-105	Paper 2 Botany	WBAT-124	Applied Botany
WT-107	Paper 1 Biochemistry	WBAT-125	Basic Biochemistry Paper II
WT-108	Paper 2 Biochemistry	WBAT-126	Metabolic Pathways Paper II
WT-110	Paper 1Wine Technology	WBAT-127	Introduction to Beer, Wine and Alcohol Technology
WT-111	Paper 2Wine Technology	WBAT-128	Sensory Evaluation of wine paper-II
WT-103	Microbiology Practical	WBAT-129	Practicals in Microbiology
WT-106	Botany Practical	WBAT-1210	Practicals in Botany
WT-109	Biochemistry Practical	WBAT-2111	Practicals in Biochemistry
WT-112	Wine Technology Practical	WBAT-1212	Practicals in Wine Technology

WBAT-111 : Basic Microbiology Paper-I
(2 Credit course) Total Hours = 30

At the end of the courses, the students will be able to

- Describes different structural parts and its arrangement of microbial cell.
- Learns importance of microbiology and the scope of the various micro-organisms in the branches of the science.
- Understand the contribution of eminent scientist in the microbiology.
- Understand the structure of bacterial cell.
- Classification of the bacteria on the basis of different parameters.
- Compare between prokaryotic and eukaryotic organism.

Unit No.	Topics	No. of Hours
Unit -1.	**Introduction, History, Branches and Scope of Microbiology**: - Contribution of Scientists in the field of Microbiology- Antony Von Leuwenhoek,Edward Jenner, Lazaro Spallanzani, Louis Pasteur, Joseph Lister, Robert Koch, Alexander Fleming and Iwanovsky. Branches and Scope of Microbiology. **Importance, occurrence and types of microorganisms: -** Classification of microorganisms, Difference between prokaryotic and eukaryotic cells, types of bacteria, fungi, viruses, protozoa and algae.	10
Unit -2.	**Microbial Physiology: -** Cell – Biology – Detailed study of bacterial cell organelles, cell wall, cell membrane, capsule, endospore, flagella, types of flagella, mechanism of flagellar movement. Cell inclusions (Gas vesicles, carboxysomes, PHB granules, metachromatic granules, glycogen bodies, starch granules, magnetosomes, sulfur granules, chlorosomes)	10
Unit – 3.	**Microbiology of yeast:** Yeast – Characteristics features of yeast in comparison with other microorganisms Yeast morphology and taxonomy, yeast cell structure and functions of various cellular components. Role of yeast in various fermentations: - Examples of various fermentations using yeast with special reference to Glycerol, baker's yeast, etc.	10

WBAT-112 : Industrial Microbiology Paper-I
(2 Credit course) Total Hours = 30

By the end of the course the students will be able to

- Acquainting students with scope of industrial microbiology.
- Understand and learn various sterilization techniques.
- Understand the nutritional requirement of bacteria.
- This course acquaints students with various types of preservation technique.
- Understand the design and preparation of media.
- Learn different types of filtrations, disinfection and fumigation techniques.
- Familiarize historical development in fermentation industry

Unit No.	Topics	No. of Hours
Unit -1.	**Unit-1 Industrial Microbiology** Definition & Scope of Industrial Microbiology. Historical development in fermentation industry. Microbiology in industry.	10
Unit -2.	**Unit-2 Sterilization technique.** Concept of asepsis, disinfection &sterilization Sterilization by heat – use of dry & moist heat. Pasteurization methods and its types. Sterilization by radiation, U.V. light & γ radiation. Filtration: Bacteriological filters, types & uses, air sterilization. Disinfectant types, action & applications, fumigation	12
Unit -3.	**Pure culture techniques: -** Design & preparation of media – Nutritional requirements ingredients of media. Types of media. Preservation of pure culture, slant culture preservation, Lyophilization.	08

WBAT-113: Introduction to Botany

(2 Credit course) Total Hours = 30

At the end of courses the students will be able to

- Acquire knowledge on ultra structure of cell.
- Understand the structure and chemical composition of chromatin and concept of cell division.
- Interpret the Mendel's Principal; acquire knowledge on cytoplasm inheritance and sex linked in hesitance.
- Understand the fundamental concepts of plant anatomy.
- Evaluate the structural organization of flowers and the process of pollination.

