

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
(Affiliated to Savitribai Phule Pune University, Pune)



Choice Based Credit System (CBCS)
Bachelor of Science (B. Sc.)

Syllabus of

T. Y. B. Sc. Botany

Implemented from

Academic year 2023 -24

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)

Board of studies in Botany

Sr. No.	Name	Designation
1.	Dr. D. D. Ahire	Chairman
2.	Dr. Y. R. Gahile	Member
3.	Dr. P. P. Sharma	Academic Council Nominee
4.	Dr. M. L. Ahire	Academic Council Nominee
5.	Dr. S. G. Auti	Vice-Chancellor Nominee
6.	Mr. D. K. Jadhav	Alumni
7.	Dr. S. A. Punekar	Industry Expert
8.	Mr. A. S. Wani	Member (co-opt)
9.	Dr. A. A. Kulkarni	Member (co-opt)
10.	Dr. B. N. Sonawane	Member (Subject expert)

1. Prologue/ Introduction of the programme:

1. To provide thorough knowledge about various plant groups from primitive to highly evolved.
2. Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of plant in taxonomy.
3. Critically evaluation of ideas and arguments by collection relevant information about the plants, so as recognize the position of plant in the broad classification and phylogenetic level.
4. Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and a depth and breadth of knowledge/expertise in the field of Plant Identification.
5. Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of plants, algae, and fungi that differentiate them from each other and from other forms of life.
6. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.
7. Students will be able to explain how plants function at the level of the gene, genome, cell, tissue, Flower development. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and mode of life cycle followed by different forms of plants.
8. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within botany.
9. To make the students aware of applications of different plants in various industries.
10. To highlight the potential of these studies to become an enterpruner.
11. To equip the students with skills related to laboratory as well as industries based studies
12. To equippe the students with skills related to laboratory as well as field based studies.
13. To make the students aware about conservation and sustainable use of plants.
14. To create foundation for further studies in Botany.
15. To address the socio-economical challenges related to plant sciences.
16. To facilitate students for taking up and shaping a successful career in Botany.

2. Programme outcomes (Pos):

PSO1. Educate students about plant science.

PSO2. Inculcate strong fundamentals on modern and classical aspects of Botany.

PSO3. Create platform for higher studies in Botany.

PSO4. Facilitate students to take-up successful career in Botany

PSO5. Acquire practical skills to gather information, assess, create and execute new ideas to develop entrepreneurial skills.

PSO6. Learn to respect and conserve nature and the environment.

3. Programme Structure and Course Titles

Sr. No.	Class	Semester	Course Code	Course Title	Credits
1.	F.Y.B.Sc.	I	BSC-BO 101 T	Plant Life and Utilization I	2
2.	F.Y.B.Sc.	I	BSC-BO 102 T	Plant Morphology and Anatomy	2
3.	F.Y.B.Sc.	I	BSC-BO 103 P	Practicals based on BO 101 and BO 102	1.5
4.	F.Y.B.Sc.	II	BSC-BO 201 T	Plant Life and Utilization II	2
5.	F.Y.B.Sc.	II	BSC-BO 202 T	Principles of Plant Science	2
6.	F.Y.B.Sc.	II	BSC-BO 203 P	Practicals based on BO 201 and BO 202	1.5
7.	S.Y.B.Sc.	III	BSC-BO 301 T	Taxonomy of Angiosperms and Plant Ecology	2
8.	S.Y.B.Sc.	III	BSC-BO 302 T	Plant Physiology	2
9.	S.Y.B.Sc.	III	BSC-BO 303 P	Practicals based on BO 301 and BO 302	2
10.	S.Y.B.Sc.	IV	BSC-BO 401 T	Plant Anatomy and Embryology	2
11.	S.Y.B.Sc.	IV	BSC-BO 402 T	Plant Biotechnology	2
12.	S.Y.B.Sc.	IV	BSC-BO 403 P	Practicals based on BO 401 and BO 402	2

