



**SOMAIYA**  
**VIDYAVIHAR**

K J Somaiya College of Science & Commerce  
Autonomous (Affiliated to University of Mumbai)



## Learning Outcomes based Curriculum Framework

(LOCF)

For

**S.Y.B.Sc. Botany**

Undergraduate Programme

from

Academic year 2022- 23





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## PREAMBLE

The revised syllabus will be effective from the academic year 2022 -23. Autonomy has given us the flexibility to frame the syllabus with a blend of Classical and Applied Botany which will open an array of opportunities in Higher Studies. Skill based courses have been incorporated which will benefit the learners to develop entrepreneurial skills. Successful completion of these courses will provide employability to the learners. It has been prepared according to the unique requirements of Botany students in focus.

The content caters to the current changing needs of the stakeholders, specifically pertaining Food Science, Aroma Therapy, Forestry, Medicinal Botany, Small Scale Industry and Sustainable Agriculture. In this revision, the student will be introduced to the Interdisciplinary approach of learning. The syllabus has been made more relevant by addition of latest topics pertaining to Botany, to encourage core competencies and discovery-based learning. Learners will be taught topics through experiential learning also. Choice has been given for a skill-based core course in both semesters to engage them in the learning process. Elective courses will have more of a practical component over theory. Skill based course will ignite the conscience about global issues amongst the learner to become a sensitive citizen.



### Program Specific Outcomes

After Successful completion of S. Y. B. Sc. Botany Curriculum, learners will be able to-

1. Categorize the plant into respective groups.
2. Investigate the mechanism of biological system with respect to genetics and biochemistry.
3. Evaluate the interaction between various biomolecules and internal cellular environment.
4. Test the presence of food adulterants and comment on different application of food additives.
5. Explore the role of essential oil in perfumery.
6. Formulate basic plant-based products in pharmaceutical and Cosmeceuticals industry.
7. Utilize various analytical techniques for validation.
8. Summarize the cellular processes at DNA level.
9. Organize and analyse the data using suitable statistical techniques.
10. Recommend strategies to mitigate environmental degradation.
11. Prioritize the conservation and management of biodiversity.
12. Acquire skill set required to perform practical techniques in Botany.
13. Analyse the effect of climate change and anthropological activities on biodiversity.
14. Create different types of flower arrangements and demonstrate the techniques of botanical art.
15. Apply conservation strategies for sustainability in agriculture.
16. Justify role of forests in community and economic development.



SEMESTER III				
Course	Mod		Cr.	Lect.
Code 22US3BOCCIPLD3		Core Course I: Plant Diversity - III		O2
I	1	Algae		12
	2	Fungi and Plant Pathology		12
	3	Bryophyta		12
Code 22US3BOCC2FAF		Core Course II: Forms and Function		O2
II	1	Taxonomy and Ethnobotany		12
	2	Anatomy		12
	3	Plant Physiology and Biochemistry		12
<b>Select Either One Core Course of 2 Credits</b>				
Code 22US3BOCC3APB		Core Course III: Applied Botany		O2
III	1	Economic Botany		12
	2	Food Science		12
	3	Fundamentals of Aromatherapy		12
<b>OR</b>				
Code 22US3BOCC3SMB		Core Course III: Small Scale Industries And Medicinal Botany		O2
Section I	1	Agricultural Industry		06
	2	Mushroom Industry		06
	3	Herbal Industry		06
Section II	1	Pharmacognosy		06
	2	Phytochemistry		06
	3	Medicinal Botany		06



SEMESTER IV				
Course	Mod.		Cr.	Lect.
Code 22US4BOCC1PLD4		Core Course I: Plant Diversity IV		O2
I	1	Microbiology		12
	2	Pteridophyta		12
	3	Gymnosperms		12
Code 22US4BOCC2FUB		Core Course II: Functional Botany		O2
II	1	Instrumentation and Technique		12
	2	Cytogenetics & Molecular biology		12
	3	Biostatistics and Bioinformatics		12
<b>Select Either One of Core Course of 2 Credits</b>				
Code 22US4BOCC3FBS		Core Course III: Forest Biology and Sustainability		O2
III	1	Agroforestry		12
	2	Ecosystem Management		12
	3	Sustainable Agricultural Practices		12
<b>OR</b>				
Code 22US4BOCC3CFH		Core Course III: Commercial Forestry And Horticulture		O2
Section I	1	Methods of Regeneration and Social Forestry		06
	2	Forest Protection		06
	3	Utilization of Forest Resources		06
Section II	1	Nursery Development		06
	2	Ornamental Horticulture		06
	3	Botanical Art		06



S.Y. B. Sc. (BOTANY) SEMESTER III

Core course - I

COURSE TITLE: Plant Diversity - III

COURSE CODE: 22US3BOCCIPLD3

[CREDITS - 02]

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Correlate thallus structures and reproductive organs in algae.
2. Examine the evolution of algae with reference to Thallus, Pigments, and Reproduction.
3. Identify the different stages of development of Diatoms and *Sargassum*.
4. Comment on sources and toxicological effects of mycotoxins.
5. Perform the isolation of fungi using suitable nutrient media.
6. Summarize general characteristics of Phycomycetes, Basidiomycetes and illustrate the life cycle of *Albugo* and *Agaricus*.
7. Predict fungal diseases based on their symptoms and apply control measures to restrict the spread of disease.
8. Correlate the evolutionary trends in gametophytes and sporophytes in Bryophytes.
9. Sketch different stages of reproductive structures in *Funaria*.
10. Summarize the Ecological & economic importance of Bryophytes.

**Module 1**

**Algae**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Explain thallus structure, pigments, habit and reproduction with reference to algae.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Compare thallus structure and reproductive organs in algae.

2. Elucidate the evolution of algae with reference to pigment, habit and reproduction.
3. Identify and describe the developmental stages in *Diatoms* and *Sargassum*.

1.1	Pigments in algae	1 L
1.2	Range of thallus in algae	3 L
1.3	Origin and Evolution of sex in algae	2 L
1.4	Structure and reproduction in <i>Diatoms</i> , <i>Sargassum</i>	6 L

**References:**

- Gangulee, H.C., Kar, A.K., (1994) College Botany Volume II, Calcutta, New Agency Ltd.
- Sharma, O.P., (2011) Algae, Mumbai, Tata McGraw Hill
- Smith, G.M., (1972) Cryptogamic Botany Volume I, Mumbai, Tata McGraw Hill
- Vashishtha, B.R., Sinha, A.K., Singh, V.P., (2008) Botany for Degree Students, New Delhi, S. Chand and Company LTD.
- Vashishtha, B.R. (1999) Botany for Degree Students, New Delhi, S. Chand, and Company LTD.

**Module 2**

**Fungi and Plant Pathology**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Analyse case study related to mycotoxins.
2. Summarize the habit and reproductive structures of *Agaricus* and *Albugo*

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Enlist the sources and toxicological effects of mycotoxins.
2. Demonstrate the isolation of fungal strains using suitable nutrient media.
3. Tabulate general characteristics of Phycomycetes and Basidiomycetes.
4. Illustrate the life cycle of *Agaricus* and *Albugo*.