Unit No.	Topics	No. of Hours
Unit 1	**Introduction to Botany** Botany - Definition and Multidisciplinary nature of Botany Plant as a living system-General & Unique features of plants as living organisms, Plant diversity – concept, Morphology of vegetative plant organs, Structure of typical plant and different parts of plant (Root, Stem & Leaf) Reproductive development: Shift from vegetative to reproductive phase Inflorescence: Definition, Types of inflorescence and Significance of inflorescence Morphology - of reproductive plant organs Flower: Definition and symmetry, Parts of flower: Pedicel, Thalamus, Floral whorls: calyx, corolla, androecium and gynoecium Fruit & its types	17
Unit 2	**Plant Cell Biology & Genetics** Unique features of a plant cell Cell cycle, cell division, mitosis and meiosis stages and their significance Programmed Cell Death- ageing, senescence and necrosis Overview of Mendel's laws of Inheritance with reference to monohybrid and dihybrid ratio, Codominance & Incomplete dominance Linkage & Crossing Over	13

WBAT-114: Plant Development and Anatomy

(2 Credit course) Total Hours = 30

At the end of courses the students will be able to

- To gain knowledge of plant cells tissue and their functions.
- Understand the process of microsprogenesis, megasprogenesis and double fertilization,
- Enable to know the internal structure of stem, leaf and root in monocot and dicot.
- Understand endosperm and its types and know the structures and development of monocot and dicot embryos.
- Understand the meristematic tissue system.
- Understand the plant growth and their regulators.

Unit No.	Topics	No. of Hours
Unit 1	**Plant Development** Unique features of plant, Shift from vegetative to reproductive phase & factors affecting Microsporogenesis, development of male gametophyte and male gamete Megasprogenesis, development of female gametophyte and female gamete Double fertilization and triple fusion & Development of endosperm Embryogenesis- Monocot & Dicot embryogenesis Plant growth regulators and their role in growth and development(*in vivo* & *in vitro* response)	**15**
Unit 2	**Plant Anatomy** Definition, concept, scope and objectives. Meristem & Meristematic tissue system: Types of meristematic tissues basedon their position & function. Structure & function of simple tissues: parenchyma, collenchyma, Sclerenchyma. Complex tissue: Structure and function of xylem and phloem & Concept of Mechanical Tissue system Epidermal & Secretary tissue system Anatomy of Monocot & Dicot (root, stem & leaf)	15

WBAT-115: Basic Biochemistry Paper-I
(2 Credit course) Total Hours = 30

At the end of courses the students will be able to-

- Understand the role of biomolecule and their functions.
- Understand the scope of biochemistry in the field of wine technology.
- Understand the structure and functions of biomolecules.
- Understand the chemical structures of carbohydrate, lipid, and their structural and metabolic role in callus system.
- Get the practical knowledge of preparation of buffers and measurement of pH
- Understand and describe classification of carbohydrate and lipid.

Unit No.	Topics	No. of Hours
Unit-1	Introduction to Biochemistry. Concept & scope of Biochemistry. Application of biochemistry in wine science.	02
Unit-2	**Water**: Types of bond, Covalent and non-covalent interactions in biomolecules with suitable examples. Properties of water, Hydrogen bonding, ionization of water, interaction of biological molecules in water, osmosis. Buffers - Biological buffers-concept, types and their importance.	08
Unit-3	**Carbohydrates:** Classification of carbohydrates –Monosaccharides, Oligosaccaharides and Polysaccharide. Monosaccharides: Structure & properties of Monosaccharides, ketoses and aldoses, D and L configuration, epimers, anomers, chemical and physical properties; glycosidic bonds, reducing and non-reducing sugars. Oligosaccharides: Sucrose, Lactose and Maltose. Polysaccharides and its classification. Functions of Carbohydrate	10
Unit-4	**Lipids:** Classification of lipids: Simple & complex lipids, fatty acids. Structure, chemical and physical properties, Complex lipids: Phospholipids and Glycolipids. Function of lipids.	10

WBAT-116: Metabolic Pathways Paper-I
(2 Credit course) Total Hours = 30

At the end of courses the students will be able to-

- Understand the chemical bonding, strong and weak interactions and biological reactions.
- Understand the importance of electron transport chain, synthesis of ATP under aerobic and anaerobic conditions.
- To acquire knowledge related to TCA cycle in central carbon metabolism.
- Understand fundamentals of high energy bond and high energy compound.
- To acquire knowledge to differentiate Exothermic reactions and Endothermic reactions.
- Understand the concept of fermentation.

Unit No.	Topics	No. of Hours
Unit -1.	Bioenergetics: Concept of bioenergetics: Concept of free energy, Laws of thermodynamics and their relevance to metabolism. Exothermic reactions and Endothermic reactions. Concept of high energy bond & high energy compounds. Substrate level & oxidative phosphorylation.	08
Unit -2.	2.1 Metabolism: Definitions & Concepts: Catabolism, anabolism, anapleurotic reactions.	04
Unit -3.	Carbohydrate metabolism: Glycolysis (E.M.P.) and fates of pyruvate. T.C.A. cycle. Fermentation.	09
Unit -4.	Electron transport System. Fatty acid degradation- β- oxidation in relation to energy production.	09

WBAT-117: Wine Technology
(2 Credit course) Total Hours=30

At the end of courses the students will be able to-

- Understand the concept of viticulture and their terminologies.
- Familiarize basic production step in white and red wine
- Understand the classification of wine.
- To acquire knowledge about grape vine and different grape varieties used in wine production
- Understand the chemical constituents of wine.
- Understand role of oak barrel in wine.