13.	T.Y.B.Sc.	V	BSC-BO 501 T	Algae and Fungi	2
14.	T.Y.B.Sc.	V	BSC-BO 502 T	Archegoniate	2
15.	T.Y.B.Sc.	V	BSC-BO 503 T	Spermatophyta and Paleobotany	2
16.	T.Y.B.Sc.	V	BSC-BO 504 T	Plant Ecology	2
17.	T.Y.B.Sc.	V	BSC-BO 505 T	Cell and Molecular Biology	2
18.	T.Y.B.Sc.	V	BSC-BO 506 T	Genetics	2
19.	T.Y.B.Sc.	V	BSC-BO 507 P	Botany Practical I Based on BO 501 and BO 502	2
20.	T.Y.B.Sc.	V	BSC-BO 508 P	Botany Practical II Based on BO 503 and BO 504	2
21.	T.Y.B.Sc.	V	BSC-BO 509 P	Botany Practical III Based on BO 505 and BO 506	2
22.	T.Y.B.Sc.	V	BSC-BO 510 T	Nursery and Gardening Management	2
23.	T.Y.B.Sc.	V	BSC-BO 511 P	Practicals based on BO 510	2
24.	T.Y.B.Sc.	VI	BSC-BO 601 T	Plant Physiology and Metabolism	2
25.	T.Y.B.Sc.	VI	BSC-BO 602 T	Biochemistry	2
26.	T.Y.B.Sc.	VI	BSC-BO 603 T	Plant Pathology	2
27.	T.Y.B.Sc.	VI	BSC-BO 604 T	Evolution and population Genetics	2
28.	T.Y.B.Sc.	VI	BSC-BO 605 T	Advanced Plant Biotechnology	2
29.	T.Y.B.Sc.	VI	BSC-BO 606 T	Plant Breeding and Seed Technology	2
30.	T.Y.B.Sc.	VI	BSC-BO 607 P	Botany Practical I Based on BO 601 and BO 602	2
31.	T.Y.B.Sc.	VI	BSC-BO 608 P	Botany Practical II Based on BO 603 and BO 604	2
32.	T.Y.B.Sc.	VI	BSC-BO 609 P	Botany Practical III Based on BO 605 and BO 606	2
33.	T.Y.B.Sc.	VI	BSC-BO 610 T	Medicinal Botany	2

34.	T.Y.B.Sc.	VI	BSC-BO 611 P	Project	2
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**Syllabus of T. Y. B. Sc. Botany
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Semester-V	Paper-I
Course Code : BSC-BO501 T	Title of Course : Algae and Fungi
Credits: 02	Total lecture: 30 Hours

Course outcomes: After the completion of course, students will able to

1. Understand the diversity among Algae.
2. Know the systematics, morphology and structure of Algae.
3. Understand the life cycle pattern of algae.
4. Understand the applications of algae.
5. Understand the classification and diversity of fungi.
6. Know the Economic Importance of fungi.

Detail Syllabus

Credit-I Algae

(15 Hours)

UNIT I: Introduction: Cryptogams- meaning. Types- Lower Cryptogams, brief review with examples. **01**

UNIT II: Algae: General characters, distribution, Thallus organization, habit and Habitat reproduction and Classification (G.M.Smith 1955) up to classes. **04**

UNIT III: Study of life cycle of algae with reference to taxonomic position, Occurrence, thallus structure, and reproduction of *Nostoc*, *Oedogonium*, *Chara*, *Sargassum* and *Batrachospermum*. **08**

UNIT IV: Economic importance of algae- Role in industry, agriculture, food, fodder, fuel and medicine. **02**

Credit-II Fungi

15 Hours

UNIT I: Fungi: General characters, Habit and habitats, thallus organization, cell wall composition, nutrition and Classification. (Alexopoulos and Mims 1979) up to classes. **03**

UNIT II: Study of life cycle of fungi with reference to taxonomic position, thallus structure, and reproduction of *Mucor* (Zygomycotina), *Saccharomyces* (Ascomycotina), *Puccinia* (Basidiomycotina), *Penecillium* and *Cercospora* (Deuteromycotina) **07**

UNIT III: Symbiotic Associations - Lichens, Mycorrhiza and their significance. **03**

UNIT IV: Economic importance fungi of Role in industry, agriculture, food and medicine. **02**

Suggested readings:

1. Vashistha B. R. et al., Botany for degreestudents-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 NewDelhi.
5. Vashishta B.R. et al., Botany for degree students-Fungi
6. Sharma, P.D.-TheFungi
7. Sharma, O.P.-Fungi Economic importance offungi
8. Alexopoulos C. J , Mims C.W. and Blacwel M.I 1996. Introductory Mycology. John Wiley and SonsInc.