5. Identify causal organisms of fungal disease.		
2.1	Mycotoxins – Definition, Source, Toxicological Study- Case Study Mucormycosis	2L
2.2	Culture techniques in fungi	2L
2.3	Structure, Life cycle and Systematic position of <i>Agaricus, Albugo</i>	4L
2.4	Diseases – Symptoms, Causal organism, Disease cycle and Control measures of Powdery Mildew and Ergot	4L
<b>References:</b> <ul style="list-style-type: none"> <li>• Dube, H.C. (1996), An Introduction to Fungi, New Delhi, Vikas Publishing House Pvt. Ltd.</li> <li>• Gangulee, H.C., Kar, A.K., (1994) College Botany Volume II, Calcutta, New Agency Ltd.</li> <li>• Sharma, O.P., (1989), Textbook of Fungi, Mumbai, Tata McGraw Hill</li> <li>• Vashishtha, B.R. (1999) Botany for Degree Students, New Delhi, S. Chand and Company LTD.</li> </ul>		
<b>Module 3</b>	<b>Bryophyta</b>	<b>[12L]</b>
<b>Learning Objectives:</b> The module is intended to <ol style="list-style-type: none"> <li>1. Analyse evolutionary trends in bryophytes.</li> <li>2. Summarize the habit and reproductive structures of <i>Pellia</i> and <i>Funaria</i></li> </ol>		
<b>Learning Outcomes:</b> After the successful completion of the module, the learner will be able to <ol style="list-style-type: none"> <li>1. Correlate the evolutionary trends in sporophytes of Bryophytes.</li> <li>2. Illustrate the life cycle of <i>Pellia, Funaria</i>.</li> <li>3. Summarize the economic importance of Bryophytes.</li> <li>4. Compile the ecological importance of Bryophytes.</li> </ol>		
3.1	Evolution of sporophyte in Bryophyta	4L





3.2	Structure, Life cycle and systematic position of <i>Pellia</i> , <i>Funaria</i>	6L
3.3	Ecological and Economic importance of Bryophytes	2L

**References:**

- Gangulee, H.C., Kar, A.K., (1994) College Botany Volume II, Calcutta, New Agency Ltd.
- Smith, G.M., (1972) Cryptogamic Botany Volume I, Mumbai, Tata McGraw Hill
- Vashishtha, B.R., Sinha, A.K., Singh, V.P., (2008) Botany for Degree Students, New Delhi, S. Chand and Company LTD.
- Dube, H.C. (1996), An Introduction to Fungi, New Delhi, Vikas Publishing House Pvt. Ltd.
- Vashishtha, B.R. (1999) Botany for Degree Students, New Delhi, S. Chand and Company LTD.



Question Paper Template

S.Y. B. Sc. (BOTANY) SEMESTER III

Core Course- I

COURSE TITLE: Plant Diversity - III

COURSE CODE: 22US3BOCCIPLD3 [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	8	8	6	0	30
II	4	4	8	8	6	0	30
III	4	4	8	8	6	0	30
Total marks per objective	12	12	24	24	18	0	90
% Weightage	13.33	13.33	26.66	26.66	20	0	100



**S.Y. B. Sc. (BOTANY) SEMESTER III**

**Core course - II**

**COURSE TITLE: Forms and Function**

**COURSE CODE: 22US3BOCC2FAF**

**[CREDITS - 02]**

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Classify the plants to respective family based on morphological, reproductive peculiarities and relate their economic importance.
2. Develop e-herbarium of particular plant specimen.
3. Correlate traditional knowledge of tribal medicines with modern medicinal practices.
4. Correlate the stellar evolution and normal versus stress induced anatomical adaptations in plants.
5. Differentiate between Primary and Normal secondary growth in dicot root and stem.
6. Compare and contrast between mechanical tissue systems based on principle of construction and distribution in plants.
7. Describe the properties of timber.
8. Comprehend the functional properties of photosynthetic pigments relevant in biochemical interaction.
9. Summarize the biochemical mechanism and compare the relationships among multiple photosynthetic pathways.
10. Interpret relationship between ecological adaptation and specific physiological reactions.
11. Criticize the physiological features from an evolutionary perspective.
12. Compare the structure, biosynthesis and biodegradation of starch and cellulose.



Module 1	Taxonomy and Ethnobotany	[12L]
<b>Learning Objectives:</b> This module is intended to <ol style="list-style-type: none"><li>1. Classify the plants to their respective families based on their morphological features.</li><li>2. Apply digital plant preservation techniques.</li></ol>		
<b>Learning Outcomes:</b> After the successful completion of the module, the learner will be able to <ol style="list-style-type: none"><li>1. Acquaint learner with plant diversity and system of classification</li><li>2. Introduce recent techniques of plant preservation.</li><li>3. Compile the significance of traditional medicinal knowledge in development of modern medicinal practices.</li></ol>		
1.1	Merits and Demerits of Bentham and Hooker System of Classification	1L
1.2	Bentham and Hooker's System of Classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of these families: Brassicaceae, Combretaceae, Rutaceae, Asteraceae, Euphorbiaceae, Liliaceae	8L
1.3	Preservation Techniques – Digital herbarium/ E-herbarium	1L
1.4	History and Scope of Ethnobotany	1L
1.5	Medicinal and Cultural importance of plants used by tribals.	1L
<b>References:</b> <ul style="list-style-type: none"><li>● Sinha R. K., Taxonomy of Angiosperms.</li><li>● Sutar R. N., Textbook of Systematic Botany, 2nd ed., Published by Ramniklal Kothari, Ahmedabad.</li></ul>		

- Sharma O.P., Plant Taxonomy. 2nd ed., Tata McGraw-Hill Education Pvt. Ltd., New Delhi.

<b>Module 2</b>	<b>Anatomy</b>	<b>[12L]</b>
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**Learning Objectives:**

This module is intended to

1. Summarize primary and secondary growth in dicot stem and root.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Demonstrate Primary and Normal secondary growth in dicot root and stem.
2. Sketch and illustrate stele in different plant parts.
3. Inspect the significance of mechanical tissue systems in plants.
4. Describe the properties of timber

2.1	Normal Secondary Growth in Dicot Stem and Root.	2L
2.2	Construction of I- girders and Distribution of Mechanical Tissue as adaptations in Different Stress conditions – Inextensibility, Inflexibility, Incompressibility and Shearing stress.	5L
2.3	Ecological Plant Anatomy – Adaptive features of Xerophytes, Hydrophytes and Epiphytes.	3L
2.4	Timber Industry – Teak, Rosewood, Sal.	2L

**References:**

- Esau, K., (1953) London, John Wiley and Sons Inc.
- Pandey, B.P., (1978) Plant anatomy, S. Chand and Company Pvt. Ltd.
- Roy, Piyush, (2010), Plant Anatomy, London, New Central Agency (p) Ltd.

<b>Module 3</b>	<b>Plant Physiology and Biochemistry</b>	<b>[12L]</b>
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**Learning Objectives:**

The module is intended to

1. Interpret the mechanism of photosynthesis in plants.

### Learning Outcomes:

After the successful completion of the module, the learner will be able to

1. Compare the physico-chemical properties of photosynthetic pigments relevant in biochemical interaction.
2. Elaborate the mechanism of photosynthetic pathways to categorize the plants into respective groups.
3. Elucidate the metabolic pathway of starch and cellulose.

3.1	Photo-Physiology – Plant pigments and their interaction with light, Light reaction and Dark reaction of photosynthesis.	3L
3.2	Photorespiration – C <sub>3</sub> , C <sub>4</sub> and CAM pathways,	5L
3.3	Carbohydrate metabolism – Structure, Synthesis and Degradation of Starch and Cellulose.	4L

### References:

- Sunderraj, D.D., Thulasidas G., Botany of Field Crops, India, Macmillan India Ltd.
- Kochhar, P.L., (1976) Plant Physiology, Delhi, Atma Ram and Sons
- Satyanarayan, U., Chakrapani, U., (2016), Biochemistry, New Delhi and Kolkata, Elsevier and Books and Allied Pvt. Ltd.
- Sinha, R.K., (2015), Modern Plant Physiology, New Delhi, Narosa Publishing House
- Verma, S.K. and Verma, M., (2005), Textbook of Plant Physiology, Biochemistry and Biotechnology, Delhi, S. Chand and Company Ltd.
- Verma, V., (1978), A Textbook of Plant Physiology, Delhi, M.K. Publications



Question Paper Template

S.Y. B. Sc. (BOTANY) SEMESTER III

Core Course- II

COURSE TITLE: Forms and Function

COURSE CODE: 22US3BOCC2FAF

[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	8	8	6	0	30
II	4	4	8	8	6	0	30
III	4	4	8	8	6	0	30
Total marks per objective	12	12	24	24	18	0	90
% Weightage	13.33	13.33	26.66	26.66	20	0	100



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Select Either One of Core Course of 2 Credits







**S.Y. B. Sc. (BOTANY) SEMESTER III**  
**Core course - III**

**COURSE TITLE: Applied Botany**

**COURSE CODE: 22US3BOCC3APB**

**[CREDITS - 02]**

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Explore new sources of plants and summarize the applications of natural plant fibres in various industries.
2. Comment on origin, history, cultivation and applications of cereals and pulses.
3. Make use of gums and resins from plants in formulation of various products.
4. Test for presence of narcotics in various plants and enlist the side effects of narcotics on human health.
5. Detect and classify the adulterants based on its biochemical properties in various types of food.
6. Organize the food additives into respective groups based on biochemical properties, function and evaluate their efficacy.
7. Explore the role of regulatory bodies in food safety.
8. Describe the significance of nutritional labelling.
9. Describe the methods of extraction and role of essential oils.
10. Summarize blending techniques.
11. Enlist carrier oils for blending.