Unit No.	Topics	No. of Hours
Unit-1	Wine making: Introduction to winemaking, important terminologiesof wine. Viticulture: Introduction to viticulture, important terminologies. Wine history ("old" and "new" world wine). 1.4 Terrior: Concept of Terrior and importance of Terrior.	10
Unit-2	Classification of wine: Generic classification, varietal classification, Vinification classification and classification on the basis of chemical Constituents. Flow chart of white wine-production and recommended varieties. Flow chart of Red wine-production and recommended varieties. Flow chart of Sparkling wine-production and recommended varieties. Production of wine from fruits other than grapes (e.g. apple).	10
Unit-3	Grapevine - Classification, function of various parts of grapevine. Common wine grape varieties –red and white grape varieties Chemical Constituents of Wines. Introduction to barrel: Distribution, species and advantages of oak.	10

WBAT-118: Sensory Evaluation of Wine Paper-I

(2 Credit course) Total Hours = 30

At the end of courses the students will be able to-

- Understand and gain knowledge about the basic taste, color and aroma of wine.
- Understand application of the aroma wheel and score card
- To acquire knowledge about the taste of the wine on basis of vision, smell and palate structure.
- Understand and learn about the tasting room, serving of wine.
- Understand the concept of Neurophysiologic mechanism of tasting.
- Understand the factors which influencing taste perception.

Unit No.	Topics	No. of Hours
Unit-1	Sensory evaluation and terminologies The basic tastes of wine: bitterness, acidity, salt, sweetness, and alcohol on the tongue. Sensory perception -study of tongue anatomy with reference to sensory response. Factors influencing taste perception.	10
Unit-2	The art of tasting wine – color, aroma and taste of wine. Neurophysiological mechanism of tasting. Sensory evaluation and scorecard: Rose worthy scorecard, Davis scorecard and Sparkling wine score-card. Introduction to aroma wheel.	10
Unit-3	Design of tasting room, timing of tasting wine. Taste the wine on the basis of three important senses i.e. vision, smell and palate structure. Selection & different types of glass, serving temperature of wine. Serving wine: Opening the bottle, selection of bottle for different wine style.	10

WBAT-119: Practical's in Microbiology

(1.5 Credit Course) Total practical's = 14

Sr. No	Experiment Title	No. of Practical's
1	Safety Measures and Good Laboratory Practices in Microbiology laboratory.	1
2	Introduction, operation, precautions and use of common microbiology laboratory instruments: Incubator, Hot Air Oven, Autoclave, Colorimeter, pH Meter, ChemicalBalance, Laminar air flow hood, Centrifuge.	2
3	Introduction and use of common laboratory glass wares: Test tubes, Culture tubes, suspension tubes, screw capped tubes, Petri plates, Pasture pipettes, Erlenmeyer flask, volumetric flask, glass spreader, Durhams tube, Cragie's tube and inoculatingneedles (wire loop, stab needles).	1
4	Learning basic techniques in Microbiology: Wrapping of glassware, Cotton plugging, cleaning and washing of glassware, Inoculation of bacterial culture, Biological waste disposal. Aseptic transfer techniques (slant to slant, broth to broth,broth to agar and Agar to Agar) .	1
5	Study of Microscope- Compound Microscope & its parts. Use of oil immersion objective.	1
6	Basic staining techniques: i) Monochrome staining ii)Negative staining.	2
7	Staining of Endospore	1
8	Staining of Capsule	1
9	Hanging drop preparation for observation of motility.	1
10	Preparation of liquid medium -nutrients broth, Sabouraud broth and PDB	1
11	Preparation of nutrient agar medium, agar slant and PDA	1
12.	Wet Mount slide preparation and its observation – Fungi.Slide culture technique	1

WBAT- 1110: Practical's in Botany
(1.5 Credit Course) Total practical's = 14

Sr. No.	Experiment Title	No. of Practical's
1.	Study of typical plant and plant parts	01
2.	Observation of different types of inflorescence in plants.	01
3.	Observation of parts of flower	01
4.	Study of different types of fruits	01
5.	Study of plant cell types using squash techniques and Maceration	01
6.	Study of Programmed Cell Death in plants	01
7.	Study of meristematic tissue system	01
8.	Study of complex and permanent tissue system.	02
9.	Study of trichomes & secretary tissue system	01
10.	Observation of typical monocot root and stem	01
11.	Observation of typical dicot root and stem	01
12.	Study of embryological evidences in plants & Observation of embryo in monocot & dicot seeds	02

