Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System (CBCS)

Bachelor of Science

Syllabus of

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

Implemented from

Academic Year 2022 - 23

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Board of Studies in Marathi

Sr. No.	Name	Designation
1.	Dr. Sanjay Tukaram Moharekar	Chairman
2.	Dr. Shubhangi Sanjay Moharekar	Member
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4.	Mr. Ashish Sudhakar Wani	Member
5.	Prof. Sanjay V. Patil	Academic Council Nominee
6.	Mr. Rajendra G. Chaure	Academic Council Nominee
7.	Prof. Syed S. Dastager	Vice-Chancellor Nominee
8.	Mr. Prasad Vinod Rajale	Alumni
9.	Mr. Manoj Madhukarrao Mukkirwar	Industry Expert
10.	Ms. Dipali D. Giramkar	Member (co-opt)
11.	Ms. Supriya P Salve	Member (co-opt)
12.		Invitee

3. Programme Structure and Course Titles: (All academic years)

Sr. No.	Class	Semester	Course Code	Course Title	Credits
1.	F. Y. B. Sc.	I	BSC-WBAT 101T	Basic Microbiology I	02
2.	F. Y. B. Sc.	I	BSC-WBAT 102T	Industrial Microbiology I	02
3.	F. Y. B. Sc.	I	BSC-WBAT 103T	Basic Botany	02
4.	F. Y. B. Sc.	I	BSC-WBAT 104T	Plant Development and Anatomy	02
5.	F. Y. B. Sc.	I	BSC-WBAT 105T	Basic Biochemistry I	02
6.	F. Y. B. Sc.	I	BSC-WBAT 106T	Computer Applications	02
7.	F. Y. B. Sc.	I	BSC-WBAT 107T	Basic Oenology	02
8.	F. Y. B. Sc.	I	BSC-WBAT 108T	Sensory Evaluation of wine I	02
9.	F. Y. B. Sc.	I	BSC-WBAT 109P	Practical's in Microbiology	1.5
10.	F. Y. B. Sc.	I	BSC-WBAT 110P	Practical's in Botany	1.5
11.	F. Y. B. Sc.	I	BSC-WBAT 111P	Practical's in Biochemistry and Computer application	1.5
12.	F. Y. B. Sc.	I	BSC-WBAT 112P	Practical's in Oenology	1.5
13.	F. Y. B. Sc.	II	BSC-WBAT 201T	Basic Microbiology II	02
14.	F. Y. B. Sc.	II	BSC-WBAT 202T	Industrial Microbiology II	02
15.	F. Y. B. Sc.	II	BSC-WBAT 203T	Plant Physiology	02
16.	F. Y. B. Sc.	II	BSC-WBAT 204T	Applied Botany	02
17.	F. Y. B. Sc.	II	BSC-WBAT 205T	Basic Biochemistry II	02
18.	F. Y. B. Sc.	II	BSC-WBAT 206T	Metabolic Pathways	02
19.	F. Y. B. Sc.	II	BSC-WBAT 207T	Introduction to Beer, Wine and Alcohol Technology	02
20.	F. Y. B. Sc.	II	BSC-WBAT 208T	Sensory Evaluation of Wine-II	02
21.	F. Y. B. Sc.	II	BSC-WBAT 209P	Practical's in Microbiology	1.5
22.	F. Y. B. Sc.	II	BSC-WBAT 210P	Practical's in Botany	1.5
23.	F. Y. B. Sc.	II	BSC-WBAT 211P	Practical's in Biochemistry	1.5
24.	F. Y. B. Sc.	II	BSC-WBAT 212P	Practical's in Wine Technology	1.5
25.	S. Y. B. Sc.	III	BSC-WBAT 301T	Fermentation Technology I	02
26.	S. Y. B. Sc.	III	BSC-WBAT 302T	Yeast Technology	02

27.	S. Y. B. Sc.	III	BSC-WBAT 303T	Brewing Technology	02
28.	S. Y. B. Sc.	III	BSC-WBAT 304T	Alcohol Technology	02
29.	S. Y. B. Sc.	III	BSC-WBAT 305T	Applied Biochemistry	02
30.	S. Y. B. Sc.	III	BSC-WBAT 306T	Vineyard Management I	02
31.	S. Y. B. Sc.	III	BSC-WBAT 307P	Practical's Course I	02
32.	S. Y. B. Sc.	III	BSC-WBAT 308P	Practical's Course II	02
33.	S. Y. B. Sc.	III	BSC-WBAT 309P	Practical's Course III	02
34.	S. Y. B. Sc.	III	BSC-WBAT 310T	Critical thinking and Scientific Temper	02
35.	S. Y. B. Sc.	III	BSC-WBAT311T	English/Hindi Communication	02
36.	S. Y. B. Sc.	III	BSC-WBAT312(A)T BSC-WBAT312(B)T	Food Technology Laboratory management	02
37.	S. Y. B. Sc.	III	BSC-WBAT313(A)P BSC-WBAT313(B)P	Practical's in Food Technology Practical's in Laboratory management	02
38.	S. Y. B. Sc.	IV	BSC-WBAT 401T	Fermentation Technology II	02
39.	S. Y. B. Sc.	IV	BSC-WBAT 402T	Fruit and Fortified Wines	02
40.	S. Y. B. Sc.	IV	BSC-WBAT 403T	Wine Technology I	02
41.	S. Y. B. Sc.	IV	BSC-WBAT 404T	Wine Technology II	02
42.	S. Y. B. Sc.	IV	BSC-WBAT 405T	Business Management	02
43.	S. Y. B. Sc.	IV	BSC-WBAT 406T	Vineyard Management II	02
44.	S. Y. B. Sc.	IV	BSC-WBAT 407P	Practical's Course I	02
45.	S. Y. B. Sc.	IV	BSC-WBAT 408P	Practical's Course II	02
46.	S. Y. B. Sc.	IV	BSC-WBAT 409P	Practical's Course III	02
47.	S. Y. B. Sc.	IV	BSC-WBAT 410T	Environmental awareness	02
48.	S. Y. B. Sc.	IV	BSC-WBAT 411T	Language Communication	02
49.	S. Y. B. Sc.	IV	BSC-WBAT 412(A) BSC-WBAT 412(B)	Biophysical and Biochemical techniques Plant tissue culture	02