**Module I**

**Economic Botany**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Compose cultivation, production and uses of plants and plant-based products.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Demonstrate the process of fibre extraction from plants.
2. Describe the cultivation methods of rice, black gram and chickpea to the farmers.
3. Make use of gums and resins from plants in formulation of various products.

1.1	Study of Fibers - Cotton, Jute, Coir and Agave	3L
1.2	Origin, History, Domestication, Cultivation, Production and uses of Cereal: Rice	2L
1.3	Origin, History, Domestication, Cultivation, Production and uses of Pulses: Black gram, Chickpea	2L
1.4	Plant based products – Narcotics: Poppy, Cannabis, Dhatura	3L
1.5	Gums and Resins from Plants	2L

**References:**

1. Kochhar, S.L. (2012) Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Sen S (1992). Economic Botany, New Central Book Agency, Kolkata.

**Module 2**

**Food Science**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Explain food adulteration and nutritional labelling.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Investigate the presence of adulterants in various types of food.
2. Compile the uses of food additives to improve food quality.
3. Discuss the legal measures in the food industry.

2.1	Food Adulterations - Introduction, Common Food Adulterants, Methods of detection of common Adulterants	3L
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2.2	Naturally occurring Toxins in food	2L
2.3	Food additives - Classification, Nature, Properties and Uses of Additives, Non-nutritive Sweeteners and Nutritive Sweeteners, Case study: Fruit products	3L
2.4	Food and Nutritional labelling	2L
2.5	Food Legislation	2L

**References:**

1. Swaminathan M., Essentials of Food and Nutrition, 2nd Ed, 1985, Ganesh and Co.
2. Krause's Food, Nutrition and Diet Therapy, 10th Edition by Mahan, L.K. & Ecott-Stump, S. (2000), W.B. Saunders Ltd.
3. Shapiro Ralph, Nutrition labelling handbook (Ed.), Marcel Dekker, N.Y., 1995
4. Summers James L., (Ed.), Dietary Supplements labelling-compliance review (third edition), Blackwell Publishing

**Module 3**

**Aromatherapy**

**[12L]**

**Learning Objectives:**

The module is intended to

1. Assess physicochemical properties of essential and carrier oils.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Elucidate the role of essential oils in aromatherapy.
2. Describe the methods of extraction of essential oils,
3. Comment on the applications of essential oils.

3.1	Aromatherapy - Definition, Origin and History	2L
3.2	Essential Oils - Methods of extraction, Storage and Precautions for use of aroma oils	3L

3.3	Carrier Oils - Almond, Olive, Sesame, Coconut, Jojoba. Blending of Aroma Oil with Carrier Oil: Orange peel, Sweet Basil, Cinnamomum and <i>Eucalyptus</i> .	3L
3.4	Healing properties of Aroma Oils.	1L
3.5	Entry route of Aroma Oil and Methods of Applications of Aroma Oil - Direct and Indirect Application: Oil Diffusers, Vaporizers, Potpourri, Incense	3L
<b>References:</b>		
<ul style="list-style-type: none"> <li>Skaria Baby P., Joy P.P. Matheu S., Matheu G., Joseph A., Joseph R., (2016) Ed. Peter K.V. Aromatic Plants – Volume 7, Kerala Agricultural University.</li> </ul>		

### Question Paper Template

S.Y. B. Sc. (BOTANY) SEMESTER III

Core Course- III

COURSE TITLE: Applied Botany

COURSE CODE: 22US3BOCC3APB [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	8	8	6	0	30
II	4	4	8	8	6	0	30
III	4	4	8	8	6	0	30
Total marks per objective	12	12	24	24	18	0	90
% Weightage	13.33	13.33	26.66	26.66	20	0	100



S.Y. B. Sc. (BOTANY) SEMESTER III  
Core course - III

COURSE TITLE: Small Scale Industry and Medicinal Botany

COURSE CODE: 22US3BOCC3SMB

[CREDITS - 02]

**Course Learning Outcome**

After the successful completion of the Course, the learner will be able to:

1. Summarize the sources, processing, storage and preservation techniques of alcoholic and non-alcoholic beverages.
2. Analyse the method of single cell protein production with respect to Algae and Fungi.
3. Summarize the history, scope, nutritional value and opportunity of mushroom cultivation.
4. Identify the various raw materials and their properties.
5. Judge the authenticity of raw materials and list the properties.
6. Criticize the scope and future prospects of the herbal industry.
7. Rephrase the research proposal to apply for a patent.
8. Explain scope and basic concepts of Pharmacognosy and Pharmacopeia.
9. Classify the plant metabolites into primary and secondary groups based on their characteristics.
10. Identify herbal drugs and recognize their therapeutic uses based on secondary metabolite content.
11. Describe the physical methods for the standardization of drugs.
12. Propose the toxicological study for a particular drug.
13. Analyse and identify the key characteristics of crude drugs.
14. Differentiate between authentic and spurious drugs.
15. List unorganized drugs.



Module 1	Agricultural Industry And Mushroom Industry	[6 L+ 6 L]
<b>Learning Objectives:</b> This module is intended to <ol style="list-style-type: none"><li>1. Acquaint with beverage and single cell protein production on industrial scale.</li><li>2. Discuss commercial aspects of the mushroom industry.</li></ol>		
<b>Learning Outcomes:</b> After the successful completion of the module, the learner will be able to <ol style="list-style-type: none"><li>1. Demonstrate the processing of plants for production of beverages and single cell protein</li><li>2. Comment on nutritional value of different types of mushrooms.</li><li>3. Design marketing techniques for commercialization of mushrooms.</li></ol>		
1.1	Beverages: Alcoholic and non-alcoholic: Wine and Coffee	2L
1.2	Single cell protein production using algae and fungi.	4L
1.3	History, development & Scope of mushroom industries in India.	2L
1.4	Nutritional and Medicinal properties of Mushrooms.	1L
1.5	Cultivation of any one type of Mushroom	1L
1.6	Economics of Mushroom Industry	2L
<b>References:</b> <ul style="list-style-type: none"><li>• Kochhar, S.L. (2012) Economic Botany in Tropics, MacMillan &amp; Co. New Delhi, India.</li><li>• Sen S (1992). Economic Botany, New Central Book Agency, Kolkata.</li><li>• Raman J et al, Current prospects of mushroom production and industrial growth in India, Journal of Mushrooms 16-4 (2018) 239-249, <a href="https://www.researchgate.net/publication/326682608_Mushroom_Industries_in_India">https://www.researchgate.net/publication/326682608_Mushroom_Industries_in_India</a></li></ul>		