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Semester-V	Paper-II
Course Code : BSC-BO 502T	Title of Course : Archegoniate
Credits: 02	Total lecture: 30 Hours

Course Work Outcome- After the completion of course students will able to

1. Know the scope and importance of the Discipline.
2. Understand the morphological, anatomical and reproductive diversity in bryophytes, pteridophytes and gymnosperms.
3. Understand the origin and thallus organization in bryophytes.
4. Understand the origin of pteridophytes.
5. Know the evolution of bryophytes and pteridophytes.
6. Understand the ecological and economic importance of bryophytes and pteridophytes.

Detailed syllabus:

Credit-I : Bryophytes

15 Hours

UNIT I: Introduction to Archegoniate.	01
UNIT II- Introduction, general characters, distribution of Bryophytes to land habit, classification of Bryophytes according to G.M. Smith (1955) up to classes with reasons.	02
UNIT III- Range of thallus organization, origin of Bryophytes - Pteridophytes and Algal hypothesis, evolution of sporophyte.	02
UNIT IV- 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> .	09
UNIT V- Ecological and economic importance of Bryophyte	01

Credit-II : Pteridophytes**15 Hours**

UNIT I- Introduction, Vascular Cryptogams, General characteristics, Classification according to K.R. Sporne (1975) up to classes with reasons, Diversity and Distribution of Pteridophytes. 02

UNIT II- Resemblances and differences between Pteridophytes and Bryophytes, Origin of Pteridophytes -Algal and Bryophytes, Evolution of Pteridophytes- Telome Theory and Enation Theory. 03

UNIT III-Study of Life Cycle of Pteridophytes with respect to Taxonomic position, Morphology, Anatomy, Reproduction, Sporophytes and Gametophytes of *Psilotum*, *Selaginella* and *Equisetum* 09

UNIT IV-Ecological and Economical Importance of Pteridophytes 01

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. Ltd Bombay.
7. Vashishta B.R. Botany for degree students Bryophytes- Vol-III
8. Vashishta B.R. Botany for degree students Pteridophytes.
- 9.P.C. Vashishta. Vascular Cryptogams. Chand and Company Ltd.
- 10 A. Rashid. An Introduction to Bryophyta. Vikas Publication House Pvt.Ltd.
11. A. Rashid. An Introduction to Pteridophytes. Vikas Publication House Pvt.Ltd.

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Semester-V	Paper-III
Course Code : BSC-BO503 T	Title of Course : Spermatophyta and Palaeobotany
Credits: 02	Total lecture: 30 Hours

Course outcomes: After the completion of course students will able to

1. Know the origin of angiosperms.
2. Understand concept of speciation.
3. Learn classification systems and selected families.
4. Know about leading botanic gardens of world and India.
5. Study of Gymnosperms along with classification
6. Learn the types of fossils.

Detailed syllabus:

Credit-I

15 Hours

UNIT I: Origin of angiosperms: with reference to time, place and ancestry- 1) Pseudanthial theory
2) Transitional-Combinational Theory **02**

UNIT II: Speciation & Endemism: Species concept (Biological, Taxonomic & Phylogenetic Species Concept), Speciation (Allopatric, Sympatric & Parapatric), Endemism and its types (Palaeoendemism, Holoendemism and Neoendemism) **04**

UNIT III: Classification: 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. **06**

UNIT IV: Herbaria and Botanical Gardens

Functions of Herbarium, Important herbaria (World: Kew herbarium; India: Central National Herbarium, Kolkata).

Botanic gardens of the world (Royal Botanic Garden, Kew) and India (Lead Botanic Garden, Shivaji University, Kolhapur). BSI- Organization and functions **03**

Credit-II Gymnosperms and Palaeobotany

15 Hours

UNIT I: Introduction, general characters, economic importance and classification according to Chamberlain (1934). **02**

UNIT II: Study of life cycle of *Pinus* and *Gnetum* with reference to distribution, morphology, anatomy, reproduction, gametophyte, sporophyte, seed structure and alternation of generations. **10**

UNIT III: 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 IInd 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/>

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Semester-V	Paper-IV
Course Code: BSC-BO504 T	Title of Course: Plant Ecology
Credits: 02	Total lecture: 30 Hours

Course outcomes:

On completion of the course, students will be able to:

1. Understand about the inter relationship between living world and environment.
2. Know Biogeography and various biogeochemical cycles.
3. Learn about the population and community ecology.
4. Understand Ecological Impact Assessment (EIA), Environmental Audit, Remote Sensing, Ecological management.

