



## **Savitribai Phule Pune University**

*(Formerly University of Pune)*

### **Three Year B.Sc. Degree Program in Botany**

**(Faculty of Science & Technology)**

### **T.Y.B. Sc Botany**

**Choice Based Credit System Syllabus**

**To be implemented from Academic Year 2021- 2022**

## Title of the Course: B. Sc Botany

### 1. Structure of Course:

Structure B.Sc. Botany syllabus					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	BO 111	Plant life and utilization I	2
			BO 112	Plant morphology and Anatomy	2
			BO 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	BO 121	Plant life and utilization II	2
			BO 122	Principles of plant science	2
			BO 123	Practical based on BO 121 & BO 122	1.5
2	3	Compulsory Course	BO 231	Taxonomy of Angiosperms and Plant Ecology	2
			BO 232	Plant Physiology	2
			BO 233	Practical based on BO 231 & BO 232	2
	4	Compulsory Course	BO 241	Plant Anatomy and Embryology	2
			BO 242	Plant Biotechnology	2
			BO 243	Practical based on BO 241 & BO 242	2
3	5	Discipline Specific Elective Course	BO 351	<b>Algae and Fungi</b>	2
			BO 352	<b>Archegoniate</b>	2
			BO 353	<b>Spermatophyta and Paleobotany</b>	2
			BO 354	<b>Plant Ecology</b>	2
			BO 355	<b>Cell and Molecular Biology</b>	2
			BO 356	<b>Genetics</b>	2
			BO 357	<b>Practical based on BO 351 &amp; BO 352</b>	2
			BO 358	<b>Practical based on BO 353 &amp; BO 354</b>	2
			BO 359	<b>Practical based on BO 355 &amp; BO 356</b>	2
	Skill Enhancement course	BO 3510	<b>Medicinal Botany</b>	2	
		BO 3511	<b>Plant Diversity and Human Health</b>	2	
3	6	Discipline Specific Elective Course	BO 361	<b>Plant Physiology</b>	2
			BO 362	<b>Biochemistry</b>	2
			BO 363	<b>Plant Pathology</b>	2
			BO 364	<b>Evolution and Population genetics</b>	2
			BO 365	<b>Advanced Plant Biotechnology</b>	2
			BO 366	<b>Plant Breeding and Seed Technology</b>	2
			BO 367	<b>Practical based on BO 361 &amp; BO 362</b>	2

			BO 368	<b>Practical based on BO 363 &amp; BO 364</b>	2
			BO 369	<b>Practical based on BO 365 &amp; BO 366</b>	2
	Skill Enhancement course		BO 3610	<b>Nursery and Gardening Management</b>	2
			BO 3611	<b>Biofertilizers</b>	2

## 2. Equivalence of Previous Syllabus:

Old Course (2015 Pattern)	New Course (2020 CBCS Pattern)
<b>Semester V</b>	<b>Semester V</b>
BO. 331 Cryptogamic Botany	BO 351 Algae and Fungi
BO. 332 Cell and Molecular Biology	BO 352 Archegoniate
BO. 333 Genetics and Evolution	BO 353 Spermatophyta and Paleobotany
BO. 334 Spermatophyta and Palaeobotany	BO 354 Plant Ecology
BO. 335 Horticulture and Floriculture	BO 355 Cell and Molecular Biology
BO. 336 Computational Botany	BO 356 Genetics
--	BO 3510 Medicinal Botany
--	BO 3511 Plant Diversity and Human Health
<b>Semester VI</b>	<b>Semester VI</b>
BO.341 Plant Physiology and Biochemistry	BO 361 Plant Physiology and Metabolism
BO.342 Plant Ecology and Biodiversity	BO 362 Biochemistry
BO.34 Plant Pathology	BO 363 Plant Pathology
BO.344 Medicinal and Economic Botany	BO 364 Evolution and population genetics
BO.345 Plant Biotechnology	BO 365 Advanced Plant Biotechnology
BO.346 Plant Breeding and Seed Technology	BO 366 Plant Breeding and Seed Technology
--	BO 3610 Nursery and Gardening Management
--	BO 3611 Biofertilizers

**T.Y.B.Sc. Botany CBCS Pattern**  
**(Semester V, Paper I) 2020-2021**  
**BO 351: Cryptogamic Botany ( Algae and Fungi)- 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
<b>Credit-I Algae</b>		<b>15</b>
<b>1.</b>	Introduction: Cryptogams- meaning. Types- Lower Cryptogams, brief Review with examples	<b>01</b>
<b>2.</b>	Algae: General characters, distribution, Thallus organization, habit and Habitat reproduction and Classification (G.M.Smith 1955) up to classes.	<b>04</b>
<b>3.</b>	Study of life cycle of algae with reference to taxonomic position, Occurrence, Thallus structure, and reproduction of <i>Nostoc</i> , <i>Oedogonium</i> <i>Chara</i> , <i>Sargassum</i> and <i>Batrachospermum</i> .	<b>08</b>
<b>4</b>	Economic importance of algae- Role in industry, agriculture, fodder and medicine.	<b>02</b>
<b>Credit-II Fungi</b>		<b>15</b>
<b>5</b>	Fungi: General characters, Habit and habitats, thallus organization, cell wall composition, nutrition and Classification. (Alexopoulos and Mims 1979) up to classes.	<b>03</b>
<b>6.</b>	Study of life cycle of fungi with reference to taxonomic position, thallus structure, and reproduction of <i>Mucor</i> ( <i>Zygomycotina</i> ), <i>Saccharomyces</i> ( <i>Ascomycotina</i> ), <i>Puccinia</i> ( <i>Basidiomycotina</i> ), <i>Penicillium</i> and <i>Cercospora</i> ( <i>Deuteromycotina</i> ) [Two members of Deutero.]	<b>08</b>
<b>7.</b>	Symbiotic Associations - Lichens, Mycorrhiza and their significance	<b>04</b>

**Suggested readings:**

1. Vashistha B. R. et al., Botany for degree students-Algae
2. Das, Datta and Gangulee-College Botany Vol. I
3. Sharma, O.P. –Algae
4. Kumar H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd New Delhi.
5. Vashishta B.R. et al., Botany for degree students- Fungi
6. Sharma, P.D.-The Fungi

7. Sharma, O.P.-Fungi Economic importance of fungi

8. Alexopoulos C. J , Mims C.W. and Blacwel M.I 1996. Introductory Mycology. John Wiley and Sons Inc.

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester V, Paper II) 2020-2021  
BO 352: Archegoniate- 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
<b>Credit-I Bryophytes</b>		<b>15</b>
<b>1.</b>	Introduction to Archegoniate	<b>01</b>
<b>2.</b>	Introduction, general characters, distribution of Bryophytes to land habit, classification of Bryophytes according to G.M. Smith (1955) up to classes with reasons	<b>02</b>
<b>3.</b>	Range of thallus organisation, origin of Bryophytes - Pteridophytes and Algal hypothesis, evolution of sporophyte	<b>02</b>
<b>4</b>	Study of Life Cycle of Bryophytes with respect to Taxonomic position, Morphology, Anatomy, Reproduction, Gametophytes and sporophytes of <i>Marchantia</i> , <i>Anthoceros</i> and <i>Funaria</i>	<b>09</b>
<b>5</b>	Ecological and economic importance of Bryophyte	<b>01</b>
<b>Credit-II Pteridophytes</b>		<b>15</b>
<b>6</b>	Introduction, Vascular Cryptogams, General characteristics, Classification according to K.R. Sporne (1975) up to classes with reasons, Diversity and Distribution of Pteridophytes.	<b>02</b>
<b>7.</b>	Resemblances of Pteridophytes with Bryophytes, Differences between Pteridophytes and Bryophytes, Origin of Pteridophytes -Algal and Bryophytes, Evolution of Pteridophytes- Telome Theory and Enation Theory.	<b>03</b>
<b>8.</b>	Study of Life Cycle of Pteridophytes with respect to Taxonomic position, Morphology, Anatomy, Reproduction, Sporophytes and Gametophytes of <i>Psilotum</i> , <i>Selaginella</i> and <i>Equisetum</i>	<b>09</b>
<b>09</b>	Ecological and Economical Importance of Pteridophytes	<b>01</b>