Module 2		Herbal Industry And Pharmacognosy	[6 L+ 6 L]
<p><b>Learning Objectives:</b></p> <p>This module is intended to</p> <ol style="list-style-type: none"> <li>1. Identify suitable raw material for herbal formulations and its regulatory aspects.</li> <li>2. Organize primary versus secondary metabolites from plants.</li> </ol>			
<p><b>Learning Outcome:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> <li>1. Outline the concept of herbal medicinal industry.</li> <li>2. Create the documents for IPR protection.</li> <li>3. Determine the presence of various primary and secondary metabolites in plants.</li> </ol>			
2.1	Herbs as a raw material - Definition of herb, herbal medicine, and herbal medicinal products		1L
2.2	Source of herb selection and authentication of herbal materials		1L
2.3	Regulatory requirements - Patent and IPR		2L
2.4	Case study – <i>Curcuma</i>		1L
2.5	Herbal drug industry - Present scope and prospects		1L
2.6	Pharmacognosy - Definition and scope.		1L
2.7	Pharmacopoeia - Introduction & types.		1L
2.8	Elementary knowledge of Primary Metabolites - Carbohydrates, Lipids, Proteins		2L
2.9	Secondary Metabolites - Alkaloids, Glycosides, Tannins, Volatile oils, Anthraquinones, Flavonoids		2L
<p><b>References:</b></p> <ul style="list-style-type: none"> <li>• Ali, M. Textbook of Pharmacognosy</li> <li>• Gokhale, S.B., Kokate, C.K., Purohit, A.P., (2009) A Textbook of Pharmacognosy, Pune, Nirali Publication.</li> </ul>			

- J. Jayaraman, Laboratory Manual in Biochemistry, 2<sup>nd</sup> Ed. , (2015) New Age International Publications.
- Plummer David T., (1998) An introduction to Practical Biochemistry, 3<sup>rd</sup> Ed, McGraw Hill Education, Indian Edition
- Devlin, T.M., 1997, 4th Ed, Text Book of Biochemistry with Clinical Correlation, Wiley Liss Inc.

**Module 3**

**Phytochemistry and Medicinal Botany**

**[6L + 6LL]**

**Learning Objectives:**

The module is intended to

1. Determine quality of drug based on physical and chemical methods of detection.
2. Select a specific monograph.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Comment on quality of drugs
2. Prove the toxic effects of drugs
3. Prepare the monograph of the plant used as a drug.

3.1	Methods of drug evaluation / Standardization of drugs - Organoleptic, Microscopic characteristics of drug	2L
3.2	Physical methods for detection of secondary metabolites - Foaming index, Swelling index, Ash value, Extractive value	1L
3.3	Chemical methods for detection of secondary metabolites.	2L
3.4	Toxicological study of drugs.	1L
3.5	Monographs of drugs with respect to biological sources, geographical distribution, macroscopic and microscopic characters, chemical constituents, therapeutic uses and adulterants of the following	6L





	plants/drugs: <i>Syzigium aromaticum</i> (Clove bud), <i>Strychnos nuxvomica</i> (seed), <i>Aloe vera</i> (leaf), Unorganized drugs: Shilajit, Camphor, Guggul, Kattha , Acacia gum.	
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**References:**

- Ali, M. Textbook of Pharmacognosy
- Gokhale, S.B., Kokate, C.K., Purohit, A.P., (2009) A Textbook of Pharmacognosy, Pune, Nirali Publication.
- J. Jayaraman, Laboratory Manual in Biochemistry, 2<sup>nd</sup> Ed., (2015) New Age International Publications.
- Plummer David T., (1998) An introduction to Practical Biochemistry, 3<sup>rd</sup> Ed, McGraw Hill Education, Indian Edition
- Devlin, T.M., 1997, 4th Ed, Textbook of Biochemistry with Clinical Correlation, Wiley Liss Inc.
- Wilson, K., Walker, J., (2009) Principles and Techniques of Biochemistry and Molecular Biology, 6<sup>th</sup> Ed, Delhi, Cambridge University Press.
- Methods of Analysis for Functional Foods and Nutraceuticals Edited by W. Jeffrey, Hursts, Routledge Publishers.



Question Paper Template

S.Y. B. Sc. (BOTANY) SEMESTER III

Core Course- III

COURSE TITLE: Small Scale Industry and Medicinal Botany

COURSE CODE: 22US3BOCC3SMB

[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	8	8	6	0	30
II	4	4	8	8	6	0	30
III	4	4	8	8	6	0	30
Total marks per objective	12	12	24	24	18	0	90
% Weightage	13.33	13.33	26.66	26.66	20	0	100



Semester III Core Course – Practical I		
Code: 22US3BOCCPI		Cr. OI
	Algae	
1	Range of thallus in Algae – Unicellular-Motile: <i>Chlamydomonas</i> . Non-Motile: <i>Cosmarium</i> . Multicellular-Colonial: <i>Volvox</i> Non-flagellate: <i>Scenedesmus</i> Filamentous: <i>Oedogonium</i> Branched filamentous: <i>Cladophora</i> Siphonaceous: <i>Vaucheria</i> Parenchymatous: <i>Chara</i>	1
2	Study of stages in the life cycle of Diatoms and <i>Sargassum</i> from fresh/preserved material and permanent slides.	2
	Fungi	
3	Study of stages in the life cycle of <i>Albugo</i> and <i>Agaricus</i> from fresh/preserved material and permanent slides.	2
4	Study of fungal diseases- Powdery mildew and Ergot.	1
	Bryophyta	
5	Study of stages in the life cycle of <i>Pellia</i> and <i>Funaria</i> from fresh/preserved material and permanent slides.	1
6	Study of Ecological and Economic importance of Bryophytes	1



Semester III Core Course – Practical II		
Code: 22US3BOCCP2		Cr. 01
Taxonomy and Ethnobotany		
1	Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of these families.  Brassicaceae, Combretaceae, Rutaceae, Asteraceae, Verbenaceae, Euphorbiaceae Liliaceae	6
2	Demonstration of digital herbarium.	
3	Identification of medicinally and culturally important plants used by tribals using specimens or photomicrograph.	
Anatomy		
4	Study of normal secondary growth in dicot stem and root.	1
5	Study of mechanical tissue system in root, stem and leaf.	1
6	Study of ecological adaptations of xerophytes, hydrophytes and epiphytes with suitable examples.	1
7	Identification of wood sample using photomicrograph.	
Physiology		
8	Study of absorption spectra of photosynthetic pigments.	1
9	Quantitative estimation of photosynthetic pigments.	1
10	Study of Hill's reaction (Demonstration) by DCPIP method.	1
11	Estimation of reducing sugar by DNSA Method.	1



Semester III Core Course – Practical III		
Code: 22US3BOCCP3		Cr. 01
Economic Botany		
1	Identification of plants as a source of Fibers: Cotton, Jute, Coir.	1
2	Identification of different varieties of Rice.	1
3	Estimation of Starch in different varieties of rice.	
4	Formulation of a Grain based Snack.	1
5	Identification of Plants as source of Narcotics using specimen and photomicrographs.	1
6	Identification of different types of gums and resins from plants. Gum Arabic, Gum Karaya, Gum Ghatti, Neem Gum, Gum Araucaria, Canada Balsam	1
Food Science		
7	Identification of Food adulterants - (Maida - Starch, Semolina - Iron flakes , Red Chili powder - Colored sawdust, Tea - exhausted powder)	1
8	Identification of different food additives	1
Aromatherapy		
9	Demonstration of extraction of Essential Oil by Clevenger Apparatus	1
10	Determination of physico-chemical characteristics of Essential Oils.	1
11	Sensory evaluation of various Essential Oils.	1



Semester III Core Course – Practical III		
Code: 22US3BOCCP3		Cr. O2
Small Scale Industry		
1	Estimation of alcohol content from fermented wine using titrimetric or distillation method.	1
2	Estimation of protein content in a given mushroom sample using Folin-Lowry method.	1
3	Identification of types of nutritionally and medicinally important mushrooms.	1
4	Identification of poisonous mushrooms using photomicrograph.	1
5	Consumer preference survey: To study economics of mushroom industry.	1
6	Herbal formulations: Conventional: Syrups, Pills	1
7	IPR case study- Neem, Basmati Rice	1
8	Identification of herbs used as raw material for herbal medicine using specimen or photomicrograph.	1
9	Determination of microbial and fungal load in a given sample of raw material.	1
10	Contemporary uses of some herbs: Turmeric latte, Detox drink	1
Medicinal Botany and Phytochemistry		
12	Preliminary screening of drugs for presence of active constituents.	1
13	Tests for the detection of Alkaloids, Tannins, Glycosides, Volatile oils, Saponins	1
14	Study of Organoleptic, Macroscopic and Microscopic characteristics of drugs: Leaf, Bark, Root	1
15	Monographs of drugs with respect to biological sources, geographical distribution, macroscopic and microscopic characters, chemical constituents, therapeutic uses and adulterants of the	3



	following plants/Drugs: <i>Syzgium aromaticum</i> (Clove bud), <i>Strychnos nuxvomica</i> (seed), <i>Aloe vera</i> (leaf)	
16	Identification of unorganized drug using specimen or photomicrograph: Shilajit, Camphor, Guggul, Kattha, Gum acacia	1