50.	S. Y. B. Sc.	IV	BSC-WBAT 413(A)P BSC-WBAT 413(B)P	Exercises in Biophysical and Biochemical technique Practical's in Plant tissue culture	02
51.	T. Y. B. Sc.	V	BSC-WBAT 501T	Basic Chemical Engineering	02
52.	T. Y. B. Sc	V	BSC-WBAT 502T	Equipment & Utilities	02
53.	T. Y. B. Sc	V	BSC-WBAT 503T	Health Benefits of Alcoholic Beverages I	02
54.	T. Y. B. Sc	V	BSC-WBAT 504T	Microbial Spoilage and Defects in Alcoholic Beverages	02
55.	T. Y. B. Sc	V	BSC-WBAT 505T	Marketing of alcoholic beverages	02
56.	T. Y. B. Sc	V	BSC-WBAT 506T	Waste Treatment I	02
57.	T. Y. B. Sc	V	BSC-WBAT 507P	Practical Course I	02
58.	T. Y. B. Sc	V	BSC-WBAT 508P	Practical Course II	02
59.	T. Y. B. Sc	V	BSC-WBAT 509P	Practical Course III	02
60.	T. Y. B. Sc	V	BSC-WBAT 510T	Term Paper writing	02
61.	T. Y. B. Sc	V	BSC-WBAT 511Pr	Project Based On Viticulture or Brewing	02
62.	T. Y. B. Sc	VI	BSC-WBAT 601T	Brewing and Alcohol Technology	02
63.	T. Y. B. Sc	VI	BSC-WBAT 602T	Sensory Evaluation of Wine, Beer and Alcohol	02
64.	T. Y. B. Sc	VI	BSC-WBAT 603T	Health benefits of Alcoholic Beverages II	02
65.	T. Y. B. Sc	VI	BSC-WBAT 604T	Maturation and Aging of Alcoholic Beverages	02
66.	T. Y. B. Sc	VI	BSC-WBAT 605T	Alcoholic Beverages: Laws and Regulatory Policies	02
67.	T. Y. B. Sc	VI	BSC-WBAT 606T	Waste Treatment II	02
68.	T. Y. B. Sc	VI	BSC-WBAT 607P	Practical Course I	02
69.	T. Y. B. Sc	VI	BSC-WBAT 608P	Practical Course II	02

70.	T. Y. B. Sc	VI	BSC-WBAT 609P	Practical Course III	02
71.	T. Y. B. Sc	VI	BSC-WBAT 610T	Enzyme Technology	02
72.	T. Y. B. Sc	VI	BSC-WBAT 611Pr	Winery or Alcohol Technology Project	02
	Total	**06**	**72**		**140**

Semester – III	Paper – I
Course Code: BSC WBAT 301 T	Title of the Course: Fermentation Technology I
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students will learn the basic knowledge of fermenter
b. Students will study about utilities required for fermentation industry
c. Students will understand the concept of sterilization and its significance
d. Students will learn to measure and control different fermentation parameters

Detailed Syllabus:

Unit I: Introduction to fermentation, fermenter designs and parts- Overview of fermentation process**,** ideal characteristics of fermenter, factors affecting design of fermenter**,** fermenter configuration, body construction material**,** parts of fermenter-aerator (sparger), agitator (Impellers), baffles, heat exchangers, seals and valves **05**

Unit II: Utilities required for fermentation- Boilers, compressors**,** cooling towers**,** chilling plants**,** refrigeration, air conditioning**,** water treatment plants **05**

Unit III: Achievement and maintenance of aseptic conditions and inoculum build-up Concept of D value and Z value, sterilization of media, sterilization of fermenter, sterilization of air supply, sterilization of exhaust gas, nutrients and other supplement, inoculum build-up **10**

Unit IV Measurement and controlling of fermentation parameters- pH sensor, temperature sensor**,** foam sensor**,** sampling and feed ports**,** buffers**,** cooling jackets**,** foam control, computer applications in process controls **10**

Suggested Readings:

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

Semester – III	Paper – II
Course Code: BSC WBAT 302 T	Title of the Course: Yeast Technology
Credits: 2 C	Total Lectures: 30

Course Outcomes (COs):

a. Students shall become aware of yeasts in wine technology.
b. Critically evaluate and solve issues or problems pertaining to fermentation due to wine.
c. Students should be able to gain in-depth understanding about yeast in fermentation.
d. Give an account of important microbial/enzymatic industrial processes in fermentation.

Detailed Syllabus:

Unit I: Yeast - Introduction, taxonomy, morphology and yeast cell structure and functions of various cellular components**,** importance of yeast strains in fermentation industry, overview of yeast strain development**,** maintenance and preservation of yeast strains and its characteristics**,** yeast culture techniques**,** autolysis. **10**

Unit II: Natural yeasts**,** microbial spoilage of alcoholic beverages due to yeast**,** Prevention of microbial spoilage of wine during fermentation, curing and storage of wine**.** **10**

Unit III: Types of growth of yeast in wine**,** primary, secondary metabolites produced by yeast**,** preparation of yeast starter cultures**,** phage contamination of yeast cultures, killer factors in fermentation**,** controlling degree of anaerobiosis during alcoholic fermentation **10**

Suggested Readings:

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

5. Singh, B.D. (2008). Biotechnology. New age International.

Semester – III	**Paper – III**
Course Code: BSC WBAT 303 T	**Title of the Course: Brewing Technology**
Credits: 2C	**Total Lectures: 30**

Course Outcomes (COs):

a. Students shall become aware of Brewing industry.
b. Students should be able to gain in-depth understanding of beer and brewing
c. Give an account of important concept regarding to beer and its terminologies
d. Students should be able to known about the materials, equipment's and methods used in beer industries.