**Note:**development of sex organs and Sporophytes is not expected.)

**Suggested readings:**

1. Chopra G.L. and Yadav D.L. A Text book of Bryophytes.
2. Das, Datta and Gangulee-College Botany Vol I
3. Parihar, N.S. An introduction to Embryophyta: Bryophyte-I
4. Puri Prem. Brayophytes, Atmaram and Sons. Delhi.
5. Parihar N.S. 1991. Bryophyta. Central Book Depot, Allahabad.
6. Sporne K.R. 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. LtdBombay.
7. Vashishta B.R. Botany for degree students Bryophytes- Vol-III
8. Vashishta B.R. Botany for degree students Pteridophytes.

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester V, Paper III) 2020-2021  
BO 353: Spermatophyta and Paleobotany - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
	<b>Credit-I ANGIOSPERMS</b>	<b>15</b>
<b>1.</b>	<b>Origin of angiosperms:</b> with reference to time, place and ancestry- 1) Pseudanthial theory 2) Transitional-Combinational Theory	<b>02</b>
<b>2.</b>	<b>Speciation &amp; Endemism</b> Species concept (Biological, Taxonomic & Phylogenetic Species Concept), Speciation (Allopatric, Sympatric & Parapatric), Endemism and its types (Palaeoendemism, Holoendemism and Neoendemism)	<b>04</b>
<b>3.</b>	<b>Classification:</b> Outline, Merit and Demerits of Cronquist's System and APG IV system of classification. Study of following families with reference to systematic position (As per Bentham & Hooker), Diagnostic characters, floral formula, floral diagram and any five examples with their economic importance – Nymphaeaceae, Oleaceae, Amaranthaceae, Cannaceae	<b>06</b>
<b>4</b>	<b>Herbaria and Botanical Gardens</b> Functions of Herbarium, Important herbaria (World: Kew herbarium; India: Central National Herbarium, Kolkata). Botanic gardens of the world (Royal Botanic Garden, Kew) and India	<b>03</b>
	<b>Credit-II GYMNOSPERMS and PALEOBOTANY</b>	<b>15</b>

6	Introduction, general characters, economic importance and classification according to Chamberlain (1934).	02
7.	Study of life cycle of Pinus and Gnetum with reference to distribution, morphology, anatomy, reproduction, gametophyte, sporophyte, seed structure and alternation of generations.	10
8.	Fossil- Definition, process of fossil formation, types of fossils.-Impression, Compression, Petrification, Pith cast and Coal ball.	03

**Suggested readings:**

1. Cronquist, A. 1968. The Evolution and Classification of Flowering Plants. Thomas Nel and Sons, Ltd. London.
2. Lawrence, G.H.M 1951. Taxonomy of Vascular Plants.
3. Singh V. and D.K Jain, 1981 Taxonomy of Angiosperms. Rastogi Publication, Meerut.
4. Swingle D.B. 1946. A Text book of Systematic Botany. Mc Graw Hill Book Co. New York.
5. Takhtajan A. 1969. Flowering Plants; Origin and Disposal.
6. Pande B.P 1997. Taxonomy of Angiosperms. S.Chand.
7. Gurucharan Singh 2005- Plant systematics
8. Naik V.N. - Taxonomy of Angiosperms.
9. Shivrajan V.V. -Introduction to Principles plant taxonomy
10. V. V. Sivarajan, N. K. P. Robson 1991. Introduction to the Principles of Plant Taxonomy IIInd Edi.
11. Sharma O.P. Plant Taxonomy Tata McGraw-Hill
12. Botanical Journal of the Linnean Society, 2009, 161, 105–121.
13. <http://www.mobot.org/MOBOT/research/APweb/>

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester V, Paper IV) 2020-2021  
BO 354: Plant Ecology - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
	<b>Credit-I</b>	<b>15</b>
1.	Introduction, interrelationship between the living world and the environment, levels of organization, components and dynamism of ecosystem, homeostasis, niche concept, concept of limiting factors	03
2.	<b>Biogeography:</b> Floristic realms, speciation and its types, biogeographic regions of India, Plant indicators	03

3.	<b>Population ecology:</b> Definition, characteristics, population growth form, r and k selection	03
4.	<b>Community ecology:</b> Introduction and Definition, community structure, physiognomy, Raunkiaer's life form classification, keystone species, edge and ecotone	04
5.	<b>Biogeochemical cycles:</b> The carbon cycle, Nitrogen cycle, Phosphorus cycle, and Hydrologic cycle	02
<b>Credit-II</b>		<b>15</b>
6.	<b>Ecological Impact Assessment (EIA)</b> Introduction, Historical Review of EIA, Objectives of EIA, Stages of EIA process: Screening; Scoping; Baseline study; Impact prediction and assessment; Mitigation; Producing Environmental Impact Statement (EIS); EIS review; Decision making; Monitoring, Compliance and Enforcement; Benefits of EIA.	05
7.	<b>Environmental Audit</b> Meaning and concept, need, objectives, benefits, types, audit protocol, process, certification, personnel environmental audit	04
8.	<b>Remote Sensing</b> Definition, basic principles, process of ecological data acquisition and interpretation, global positioning system, application of remote sensing in ecology.	04
9.	<b>Ecological management:</b> Concepts, sustainable development, sustainability indicators	2

## References:

1. Current sciences special issue remote sensing for national development Volume 61 numbers 3 and 4 August 1991
2. Daubenmire R.F. 1974. Plants and Environment- A Text Book of Plant Ecology (3rd edition). John Wiley & Sons. New York.
3. E.P. Odum. 1996. Fundamentals of Ecology. Natraj Publishing, Dehradun.
4. G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Hand book, McGraw Hill, 1980.
5. George Joseph Fundamentals of remote sensing (Second edition, 2005) by Universities press (India) Private Ltd., Hyderabad.
6. John R. Jensen (2000) Remote sensing of the environment, Dorling Kindersley India Pvt. Ltd,
7. Kendeigh S.C. 1980. Ecology with Special Reference to Animals and Man. Prentice Hall of India Pvt. Ltd., New Delhi.
8. Kermondy F.J. 1996. Concepts of Ecology. Prentice Hall of India Pvt. Ltd. New Delhi.
9. Kumar H.D. 1996. Modern Concepts of Ecology (3rd edition). Vikas Publishing House Pvt., Ltd. Delhi.



10. Kumar H.D. 1997. General Ecology. Vikas Publishing Pvt. Ltd., Delhi.
11. Larry W. Canter, " Environment Impact Assessment", McGraw-Hill Book Company, New York
12. M. Anji Reddy Textbook of Remote sensing and GIS (Third edition, 2006) by BS Publication, Hyderabad
13. Singh JS, Singh SP, & Gupta SR, (2006) Ecology, Environment and Resource Conservation. Anamayapubl, New Delhi
14. Smith L.R. 1996. Ecology and Field Biology (5th edition). Harper Collns College Publishers, USA.
15. Smith L.R. and Mith T.M. 1998. Elements of Ecology. (4th edition). An imprint of Addison Wesley, Longman ink., California
16. Weaver. J.E. and Clements. S.E. 1966. Plant Ecology. Tata McGraw Publishing Co. Ltd. Bombay.