WBAT-1111: Practical in Biochemistry
(1.5 Credit course) Total practical = 14

Sr. No	Experiment Title	No of Practical's
1	Safety Measures and practices in chemistry laboratory.	1
2	Molarity, molality, normality, ppm, ppb.	1
3	Laboratory Equipments: Working Principle and Handling a) Distillation unit b) Colorimeter & spectrophotometer c) pH meter d) Balance e) Centrifuge	2
4	Preparation of Buffers of desire pH and Molarity – Acetate buffer and phosphate buffer.	1
5	Determination of alkalinity of water.	1
6	Titration of Strong acid with the strong base.	1
7	Titration of Weak acid with strong base.	1
8	Determination of Ascorbic acid.	1
9	Estimation of reducing sugar by DNSA method.	1
10	Paper chromatography of sugars.	1
11	TLC of amino acids/ Sugars	2
12	Determination of ƛ max	1

WBAT-1112: Practical in Wine Technology
(1.5 Credit course) Total practical = 14

Sr. No	Experiment Title	No of Practical's
1	Introduction to Wine technology Laboratory and common Wine technology laboratory instruments e.g. Refractometer, Hydrometer Colorimeter, pH Meter, Distillation Unit, Chemical Balance etc	2
2	Identification of grape and wine varieties.	2
3	A small survey on *"Wine as an alcoholic drink":* Report writing.	2
4	To study threshold detection of acid taste.	1
5	To study threshold detection of sweet taste.	1
6	To study threshold detection of bitter taste.	1
7	To study threshold detection of bitter taste.	1
8	Study of aroma wheel.	1
9	Types of wine glasses.	1
10	Study of a 50 KL winery.	2

Recommended Textbooks and References for Microbiology:

1. Casida L. E. (Jr) (1993) Industrial Microbiology, 5th Reprint
2. Patel A. H. (2005) Industrial Microbiology.
3. Michael J. Pelzer, E.E.S. Chan, Noel R. Krieg (1993) Microbiology
4. P. Gunasekaran (2005) Laboratory Manual in Microbiology
5. Lansing M. Prescott John P. Harley & Donald A. Klein (2005) Microbiology
6. Rojer A. Stanier (1989) General Microbiology
7. Pawar C. B. & H. F. Daginawala (1982) General Microbiology Vol.-2
8. Stanbury, P. F., Whitaker A. & Hall S. T. (2008) Principles of Fermentation Technology
9. Panda U. N. (2005) Handbook of Microbiology and parasitology
10. Anuradha De. (2009) Practical and applied microbiology
11. Prescoff Hurley Kline's (2008) Microbiology
12. Sathe S. T. Pharande S. R. (2010) Introduction to Microbiology

Recommended Textbooks and References for Botany:

1. Naik, V.N (1991). Taxonomy of Angiosperm. Tata McGraw-Hill Publishing Company Ltd., New Delhi
2. Lawerence, G.H.M. (1967). Taxonomy of Vascular plants. Oxford & IBH Publishing Co. Calcutta
3. Majumdar, R.B. (1963). An Introduction to Spermatophyta. Merit Publishers, Calcutta
4. Singh, V. & Jain, D.K. (1996). Taxonomy of Angiosperms. Rastoghi Publ., Merrut, India
5. Ariens, E.J., Simonis, A.M. and Offermeiers, J. (1976). Introduction to General Toxicology, Academic Press, New York
6. Pandey, K., Shukla, J.P. and Trivedi, S.P. Fundamentals of Toxicology, New Central Book Agency, Kolkata
7. Datta, S.C. (1980). Plant Physiology, Central Book Depot, Allahabad

Recommended Textbooks and References 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 of Biochemistry
5. Sadasivam S. & Manickam A. (2010) Biochemical Methods
6. Gurdeep P.Chaiwal & sham K. Anand (2007) Industrial methods of chemical Analysis

Deb A. C. (2004) Fundamentals of biochemistry

Recommended Textbooks and References for Wine technology:

1) Ronald S. Jackson (2002) Wine Testing a professional handbook
2) Ron s. Jockson (2000) Wine science principles practices & perception
3) Vine, Richard p (1997) Wine Appreciation
4) Emile Peynavd (1997) The taste of wine
5) Brue W. Zoecklein, Kenneth Fugelsang, Barry H. Gump Fred S. Nury (1999) Wine Analysis and production
6) C. S. Ough (1992) Wine making Basics
7) Roger B.Boulton (1996) Principles and practices of wine making
8) Emile Peynalld (1984) Knowing & making wine
9) Patrice Iland & Peter Gago (1997) Australian wine from the grasp vine to the glass.