Detailed syllabus:**Credit-I****15 Hours**

UNIT I: 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**

UNIT II: Biogeography: Floristic realms, speciation and its types, biogeographic regions of India's Plant indicators. **03**

UNIT III: Population ecology: Definition, characteristics, population growth form/curve, r and k selected species. **03**

UNIT IV: Community ecology: Introduction and Definition, community structure, physiognomy, Raunkiaer's life form classification, keystone species, edge and ecotone. **04**

UNIT V: Biogeochemical cycles: The carbon cycle, Nitrogen cycle, Phosphorus cycle, and Hydrologic cycle. **02**

Credit-II**15 Hours**

UNIT I: Ecological Impact Assessment (EIA) 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**

UNIT II: Environmental Audit

Meaning and concept, need, objectives, benefits, types, audit protocol, process, certification, personnel environmental audit. **04**

UNIT III: Remote Sensing

Definition, basic principles, process of ecological data acquisition and interpretation, global positioning system, application of remote sensing in ecology. **04**

UNIT IV: Ecological management: Concepts, sustainable development, sustainability indicators. **02**

Suggested Readings:

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 Handbook, 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. Kermond 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. Anamaya publ, New Delhi
14. Smith L.R. 1996. Ecology and Field Biology (5th edition). Harper Collins 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.

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Semester-V	Paper-V
Course Code : BSC-BO505 T	Title of Course : Cell and Molecular Biology
Credits: 02	Total lecture: 30 Hours

Course outcomes: By the end of this course, the students will Able to-

1. Know the structure of cells in relation to functional aspects.
2. Understand the internal organization of the cell.
3. Study the details of cell signaling mechanism.
4. Learn the functioning of cell at molecular level.

Detailed syllabus:

Credit-I Cell Biology.

15 Hours

UNIT I-Introduction to Cell Biology: Definition, Brief history of Cell Biology, Units of measurement for cell, Interdisciplinary nature of Cell Biology, Cell theory. **01**

UNIT II-Cell organelles:

Ultrastructure, components and functions of - Cell wall, Cell membranes, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi apparatus, Lysosomes, Vacuoles, Peroxisomes and Glyoxysomes. **06**

UNIT III-Nucleus:

Morphology and ultrastructure of nucleus, nucleolus and nucleolar organizer, Nuclear envelope – structure of nuclear pore complex, transport of molecules across nuclear envelope. **03**

UNIT IV-Chromosomes:

Structure of Chromosomes, Euchromatin and heterochromatin, Histones, Packing of DNA in to chromosomes in eukaryotes, Karyotype and ideogram, Giant chromosomes- Polytene and lampbrush chromosomes. **(03)**

UNIT V-Cell signaling:

Introduction and definition, Signaling molecules and receptors, Calcium signalling pathway in plants. **(02)**

Credit-II

(15 Hours)

UNIT II: Molecular Biology

UNIT I-Genetic material DNA:

Historical perspective from 1953 to 2020, Griffith's Avery's transformation experiments, Hershey-Chase bacteriophage experiment. **(03)**

UNIT II-DNA replication (Prokaryotes and Eukaryotes):

Molecular mechanism of DNA replication. Enzymes involved in both prokaryotic and eukaryotic DNA replication and their inhibitors (Antibiotics). **(04)**

UNIT III-Gene expression:

Transcription (Prokaryotes in details and passing remarks on Eukaryotes) Types of RNA: mRNA, tRNA, rRNA; types of promoters; types of RNA polymerase enzymes in eukaryotes; molecular mechanism of transcription. **(03)**

UNIT IV-Translation (Prokaryotes and Eukaryotes):

Definition, concept and properties of genetic code; molecular mechanism of translation. **(03)**

UNIT V- Regulation of gene expression:

Concept of operon, *lac* operon and *trp* operon, positive and negative control, one gene one enzyme hypothesis. **(02)**

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, VeerBala Rastogi
6. Fundamentals of Molecular Biology, G.K. Pal and Ghaskadabi
7. Cell and Molecular Biology, Robertis and De Robertis
8. Molecular Cell Biology, 4th Edition, Lodish S. Baltimore
9. Molecular Biology of Gene, Watson J.D.
10. Biochemistry and Molecular Biology of Plants, Buchanan B.B.
11. Molecular and Cell Biology, Wolfe S.L.
12. Cell Biology, Molecular Biology, Genetic, Evolution and Ecology, Verma & Agarwal

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Semester-V	Paper-VI
Course Code : BSC-BO506 T	Title of Course : Genetics
Credits: 02	Total lecture: 30 Hours

Course outcomes:

After completion of course students will able to

1. Learn the concepts of genetics
2. Understand mechanism of inheritance.
3. Know the different types of genetic interactions.
4. Understand about mutation and its types.
5. Know about sex linked inheritance mechanism.