S.Y. B. Sc. (BOTANY) SEMESTER IV

Core Course - I

COURSE TITLE: Plant Diversity IV

COURSE CODE: 22US4BOCCIPLD4

[CREDITS - 02]

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Differentiation and staining of different microbial organisms.
2. Discuss the structure of virus.
3. Analyse water sample for its potability.
4. Choose suitable culture media for the growth of microorganisms.
5. Enlist the general characteristics of Division- Calamophyta.
6. Illustrate the life cycle of *Equisetum*.
7. Identify the different types of ornamentals ferns and enlist economic uses.
8. Correlate the evolutionary process in Pteridophytes with reference to soral structures.
9. Summarize the types of steles and interpret its evolution.
10. Identify different tissues in Gymnosperms using different micro-preparations.
11. Illustrate the life cycle of *Pinus*.
12. Categorize the origin of fossils to geological time scale.
13. Correlate the morphological and anatomical features of fossil plants with their extinct status.

**Module 1**

**Microbiology**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Elaborate fundamentals of virology.
2. Enumerate bacteria from suitable sources using suitable microbiological techniques.



**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Tabulate the morphological features of viruses.
2. Apply pure culture methods to grow bacteria in the laboratory.
3. Prove the quality of water.

1.1	Viruses - General characters, size and shape, ultrastructure, classification (Plant, Animal and Bacterial viruses).	2L
1.2	Multiplication of bacteriophage T4, Significance of viruses (Positive and Negative aspect).	2L
1.3	Methods in Microbiology - Culture media preparation, Pure culture methods.	3L
1.4	Microbiology of water - Types of water, Factors affecting growth of bacteria in water.	2L
1.5	Microbiological Analysis For Water purity - i) Presumptive Test, ii) Confirmed Test, iii) Complete Test	3L

**References:**

- Kale V.V., Bhusari K.P. (2015) Applied Microbiology, Mumbai, Himalaya Publication House.
- Pelczar M.J., Chan E.C.S., Kriwng Noel R., (2004) Microbiology, New Delhi, Tata McGraw Hill
- Powar, C.B., Dajinawala, H.F., (1989) General Microbiology, Mumbai, Himalaya Publication

**Module 2**

**Pteridophyta**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Comment on habit and reproduction with reference to Pteridophytes.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

<ol style="list-style-type: none"> <li>Recall the general characteristics of Division Calamophyta.</li> <li>Describe life cycle of <i>Equisetum</i>.</li> <li>Summarize the evolution of sorus in Pteridophytes.</li> <li>Comment on the stellar evolution.</li> </ol>		
2.1	General characteristics of Division: Calamophyta	2L
2.2	Structure, Life Cycle and Systematic position of <i>Equisetum</i>	3L
2.3	Types of Stele with reference to Pteridophyta	3L
2.4	Evolution of Sorus	2L
2.5	Ornamental Ferns - Types and Uses	2L
<p><b>References:</b></p> <ul style="list-style-type: none"> <li>Rashid,A. 1999. Pteridophyta. Vikas Publishing House, New Delhi</li> <li>Sambamurthy AVSS, A Textbook of Bryophyta, Pteridophyta, Gymnosperms and Paleobotany</li> <li>Sharma,O.P 2006.Text book of Pteridophyta. . Macmillan India Ltd.,New Delhi.</li> <li>Smith,G.M. 1976. Cryptogamic Botany Vol.II. Tata McGraw Hill, Publishing Co. Ltd. New Delhi.</li> <li>Vashishta, B.R., (1999) Botany for Degree Students. S. Chand and Company Ltd, New Delhi.</li> </ul>		
<b>Module 3</b>	<b>Gymnosperms</b>	<b>[12L]</b>
<p><b>Learning Objectives:</b></p> <p>The module is intended to</p> <ol style="list-style-type: none"> <li>Summarize the habit and reproduction with reference to Gymnosperms.</li> </ol>		
<p><b>Learning Outcomes:</b></p> <p>After the successful completion of the module, the learner will be able to</p> <ol style="list-style-type: none"> <li>Classify the Gymnosperms to respective orders.</li> <li>Describe the life cycle of <i>Pinus</i>.</li> <li>Apply the geological timescale to trace the origin of fossil plants.</li> </ol>		



3.1	Classification of Gymnosperms up to the order according to the system proposed by D. D. Pant.	3L
3.2	Structure, Life cycle and Systematic position of <i>Pinus</i>	4L
3.3	Geological Time Scale	1L
3.4	Study of <i>Rhynia</i> , <i>Calamites</i>	4L

**References:**

- Sambamurthy AVSS, A Textbook of Bryophyta, Pteridophyta, Gymnosperms and Paleobotany
- Sharma, O.P 2006. Text book of Gymnosperms. . Macmillan India Ltd., New Delhi.
- Vashishta, B.R., (1999) Botany for Degree Students. S. Chand and Company Ltd, New Delhi.

**Question Paper Template****S.Y. B. Sc. (BOTANY) SEMESTER IV****Core Course- I****COURSE TITLE: Plant Diversity IV****COURSE CODE: 22US4BOCCIPLD4****[CREDITS - 02]**

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	8	8	6	0	30
II	4	4	8	8	6	0	30
III	4	4	8	8	6	0	30
Total marks per objective	12	12	24	24	18	0	90
% Weightage	13.33	13.33	26.66	26.66	20	0	100



S.Y. B. Sc. (BOTANY) SEMESTER IV

Core Course - II

COURSE TITLE: Functional Botany

COURSE CODE: 22US4BOCC2FUB

[CREDITS - 02]

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Compare and contrast between phase contrast and fluorescence microscopy.
2. Design an experiment for separation of biomolecules.
3. Suggest specific chromatographic technique for solute analysis.
4. Demonstrate the technique of electrophoresis for analysis of biomolecules.
5. Illustrate the structure of DNA.
6. Interpret the mechanism of chromosome packaging.
7. Categorize the chromosomes to its respective groups.
8. Summarize the process and regulatory factors of DNA replication in Prokaryotes.
9. Compare and contrast the process of mitosis and meiosis.
10. Explain the genetic basis for sex determination in living organisms.
11. Correlate the features of normal distribution with standard deviation.
12. Select the region of acceptance versus rejection based on normal distribution for an experiment.
13. Propose suitable hypothesis and analyse the types of error that may have occurred while concluding an experimental data.
14. Choose the correct mode of analysis for specific data.

**Module 1**

**Instrumentation and Technique**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Apply specific analytical techniques during experimental observations / determination.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Select suitable microscopic techniques for observation of tissue.
2. Relate chromatography techniques to analyse biomolecules.
3. Demonstrate the technique of electrophoresis.

1.1	Microscopy - Phase Contrast, Fluorescence	4L
1.2	Chromatography - Principle, Working and Instrumentation of Column Chromatography, Types of Column chromatography: Affinity, Ion exchange, Gel exclusion.	5L
1.3	Electrophoresis: Agarose gel and PAGE - Principle, Working and Applications	3L

**References:**

- Wilson, K., Walker, J., (2009) Principles and Techniques of Biochemistry and Molecular Biology, 6<sup>th</sup> Ed, Delhi, Cambridge University Press.

**Module 2**

**Cytogenetics & Molecular Biology**

**[12L]**

**Learning Objectives:**

This module is intended to

1. To describe various molecular phenomena occurring in a cell.

**Learning Outcome:**

After the successful completion of the module, the learner will be able to

1. Discuss the DNA model proposed by Watson and Crick.
2. Recall the mechanism of chromosome packaging.
3. Explain the process of DNA replication in Prokaryotes.
4. Distinguish the types of chromosomes based on the position of centromere.
5. Sketch and label the different stages of cell division.
6. Comment on the pattern of inheritance in a population.