Semester –II

WBAT-121: Basic Microbiology Paper-II

(2 Credit course) Total Hours = 30

At the end of course the students will be able to-

- Understand the basic of microscopy, their parts, working distance, resolving power, resolution and magnification.
- Understand the principal and application of bright field and dark field microscope.
- Understand the bacterial growth curve.
- Learn various staining technique.
- Understand the properties and role of fixative, mordents decolorize and accentuates in staining.
- Understand the difference between monochrome and differential staining, gram staining.

Unit No.	Topics	No of Hours
Unit -1.	**Microscopy**: Principles of Microscopy- resolving power, resolution, contrast, numerical aperture, working distance and magnification. Rayleigh criteria, Working. Principles and applications of a) Bright field microscope & b) Dark field microscope. Electron Microscopy – TEM, SEM.	10
Unit -2.	**Microbial Growth**: Growth curve, introduction to kinetics of growth, generation time, growth rate. Reproduction in microorganisms: sexual reproduction and asexual reproduction. Measurement of Bacterial growth- Methods of enumeration: Microscopic methods (Direct microscopic count, counting cells), Plate counts (Total viable count), Turbidometric methods.	12
Unit – 3.	**Staining Techniques:** Definitions of Stain; Types of stains (Basic and Acidic). Properties and role of Fixatives, Mordants, Decolourisers and Accentuators. 3.3Monochrome staining, Negative (Relief) staining and Differential staining - Gram staining .	8

WBAT-122: Industrial Microbiology Paper-II

(2 Credit course) Total Hours = 30

At the end of the courses the students will be able to-

- Understand the basic components of typical fermentation medium.
- To acquire knowledge about the role of nutrients in microbial growth.
- Understand the concept of stock culture and its maintenance.
- Understand the fermentation process and types of fermentation.
- Understand the concepts of upstream and downstream processing.
- To acquire knowledge about the culture collection centers, their objective and working.

Unit No.	Topics	No of Hours
Unit -1.	**Unit-1. Fermentation Media** Components of typical fermentation medium. Role of nutrients in microbial growth. Crude sources of N & C. Antifoam agents. Stock cultures and its maintenance. Industrial microbiological products as Primary and secondary metabolites.	15
Unit -2.	**Unit-4 Fermentation Process** Concept of fermentation and types of fermentation. Primary and secondary screening. Strain improvement Inoculum preparation – outline. Culture collection centres and their objectives and working. Concepts of upstream & downstream processing.	15

WBAT - 123: Plant Physiology

(2 Credit course) Total Hours = 30

At the end of the course the students will be able to-.

- Understand the concepts of transpiration and gutation.
- Understand the relations between plant water and their metabolism.
- Understand the concept of translocation and source sink relationship.
- Understand the plant and its interaction with surrounding, biotic & Abiotic components.
- To acquire knowledge about metabolic changes during seed germination and fruit ripening.
- Understand the response of plant to biotic stress and abiotic stresses

Unit No.	Topics	No of Hour
Unit 1	**Plant Physiology: Plant water relations & Primary Metabolism** Physiology –Definition, concept Permeability, Diffusion, Osmosis – Definition, significance, types, mechanism, laws and factors affecting, Osmotic pressure (OP), turgor pressure (TP) and wall pressure (WP), relation between OP, DPD (Suction pressure) and TP Absorption of water: Ascent of sap –Cohesion-tension theory Transpiration & Gutation – Definition, concept (structure of stomata & Hydathodes) & Significance Overview of Photosynthesis & Respiration: Definition and concept, Structure of Chloroplast, Photochemical and biosynthetic phases, Photosynthesis in plants, significance of photosynthesis and Photorespiration, structure of mitochondria Translocation –Definition, concept, pathway of translocation, Sourcesink relationship.	17
Unit 2	**Stress Physiology, Physiology of Flowering, Seed Germination, and Fruit ripening** Plant & its interaction with surrounding (Biotic & Abiotic components) Response of plants to biotic stresses and abiotic stresses General classification & major pathways of secondary metabolites & its role Introduction to physiology of flowering: a) photoperiodism and b) vernalization Metabolic changes during seed germination & fruit ripening	13

WBAT-124: Applied Botany

(2 Credit course) Total Hours = 30

At the end of the course the students will be able to-

- Understand the concept of plant propagation.
- To acquire knowledge of various types of propagation like sexual propagation, vegetative propagation and artificial propagation.
- Understand the concept of cell theory and callus totipotency.
- Understand the organ culture technique.
- Understand the concept of embryo and endosperm culture.
- Understand the micro propagation and somaclonal variations.