Detailed syllabus:**Credit-I****15 Hours****UNIT I: Introduction to Genetics.**

History, Definition, Concept, heredity, variation, Genetical terminology, branches and applications of Genetics. **1**

UNIT II: Mendelism

Monohybrid cross, Law of dominance, Incomplete dominance, (Codominance), Law of segregation, Dihybrid cross, Dihybrid ratio, Law of independent assortment, Back cross and Test cross. **4**

UNIT III: Neo Mendelism (Gene Interaction)

Genetic interaction, Epistatic interactions –supplementary gene (recessive epistasis 9:3:4), Inhibitory genes (13:3), Masking genes (12:3:1), NonEpistatic inter-allelic genetic interactions-Complementary genes (9:7), Duplicate genes (15:1) **3**

UNIT IV: Multiple alleles

Definition, Concept, Characters of multiple alleles, Examples of multiple alleles – Blood group in human and self-incompatibility in *Nicotiana*. **2**

UNIT V: Linkage, Recombination and Crossing Over

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 **4**

UNIT VI: Mutation: Concept, definition and types **1**

Credit-II

15 Hours

UNIT I: Numerical alterations of chromosomes:

Euploidy, Aneuploidy-Concept and Types, Aneuploidy in Plants and Human, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy **3**

UNIT II: Structural alterations of chromosomes.:

Types, cytology and genetic effects of Deletion, Duplication Inversion and Translocation with examples. **4**

UNIT III: Cytoplasmic & Quantitative Inheritance:

Concept of quantitative inheritance, Inheritance of quantitative trait in Maize (Cob length), Cytoplasmic inheritance Definition and concept, Chloroplast- Variation in Four O'clock plants, Mitochondria- Petite mutants in yeast. **4**

UNIT IV: Sex Linked Inheritance:

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. **4**

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.

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Semester-V	Practical Paper-I
Course Code: BSC-BO 507 P	Title of Course: Practical based on BO 501 and BO 502
Credits: 02	Total lecture: 60 Hours

Course outcomes: On completion of the course, students are able to:

1. Learn the techniques of staining and mounting of Algae, Fungi, Bryophytes and Pteridophytes.
2. Learn about recognition and collection of Algae, Fungi, Bryophytes and Pteridophytes from natural habitat.
3. Understand the diversity among Algae, Fungi, Bryophytes and Pteridophytes.
4. Know the systematic and occurrence of Algae, Fungi, Bryophytes and Pteridophytes.
5. Know the thallus structure, anatomy and reproduction of Algae, Fungi, Bryophytes and Pteridophytes.

Practicals :

1. Study of Algae with respect to systematic position, thallus structure and reproduction of *Nostoc*, *Oedogonium*, *Chara*, *Sargassum*, *Palmaria/Chondrus*. 4P
2. Study of Fungi respect to systematic position, thallus structure and reproduction of *Mucor*, *Saccharomyces*, *Penicillium*, *Puccinia* and *Cercospora*. 4P
3. Study of *Marchantia* with respect to systematic position, morphology of thallus –rhizoids and scales, Gemma Cup, structure of sporophyte, reproduction. 1P
4. Study of *Anthoceros* with respect to systematic position, structure of gametophyte, anatomy of thallus, structure of Sporophytes, reproduction. 1P

5. Study of *Funaria* with respect to systematic position, morphology of thallus- leaf, rhizoids, operculum, Anatomy of axis, leaf, reproduction. 1P
6. Study of Sporophyte evolution in Bryophytes with the help of permanent slides. 1P
7. Study of *Psilotum* with respect to Taxonomic position, Morphology of sporophyte, anatomy and reproductive structure. 1P
8. Study of *Selaginella* with respect to Taxonomic position, Morphology of sporophyte, anatomy and reproductive structures. 1P
9. Study of *Equisetum* with respect to taxonomic position, Morphology of Sporophyte, anatomy and reproductive structure. 1P
10. Study of Stelar evolution in Pteridophytes with the help of permanent slides. 1P

Note: Compulsory excursion tour for collection of Algae, Fungi, Bryophytes and Pteridophytes from natural habitat and submission of report.