2.1	DNA structure - Watson and Crick model	1L
2.2	DNA replication - Prokaryotic and Eukaryotic	4L
2.3	Chromosome packaging, Chromosome Structure - Metacentric, sub-metacentric, Telocentric and Acrocentric	1L
2.4	Physical basis of heredity	2L
2.5	Cell cycle & Cell division - Mitosis, Meiosis	2L
2.6	Chromosomal basis of inheritance and determination of sex	2L

**References:**

- Dubey, R.C., 2005 A Textbook of Biotechnology S.Chand & Co, New Delhi
- Fulekar M.H. (2014) Environmental Biotechnology. Science Publisher, USA.
- Gupta P.K (1995) Genetics and Cytogenetics. Rastogi Publications, Meerut .
- Kar D.K. and Halder S. (2006) Plant Breeding and Biometry. New Central Book Agency (P) Ltd., Kolkata.
- Lewin B. 2000. Genes VII. Oxford University Press, New York.
- Strickberger 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.
- Verma P.S. and Agarwal V.K. (1991), Genetics. S Chand Comp. Ltd. Ramnagar

<b>Module 3</b>	<b>Biostatistics</b>	<b>[12L]</b>
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**Learning Objectives:**

The module is intended to

1. Explain suitable statistical tools.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Discuss the properties of normal distribution and demonstrate the region of acceptance versus region of rejection.



2. Outline the concept of hypothesis and types of errors.
3. Show chi-Square method and correlation for analysis of specific data.

3.1	Normal distribution - Concept, Normal Distribution Curve, Properties of Normal Distribution, Relationship between Normal Curve area and Standard Deviation, Region of Acceptance and Rejection in brief	4L
3.2	Concept Hypothesis, Types of Errors	2L
3.3	Chi-square test with contingency	3L
3.4	Correlation	3L

**References:**

- Mahajan B. K. (1991) Methods of Biostatistics. Jaypee brothers, New Delhi.
- Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai.
- Prasad S. (2006) Elements of Biostatistics. Jogi Publications, Meerut.
- Purohit S.G., Ranade V.D., Dusane A.V. (2002) Introduction to Biometry Narendra Prakashan Pune.
- Rastogi V. B. (2017) Fundamentals of Biostatistics. Medtech, New Delhi.





Question Paper Template

S.Y. B. Sc. (BOTANY) SEMESTER IV

Core Course- II

COURSE TITLE: Functional Botany

COURSE CODE: 22US4BOCC2FUB [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	8	8	6	0	30
II	4	4	8	8	6	0	30
III	4	4	8	8	6	0	30
Total marks per objective	12	12	24	24	18	0	90
% Weightage	13.33	13.33	26.66	26.66	20	0	100



**SOMAIYA**  
**VIDYAVIHAR**

K J Somaiya College of Science & Commerce  
Autonomous (Affiliated to University of Mumbai)



Select Either One of Core Course of 2 Credits





S.Y. B. Sc. (BOTANY) SEMESTER IV

Core course - III

COURSE TITLE: Forest Biology and Sustainability

COURSE CODE: 22US4BOCC3FBS

[CREDITS - 02]

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Recommend multipurpose tree of agroforestry.
2. Appreciate agroforestry innovations which can make a positive impact on the environment.
3. Design strategies for restoration of ecosystems and achieve sustainable development goals. Solve case study.
4. Infer the environmental flows.
5. Assess the effects of anthropological activities on wetlands and pastureland.
6. Suggest the measures to reduce the pollution in urban areas.
7. Plan the development of a green wall and green roof.
8. Apply and implement conservation strategies for sustainability management of agriculture.
9. Compile the factors affecting sustainable agriculture practices.

**Module 1**

**Agroforestry**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Discuss the aspects of agroforestry.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Demonstrate importance of agroforestry
2. Select field experiment in relation to agroforestry.
3. Describe mechanism of biophysical and socio-economic interaction in agroforestry system

1.1	Concept of Agroforestry	2L
1.2	Classification of Agroforestry systems	2L
1.3	Diagnosis and Design of Agroforestry	2L
1.4	Needs of Agroforestry	2L
1.5	Field Experiments in Agroforestry	2L
1.6	Opportunities and Challenges	2L

**References:**

- Negi S.S. (2008) Handbook of Forestry.
- Pretty, J., 363 (2008) 447-465 Agricultural Sustainability: Concepts, Principles and Evidence, Essex, UK
- Sagwal S. S. (2016) Introductory Forestry. Kalyani Publisher, New Delhi

**Module 2**

**Ecosystem Management**

**[12L]**

**Learning Objectives:**

This module is intended to

1. Elaborate concepts of ecosystem management.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Summarize the effects of invasive species in specific ecosystems.
2. Enlist the threats to specific types of ecosystem.
3. Compile reports on ecosystem management.
4. Refer the strategies for management of pastureland.
5. Review the strategies made for conservation of wetlands.

2.1	Terrestrial Ecosystem Management - Restoration Ecology, Invasive Species Management.	3L
2.2	Aquatic Ecosystem Management - Wetland Conservation: Case Study, Environmental Flows	3L
2.3	Agro-ecosystem Management - Crop Management, Pastureland Management, Plantation Management.	3L

2.4	Urban Ecology - Urban Greening: Case Study, Living Shorelines.	3L
<b>References:</b> <ul style="list-style-type: none"> <li>• <a href="https://www.sciencedirect.com/topics/earth-and-planetary-sciences/urban-ecology">https://www.sciencedirect.com/topics/earth-and-planetary-sciences/urban-ecology</a></li> <li>• Pataki D. E., Frontiers in Ecology and Evolution., (2015) Grand challenges in urban ecology <a href="https://www.frontiersin.org/articles/10.3389/fevo.2015.00057/full">https://www.frontiersin.org/articles/10.3389/fevo.2015.00057/full</a></li> </ul>		
<b>Module 3</b>	<b>Sustainable Agricultural Practices</b>	<b>[12L]</b>
<b>Learning Objectives:</b> The module is intended to <ol style="list-style-type: none"> <li>1. Demonstrate sustainable agricultural practices.</li> </ol>		
<b>Learning Outcomes:</b> After the successful completion of the module, the learner will be able to <ol style="list-style-type: none"> <li>1. Apply and implement conservation strategies for sustainability management of agriculture.</li> <li>2. Experiment with materials to prepare the compost.</li> <li>3. Represent schematically the irrigation system installed in agricultural land.</li> <li>4. Invent techniques of irrigation to conserve the water.</li> </ol>		
3.1	Introduction to Sustainable Agricultural Practices - Concept, Principle, Components: Soil, Water, Sustainable Pest Management.	4L
3.2	Soil conditioning - Biochemistry of Composting and Characterization of Biocompost: Particle size, C: N ratio, Temperature, pH and Aeration.	3L
3.3	Agricultural Water Management - Irrigation and Drainage Management, Water Recycle Practices: Rain water and Grey water.	3L



3.4	Effective Irrigation Technology for reducing water loss. Case Study.	2L
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**References:**

- Pretty, J., 363 (2008) 447-465 Agricultural Sustainability: Concepts, Principles and Evidence, Essex, UK
- Sagwal S. S. (2016) Introductory Forestry. Kalyani Publisher, New Delhi
- Thorat, S., Inamdar, V., Bhor, P., Nandre, D., Rajput, H., Ambad, S., Hendre, P., Resource Book on Horticulture Nursery Management, NAIP-ICAR, Nashik, The Registrar, Yashwantrao Chavan Maharashtra Open University, Nashik
- Tripathi, P.C., Sakthivel, T., Hazarika, S., Reddy, T.M., (2010), Compendium of Training Programme on Nursery Management of Horticultural Crops, Karnataka, Indian Institute of Horticultural Research
- <https://www.nepjol.info/index.php/HN/article/download/4229/3590>
- <http://www.ecotippingpoints.org/our-stories/indepth/india-rajasthan-rainwater-harvest-restoration-groundwater-johad.html>
- Rain water harvesting and conservation, Manual, Government of India (2002)
- Watershed management, Prof T.I Eldho, Department of Civil Engineering, IIT Bombay