Unit No.	Topics	No of Hours
Unit 1	**Methods of Plant Propagation**	11
	1.1 Propagation:-Definition, scope and objectives, Types of Plant propagation; Sexual propagation and asexual plant propagation & its advantages and disadvantages	
	Sexual Propagation: Seed development and viability, seed dormancy, growing seedlings in indoor containers and field nurseries, seedling transplanting; advantages and disadvantages of seed propagation. Vegetative propagation- organs used in propagation- Natural- bulbs, corns, tubers, rhizomes (storage organs), stolons and runners. Artificial propagation-Cutting, layering (air and ground), grafting and budding; advantages and disadvantages of artificial propagation.	

Unit 2	**Plant Tissue Culture** Concepts of Cell theory & Cellular totipotency, Landmarks in plant tissue culture. Organization of plant tissue culture laboratory – General laboratory & Inoculation room, Culture room, different work areas, equipments & instruments required Media preparation & Aseptic techniques – Nutritional requirements of explant, Preparation of media & its sterilization, Washing, packing & sterilization of glass wares, surface sterilization, Aseptic work station, precautions to maintain aseptic conditions. 'Explant' for plant tissue culture, Concept of differentiation, dedifferentiation and redifferentiation, Callus formation, organogenesis & embryogenesis Organ culture technique – Introduction, principle, factors affecting w.r.t. root tip culture, leaf culture, shoot tip & meristem culture & its applications Concept of Haploid production & its applications Concept of embryo and endosperm culture & its applications 2.7 Micropropagation and Somaclonal variations	**19**

WBAT-125: Basic Biochemistry Paper-II

(2 Credit course) Total Hours = 30

At the end of the course the students will be able to-

- Understand the classification of biomolecules like Proteins. Enzymes, Nucleic acid and vitamins.
- Understand the general properties of enzyme their activation and inhibition.
- Understand the general structure of DNA & RNA.
- Understand the biochemical functions of fat soluble and water soluble vitamins.
- To acquire the knowledge about protein denaturation and renaturation.
- Understand the function of proteins.

Unit No.	Topics	No of Hours
Unit-1	**Proteins:** Amino acids and their Classification. Protein structure: Primary structure, Secondary structure, Tertiary and Quarternary structure, bonds in protein molecules. Protein denaturation and renaturation. Functions of proteins,	12
Unit-2	**Enzymes-** 2.1Definition, general properties, enzyme activation and inhibition. 2.2Models for enzyme catalysis. 2.3Enzyme classification.	10
Unit-3	**Nucleic acids**- Definition, general structure of DNA and RNA.	04
Unit-4	**Vitamins:** Classification**,** Biochemical functions of fat soluble and water soluble Vitamins.	04

WBAT-126: Metabolic Pathways Paper-II
(2 Credit course) Total Hours = 30

At the end of the course the students will be able to-

- Understand the protein metabolism.
- To acquire the knowledge about transamination and oxidative domination.
- Understand the metabolic fates of amino acid and learn about urea cycle.
- Understand the biochemistry of fermentation process.
- Understand the concept of homeostasis.
- Understand the regulation of enzyme at different level and it's types.

Unit No.	Topics	No. of Hours
Unit -1.	**Protein metabolism**: A) Transamination and oxidative deamination. B) Metabolic fates of amino acids. C) Urea cycle.	8
Unit -2.	**Nucleic acid**- Metabolism: Introduction to de novo & salvage synthesis.	4
Unit -3.	**Fermentation:** a) Biochemistry of ethanol Fermentation. b) Concept of Primary & secondary metabolites with examples. c) Overview of anaerobic fermentations by bacteria eg. Lactic acid.	10
Unit – 4.	**Metabolic Regulation** a) Concept of homeostasis. b) Regulation at Enzyme level – feed back inhibition and its types.	8

WBAT-127: Introduction to Beer, Wine and Alcohol Technology

(2 Credit course) Total Hours = 30

At the end of the course the students will be able to-

- Understand the fundamentals of traditional and commercial winemaking practices.
- To acquire knowledge about raw materials and equipment use in wine production.
- To gain knowledge about the history of brewing.
- Understand the various types of alcoholic beverages.
- Understand the anatomical and chemical constituents of oak and its role.
- To gain knowledge about the role of sulfur dioxide in vinification.