Detailed Syllabus:

Unit I: Introduction to beer: Beer and its terminologies **–** Brewery, brewing, craft beer, home brewer, home brewing, etc.**,** beer production**,** ingredients involved in beer –Water, fermentable carbohydrates, hops, yeast, equipment configuration and designs of grain milling, mashing, lautering, boiling- type and length, temperature of fermentation, time of maturation, filtration etc., origins of different style of beer**,** the beer styles –ales, lagers etc.**,** methods used to define brewers association's beer style guidelines **10**

Unit II: Outline of brewing: Outline of the brewing steps-malts, adjuncts ,brewing liquor, milling, mashing, wort separation, wort boiling, trub removal, wort cooling/aeration , yeast handling, yeast pitching, fermentation, yeast removal, aging, clarification, packaging, warehousing and distribution **12**

Unit III: Malting technology: Barley and malt: - barley – structure and function: the husk the pericarp, testa, aleurone layer, starchy endosperm, the embryo, malt production: drying, storage, and handling, steeping, germination, kilning and malt quality, malt varieties **08**

Suggested Readings:

1. Harnesey, Tan S.(2003). A History of Beer & Brewing. Royal Society of chemistry.
2. Steven, Deeds. (2013). Brewing Engineering : Great Beer Through Applied Science.USA Publication.
3. Lewis, Michel j. & Young, Tom.W.(2013). Brewing. Kluwer Academic/ Plenum Publisher, New york.
4. John, J Palmer & Colin. Kaminski. (2013). Water : a comprehensive guide for brewers. Brewers Publications.
5. White ,Chris & Zaianshef, jamil. Yeast : the practical guide to beer fermentation.
6. Mallett , John. (2014). Malt : a practical guide from field to brewouse. Brewers Publications. 7. Hieronymus, Stan. (2012). Hops: the practical guide to aroma, bitterness and the culture of hops. Brewers Publications.
7. American Society of Brewing Chemists, U.S.A.: Methods of analysis of American society of brewing chemists. (8th rev.) U.S.A. American society of brewing chemists, 1996.
8. Arntzen,C.J.,ed.: Encyclopedia of agricultural science, vol. 1: - A - D. N. York, Academic Press, 1994.
9. Birch,G.G.: Alcoholic beverages. London, Elsevier Applied Science Pub.1985.
10. Government of India. Technical Excise Manual. --(663.16GOV)
11. Hardwick,W.A.,ed.: Handbook of brewing. N. York, Marcel Dekker,Inc.,1995.(663.3 HARHAR)
12. Hough,J.S.,Briggs,D.E.,Stevens,R.,Young,T.W.: Malting & brewing science, vol. 2 : hopped wort & water. London, Champman & Hall, 1982.
13. Pollock, J.R.A., and ed.: Brewing science vol. 1.London, Academic Press, 1979, (663.3POL)
14. Pollock, J.R.A., and ed.: Brewing science, vol. 2. London, Academic Press, 1981. (663.3POL)

Semester – III	Paper – IV
Course Code: BSC WBAT 304 T	Title of the Course: Alcohol Technology
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Learn the distillery process.
b. To study the fermentation concept and calculate their efficiency.
c. To Study handling methods of molasses.
d. Understand the role of enzyme in starch processing.

Detailed Syllabus:

Unit I: Introduction to distillery- Study of distillation unit and their process, role, scope & functions of technical person in distillery, raw materials used in alcohol production- sugar containing; starch, containing and cellulosic raw materials, stoichiometry- calculation of theoretical yield from single glucose unit, relation between practical yield and theoretical yield, beverage alcohol products-pot and continuous distillate products for making maturation & white sprits **08**

Unit II: Fermentation- Yeast propagation under plant conditions in molasses and starch based distillery, characteristics of distillers yeast, types of yeast strains, conventional batch process for distillery, calculation of efficiency and recovery in alcohol production. **06**

Unit III: Starch processing and role of enzymes in distillery- Introduction to starch (types of starch molecules, structure), saccharification process- physical, chemical enzymatic method-introduction and working of enzyme, enzymes used in distilleries (α-amylase and amyloglucosidase), enzyme activity-effect of temperature and pH on the activity of the enzyme, enzyme handling and storage **10**

Unit IV: Molasses handling- Molasses- composition, grades, storage and cost, molasses dilution practices adopted, design of diluter, and their parts, preclarification of molasses advantages and drawbacks, molasses sterilization/pasteurization, storage and handling methods of molasses **06**

Suggested Readings:

1. Patel, A.H. (2008). Industrial Microbiology. MaCmillan Publication, New Delhi.
2. Stanbuzy, Peter & Whitaker, A. (2008). Principal of Fermentation Technology. Butterworth Heinemann.
3. Srivastava, M.L. Fermentation Technology.
4. John, J Palmer & Colin. Kaminski. (2013). Water: a comprehensive guide for brewers.Brewers Publications.

Semester – III	Paper – V
Course Code: BSC WBAT 305 T	Title of the Course: Applied Biochemistry
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Learn the extraction and purification methods of metabolites used in fermentation industry.
b. Students will understand production of various metabolites in wine & its stabilization.
c. Students will learn clarification, stabilisation and preservation techniques.

Detailed Syllabus:

Unit I: Downstream processing- Filtration and centrifugation, crystallization, ion exchange, electrodialysis, solvent extraction, de-colorization techniques involve in industry.

10

Unit II: Metabolites produced in wine- Production of acetic acid by yeast, importance of skin contact -phenolic compounds, unsaturated fatty acids and sterols, malolactic fermentation, biochemistry of H2S production of during fermentation **10**

Unit III: Role of biochemistry in clarification and stabilization using- Proteins, polyvinyl polypyrrolidone, bentonite.