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester V, Paper V) 2020-2021  
BO 355: Cell and Molecular Biology - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
<b>Credit-I Cell Biology</b>		<b>15</b>
<b>1.</b>	<b>Introduction to Cell Biology:</b> Definition, Brief history of Cell Biology, Units of measurement for cell, Interdisciplinary nature of Cell Biology	<b>01</b>
<b>2</b>	<b>Cell organelles:</b> Ultrastructure, components and functions of Cell wall and cell membranes, mitochondria and Chloroplast, endoplasmic Reticulum, Golgi apparatus, Lysosomes, Vacuoles, Peroxisomes & Glyoxysomes	<b>06</b>
<b>3.</b>	<b>Nucleus:</b> Morphology and ultrastructure of nucleus, nucleolus and nucleolar organizer Nuclear envelope – structure of nuclear pore complex, transport of molecules across nuclear envelope.	<b>03</b>
<b>4.</b>	<b>Chromosomes:</b> Euchromatin and heterochromatin Histones, Packing of DNA into chromosomes in eukaryotes, Karyotype and ideogram, Polytene chromosomes and lampbrush chromosomes.	<b>03</b>
<b>5</b>	<b>Cell signaling:</b> Introduction and definition, Signaling molecules and receptors, Calcium signaling pathway in plants	<b>02</b>
<b>Credit-II Molecular Biology</b>		<b>15</b>
<b>5</b>	<b>Genetic material DNA:</b> historical perspective from 1953 to 2020, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment.	<b>02</b>

6.	<b>DNA replication (Prokaryotes and Eukaryotes):</b> Molecular mechanism of DNA replication. Enzymes involved in both prokaryotic and eukaryotic DNA replication and their inhibitors (antibiotics).	03
7.	<b>Gene expression:Transcription (Prokaryotes in details and passing remarks on Eukaryotes)</b> Types of RNA: mRNA, tRNA, rRNA; types of promoters; types of RNA polymerase enzymes in eukaryotes; molecular mechanism of transcription.	04
8	<b>Translation (Prokaryotes and Eukaryotes):</b> Definition, concept and properties of genetic code; molecular mechanism of translation.	03
9	<b>Regulation of gene expression:</b> Concept of operon, <i>lac</i> operon and <i>trp</i> operon, positive and negative control, one gene one enzyme hypothesis.	03

### Suggested readings:

1. Cell and Molecular Biology , S. C. Rastogi
2. Cytology, T. S. Verma and V. K. Agarwal 3. Cell Biology, C. B. Pawar
4. Cell and Molecular Biology, P. K. Gupta
5. Fundamentals of Molecular Biology, Veer Bala Rastogi
6. Fundamentals of Molecular Biology, G. K. Pal and Ghaskadabi
7. Cell Biology, Molecular Biology, Genetic, Evolution and Ecology, Verma and Agarwal
8. Cell and Molecular Biology, Robertis and DeRobertis
9. Molecular Cell Biology, 4th Edition, Lodish S. Baltimore
10. Molecular Biology of Gene, Watson J. D.
11. Biochemistry and Molecular Biology of Plants, Buchanan B. B.
12. Molecular and Cell Biology, Wolfe S.L.

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester V, Paper VI) 2020-2021  
BO 356: Genetics - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
	<b>Credit-I</b>	<b>15</b>
1.	<b>Introduction to Genetics.</b> History, Definition, Concept, branches and applications of Genetics.	<b>01</b>
2	<b>Mendelism</b> Genetical terminology, Monohybrid cross, Law of dominance, Incomplete dominance, Law of segregation, Dihybrid cross, Dihybrid ratio, Law of	<b>04</b>

	independent assortment, Back cross and Test cross.	
<b>3.</b>	<b>Neo Mendelism (Gene Interaction)</b> Genetic interaction, Epistatic interactions –supplementary gene (recessive epistasis 9:3:4), Inhibitory genes (13:3), Masking genes (12:3:1), Non-Epistatic inter-allelic genetic interactions-Complementary genes (9:7), Duplicate genes (15:1)	<b>03</b>
<b>4.</b>	<b>Multiple alleles</b> Definition, Concept, Characters of multiple alleles, Examples of multiple alleles – Blood group in human and self-incompatibility in Nicotiana.	<b>02</b>
<b>5</b>	<b>Linkage, Recombination and Crossing Over</b> Linkage- Definition and Types, Crossing over: Definition and Types, Construction of a linkage map by two point test cross and three point test cross, Recombination: Concept, definition and types	<b>04</b>
<b>6</b>	<b>Mutation:</b> Concept, definition and types	<b>01</b>
<b>Credit-II</b>		<b>15</b>
<b>5</b>	<b>Numerical alterations of chromosomes.:</b> Euploidy, Aneuploidy-Concept and Types, Aneuploidy in Plants and Human, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy	<b>03</b>
<b>6.</b>	<b>Structural alterations of chromosomes.:</b> Types, cytology and genetic effects of Deletion, Duplication Inversion and Translocation with examples.	<b>04</b>
<b>7.</b>	<b>Cytoplasmic &amp; Quantitative Inheritance:</b> Concept of quantitative inheritance, Inheritance of quantitative trait in Maize (Cob length), Cytoplasmic inheritance Definition and concept, Chloroplast- Variegation in Four O'clock plants, Mitochondria- Petite mutants in yeast.	<b>04</b>
<b>8</b>	<b>Sex Linked Inheritance:</b> Concept of Sex chromosomes and autosomes, Inheritance of X- linked genes –Inheritance of colour blindness in humans, Inheritance of Y-linked (Holandric genes) in humans, Sex influenced genes, Sex-limited genes.	<b>04</b>

**Suggested readings:**

1. Atherly, A.G., Girton, J.R. and McDonald, J.F 1999. The Science of Genetics Saunders College Publishing, Frot Worth, USA.
2. Hartle D.L and Jones, E.W 1998 Genetics: Principles and Analysis (Fourth Edition). Jones and Bartlett Publishers, Massachusetts, USA.
3. Khush, G.S 1973. Cytogenetics of Aneuploids. Academic Press, New York, Lewis, R. 1997. Human Genetics: Concepts and Application (Second Edition). WCB McGraw Hill, USA.
4. Russel, P.J. 1998. Genetics (Fifth Edition). The Benjamin/Cummings Publishing Company IND., USA.
5. Snustad, D.P and Simmons, M.J 2000. Principles of Genetics (Second Edition). John Wiley and Sons Inc., USA.
6. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
7. Sarin C 2004 (Sixth Edition) Genetics. TATA McGraw-Hill Publishing Company Ltd., New Delhi.
8. Ahluwalia K.B 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
9. Burus and Bottino 1989. (Sixth Edition). The Science of Genetics. Macmillan Publishing Company, New York (USA).
10. Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai.
11. Strickberger 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.
12. Allard R.W 1995. Principles of Plant Breeding. John Wiley and Sons, Inc., Singapore.
13. Sharma J.R 1994 Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers Company Ltd., New Delhi.
14. Verma and Agarwal, Genetics, S. Chand Co, New Delhi.
15. Singh B.D 2004. Genetics. Kalyani Publication, Ludhiana.
16. Gupta P.K Genetics and Cytogenetics, Rastogi Publications.
17. Gupta P. K. Genetics Rastogi Publications.
18. Phundan Singh Genetics, Kalyani Publications.
19. Verma P.S and Agarwal V.K. (2006) Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
20. Shukla R.S. & Chandel P.S. Cytogenetics, Evolution & Biostatistics. S.Chand Publications.
21. Tomar & Singh Evolutionary Biology, Rastogi Publications.