Unit No.	Topics	No of Hours
Unit-1	Traditional and Commercial winemaking practices: A comparative study. Raw materials and equipment use in wine production: crusher, press fermenter, pump and additives used in wines. 1. 3Automation in wine industry: Importance of automation operation in wine industries. 1.4 New concept in wine production – organic wine and biodynamic wine.	10
Unit-2	Introduction and History of Brewing Basic concept of alcoholic beverages - Vodka, Gin, Brandy, Whiskey, Rum, Beer, Fruit wines, Carbonated drinks. Alcoholic beverage and health: Effects on the human health. Status of Indian brewing, winemaking and alcohol.	10
Unit-3	Anatomical and chemical constituents of oak and liberation of oak flavors from the barrel in beer and alcohol; cask in wine. Work with barrels (stacking, maintenance). 3.3Oak chips versus oak barrels. Pre-fermentation actions (use of enzyme, skin contact, maceration). Role of sulphur-di-oxide in vilification.	10

WBAT-128: Sensory Evaluation of Wine paper-II (2 Credit course) Total Hours = 30

At the end of the course the students will be able to-

- Acquainting students with wine clarity and wine aroma.
- To acquire knowledge about various wine tasting sheets.
- Familiarize the students with tasting exercises and tasting situations.
- To acquire knowledge about new trends in the world of wine.
- Understand the rules of matching food with wine
- To gain knowledge and understand the primary, secondary and tertiary wine aroma.

Unit No.	Topics	No of Hours
Unit-1	Concept of wine clarity. Wine aroma - primary, secondary, tertiary aroma. off odors in wine – sulfur odor, oxidation, geranium, vegetative, corky. New trends I n the world of wine: Advantages and disadvantage of different closure (Screw cap, cork, Zork, synthetic cork, vino seal and crown caps) used for wine bottles.	10
Unit-2	Intorudction to tasting sheet: White wine. Introduction to tasting sheet: red wine. Introduction to tasting sheet: sparkling wine. Matching wine with food: Theory of food combination such as sweet, sour, salty and spicy food with wine.	10
Unit-3	3.1 Pre- tasting organization – testing area, number of samples replicates, temperature, cork removal, decanting, dispensers, glasses ,number of tasters . 3.2Tasting situations – wine competitions, trade tasting, wine appreciation courses, home tasting. Tasting exercises – Duo –trio test, blind tasting, triangular taste. Study of effervescence, ISO standard glass, Tears.	10

WBAT -129: Practical's in Microbiology (1.5 Credit Course) Total Practical's = 14

Sr. No	Experiment Title	No of Practical's
1	Isolation of bacteria and yeast from natural sources.	1
2	Observation of the growth of cultures and reporting of colony and cultural characteristics(Nutrient agar, Sabouraud's agar)	1
3	Isolation of microorganism by streak plate method	1
4	Isolation of microorganism by spread plate method	1
5	Isolation of microorganism by pour plate method.	1
6	Yeast for enumeration of yeast by Neubauer's chamber.	1
7	Special staining techniques: Gram staining for differentiation of bacteria.	2
8	Effect of pH on Microbial Growth.	1
9	Effect of salts on microbial growth.	1
10	Effect of Temperature on Microbial Growth	1
11	Aseptic Transfer Techniques	1
12	Microscopic observation of fungi.	1
13	Preservation of cultures on slants.	1

WBAT- 1210: Practical's in Botany (1.5 Credit Course) Total practical's: 14

Sr. No.	Experiment Title	Number of Practical's
1.	Study of osmosis and turgor pressure	**01**
2.	Determination of Diffusion Pressure Deficit using potato tubers.	**01**
3.	Study of translocation in plants.	**01**
4.	Determination of rate of respiration	**01**
5.	Study of stomata and transpiration in plants	**01**
6.	Testing presence of phenols in the plant tissue by ferric chloride test.	**01**
7.	Separation of leaf pigments by strip chromatography	**01**
8.	Preparation of nursery beds and rising of plants by different propagation methods	**01**
9.	PTC Laboratory: organization of facility and equipment, Aseptic manipulation – washing, capping, packing & sterilization, laminar flow operation and safety precautions	**02**
10.	Stock solutions & media preparation	**01**
11.	Effect of plant growth regulators on in vitro response of explants.	**02**
12.	Initiation of shoot tip & axillary bud culture, anther culture	**01**

WBAT-1211: Practical in Biochemistry (1.5 Credit course) Total practical = 14

Sr. No	Experiment Title	No of Practical's
1	Qualitative test for carbohydrate.	1
2	Qualitative test for Lipid/ Proteins	1
3	pH measurement- Use of pH indicator.	1
4	pH measurement- Use of pH meter	1
5	Total Carbohydrate estimation by phenol sulphuric acid method	1
6	Paper chromatography of amino acids.	1
7	Protein estimation- Folin Lowry method.	1
8	Protein estimation- Biuret method.	1
9	Enzyme assay (amylase).	2
10	Extraction of lipids in organic solvents. (chloroform, methanol)	2
11	Determination of chlorine content in water.	1
12	TLC of lipids	1