Tartaric acid, tartrates, citric acid and wine stability- Static cold stabilization, contact cold stabilization, ion-exchange stabilization, estimation of cold stability, prevention of crystallisation, protein instability, methodology for the microbiological stabilization of must and wine **08**

Unit IV: Role of biochemistry in storage and preservation controlling the- spoilage flora – sulfur dioxide, dimethyldicarbonate, sorbic acid, benzoic acid, technique used to determine a wine's propensity to develop turbidity identification of sediment in wine **02**

Suggested Readings:

1. Keith Wilson. (2005). Practical Biochemistry Biology Principles &Techniques. Cambridge university press.

2. Deb,A. C.(1999). Concepts of biochemistry : theory & practical. Book &Allied Publication.

3. Lehninger, Albert L.(1984). Biochemistry. Kalyani Publishers.

4. Nelson, David L. & Michael, M.(2005). Lehninger principles of Biochemistry. W.H. Freeman & Company

5. Sadasivam,S. & Manickam, A.(2010). Biochemical Methods. New age International Publications.

6. Chaiwal, Gurdeep P. & Anand, Sham K. (2007). Industrial methods of chemical Analysis. Himalaya publishing house.

7. Deb,A. C.(2004).Fundamentals of biochemistry. New Central Bank Agency.

Semester – III	Paper – VI
Course Code: BSC WBAT 306 T	Title of the Course: Vineyard Management I
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students will learn history and origin of grape vines
b. Students will understand effect of physicochemical factors of the soil on vine growth and development
c. Students will learn the technique of grape vine propagation
d. Students will learn the biology and symptomatology of the most common pests and diseases of grapevines

Detailed Syllabus:

Unit I: Introduction to soil- Soil and its function; study of different types of soil (as per ICAR classification), pedogenesis /process of soil formation- physical, chemical and biological properties of soil, content of soil colloids and effect on nutrient availability **08**

Unit II: Origin of cultivated plants and grapes- Concept of centres of origin**,** history and origin of grape vines in India and world**,** relationship of grapevine and climatic factors. **06**

Unit III: Methods/technique of grapevine propagation- Propagation of own rooted vines/seed propagation of grapevine, concept of vegetative/clonal propagation of grapevines, propagation of grapevines by cutting method (selection, collection, storage and establishment of cuttings), concept of clone, scion and rootstock**,** propagation of grapevines by budding technique, propagation of grapevines by grafting technique **10**

Unit IV: Introduction to vineyard establishment- Method of plantation: Pit and trenches**,** care of young vine: irrigation, nutritional requirement of grapevines availability of nutrients and influence on uptake (macro and micronutrients), weeds and weeding methods, training of young grape vine frame works used **06**

Suggested Readings:

1. Training and Pruning in grapes by R.G. Somkuvar
2. How to Start A Vineyard In 2020: The Step by Step Guide To Starting A Vineyard In 2020 Kindle Edition by Alex Johnson
3. Proceeding American society for Enology and viticulture. American Society of Enology & viticulture.
4. Phil, Nicholas, Peter, Magarey & Malcom, Wachtel (2003). Diseases and pests Grape production series. Winetitiles.
5. Dry, P.R. & Coombe, B.G. (2005). Viticulture Vol.1 Resources. Winetitiles.
6. Dry, P.R. & Coombe, B.G. (2006). Viticulture vol. 2 practices. Winetitiles.
7. John, Kent & Richard, Early (2003). Pesticide applications inVineyards. Charles stuart university.
8. White, Robert E. (2003). Soil for fine wines. Oxford university press.
9. Andrew, Markides & Richard, Gibson. Australian Society of Viticulture & Enology.
10. Flaheherty, Donald L., Peter, Christensen L., Thomas, Lalini W., Marosis,James J., Philips, Phil A.&Wilson, Lloyd T. Grape pest management.
11. Kunkee, Ralph E. Introduction to wine making : viticulture and enology-3.
12. Helmut , Konig. Biology of microorganisms on grapes : in must and wine.
13. https://www.vineyardteam.org/files/resources/Draft%20Copy%20of%20A%20Practical%20Guide%20to%20Developing%20a%20Commercial%20Wine%20Vineyard.pd

Semester – III	Paper – VII
Course Code: BSC WBAT-307 P	Title of the Course: Practical's Course -I
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Students will practically learn working of laboratory fermenter
b. Students will practically understand how to physical and chemical parameter affect growth of yeast
c. Students will be able to isolate, identified yeast and bacteria morphologically
d. Students will learn the technique for yeast cell population

Detailed Syllabus:

1. Study of laboratory fermenter 1
2. Preparation of nutrient media and morphological identification of yeast 2
3. Preparation of nutrient media and morphological identification of LAB and AAB 2
4. Determination of cell density of given microorganism by turbidiometry method 1
5. To Study of natural yeasts present on natural sources 1
6. Inoculums development of yeast and determination of factors affecting growth of yeast 2
7. Determination of viable count of yeast from fermenting wine sample by Neubars chamber 1
8. To determine the thermal death rate (TDR) and Thermal death time (TDT) of the given organism 2
9. To study the effect of U.V radiations on microbial growth 1
10. Case study-culture preservation methods. 1
11. Bacterial motility by swarmming growth method 1

Semester – III	Paper – VIII
Course Code: BSC WBAT- 308 P	Title of the Course: Practical's course –II
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Learn the estimation technique of alcohol content
b. To determine volatile acids in fermented broth.
c. To study pruning techniques for canopy management

Detailed Syllabus:

1. Determination of total, fixed and volatile acidity rectified sprit 2
2. Study of different malt and malting process 1
3. To conduct potassium permanganate test for finding the quality of spirit 2
4. Determination alcohol content of spirit by ebulliometer method 1
5. Determination alcohol content of spirit by potassium dichromate method 1
6. Reduction and blending of sprit 1
7. Estimation of alcohol content in molasses fermented broth 1
8. Estimation of volatile acids in molasses fermented broth 2
9. Production of beer 3
10. Visit to brewery or distillery and submission of the report 1

Semester – III	Paper – IX
Course Code: BSC WBAT- 309 P	Title of the Course: Practical's Course -III
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Students will learn basic techniques of soil analysis
b. Students will practice the techniques of grape vine propagation
c. Students will study nutritional requirement of grapevine
d. Students will study the morphology of grape vine

Detailed Syllabus:

1. To study the technique of collecting and preserving representative sample of soil 1
2. Study of Physical properties of soil: To determine the colour and particle size of the soil sample, To determine the water holding capacity of the given soil sample 2
3. To determine pH and conductivity of the soil sample 1
4. To determined alkalinity, chlorides contents in the soil sample 1
5. To determine calcium and magnesium contents of the given soil sample 1
6. To determine available Phosphorus 1
7. To determine Nitrogen in the given soil sample 1
8. To study grape varieties suitable for propagation in a favourable climatic conditions 1
9. To study grape propagation by stem cuttings 1
10. To study grape propagation by grafting 1
11. To study grape propagation by budding 1
12. To study method of plantation, irrigation and supply of nutrients for the young grapevines 1
13. To study and observe the morphology of grape plant 1
14. Visit to vineyard and report writing 1

Semester – III	Paper – XII
Course Code: BSC WBAT 312 (A) T	Title of the Course: Food Technology
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students shall become aware of fundamentals of food biotechnology
b. Critically evaluate and solve issues or problems pertaining to food science.
c. Students should be able to gain in-depth understanding of biotechnology of fermented foods.
d. Give an account of important microbial/enzymatic industrial processes in food and fuel industry.

Detailed Syllabus:

Unit I: Introduction to food technology, study of different types of food and its composition, microbes involved in food technology, overview of role of microbes in food spoilage & its control, food poisoning and microbial toxins **07**

Unit II: Enzymes in food industry, role of enzymes in food industry, amylases, proteases, lipases, cellulases, pectinases **05** **Unit III:** Prebiotics and probiotics, prebiotics-food sources, [dietary fiber, oligosaccharides (galacto-oligosaccharides, fructo-oligosaccharides), resistant starch, sugar alcohols], probiotics-food sources, traditional food as a source of probiotics, strains of microorganisms used as probiotics, role in health and disease **08**

Unit IV: Quality improvement: Concepts of quality control and quality assurance in food industries, food laws and regulations: national food laws, food safety and standards act, mandatory and voluntary food laws, Indian food certifications, FSSAI rules, duties and responsibilities. **10**

Suggested Readings:

1. Anthony Pometto (2005). Food Biotechnology, 2nd Edition. CRC Press

2. Byong H Lee (2014). Fundamentals of Food Biotechnology, 2nd Edition, Wiley-Blackwell

3. Goldberg, I 1994. Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall

4. Gibson, GR and William, CM. 2000. Functional foods - Concept to Product. Woodhead publishing.

Semester – III	Paper – XIII
Course Code: BSC-WBAT312(B)T	Title of the Course: Laboratory Management
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students will study the Laboratory design and management
b. Students will able to understand basic design consideration, control measures
c. Students will understand Framework of laboratory project
d. Students will learn the operation and maintenance of laboratory

Detailed Syllabus:

Unit I: Introduction to laboratory design and management **02**

Unit II: Design Considerations - Facility space, storage, surfaces and finishes, furniture, facilities and systems, laboratory equipment **06**

Unit III: Heightened control measures - Controlled access systems, additional design features, directional airflow and inward airflow, HEPA filters, waste disposal, laboratory emergency response **07**

Unit IV: Framework of a laboratory project – planning team, costs, time scale, quality **05**

Unit V: Design- user requirement specification, workflow diagrams, typical project design stages, budget, procurement. **05**

Unit VI: Operation and maintenance- safety of maintenance personnel, design for maintenance, operating and maintenance manuals, maintenance contracts, planned maintenance, breakdown maintenance, maintenance records and inspections **04**

Unit VII: Decommissioning laboratory facilities **01**

Suggested Readings:

1. Janet S. Baum, Louis J. DiBerardinis, Melvin W. First, Gari T. Gatwood (2013). Guidelines for Laboratory Design: Health, Safety, and Environmental Considerations. Wiley Global Education.

2. Leonard Mayer, (1995). Design and Planning of Research and Clinical Laboratory Facilities. Wiley Global Education.

3. Griffin Brian (1998). Laboratory Design Guide. Taylor & Francis Ltd

4. Laboratory biosafety manual, fourth edition. Geneva: World Health Organization; 2020 (Laboratory biosafety manual, fourth edition and associated monographs).

5. Risk assessment. Geneva: World Health Organization; 2020 (Laboratory biosafety manual, fourth edition and associated monographs).

6. Biological safety cabinets and other primary containment devices. Geneva: World Health Organization; 2020 (Laboratory biosafety manual, fourth edition and associated monographs).

Semester – III	Paper – XIV
Course Code: BSC WBAT 313 (A) P	Title of the Course: Practicals in Food Technology
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Students will study different types of foods.
b. Students will learn about food preservation methods.
c. Students will analyzed nutrient content of food.
d. Students will understand how to detect food adulterants.

Detailed Syllabus:

1. Study of different types of food and its characterization 1
2. Determination of peroxide value of oil 1
3. Testing of adulteration of different food sample 2
4. Preparation and preservation of food by drying 1
5. Preparation and preservation of food by salting 2
6. Preservation of food by pasteurization 2
7. Preparation and preservation of food by sugar 2
8. Production and evaluation of probiotic food 1
9. Determination of moisture content of different food sample 1
10. Determination of carbohydrate content of different food sample 1
11. Determination of protein content of different food sample 1

Visit to food processing industry and report writing (Compulsory)

Semester – III	Paper – XV
Course Code: BSC-WBAT313(B)P	Title of the Course: Practicals in Laboratory Management
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Students will study different types of laboratory and their components
b. Students will able to understand working principle of laboratory equipment, their handling and maintenance
c. Students will learn the laboratory safety, design layout and preparation of SOP's

Detailed Syllabus:

1.	Study of different type of laboratories	01
2.	To study laboratory spaces, facilities, storage and furniture	02
3.	To study the working principle of laboratory equipment	02
4.	Handling of laboratory equipments	02
5.	To prepare the laboratory layout for establishing new laboratory	02
6.	Hands on training of laboratory safety/biosafety management	02
7.	Study of preparation of SOPs for laboratory instruments	02
8.	Maintenance of some basic laboratory equipment	02

Semester – IV	Paper – I
Course Code: BSC WBAT 401 T	Title of the Course: Fermentation Technology II
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students will understand the importance of process of media optimization
b. Students will learn the technique of yeast strain development
c. Students will study technique to check the efficiency of yeast
d. Students will learn the fermentation processes for different product