22. Darbeshwar Roy Crop Evolution & Genetic Resources.

**T.Y.B.Sc. Botany CBCS Pattern  
Practical (Semester V Paper VII) 2020-2021  
BO 357: Practical based on BO351 and BO352 (2 Credits)**

Sr. No.	Title	No. of Practical
1.	Study of Algae with respect to systematic position, thallus structure and reproduction of <i>Nostoc</i> , <i>Oedogonium</i> , <i>Chara</i> , <i>Sargassum</i> , <i>Palmaria/Chondrus</i> .	04
2	Study of Fungi respect to systematic position, thallus structure and reproduction of <i>Mucor</i> , <i>Saccharomyces</i> , <i>Penicillium</i> , <i>Puccinia</i> and <i>Cercospora</i> .	04
3.	Study of <i>Marchantia</i> with respect to systematic position, morphology of thallus –rhizoids and scales, Gemma Cup, structure of sporophyte, reproduction.	01
4.	Study of <i>Anthoceros</i> with respect to systematic position, structure of gametophyte, anatomy of thallus, structure of Sporophytes, reproduction.	01
5	Study of <i>Funaria</i> with respect to systematic position, morphology of thallus- leaf, rhizoids, operculum, Anatomy of axis, leaf, reproduction	01
6	Study of Sporophyte evolution in Bryophytes with the help of permanent slides.	01
7	Study of <i>Psilotum</i> with respect to Taxonomic position, Morphology of sporophyte, anatomy and reproductive structure	01
8	Study of <i>Selaginella</i> with respect to Taxonomic position, Morphology of sporophyte, Anatomy and reproductive structures.	01
9	Study of <i>Equisetum</i> with respect to taxonomic position, Morphology of Sporophyte, anatomy and reproductive structure	01
10	Study of Stellar evolution in Pteridophytes with the help of permanent slides	01

**Note:** Botanical Excursion and submission of Tour Report with Photographs is compulsory.

**T.Y.B.Sc. Botany CBCS Pattern**  
**Practical (Semester V Paper VIII) 2020-2021**  
**BO 358: Practical based on BO353 and BO354 (2 Credits)**

Sr. No.	Title	No. of Practical
<b>1.</b>	Study of following families with reference to systematic position (following Bentham & Hooker), Diagnostic characters, floral formula, floral diagram of Nymphaeaceae, Oleaceae, Amaranthaceae, Cannaceae	<b>04</b>
<b>2</b>	Preparation of Botanical keys: Indented and bracketed keys by using vegetative and reproductive characters	<b>01</b>
<b>3</b>	Study of internal and external morphology of Gnetum	<b>01</b>
<b>4.</b>	Study of internal and external morphology of Pinus	<b>01</b>
<b>5.</b>	Study of the following with the help of slides and/ or specimens. i) Impression ii) Compression iii) Petrification	<b>01</b>
<b>6</b>	Study of polluted water body with ref. to BOD (D zero day and D fifth day).	<b>02</b>
<b>7</b>	Study of physicochemical properties of water body by using Sacchi disc, pH meter and electric conductivity meter	<b>02</b>
<b>8</b>	Acquisition of ecological data of particular locality by using GPS/ altimeter/geographic maps etc	<b>02</b>
<b>9</b>	Study of suitable ecosystem by line/belt transect method/ nested quadrat method	<b>02</b>

**Note:** Excursion tours of long and short duration are compulsory

**T.Y.B.Sc. Botany CBCS Pattern**  
**Practical (Semester V Paper IX) 2020-2021**  
**BO 359: Practical based on BO355 and BO356 (2 Credits)**

Sr. No.	Title	No. of Practical

1.	Cytological techniques-preparation of Fixatives, preparation of stains (Aceto carmine and Aceto-orcein).	01
2	Isolation of nuclei and characterization	01
3	Study of various stages of mitosis and meiosis	01
4	Induction of C metaphase in suitable plant material	01
4	Study of Chromosomes Morphology (from colchicines pretreated Onion root tip cells)	01
6	Isolation of plant genomic DNA by suitable method.	01
7	Estimation of Plant DNA by DPA method	01
8	Extraction and estimation of RNA by Orcinol Method	01
9	To study the monohybrid and dihybrid crosses with suitable data and its analysis by Chi-Square test.	01
10	Induction of tetraploidy in onion root cells and preparation of squash for observation of tetraploid cells.	01
11	Preparation of salivary gland chromosomes in <i>Chironomous</i> larvae.	01
12	Study of human genetic traits viz. PTC taste sensitivity, earlobe and rolling tongue, height, Skin colour, Hair colour, Eye colour in known population.	01
13	Genetic problems on gene mapping using three point test cross data.	01
14	Study of structural heterozygotes (multiple translocations) in <i>Rhoeo</i> .	01
15	Problems on quantitative inheritance. (Cob length in Maize)	01
16	Problems on Multiple Alleles. (Blood group in Human)	01

### Skill Enhancement course

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester V, Paper X) 2020-2021  
BO 3510: Medicinal Botany - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
<b>Credit-I</b>		<b>15</b>
1.	<b>Medicinal Plants:</b> History, Scope and Importance	<b>01</b>
2	<b>Indigenous Medicinal Sciences;</b> Definition and Scope	<b>01</b>
3.	<b>Ayurveda:</b> History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments	<b>04</b>
4.	<b>Siddha:</b> Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.	<b>02</b>
5	<b>Unani:</b> History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.	<b>02</b>
6	<b>Conservation of endangered and endemic medicinal plants:</b> Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens.	<b>05</b>
<b>Credit-II</b>		<b>15</b>
5	<b>Propagation of Medicinal Plants:</b> Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.	<b>05</b>
6.	<b>Ethnobotany and Folk medicines:</b> Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany.	<b>05</b>
7.	<b>Folk medicines</b> of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.	<b>05</b>

### Suggested Readings

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.



**Skill Enhancement course****T.Y.B.Sc. Botany CBCS Pattern  
(Semester V, Paper XI) 2020-2021****BO 3511: Plant Diversity and Human Health - 2 Credits (30 Lectures)**

<b>Sr. No.</b>	<b>Topic Details</b>	<b>No. of Lectures</b>
	<b>Credit-I</b>	<b>15</b>
<b>1.</b>	<b>Plant diversity</b> and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level,	<b>03</b>
<b>2</b>	<b>Agrobiodiversity</b> and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.	<b>05</b>
<b>3.</b>	<b>Loss of Biodiversity:</b> Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss,	<b>04</b>
<b>4.</b>	Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations.	<b>03</b>
	<b>Credit-II</b>	<b>15</b>
<b>5</b>	<b>Conservation of Biodiversity:</b> Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.	<b>08</b>
<b>6.</b>	Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.	<b>07</b>

**Suggested Readings**

Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester VI, Paper I) 2020-2021  
BO 361: Plant Physiology and Metabolism - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
<b>Credit-I</b>		<b>15</b>
<b>1.</b>	<b>Mineral nutrition:</b> Classification of mineral elements, macro and micronutrients; Role of essential elements; Transport of ions across cell membrane, Ionophores, Carriers and Channels	<b>03</b>
<b>3.</b>	<b>Photosynthesis:</b> Mechanism of photosynthesis- Electromagnetic spectrum Ultra-Structure of Chloroplast, Organization of Light-Absorbing Antenna Systems, Light Reaction: (Cyclic and Non-cyclic photophosphorylation), Dark Reaction: Calvin-Benson Cycle, Photorespiration, C4 cycle and CAM pathway of carbon fixation).	<b>07</b>
<b>4.</b>	<b>Respiration:</b> Types of respiration (Aerobic and anaerobic), Mechanism of aerobic respiration (Glycolysis, TCA cycle, Terminal oxidation and phosphorylation in respiratory chain); Pentose Phosphate Pathway.	<b>05</b>
<b>Credit-II</b>		<b>15</b>
<b>5</b>	<b>Stomatal Biology:</b> Light-dependent Stomatal Opening, Mediation of Blue-light Photoreception in Guard Cells by Zeaxanthin, Reversal of Blue Light-Stimulated Opening by Green Light, The Resolving Power of Photophysiology (Overview).	<b>04</b>
<b>6.</b>	<b>Translocation in phloem:</b> Composition of phloem sap, girdling experiment; Pressure flow model.	<b>03</b>
<b>7.</b>	<b>Plant growth regulators:</b> Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.	<b>05</b>
<b>8</b>	<b>Photomorphogenesis:</b> Red and far red light responses on photomorphogenesis; Phytochrome (discovery and mode of action).	<b>03</b>

**Suggested Readings:**

- Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy 2015. Plant Physiology and Development (Sixth Edition) Sinauer Associates, Inc Publishers Sunderland, Massachusetts U.S.A.