WBAT-1212: Practical in Wine Technology (1.5 Credit course) Total practical = 14

Sr. No	Experiment Title	No of Practical's
1	Scoring of wine using different tasting sheet.	1
2	Sensory evaluation of white wine and red wine.	2
3	Filed visit and report writing Vineyard /Winery.	2
4	Matching wine with food.	1
5	Effect of age on the appearance of white and red wine.	1
6	Interaction of sweet and acid taste.	1
7	Interaction of sweet, acid and bitter taste.	2
8	Effect of the serving temperature on wines.	1
9	Effect of pH on the sensory evaluation of wine.	1
10	The sense of feel.	1
11	Identification of off odors in wine.	1

Recommended Textbooks and References for Microbiology:

1. 1.Casida L. E. (Jr) (1993) Industrial Microbiology, 5th Reprint
2. Patel A. H. (2005) Industrial Microbiology.
3. Michael J. Pelzer, E.E.S. Chan, Noel R. Krieg (1993) Microbiology
4. 4.P. Gunasekaran (2005) Laboratory Manual in Microbiology
5. Lansing M. Prescott John P. Harley & Donald A. Klein (2005) Microbiology
6. Rojer A. Stanier (1989) General Microbiology
7. Pawar C. B. & H. F. Daginawala (1982) General Microbiology Vol.-2
8. Stanbury, P. F., Whitaker A. & Hall S. T. (2008) Principles of Fermentation Technology
9. 9 Panda U. N. (2005) Handbook of Microbiology and parasitology
10. Anuradha De. (2009) Practical and applied microbiology
11. Prescoff Hurley Kline's (2008) Microbiology
12. Sathe S. T. Pharande S. R. (2010) Introduction to Microbiology

Recommended Textbooks and References for Botany:

01. Bhojwani, S.S., & Bhatnagar, S.P. An embryology of Angiosperm
02. Maheshwari, P. An Introduction to embryology of Angiosperm
03. Pandey, S.N. & Ajanta Chadha. Plant Anatomy and Embryology. Vikas Publishing House Pvt. Ltd., New Delhi
    Chandurkar, P.J. (1983). Plant Anatomy. Oxford & IBH Publishing Co, Calcutta
04. Khan, M.R., Ahire, S.V., Gadekar, S.S., Parale, A.P. and Auti, S.G. (2014) Plant Anatomy& Embryology and
    Plant Biotechnology, Success Publication.
05. Eames, A.J. &Macdaniels, L.H. (1947) An Intriduction to Plant Anatomy. McGraw-Hill, N.Y. and London
06. Esau,K. (1977). Anatomy of seed plants, John Wiley & Sons, Inc. London
07. Fahn, A.(1997). Plant Anatomy. Pergamon Press, Oxford
08. Pandey, B.P.(1979). Plant Anatomy. S Chand & Company Ltd. New Delhi
09. Roy Pijush (2012). Plant Anatomy. New Central Book Agency (P.) Ltd. Pune
10. Vasishta, P.C. (1981). Plant Anatomy. Pradeep Publications to embryology
11. Gokhale, S.B. and Kokate, C.K. (1987). Pharmacognosy
12. Wallis,T.E.(1985). A Text book of Pharmacognosy, CBS Publishers & Distributors, New Delhi
13. Sadhu, M.K. (1989). Plant Propagation. Wiley Eastern Ltd. New Delhi.
14. De, K.K.(2004). An Introduction to Plant Tissue Culture. New Central Book Agency (P.) Ltd. Kolkata
15. Devlin, R.M. (1969). Plant Physiology, Affiliated East-West Press Pvt.Ltd. New Delhi
16. Razdan, M.K.(1996). An Introduction to Plant Tissue Culture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

Recommended Textbooks and References 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 of Biochemistry
5. Sadasivam S. & Manickam A.(2010) Biochemical Methods
6. Gurdeep P.Chaiwal & sham K. Anand (2007) Industrial methods of chemical Analysis
Deb A. C.(2004) Fundamentals of biochemistry

Recommended Textbooks and References for Wine technology:

1. Ronald S. Jackson (2002) Wine Testing a professional handbook
2. Ron s. Jockson (2000) Wine science principles practices & perception
3. Vine, Richard p (1997) Wine Appreciation
4. Emile Peynavd (1997) The taste of wine
5. Brue W. Zoecklein, Kenneth Fugelsang, Barry H. Gump Fred S. Nury (1999) Wine Analysis and production
6. C. S. Ough (1992) Wine making Basics
7. Roger B.Boulton (1996) Principles and practices of wine making
8. Emile Peynalld (1984) Knowing & making wine
9. Patrice Iland & Peter Gago (1997) Australian wine from the grasp vine to the glass