Detailed Syllabus:

Unit I: Process Optimization-Concept of inoculum, media formulation, composition of fermentation medium with respect to: source of carbon, nitrogen, amino acids, vitamins, minerals, pH, water, buffering capacity, additives used in wine fermentation, methods for media optimization. **08**

Unit II: Yeast strains and activity determination- Techniques of yeast strain development, types of yeast strains used in different fermentations, yeast cell autolysis, determination methods for yeast activity **12**

Unit III: Products of fermentation- Oriental fermented foods**,** the microbial production of organic acids, the microbial production of amino acids, production of baker's yeast **10**

Suggested Readings:

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

Semester – IV	Paper – II
Course Code: BSC WBAT 402 T	Title of the Course: Fruit and Fortified Wines
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students shall become aware of different types of fruits with its benefits.
b. Students should be able to gain in-depth understanding of different types of fruit wines.
c. Students should be able understand *Botrytis cinerea* and its useful and harmful effects.

Detailed Syllabus:

Unit I: Fruits- Traditional and nontraditional fruits, seasonal fruits, perishable and nonperishable fruits, harmonious blends of fruits with grape wine. **06**

Unit II: Fruit wines- Fruit wines: Banana, Orange wine, guava wine and strawberry wine, soft or hard as per consumer demand wines from traditional fruits: pomegranate, orange or any other fruit of choice, wine from non-traditional fruits: Jamun, cashew nut, and nonalcoholic beverages from fruits: Concept of nonalcoholic fruit wine. **08**

Unit III: Fortified wines- The concept of fruit beer and alcoholic wine as compared to synthetic beverages, 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. **08**

Unit IV: Evolution of wines - *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, retention of portion of grape sugar in wine, evaluation of winery for sustainable production, carbonated fruit beverages as alternative for the synthetic drinks. **08**

Suggested Readings:

1. Gayon, P. Ribereallll , Denis, Dubardieu, B. & Doneche, Aline Lonvalld . (2000). Hand book of enology volume–I. John Wiley 7 Sons, ltd.
2. Jockson , Ron S. (2000). Wine science principles practices & perception. Academic press.

3. Zoecklein, Brue W., Fugelsang, Kenneth, Gump, Barry H. & Nury, Fred S. (1999).Wine Analysis and production. Kluwer Academic/Plenum Publication.
4. Ough, C. S. (1992). Wine making Basics. The Howorth press, Inc.
5. Boulton , Roger B. (1996). Principles and practices of winemaking. Sptinger sciencet Business Media.Inc.
6. Phil, Nicholas, Peter, Magarey & Malcom, Wachtel (2003). Diseases and pests Grape production series. Winetitiles.
7. Dry, P.R. & Coombe, B.G. (2005). Viticulture Vol.1 Resources. Winetitiles.
8. White, Robert E. (2003). Soil for fine wines. Oxford university press.
9. Andrew, Markides & Richard, Gibson. Australian Society of Viticulture & Enology.

Semester – IV	Paper – III
Course Code: BSC WBAT 403 T	Title of the Course: Wine Technology I
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. To study red wine varieties.
b. Learn the Making process of red wine.
c. To study the types of yeast strain and their role in fermentation.
d. To study effect of seasonal fluctuations on grape properties.

Detailed Syllabus:

Unit I: Red wine objectives: To provide an overview of red wine, red wine varieties, styles and their significance, methods of making of red wine and rose style wines, to provide enough information to understand the red wine making process in addition, to differentiate it from white wine making, effect of temperature on grape maturation, effect of seasonal fluctuations on quality of grape. **12**

Unit II: Red wine making process: Harvesting of grapes & crushing, preparation & extraction of must, maceration, selection of different yeast strain used for red wine making, fermentation, activation of yeast and cap management, pump over operation: Adjustment of temperature, pH, acidity and extraction of color, pressing (free run or pressed fraction combined or kept separate or without MLF), malolactic fermentation, clarification and stabilization. **12**

Unit III: Flavors enhancement and aging of wine: Addition and management of flavors and aroma in wine, barrel ageing & maturation in bottle, quality control, bottling **06**

Suggested Readings:

1. Proceeding American society for Enology and viticulture. American Society of Enology & viticulture. (2000).
2. Ough, C. S. (1992). Wine making Basics. The Howorth press, Inc.
3. Andrew, Markides & Richard, Gibson. Australian Society of Viticulture & Enology.
4. Boulton, Roger B. (1996). Principles and practices of winemaking. Sptinger science Business Media.Inc.

Semester – IV	Paper – IV
Course Code: BSC WBAT 404 T	Title of the Course: Wine Technology II
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Learn the making process of white wine.
b. Understand the post fermentation processes.
c. To study the types of fermentation in making process.
d. To study the basic outline of parameter adjustment methods.

Detailed Syllabus:

Unit I: Introduction to white wine- White wine varieties and style, chemical constituent of grape juice, study of yeast strains used in white wine making styles. **05**

Unit II: Fermentation for White wine making- Harvesting, crushing, pressing, juice adjustments, addition of active yeast**,** fermentation: Control of fermentation parameter, option of fermentation **07**

Unit III: Post fermentation Processes- Racking, clarification and stabilization, maturation and aging (in oak barrel, stainless steel barrel etc.), blending, chilling, filtration using filter aid, bottling step- corking, sealing, adjustment the level of sulfur dioxide before bottling the wine. **08**

Unit IV: Other wine making process- Basic outline of sweet wine production, basic outline of sparkling wine production, basic outline of ice wine production **10**

Suggested Readings:

1. Gayon, P. Riberealll, Denis, Dubardieu, B. & Doneche, Aline Lonvalld. (2000). Handbook of enology volume–I. John Wiley 7 Sons, ltd.
2. Jockson, Ron S. (2000). Wine science principles practices & perception. Academic press.
3. Zoecklein, Brue W., Fugelsang, Kenneth, Gump, Barry H. & Nury, Fred S. (1999).Wine Analysis and production. Kluwer Academic/Plenum Publication.
4. Ough, C. S. (1992). Wine making Basics. The Howorth press, Inc.