2. Epstein, E., and Bloom, A. J. (2005) Mineral Nutrition of Plants: Principles and Perspectives, 2nd ed. Sinauer Associates, Sunderland, MA.
3. Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.
4. V. K. Jain (2017) Fundamentals of Plant Physiology S. Chand Publications.

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester VI, Paper II) 2020-2021  
BO 362: Biochemistry - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
<b>Credit-I</b>		<b>15</b>
<b>1.</b>	<b>Foundation of Biochemistry:</b> From molecules to the first cell (origin of a cell), Miller and Urey experiment. Biomolecules of a cell, functional groups in biomolecules, conformations and configurations of biomolecules.	<b>03</b>
<b>2</b>	<b>Water: The solvent of life:</b> Physical properties of water, structure of water molecule, polarity of water molecule, weak interactions in aqueous solutions.	<b>02</b>
<b>3.</b>	<b>Amino acids and proteins:</b> Structure, classification, properties and functions of amino acids. Structure (primary, secondary, tertiary and quaternary), properties and functions of proteins. Biological disorders of amino acid metabolism. Commercial applications.	<b>05</b>
<b>4.</b>	<b>Enzymes:</b> Definition, nature of enzymes and co-factors, classification and properties of enzymes, active site. Mechanism of enzyme action: free energy, activation energy, binding energy, transition state, lock and key hypothesis, induced fit theory. Factors affecting enzyme activity: pH, temperature, substrate concentration, enzyme concentration. Enzyme inhibition: Competitive, uncompetitive, non-competitive. Reversible and irreversible inhibition, feedback inhibition.	<b>05</b>
<b>Credit-II</b>		<b>15</b>
<b>5</b>	<b>Carbohydrates:</b> Definition, classification of carbohydrates- Monosaccharides: aldoses and ketoses, configurations, linear to ring structure; Oligosaccharides: glycosidic bond, reducing and non-reducing sugars; Polysaccharides: homopolysaccharides, heteropolysaccharides,	<b>08</b>

	examples, their structures, locations and role. Properties and functions of carbohydrates. Commercial applications.	
6.	<b>Lipids:</b> Definition, classification of lipids: simple, conjugate and derived lipids, properties and functions of lipids. Biological disorders of lipid metabolism. Commercial applications.	<b>05</b>
7.	<b>Vitamins:</b> Definition, classification of vitamins. source and functions of vitamins.	<b>02</b>

### Suggested Readings:

1. Nelson, D. L., & Cox, M. M. (2017). *Lehninger principles of biochemistry* (7<sup>th</sup> ed.). W.H. Freeman.
2. Buchanan, B. B., Gruissem, W., & Jones, R. L. (2000). *Biochemistry & molecular biology of plants*. Rockville, Md.: American Society of Plant Physiologists.
3. Taiz, L. Zeiger, E., Moller, I.M. and Murphy, A. (2015) *Plant Physiology and Development*. 6th Edition, Sinauer Associates, Sunderland, CT.
4. Jain, J. L., Jain, S. & Jain, N. (2020) *Fundamentals of Biochemistry*, Revised edition, S. Chand Publishing
5. Verma S.K. and Verma M. (2007) *A text book of Plant Physiology, Biochemistry and Biotechnology*, S. Chand Publishing.

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester VI, Paper III) 2020-2021  
BO 363: Plant Pathology - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
	<b>Credit-I</b>	<b>15</b>
1.	<b>Fundamentals of Plant Pathology:</b> Introduction, Important terminology- Incitants, Host, Symptoms, Parasite, Pathogen, Inoculum, Penetration, Infection, Incubation, Disease. Economic importance of plant diseases, History of plant pathology, Introduction to Indian Agriculture Research Institute (IARI), International Crop Research Institute for Semi-Arid Tropics (ICRISAT), Contribution of Anton De Bary and Prof. B.B. Mundkur.	<b>02</b>
2	Disease Development: Concept of disease cycle, Inoculation, Prepenetration, Penetration, Infection, Dissemination. Epidemics-Forms,	<b>02</b>

	Decline, Exponential model.	
<b>3.</b>	<b>Defense Mechanisms:</b> Concept and Definition, Types-Preexisting- Structural and chemical, Induced- Structural and Biochemical.	<b>02</b>
<b>4.</b>	<b>Methods of Studying Plant Diseases.</b> Macroscopic study, Microscopic study, Koch's postulates. Types of culture Media, Pure culture methods- Streak plate, Pour plate, Spread plate.	<b>02</b>
<b>5</b>	<b>Fungal Plant Diseases</b> Introduction to fungi as plant pathogens. Study of Diseases- Downy mildew of Grapes, Head smut of Jowar, Tikka diseases of Groundnut with reference to causal organism, symptoms and disease management.	<b>04</b>
<b>6</b>	<b>Bacterial Plant Diseases.</b> Introduction to bacteria as plant pathogens, Study of Diseases- Citrus Canker, Black arm of Cotton with reference to causal organism, symptoms and disease management.	<b>03</b>
<b>Credit-II</b>		<b>15</b>
<b>5</b>	<b>Mycoplasma Plant Diseases:</b> Introduction to Mycoplasma as plant pathogens, Study of Diseases- Grassy shoot disease of sugarcane, Little leaf of brinjal with reference to causal organism, symptoms and disease management.	<b>03</b>
<b>6.</b>	<b>Nematodal Plant Diseases:</b> Introduction to Nematodes as plant pathogens. Study of Diseases- Root knot diseases of vegetables, Soyabean cyst Nematodes with reference to causal organism, symptoms, Integrated management of Nematodal diseases.	<b>02</b>
<b>7.</b>	<b>Viral Plant Diseases:</b> Introduction of Virus as plant pathogens. Study of Diseases- Papaya Mosaic Disease, Bunchy top of Banana with reference to causal organism, symptoms and causal organism	<b>02</b>
<b>8</b>	<b>Non-Parasitic Diseases.</b> The impact and abiotic causes- Temperature, Soil moisture and relative humidity, Poor oxygen, Poor light, Air pollutants, mineral deficiencies. Herbicidal injury, Study of Mango necrosis, Black Heart of Potato.	<b>04</b>
<b>9</b>	<b>Principles of plant diseases control:</b> General account, Quarantine,	<b>04</b>

	Eradication, cultural control practices, Biological control. Curative measures, chemical control, Use of Effective Microorganism solution (EMS), Microbial Pesticides.	
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**Suggested Readings:**

1. Singh R. S. (2019) Introduction to Principles of Plant Pathology 4Ed (PB2019) Paperback.
2. Plant Pathology 2/e PB....Sharma PD Paperback – 1 January 2016
3. A.V.S.S. Sambamurty (2010) Principles of plant pathology, Wiley distributor
4. George Agrios (2004) Plant Pathology 5th Edition, Academic Press