Question Paper Template

S.Y. B. Sc. (BOTANY) SEMESTER IV

Core Course- III

COURSE TITLE: Forest Biology and Sustainability

COURSE CODE: 22US4BOCC3FBS [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	8	8	6	0	30
II	4	4	8	8	6	0	30
III	4	4	8	8	6	0	30
Total marks per objective	12	12	24	24	18	0	90
% Weightage	13.33	13.33	26.66	26.66	20	0	100



S.Y. B. Sc. (BOTANY) SEMESTER IV

Core course - III

COURSE TITLE: Commercial Forestry and Horticulture

COURSE CODE: 22US4BOCC3CFH

[CREDITS - 02]

**Course Learning Outcomes**

After the successful completion of the Course, the learner will be able to:

1. Organize a social forestry program.
2. Choose economically important tree species and evaluate their benefits.
3. Demonstrate methods of regeneration.
4. Identify forest and defects in forest.
5. Discuss the need of forest protection.
6. Design and implement protection against injuries by plants and animals.
7. Enlist the sources of major forest products.
8. State the uses of non-timber products.
9. Plan the procuring and marketing of forest products.
10. Develop entrepreneurial skills in the field of horticulture and nursery management.
11. Identify and enlist the indoor and ornamental plants.
12. Suggest flower arrangement for different places and occasions.
13. Prepare different styles of Bonsai.
14. Construct a vertical wall garden.
15. Experiment with different plant material to make botanical art.

**Module 1**

**Methods of Regeneration, Social Forestry and Forest Protection**

**[6 L+ 6 L]**

**Learning Objectives:**

This module is intended to

1. Suggest methods of regeneration and social forestry.
2. Discuss methods of forest protection.



**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Acquaint with the social forestry program
2. Select multipurpose tree species for community forestry
3. Tabulate the economic benefits of Social forestry.
4. Summarize forest needs and defects in the forest
5. Predict the scope of Forest protection
6. Tabulate various factors of forest degradation

1.1	Natural and Artificial Regeneration	2L
1.2	Commercial and Non - commercial farm forestry	2L
1.3	Community Forestry	2L
1.4	Urban Forestry	2L
1.5	Economic Benefits of Social Forestry	2L
1.6	Forest Fires	1L
1.7	Protection against Atmospheric agencies, Injuries by Plants and Animals and Shifting Cultivation.	1L

**References:**

- Negi S.S. (2008) Handbook of Forestry.
- Sagwal S. S. (2016) Introductory Forestry. Kalyani Publisher, New Delhi
- Krishnan, P.R., Kalia, R. K., Tewari, J.C., Roy, M.M., (2014) Plant Nursery Management: Principles and Practices, Jodhpur, Central Arid Zone Research Institute

<b>Module 2</b>	<b>Utilization of Forest Resources and Nursery Development</b>	<b>[6 L+ 6 L]</b>
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**Learning Objectives:**

This module is intended to

1. Tabulate forest resources.
2. Design nursery.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Take part in surveying the resources available from the forest.
2. Propose the marketing strategy for forest resources.
3. Demonstrate propagation techniques
4. Plan Nursery setup

2.1	Definition of Forest Utilization	1L
2.2	Utilization of Major Forest Products	1L
2.3	Utilization Non -Timber Forest Products	1L
2.4	Labor organization and Modes of sale	1L
2.5	Introduction, Components of Nursery, Classification, Factors affecting the Establishment of a Nursery.	2L
2.6	Preparation of Nursery Beds.	2L
2.7	Propagation by Specialized Organs: Bulb, Tuber, Corms, Runner, Offset, Sucker, Rhizome	2L
2.8	Management, Marketing and Economics of Nursery Practices	2L

**References:**

- Negi S.S. (2008) Handbook of Forestry.
- Sagwal S. S. (2016) Introductory Forestry. Kalyani Publisher, New Delhi
- Krishnan, P.R., Kalia, R. K., Tewari, J.C., Roy, M.M., (2014) Plant Nursery Management: Principles and Practices, Jodhpur, Central Arid Zone Research Institute
- Kumar, V., Tiwari, A. (2018) Practical Manual of Nursery Management, New Delhi, Agro-Biovet Press
- Thorat, S., Inamdar, V., Bhor, P., Nandre, D., Rajput, H., Ambad, S., Hendre, P., ( ), Resource Book on Horticulture Nursery Management, NAIP-ICAR, Nashik, The Registrar, Yashwantrao Chavan Maharashtra Open University, Nashik

- Tripathi, P.C., Sakthivel, T., Hazarika, S., Reddy, T.M., (2010), Compendium of Training Programme on Nursery Management of Horticultural Crops, Karnataka, Indian Institute of Horticultural Research

**Module 3**

**Ornamental Horticulture and Botanical Art**

[6 L+ 6 L]

**Learning Objectives:**

The module is intended to

1. Enlist plants for garden locations.
2. Develop entrepreneurial skills through botanical knowledge.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to

1. Identify and choose plants for different garden locations
2. Describe the characteristic features of specific gardens
3. Demonstrate the technique of Ikebana, Bonsai, Terrarium, Kokedama and vertical wall garden
4. Suggest flower arrangement for different places and occasions

3.1	General Cultivation of Ornamental Plants - Annuals, Trees, Grasses, Bulbous, Ornamentals shrubs, Climbers, Indoor plants, Palms and Cycads, Cacti and Succulents, Ferns and Orchids.	3L
3.2	Importance of Garden Features - Arbour, Patio, Deck, Gazebo, Pebble Garden, Bog Garden	3L
3.3	Flower Arrangement - Technique and Importance of Ikebana, Western Style.	3L
3.4	Importance and Applications of Vertical Garden, Terrarium, Bonsai, Kokedama	3L

**References:**

- Tripathi, P.C., Sakthivel, T., Hazarika, S., Reddy, T.M., (2010), Compendium of Training Programme on Nursery Management of Horticultural Crops, Karnataka, Indian Institute of Horticultural Research



- [https://www.researchgate.net/publication/334761905\\_Flower\\_arranging\\_and\\_Designing](https://www.researchgate.net/publication/334761905_Flower_arranging_and_Designing)
- [https://agritech.tnau.ac.in/horticulture/horti\\_Landscaping\\_freshflower.html](https://agritech.tnau.ac.in/horticulture/horti_Landscaping_freshflower.html)
- INOUE Osamu, Kyoto university of Art and Design, Theory of Time in Ikebana,  
[https://www.researchgate.net/publication/340871864\\_Theory\\_of\\_Time\\_in\\_Ikebana](https://www.researchgate.net/publication/340871864_Theory_of_Time_in_Ikebana)
- <https://web-japan.org/factsheet/en/pdf/27Ikebana.pdf>, IKEBANA, Tradition and Creativity in Floral Art.



Question Paper Template

S.Y. B. Sc. (BOTANY) SEMESTER IV

Core Course- III

COURSE TITLE: Commercial Forestry and Horticulture

COURSE CODE: 22US4BOCC3CFH

[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	8	8	6	0	30
II	4	4	8	8	6	0	30
III	4	4	8	8	6	0	30
Total marks per objective	12	12	24	24	18	0	90
% Weightage	13.33	13.33	26.66	26.66	20	0	100



Semester IV Core Course – Practical I		
Code: 22US4BOCCPI		Cr. 01
1	Study of Ultrastructure of Plant and Animal viruses / Bacteriophage with the help of photomicrographs.	1
2	Preparation of Culture Media and Preparation of Slants and Plates	1
3	Study of Streak Plate Technique for Isolation of bacteria.	1
4	Basic Principles of Staining - Differential: Gram staining and Special staining- Endospore, Negative	1
5	Effects of plant extract (Turmeric and Garlic) on microbial growth by the pour plate technique.	1
6	Determine the Potability of Water samples collected from different localities using MPN Technique. Case Study.	1
7	Study of stages in the life cycle of <i>Pteris</i> and <i>Equisetum</i> from fresh/preserved material and permanent slides.	2
8	Study of Types of Stele with the help of permanent slides.	1
9	Ornamental ferns, Types and Uses.	1
10	Study of Stages in the Life Cycle of <i>Pinus</i> from fresh / preserved material and permanent slides.	1
11	Study of different Types of Fossils.	1
12	Study of <i>Rhynia</i> with the help of permanent slides.	