5. Boulton, Roger B. (1996). Principles and practices of winemaking. Sptinger science Business Media.Inc.

Semester – IV	Paper – V
Course Code: BSC WBAT 405 T	Title of the Course: Business Management
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students shall become aware of fundamentals of business communication
b. Critically evaluate and solve issues or problems pertaining to business management.
c. Students should be able to gain in-depth understanding of importance of planning and organizing in management.

Detailed Syllabus:

Unit I: Principles of management- Concept of management and its development, scientific management approach, administrative approach, behavioural approach, international marketing approach **06**

Unit II: Function of management- Planning, organizing and its importance**,** types of organization, staffing, recruitment directing, motivation and leadership communicating, level of management **08**

Unit III: Entrepreneurship- Introduction to entrepreneurship, types of entrepreneurships (small, start-ups, large, MSME), comparison between business and entrepreneurship, making business plans

Business Information System- Management information systems (MIS), e-business information system **08**

Unit IV: Business communication- Definition, importance, method of business communication: (verbal, non-verbal, written, upward – downward & horizontal)**,** soft skills – definition, importance, elements of good speaking & listening, interview skills, techniques of interview, business letters – meaning, importance, structure of business letter

financial management in business: definition: (finance, business finance and financial management), objectives of financial management, pricing strategies of alcohol industry

supply chain management: introduction on supply chain management, definition of demand & types of demand – what is demand curve, demand & supply network, case study of any one company`s SCM **08**

Suggested Readings:

1. Azhar, Kazmi- Business Policy
2. C. Paramasivan& T. Subramanian`s- New Age Financial Management
3. M, Balusubrahmanian -Business communication
4. Narayanamurthy, Gopalakrishnan, and Anand Gurumurthy- A case study on downstream supply chain of an Indian alcoholic beverage manufacturer–some insights for the global business.

Semester – IV	Paper – VI
Course Code: BSC WBAT 406 T	Title of the Course: Vineyard Management II
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students will learn significance of grape vine training and pruning
b. Students will understand the aerial environment impacting vine growth and development
c. Students will learn morphological, physiological and biochemical changes during berry maturation
d. Students will learn significance in biology and symptomatology of the most common pests and diseases of grapevines
e. Students will know commonly used machines in Vineyard management

Detailed Syllabus:

Unit I: Climatic factors and Canopy management- Relationship of grapevine and climatic factors**,** definition and concept of canopy, canopy microclimate: canopy attenuation, solar radiation**,** study pf training and pruning practices and its effect in canopy management, study of different trellising system and its effect on grape maturity, technique to be followed for canopy management. **10**

Unit II: The grape and its maturity- Study of phenology: Vegetative and reproductive 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 winemaking style and wine varieties**,** vintage planning-sampling and study of maturity **07**

Unit III: Study of harvesting techniques and machinery- Study of hand harvesting: advantages and disadvantages**,** study of machine harvesting: advantages and disadvantages**,** study of commonly used machines in vineyard **03**

Unit IV: Plant management program (PMP)- Study of different diseases and pest with respect to causal organism, scientific name and origin, symptoms and control measures

(Physical, Chemical and Biological, IPM), study of different berry disorders, study of different nutrient deficiency and control measures, precautionary and preventative measures. **10**

Suggested Readings:

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

Semester – IV	Paper –VII
Course Code: BSC-WBAT 407P	Title of the Course: Practical's Course -I
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Students will practically learn oriental fermented food product
b. Students will practically understand how to prepare inoculums development of yeast, mycelia and bacteria.
c. Students will be able to prepare wines from different fruits, fortified wine and also apple cider.

Detailed Syllabus:

1. Production of oriental fermented food product 01
2. Inoculums development of yeast and determination of exponential growth Phase of yeast 01
3. To study the effect of alcohol concentration on yeast growth 01
4. Determination of ability to produce acetic acid by yeast strain 01
5. Study of tropical, non-tropical, perishable and non-perishable fruits. 01
6. To study grape varieties for fortified wine and preparation of any one type of fortified wine with its characterization. 03
7. Wine making from Pineapple/ Pomegranate/ any other fruit of choice. 03
8. Apple cider making along with its filtration or clarification 03
9. Blending and maturation of any wine of your choice. 01

Semester – IV	Paper –VIII
Course Code: BSC-WBAT 408 P	Title of the Course: Practical's Course -II
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Learn the selection method of grape variety.

b. To study types of yeast strain.

c. To understand the making process of red wine and white wine.

d. To learn the estimation method to determine TRS and alcohol in wine.

Detailed Syllabus:

1.	Study and Selection grape variety for wine making	1
2.	Preparation of must from grapes for wine making- Crushing, pressing	2
3.	Extraction and estimation of pigment from grapes	1
4.	To determine fermentation parameter like pH and acidity in wine.	2
5.	To estimate the Total Reducing Sugar (TRS)	1
6.	To estimate the alcohol content in wine	2
7.	Red wine making	3
8.	White wine making	3

Semester – IV	Paper – IX
Course Code: BSC-WBAT 409 P	Title of the Course: Practical's Course -III
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Students will practically learn grape vine training and pruning
b. Students will learn significance in biology and symptomatology of the most common pests and diseases of grapevines
c. Students will learn morphological, physiological and biochemical changes during berry maturation
d. Students will know commonly used machines in Vineyard management

Detailed Syllabus:

1. To study training techniques used in vineyard 1
2. To study pruning techniques used in vineyard 2
3. To study the development of grapes berry, its morphology, anatomy and microscopic features. 1
4. To observe and study the morphology of weeds occur in vine yard and its Management 1
5. Preparation of solutions and mixtures: Bordeaux mixture, antibiotics and plant growth regulators 1
6. To study the morphological and anatomical structure of infected part of Powdery mildew of grape leaf 1
7. To study the morphological and anatomical structure of infected part of Downey mildew 1
8. To study the morphological and anatomical structure of infected part of Anthracnose of grape leaf 1
9. Study of various grape pests and its management 1
10. To study and observe nutrient deficiency symptoms of in grapes 1
11. To study and learn harvesting techniques of matured grapes 1