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester VI, Paper IV) 2020-2021  
BO 364: Evolution and Population genetics- 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
	<b>Credit-I</b>	<b>15</b>
<b>1</b>	<b>Organic Evolution:</b> Distinction between Origin of life and Organic Evolution, Historical account of Origin of life, Origin of Earth Vs Origin of life: Gaia Hypothesis, Earliest Fossils, Prebiotic Evolution, Abiotic synthesis of organic matter, Primordial soup, origin of membranes, Oparin's Coacervate model, Theory of Panspermia, Early life and RNA and Origin of genetic code	<b>06</b>
<b>2</b>	<b>Organic Evolution:</b> The concept of organic evolution, Theories of Evolution, Pre-Darwinian period, Theory of Inheritance of acquired characters (Lamarck's), Darwinism- Theory of Natural Selection, Post-Darwinian period- Modern synthetic theory	<b>05</b>
<b>2</b>	<b>Evidences of Evolution</b>  Direct evidences and conclusions from fossil records, Indirect evidences, Evidences from Genetics, Evidences from bio-geographical relations	<b>04</b>
	<b>Credit-II</b>	<b>15</b>
<b>4</b>	<b>Evolution Through Ages:</b> Fossils and Geological Time scale: Fossils and	<b>05</b>

	Fossilization, Conditions of fossilization, Dating of fossils: Uranium Lead method, Radio-carbon method, U-series and ESR method, Geological Time scale: Eras, Periods, epochs, and duration in millions of years and plant life.	
<b>5.</b>	<b>Population Genetics and Evolution:</b> Concept of Mendelian population, Gene Pool and its models, Hardy-Weinberg law of gene frequencies, Factors affecting allelic frequency, Genetic polymorphism	<b>04</b>
<b>5.</b>	<b>Speciation and Isolating Mechanisms:</b> Introduction, Morphological Criteria for Species and Races, Allopatric and Sympatric Populations, Isolating Mechanisms: Pre zygotic Isolation mechanisms: Concept, Spatial & Ecological;, Seasonal Isolation, Ethological Isolation, Mechanical Isolation, Post zygotic Isolation mechanisms: Concept, Hybrid in viability, Hybrid sterility & Hybrid breakdown.	<b>06</b>

**Suggested readings:**

1. P. K Gupta, Cytology, Genetics and Evolution , Rastogi Publications
2. Verma P.S and Agarwal V.K. (2006) Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S. Chand and Company, New Delhi
3. Shukla R.S. & Chandel P.S. Cytogenetics, Evolution & Biostatistics. S. Chand Publications,
4. Tomar & Singh, Evolutionary Biology, Rastogi Publications
5. Suryaprakash Mishra. A textbook of Cell Biology, Genetics and Evolution, Kalyani Publication
6. N Shukla, Population Genetics, DISCOVERY PUBLISHING, PVT. LTD.
7. Veer Bala Rastogi .Organic Evolution (Evolutionary Biology), Scientific International Pvt. Ltd.
8. N. Anurgam, Evolution, Saras Publications
9. N. Anurgam, Organic Evolution, Saras Publications

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester VI, Paper V) 2020-2021  
BO 365: Advanced Plant Biotechnology - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
	<b>Credit-I</b>	<b>15</b>
<b>1</b>	<b>Biotechnology:</b>	<b>02</b>

	Introduction, Traditional and modern Biotechnology. Impact of Biotechnology on Health care, Agriculture, and Environment	
<b>2</b>	<b>Plant Tissue Culture:</b> Concepts of Cell theory & Cellular totipotency, Landmarks in plant tissue culture. Pluripotency, Differentiation, dedifferentiation, redifferentiation, Hormones used in PTC, 'Explant' for plant tissue culture and Response of explants in vitro– callus formation, organogenesis (direct and indirect) and embryogenesis (direct and indirect). Micro propagation of Banana (in detail from Selection of explant to hardening and marketing)	<b>06</b>
<b>3.</b>	<b>Techniques of Genetic Engineering and Methods of gene transfer in Plants-</b> Introduction to Molecular tools: Definition and role of Nucleases, Polymerases, Ligases, Polynucleotide kinases, Alkaline Phosphatases. Types of vectors- Definition and characters (2-4) of Plasmids, Phages, Cosmids, BAC, YAC, Plant viruses, Animal viruses.  Methods of gene transfer in Plants –  Direct gene transfer – Definition and concept of Electroporation, Microinjection, and Gene gun  Indirect gene transfer- Agrobacterium mediated gene transfer method, Ti-plasmid: structure and functions, T-DNA  Gene amplification technique -Polymerase chain reaction  DNA finger printing	<b>07</b>
<b>Credit-II</b>		<b>15</b>
<b>4</b>	<b>Cryopreservation and Germplasm Conservation</b>  Definition and concept, techniques of cryopreservation, cold storage, long term and short term storage, applications.  <b>Germplasm Conservation:</b> Preservation of Cell, tissue, organ, whole organism. Concept of Gene Bank, DNA Bank, Seed Bank, Pollen Bank etc.	<b>03</b>
<b>5.</b>	<b>Biotechnology and Society</b>	<b>05</b>



	Biotechnology- Benefits, GM foods and its safety, Recombinant foods and religious beliefs, Recombinant therapeutic product for human health care. Patenting of biotechnological inventions and Intellectual property rights.	
<b>5.</b>	<p><b>Microbial Biotechnology:</b></p> <p>Biochemistry of fermentation, Microorganism used in fermentation, fermentable substrate, Ethanol fermentation methods, Distilleries producing alcohols. Commercial production: Alcoholic beverages, organic acids, citric acids. Advantages of fermentation.</p> <p><b>Transgenic Plants as Bioreactors:</b> Metabolic engineering of starch, cyclodextrins, fructans, Bioplastics, Genetically engineered plants as protein factories, Production of therapeutic proteins from plants.</p>	<b>06</b>
<b>6</b>	<p><b>Nano-biotechnology</b></p> <p>Definition and concept, Applications of nanotechnology in agriculture (fertilizers and pesticides).</p>	<b>01</b>

### Suggested readings:

1. R. C. Dube (2008) - A Text Book of Biotechnology, S. Chand
2. P.K. Gupta-Elements of Biotechnology
3. Satyanarayana-Biotechnology
4. Kalyan Kumar De-Plant tissue culture
5. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
6. Verma and Agrawal- Molecular Biology
7. Devi P.2008-Principle and Methods of plant Molecular Biology, Biochemistry and Genetics Agrobios, Jodhpur, India.
8. Glick B.R. and Tompson J.E. 1993 Methods in Plant Molecular Biology and Biotechnology CRC Press Boca Raton, Florida.
9. Hall R.D. (Ed.) 1999 Plant cell culture Protocol human press Inc., New Jersey, USA

10. Kumar H.D. 2002 A Text Book of Biotechnology 2nd Edn. Affiliated Easyt West Press Private Ltd New Delhi.
11. Ramawat K.G. 2003 Plant Biotechnology, S. Chand & Co. Ltd . Ramnagar New Delhi. 110055
12. Trivedi P.C.2000 Plant Biotechnology, Panima Publishing Carpation, New Delhi.
13. Rajdan- Plant tissue culture.
13. Kalyan Kumar De-Plant tissue culture
14. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
15. .Razdan M.K. - Introduction to Plant Tissue culture (Oxford & IBH Publ, New Delhi)