Semester IV Core Course – Practical II		
Code: 22US4BOCCP2		Cr. 01
1	Study of Phase Contrast Microscope.	1
2	Study of Fluorescence microscopy using photomicrograph.	1
3	Problems based on postulation of Hypothesis and Types of Errors.	1
4	Problems based on Chi-Square test.	1
5	Problem based on Correlation.	1
6	Study of Meiosis in suitable plant material.	1
7	Isolation of eukaryotic DNA from suitable plant material.	1
8	Demonstration of AGE	1
9	Demonstration of PAGE	1
10	Numerical Anomalies in Chromosome: Down's syndrome, Klinefelter's syndrome, Turner syndrome	1
11	Demonstration of Separation of Photosynthetic pigments using column chromatography.	1



Semester IV Core Course – Practical III		
Code: 22US4BOCCP3		Cr. 01
1	Study of plot design and arrangement for alley cropping experiment.	1
2	Study of ecological instruments: Soil thermometer, Hygrometer, Wind Anemometer, Rain Gauge, Lux Meter	1
3	Estimation of Biomass from polluted and restored area.	1
4	Study of different parameters of Compost: Alkalinity, Acidity, Hardness and Organic carbon	3
5	Study of soil macro and micronutrients.	1
6	Study of site for plantation: Edaphic factors, Climatic conditions.	1
7	Estimation of available nutrients like P, K and Ca by suitable chemical method.	3
8	Study of Soil Micro-flora.	1
9	Case Study on Rain Water Harvesting	1





Semester IV Core Course – Practical III		
Code: 22US4BOCCP3		Cr. OI
	Forestry	
1	Study of Major Forest Products.	1
2	Study of Minor Forest Products.	1
3	Identification of plants suitable for social forestry.	1
	Horticulture	
4	To perform method of propagation by specialized organs.	1
5	To design the layout of a Nursery.	1
6	Identification of Annuals, Trees, Grasses, Bulbous ornamentals shrubs, Climbers, Indoor plants, Palms and Cycads, Cacti and Succulents, Ferns and Orchids (2-3 plants of each category)	2
7	Identification of different features of Garden using photographs.	1
8	Demonstration of Flower Arrangement: Ikebana and Western	1
9	Demonstration of Vertical Garden, Terrarium, Bonsai and Kokedama	2



**Scheme of Examination:**

**Theory Course:**

- **Internal Assessment:** Mid Sem Examination 25 Marks + Assignment 15 Marks  
**Or**  
**Value Added Course** for “Aromatherapy” for total 40 Marks
- **External Assessment:** Semester End Examination question paper based on Bloom’s Taxonomy 60 Marks

**Practical Assessment:** Continuous assessment with ICT tools (20 Marks), Semester End Exam (30 Marks) / Course

Modes for Continuous Assessment based on feasibility

- Mini-projects + Presentation
- Models
- Tests
- Worksheets: Excel, Reagent Preparation
- Assignments
- Report Writing/ Mind maps
- Field Diary
- Digital Catalogue of the Plants of SVV campus

Note: Minimum 75% attendance is mandatory for continuous evaluation.

**Field Visits:**





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**S. Y. B. Sc. Botany Semester III**

**Practical I – Plant Diversity III**

(Algae, Fungi and Plant Pathology, Bryophyta)

**Skeleton Question Paper**

Duration: 02 Hrs.

**N.B.**

- I. Candidates should show their slides/ preparations/ results for all questions to the examiner.

	<b>Max. Marks</b>	<b>30 M</b>
<b>Q1.</b> Identify, classify, sketch and describe the specimen A, B and C. Show the slides to the examiner	<b>12 M</b>	
<b>Q2.</b> a. Identify the given algae and assign the specific thallus type.	<b>05 M</b>	
b. Identify the given specimen and describe its economic and ecological applications.	<b>05 M</b>	
<b>Q3.</b> Viva	<b>03 M</b>	
<b>Q4.</b> Journal	<b>05 M</b>	

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**S. Y. B. Sc. Botany Semester III**

**Practical II – Forms and Function**

(Taxonomy and Ethnobotany, Anatomy, Plant Physiology and Biochemistry)

**Skeleton Question Paper**

Duration: 02 Hrs.

**N.B.**

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.

	Max. Marks	
Q 1. Classify specimen A and B up to its family giving reasons. Write the floral formula, sketch and label L.S. of flower and T.S. of the ovary.		30 M
Q 2. a. Prepare a temporary stain of given specimen C and comment on the peculiar structure observed therein. Show the slide to the examiner.		08 M
b. Sketch and describe the mechanical tissue system in given specimen D. Show the slide to the examiner.		06 M
Q 3. Perform the given physiology experiment E. Record the observation and comment on its results.		04 M
Q 4. Field report		07 M
		05 M

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**S. Y. B. Sc. Botany Semester III**  
**Practical III – Applied Botany**  
(Economic Botany, Food Science, Fundamentals of Aromatherapy)

**Skeleton Question Paper**

Duration: 02 Hrs.

**N.B.**

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.

	Max. Marks	30 M
Q1. Project		25 M
Q2. Journal		05 M

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**S. Y. B. Sc. Botany Semester III**

**Practical III – Small Scale Industry and Medicinal Botany**

(Agricultural Industry, Mushroom industry, Herbal industry, Pharmacognosy,  
Phytochemistry, Medicinal Botany)

**Skeleton Question Paper**

Duration: 02 Hrs.

**N.B.**

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.

	Max. Marks	30 M
Q1. Project		25 M
Q2. Journal		05 M

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**S. Y. B. Sc. Botany Semester IV**

**Practical I – Plant Diversity IV**

(Microbiology, Pteridophyta, Gymnosperm)

### Skeleton Question Paper

Duration: 02 Hrs.

**N.B.**

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.

	Max. Marks	30 M
Q1. Perform the given microbiology experiment A.		08 M
Q2. Identify, classify, sketch and describe the specimen B and C. Show the slide to the examiner.		12 M
Q3. Viva		05 M
Q4. Journal		05 M

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**S. Y. B. Sc. Botany Semester IV**

**Practical II – Functional Botany**

(Instrumentation and Technique, Cytogenetics and Molecular Biology,  
Biostatistics and Bioinformatics)

### Skeleton Question Paper

Duration: 02 Hrs.

**N.B.**

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.

	Max. Marks	30 M
Q 1. Make a smear preparation from the given plant material <b>A</b> and Comment on different stages observed there in.	12 M	
Q 2. Identify the chromosomal anomaly from the given chromosomal spread <b>B</b> . State the resulting features.	08 M	

Or

Solve the statistical problem **B** allotted to you.

Q 3. Viva	05 M
Q 4. Journal	05 M

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**S. Y. B. Sc. Botany Semester IV**  
**Practical III – Forest Biology and Sustainability**  
(Agroforestry, Ecosystem Management, Sustainable Agricultural Practices)

### Skeleton Question Paper

Duration: 02 Hrs.

**N.B.**

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.

	Max. Marks	30 M
Q1. Project		25 M
Q2. Journal		05 M

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**S. Y. B. Sc. Botany Semester IV**

**Practical III – Commercial Forestry and Horticulture**

(Methods of Regeneration and Social Forestry, Forest Protection, Utilization of Forest Resources, Nursery Development, Ornamental Horticulture, Botanical Art)

**Skeleton Question Paper**

Duration: 02 Hrs.

**N.B.**

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.

	Max. Marks	30 M
Q1. Project		25 M
Q2. Journal		05 M

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