12. To observe and study the different disorders like pink berry, water berry, short berry, of grape	1
13. To study different equipment and implements used in Vineyard	1
14. Visit to vineyard and winery and report writing	1

Semester – IV	Paper – XII
Course Code: BSC-WBAT 412(A)T	Title of the Course: Biophysical and Biochemical techniques
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

1. The students will get the theoretical knowledge of various instruments
2. The students will learn about centrifugation & electrophoresis.
3. The students will be able to implement the use of instruments like, UV-VIS spectroscopy

Detailed Syllabus:

Unit I: Introduction: Scientific notation and units, biochemical calculations, pH, buffer solutions, calibration of pipette, pH meter **04**

Unit II: Microscopy and Spectroscopy

Microscopy: Introduction to different types of microscopes, inverted microscopy, confocal microscopy, phase contrast, fluorescence microscopy, preparation of specimens for different types of microscopy

Spectroscopy: The electromagnetic spectrum, concept and measurement of transmittance and absorbance, beers lamberts law**,** molar extinction coefficient, limitations of beers lamberts law **12**

Unit III: Chromatographic Techniques- Introduction to chromatography, general principle, types of chromatography – Partition chromatography: Paper chromatography, Thin layer chromatography, column chromatography–columns, stationary phases, packing of columns, application of sample, column development, fraction collection and analysis, ion exchange chromatography, Size exclusion chromatograph **08**

Unit IV: Electrophoresis- General principle, factors affecting electrophoresis, agarose gel electrophoresis, polyacrylamide electrophoresis - SDS-PAGE & Native PAGE, applications **06**

Suggested Readings:

1. Wilson K and Goulding K.H., Abiologist's guide to Principles and Techniques of Practical Biochemistry

2. Willard and Merrit, Instrumental Methods and Analysis

3. Ewing GW, Instrumental Methods of Chemical analysis.

4. Vogel's, Text Book of Quantitative Chemical Analysis, 6 th Edition, 2004.

5. Raymond P.W. Scott, Techniques and Practice of Chromatography–Vol.70.

6. Sethi P.D, Dilip Charegaonkar, Chromatography–2 nd Edition.

7. Hanes, Gel Electrophoresis of Proteins- A Practical Approach,

8. Biophysical chemistry by Upadhyay, Upadhyay and Nath, Himalaya publication house

Semester – IV	Paper – XIII
Course Code: BSC-WBAT 412(B)T	Title of the Course: Plant tissue culture
Credits: 2C	Total Lectures: 30

Course Outcomes (COs):

a. Students will learn the different techniques of plant tissue culture.
b. Students will acquire a knowledge of aseptic techniques.
c. Students will understand the organization of PTC laboratory
d. Students will gain the knowledge of crop improvement techniques

Detailed Syllabus:

Unit I: Concept of plant tissue culture- History of plant tissue culture**,** basic requirements of PTC lab and establishment of commercial PTC lab**,** aseptic techniques practiced in PTC lab, explant and its nutritional requirement, response of explants in vitro **08**

Unit II: *In-vitro* plant multiplication- Advantages over conventional methods, micro-propagation techniques (organogenesis, embryogenesis, adventitious shoot proliferation), stages of micro-propagation (stage 0 to stage 4), commercial application of micro propagation, disadvantages of micro-propagation **08**

Unit III: Plant tissue culture in crop improvement- Somaclonal variation**,** embryo rescue**,** endosperm culture, *In-vitro* androgenesis and gynogenesis **08**

Unit IV: Applications of plant tissue culture- Virus free plant production, production of bioactive secondary metabolites**,** biodiversity conservation**,** genetic transformation **06**

Suggested Readings:

1. Razdan M.K. (2009) - Introduction to Plant Tissue culture (Oxford & IBH Publ, New Delhi)

2. Bhojwani S.S. & Razdan M.K. (1996) - Plant Tissue Culture: Theory & Practice (Elsevier, New Delhi)
3. Jha TB & Ghosh B (2007) – Plant tissue culture: Basic and applied (Universities Press, Hyderabad

Semester – IV	Paper –XIV
Course Code: BSC-WBAT 413(A)P	Title of the Course: Exercises in Biophysical and Biochemical technique
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Learn the Biophysical and Biochemical techniques
b. To study the solution preparation
c. The student will get practical knowledge of Preparation of buffers

Detailed Syllabus:

1. Preparation of solutions 1
2. Preparation of buffer 1
3. Calibration of pipette and pH meter 1
4. Thin layer chromatography – sugar , amino acids 2
5. Paper chromatography – amino acids 2
6. Estimation of cholesterol 1
7. Estimation of ascorbic acid – DCPIP method 1
8. Absorbance spectra of Protein, nucleic acid 1
9. Chromatography – Ion-exchange –separation of compounds 2
10. Agarose gel electrophoresis 1
11. Electrophoresis – separation of mixture of proteins – Native PAGE and activity staining 2

Semester – IV	Paper –XV
Course Code: BSC-WBAT 413(B)P	Title of the Course: Practical's in Plant tissue culture
Credits: 2C	Total Lectures: 15 (15×3Hrs.) = 45 Hrs.

Course Outcomes (COs):

a. Students will study the organization of PTC laboratory.
b. Students will understand importance of media preparation.
c. Students will know the importance of aseptic manipulation.
d. Learn about in vitro propagation of plants through various tissue culture techniques.

Detailed Syllabus:

1. PTC Laboratory: organization of facility and equipment 1
2. Stock solutions & media preparation 2
3. Aseptic manipulation – washing, capping, packing & sterilization, laminar flow operation and safety precautions 2
4. Aseptic seed germination/embryo culture 1
5. Establishment of callus culture, callus morphology & internal structure 2
6. Establishment of suspension culture technique–initiation of culture, sub-culturing and growth measurement 2
7. *In vitro* response of explants to plant growth regulators 2
8. Initiation of shoot tip & axillary bud culture 2
9. Establishment of anther/pollen culture 1