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester VI, Paper VI) 2020-2021  
BO 366: Plant Breeding and Seed Technology - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
	<b>Credit-I –Plant Breeding</b>	<b>15</b>
<b>1</b>	<b>Introduction:</b> Definition, Scope and objectives and History of Plant breeding in India	<b>01</b>
<b>2</b>	<b>Techniques and practices of plant breeding</b>	<b>02</b>
	<b>A. Plant Introduction</b> <ul style="list-style-type: none"> <li>• Definition</li> <li>• Types (Primary and Secondary)</li> <li>• Procedure</li> <li>• Merits and Demerits</li> <li>• Important Achievements</li> </ul>	
	<b>B. Selection methods</b> <ul style="list-style-type: none"> <li>• Concept,</li> <li>• Types of selections –mass selection, pure line selection and clonal selection.</li> <li>• Advantage and disadvantages of selection</li> <li>• Achievements of selection breeding</li> </ul>	<b>03</b>
	<b>C. Hybridization</b> <ul style="list-style-type: none"> <li>• Definition, Concept and Objectives</li> <li>• Precaution to be taken during hybridization</li> <li>• Types: Intervarietal and Distant</li> <li>• General procedure of hybridization</li> <li>• Methods of hybridization: Pdigree and bulk</li> <li>• Hybrid vigour and heterosis</li> </ul>	<b>04</b>
<b>3</b>	<b>Advanced techniques in Plant breeding</b>	<b>03</b>
	<b>A. Mutation breeding</b>	

	<ul style="list-style-type: none"> <li>• Definition and concept</li> <li>• Mutagens (Physical and Chemical)</li> <li>• Mutants</li> <li>• Types of mutation (Spontaneous and Induced)</li> <li>• Application of mutation breeding</li> <li>• Limitations of mutation breeding</li> </ul>	
	<p><b>B. Tissue Culture</b></p> <ul style="list-style-type: none"> <li>• Definition and concept</li> <li>• Totipotency</li> <li>• Application of tissue, embryo and anther culture in seed production</li> </ul>	<b>02</b>
<b>Credit-II - SEED TECHNOLOGY</b>		<b>15</b>
<b>4</b>	<p><b>Introduction to Seed Technology</b></p> <ul style="list-style-type: none"> <li>• Seed as a basic input in agriculture</li> <li>• Classes of seed               <ol style="list-style-type: none"> <li>1. Nucleus</li> <li>2. Breeder</li> <li>3. Foundation</li> <li>4. Certified</li> </ol> </li> </ul> <p>Role of seed technology</p>	<b>02</b>
<b>5.</b>	<p><b>Seed legislation</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Seed legislation in India (Seed Act)</li> </ul>	<b>01</b>
<b>6</b>	<p><b>Seed Production</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• National Seed Corporation (NSC) and its objectives</li> <li>• State Seed Corporation (SSC) and its objectives</li> <li>• General procedure for Seed Production               <ul style="list-style-type: none"> <li>○ Location and Season</li> <li>○ Land requirement</li> <li>○ Importance of soil and water testing</li> <li>○ Cultural practices</li> <li>○ Isolation distance</li> <li>○ Plant protection</li> <li>○ Weed Control</li> <li>○ Rouging</li> <li>○ Harvesting</li> <li>○ Threshing</li> <li>○ Seed Processing</li> </ul> </li> </ul>	<b>03</b>
<b>7</b>	<p><b>Seed Certification</b></p> <ul style="list-style-type: none"> <li>• Definition, Objectives and Concept</li> <li>• Phases of Seed Certification</li> <li>• General procedure of seed certification</li> <li>• Field inspection</li> <li>• Duties of seed inspector</li> </ul>	<b>02</b>
<b>8</b>	<p><b>Seed Testing</b></p>	<b>03</b>

	<p><b>A. Physical Purity Analysis</b></p> <ul style="list-style-type: none"> <li>• Definition of purity components</li> <li>• Physical Purity Work Board</li> <li>• Procedure</li> </ul> <p><b>B. Moisture Testing</b></p> <ul style="list-style-type: none"> <li>• Concept</li> <li>• Air oven method</li> <li>• Digital Moisture Meter</li> </ul> <p><b>C. Germination testing</b></p> <ul style="list-style-type: none"> <li>• Definition and objectives</li> <li>• Procedure and methods for germination testing (Paper, Sand and Soil )</li> <li>• Seedling evaluation (Normal Seedlings, Abnormal Seedlings, Multigerm Seed Units and Non-germinated Seeds)</li> </ul>	
<b>9</b>	<p><b>Seed Pathology and Entomology</b></p> <ul style="list-style-type: none"> <li>• Definition</li> <li>• Seed Borne pathogens <ul style="list-style-type: none"> <li>○ Fungi</li> <li>○ Bacteria</li> <li>○ Viruses</li> </ul> </li> <li>• Influence of seed borne pathogens on seed production</li> <li>• Common insect pest and its impact on seed production</li> </ul>	<b>02</b>
<b>10</b>	<p><b>Seed Storage</b></p> <ul style="list-style-type: none"> <li>• Definition and Concept</li> <li>• Seed treatment</li> <li>• Management of seed storage structures <ul style="list-style-type: none"> <li>○ Sanitization</li> <li>○ Dehumidification</li> <li>○ Fumigation</li> </ul> </li> </ul>	<b>02</b>

## Suggested readings:

1. Laxmi lal somani and Devidas patel (2020) Textbook of seed science and technology, Agrotech publishing co.
2. Vijay Pal Singh Panghal and Axay Bhuker (2020) Seed Science and Technology. Kalyani publisher
3. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
4. Sharma J.R 1994 Principles and practices of Plant Breeding. Tata McGraw Hill Publishers Company Ltd., New Delhi.
5. Singh B.D 1996 Plant Breeding – Principles and methods. Kalyani Publications, Ludhiana.
6. Allard R.W 1995. Principles of Plant Breeding. John Wiley and Sons, Ice., Singapore.
7. Agarwal R.L. --- Seed Technology, Oxford & IBH Publishing Co Pvt.Ltd

## 8. TNAU (ICAR) Principles of Seed technology (2020)

**T.Y.B.Sc. Botany CBCS Pattern**  
**Practical (Semester V Paper VII) 2020-2021**  
**BO 367: Practical based on BO361 and BO362 (2 Credits)**

Sr. No.	Title	No. of Practical
1.	Determination of osmotic potential of plant cell sap by plasmolysis method	01
2	Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.	01
3	Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.	01
4	To study the effect of light intensity and bicarbonate concentration on O <sub>2</sub> evolution in photosynthesis.	01
5	Comparison of the rate of respiration in any two parts of a plant.	01
6	Separation of amino acids by paper chromatography.	02
7	Demonstration experiments (any four) i). Bolting. ii). Effect of auxins on rooting. iii). Suction due to transpiration. iv). R.Q. v). Respiration in roots.	01
8	Estimation of total free amino acids by spectrophotometry	01
9	Separation of amino acids by paper chromatography.	01
10	Estimation of soluble proteins by Lowery <i>et. al.</i> method.	01
11	Demonstration of Enzyme activity: Amylase /invertase /catalase	01

12	Estimation of reducing sugars by DNSA method.	01
13	Estimation of Vitamin C (Ascorbic acid) from plants.	01
14	Qualitative tests for starch, lipids and proteins.	01
15	Determination of the iodine number of lipids using Hanus method.	01

**T.Y.B.Sc. Botany CBCS Pattern  
Practical (Semester V Paper VIII) 2020-2021  
BO 368: Practical based on BO363 and BO364 (2 Credits)**

Sr. No.	Title	No. of Practical
1.	Preparation of any one culture media for isolation of plant pathogens.	01
2	Culture technique- Streak plate methods, pour plate methods, Spread plate methods.	01
3	Study of any two of fungal (Downy mildew of Grapes, Head smut of Jowar, Tikka diseases of Groundnut) diseases	01
4	Study of any two of each bacterial and mycoplasma diseases	01
5	Study of any two of each viral and non-parasitic diseases of plants.	01
6	Preparation of 1% Bordeaux mixture and Bordeaux paste 10%.	01
7	Preparation of Jivamruta.	01
8	Study of Koch's Postulates.	01
9	Study of Fungicides and Microbial pesticides.	01
9	Study of Geological time scale	01
10	Study of types of Fossils : i) Coal ball ii) Rhynia vii) Lyginopteris iii) Pentoxylon iv) Nipaniophyllum v) Lepidodendron	01
11	Demonstration of any three evidences of Organic Evolution	01
12	Numerical Problems based on Allele frequency and Genotype frequency	01
13	Numerical Problem based on Hardy-Weinberg Equilibrium	01

14	Study of Sympatric and Allopatric speciation with suitable example	01
15	Study of Isolation mechanism : Prezygotic & Postzygotic(Any one example from each)	01
16	Submission of Report on Visit to Paleobotany Laboratory/Museum/Fossil Garden	01

**T.Y.B.Sc. Botany CBCS Pattern  
Practical (Semester V Paper IX) 2020-2021  
BO 369: Practical based on BO365 and BO366 (2 Credits)**

Sr. No.	Title	No. of Practical
1.	Preparation and sterilization of MS Medium and Callus Induction using leaf primordia	01
2	Production of secondary metabolites in any suitable plant material	01
3	Artificial seed production by Sodium Alginate method encapsulation (somatic embryogenesis)	01
4	Demonstration to equipments used in genetic engineering like gene gun, PCR, gel doc, microcentrifuge, electrophoresis, micropipettes, incubator, shaker etc. (live/videos/photographs/visit to research labs)	01
5	Study of Transgenic plants- Arabidopsis thaliana as a model plant, Bt- Brinjal, Flr-svr Tomato, and other GM crops like soybean, maize, tobacco as a pharmaceuticals, banana as a edible vaccine etc. (live/videos/photographs/visit to research labs)	01
6	Preparation of plant based nano-particles	01
7	Demonstration to Fermentation of fruit juice and wine production from grapes/pomegranate/jamun/ apple/ber (live/videos/photographs/visit to research labs)	01
8	Problems on genetic engineering (set of problems will be given on restriction enzymes, vectors etc.)	01

9	Demonstration of Hybridization Techniques (Emasculation, Hand Pollination, Bagging and Tagging) in cotton and tomato.	01
9	Effect of chemical mutagens on seed germination and seedling growth.	01
10	Study of pollen viability and floral morphology of crops	01
11	To test seed moisture by hot air oven method	01
12	To study germination methods (Paper, Sand and Soil)	01
13	Physical purity analysis of seed sample	01
14	Visual examination of dry seeds for disease symptoms	01
15	To study any one common seed insect pest w.r.t to their life cycle, way of infestation/damage, symptoms and control measures.	01
16	Visit to a Plant Breeding Research Centre/ Seed Industry and report submission	01

Note: Submission of minimum 10 seed samples along with their botanical names, family, variety etc. to the department at the time of final practical examination

### Skill Enhancement course

#### T.Y.B.Sc. Botany CBCS Pattern (Semester VI, Paper X) 2020-2021

#### BO 3610: Nursery and Gardening Management- 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	<b>Credit-I Nursery Management</b>	<b>15</b>
<b>1</b>	<b>Nursery:</b> definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.	<b>03</b>
<b>2</b>	<b>Seed:</b> Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion –Seed production technology - seed testing and certification.	<b>03</b>
<b>3.</b>	<b>Vegetative propagation:</b> air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants– greenhouse - mist chamber, shed root, shade house and glass house.	<b>09</b>



<b>Credit-II Gardening Management</b>		<b>15</b>
<b>4</b>	Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design -computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	<b>08</b>
<b>5.</b>	Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.	<b>07</b>

### Suggested Readings

1. Bose T.K. & Mukherjee, D., Gardening in India, Oxford & IBH Publishing Co., New Delhi. 1972.
2. Sandhu, M.K., Plant Propagation, Wile Eastern Ltd., Bangalore, Madras. 1989.
3. Kumar, N., Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 1997.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. 1993.
6. Janick Jules. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA. 1979.

**T.Y.B.Sc. Botany CBCS Pattern  
(Semester VI, Paper X) 2020-2021  
BO 3611: Biofertilizers- 2 Credits (30 Lectures)**

<b>Sr. No.</b>	<b>Topic Details</b>	<b>No. of Lectures</b>
<b>Credit-I</b>		<b>15</b>
<b>1</b>	<b>Introduction:</b> 1.1 Introduction, Scope and importance of Biofertilizers 1.2 General account of the microbes used as Biofertilizers	<b>02</b>
<b>2</b>	<b>Bacterial Biofertilizers</b> 2.1. Isolation of Rhizobium, Identification, Mass multiplication, Carrier based inoculants. 2.2. Azospirillum isolation and mass multiplication, carrier based	<b>09</b>

	<p>inoculants and associative effect of different organisms</p> <p>2.3. Azotobacter, classification and characteristics</p> <p>2.4. Crop response to Azotobacter inoculums, Mass multiplication of Azotobacter</p> <p>2.5. Applications of Azospirillum</p> <p>2.6. Phosphate solubilizing Bacteria</p>	
<b>3.</b>	<p><b>Algal Biofertilizers</b></p> <p>3:1. Cyanobacteria (Blue Green Algae): Isolation of Anabaena from Azolla, Mass Multiplication of Anabaena</p> <p>3.2. Azolla - Anabaena relationship</p> <p>3.3. Biological Nitrogen fixation</p> <p>3.4. Blue Green algae in a rice cultivation.</p> <p>3.5. Applications of BGA</p>	<b>04</b>
	<b>Credit-II</b>	<b>15</b>
<b>4</b>	<p><b>Fungal Biofertilizers</b></p> <p>4.1. Introduction, Occurrence and Distribution of Mycorrhizal association.</p> <p>4:2. Types of Mycorrhizal association, growth and yield - colonization of VAM - Vesicular Arbuscular Mycorrhiza</p> <p>4.3. Mycorrhizal applications in agriculture</p>	<b>09</b>
<b>5.</b>	<p><b>Compost and Manure</b></p> <p>5.1. Organic Farming, green manuring, organic manures and their uses</p> <p>5.2. Recycling by composting method of biodegradable, municipal, agricultural and industrial wastes</p> <p>5.3. Biocompost making methods, Types and methods of vermicomposting</p> <p>5.4. Benefits of vermicompost, field applications</p>	<b>06</b>

### Suggested readings

1. Dubey, R. C. (2005). A text book of Biotechnology. S. Chand & Co. New Delhi, India.
2. Kumaresan, V. (2005). Biotechnology. Saras Publication, New Delhi, India.
3. Sathe, T. V. (2004). Vermiculture and Organic Farming. Daya Publishers, Delhi, India.
4. Jshon, Jothi Prakash, E. (2004). Outline of Plant Biotechnology. Emkay Publication, New Delhi, India.
5. Subha Rao, N. S. (2000). Soil Microbiology. Oxford and IBH Publishers, New Delhi, India.
6. Vayas, S. C., Vayas S. and Modi, H. (1990). Biofertilizers and Organic Farming. Ekta Publication, Nanded, India.

### **Webliography**

1. Production of various Biofertilizers. [www.biologydiscussion.com](http://www.biologydiscussion.com)
2. Biofertilizers [vikaspedia.in](http://vikaspedia.in)
3. [www.solverchem.com](http://www.solverchem.com)