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Semester-V	Practical Paper-II
Course Code: BSC-BO 508 P	Title of Course: Practical based on BO 503 and BO 504
Credits: 02	Total lecture: 60 Hours

Course outcomes: On completion of the course, students are able to

1. Learn local plants families in details.
2. Prepare the identification keys of locally available plants.
3. Identify fossil plant specimens.
4. Determine physicochemical properties of water.
5. Asses the ecological data of local area.
6. Understand the techniques of biodiversity study.
7. Know the systematic, morphology and structure of Gymnosperms.

Practicals:

1. Study of following families with reference to systematic position (following Bentham & Hooker), Diagnostic characters, floral formula, floral diagram of Nymphaeaceae, Oleaceae, Amaranthaceae, Cannaceae. 4P
2. Preparation of Botanical keys: Indented and bracketed keys by using vegetative and reproductive characters. 1P
3. Study of external and internal morphology of Gnetum. 1P
4. Study of external and internal morphology of Pinus. 1P
5. Study of the following with the help of slides and/ or specimens.
i) Impression ii) Compression iii) Petrification. 1P
6. Study of polluted water body with ref. to BOD (D zero day and D fifth day). 2P
7. Study of physicochemical properties of water body by using Sacchi disc, pH meter and electric conductivity meter. 2P
8. Acquisition of ecological data of particular locality by using GPS/ altimeter/geographical maps etc. 2P

9. Study of suitable ecosystem by line/belt transect method/ nested quadrat method. 2P

Note: Visit to biodiversity center/ ecology institutes/ palaeobotany institutes and submission of report is compulsory.

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Semester-V	Practical Paper-III
Course Code: BSC-BO 509 P	Title of Course: Practical based on BO 505 and BO 506
Credits: 02	Total lecture: 60 Hours

Course outcomes: On completion of the course, students are able to

1. Understand different cytological and staining techniques.
2. Know about mitotic and meiotic stages of cell division.
3. Isolate and extract plant genomic DNA and RNA.
4. Learn to dissect larvae to study polytene chromosomes.
5. Understand relationship between phenotype and genotype in human genetic traits;
6. Induce polyploidy in plants.

Practicals :

- | | |
|--|----|
| 1. Cytological techniques-preparation of Fixatives, preparation of stains (Aceto carmine and Aceto-orcein). | 1P |
| 2. Isolation of nuclei and characterization. | 1P |
| 3. Study of various stages of mitosis and meiosis. | 1P |
| 4. Induction of C metaphase in suitable plant material. | 1P |
| 5. Study of Chromosomes Morphology (from colchicines pretreated Onion root tip cells) | 1P |
| 6. Isolation and quantification of plant genomic DNA by DPA method . | 1P |
| 7. Extraction and estimation of RNA by Orcinol Method. | 1P |
| 8. To study the monohybrid and dihybrid crosses with suitable data and its analysis by Chi-Square test. | 1P |
| 9. Induction of tetraploidy in onion root cells and preparation of squash for observation of tetraploid cells. | 1P |
| 10. Preparation of salivary gland chromosomes in <i>Chironomous</i> larvae. | 1P |

11. Study of human genetic traits viz. PTC taste sensitivity, earlobe and rolling tongue, height, Skin colour, Hair colour, Eye colour in known population. 1P
12. Genetic problems on gene mapping using three point test cross data. 1P
13. Study of structural heterozygotes (multiple translocations) in *Rhoeo*. 1P
14. Problems on quantitative inheritance. (Cob length in Maize) 1P

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Semester-V	Paper-X
Course Code: BO 510: - SEC A1	Title of Course: Nursery and Gardening Management
Credits: 02	Total lecture: 30 Hours

Course Outcome:

On completion of the course, students are able to:

1. Understand the different types of nurseries.
2. Know the seed viability and germination methods.
3. Learn the different propagation techniques.
4. Understand the process of gardening operations and tools of gardening.
5. Learn the cultivation processes of various vegetable crops.

Detailed syllabus:**Credit 1 = Credit-I Nursery Management****15 Hours**

UNIT I :Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. **3**

UNIT II :Seed: 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. **3**

UNIT III: Vegetative propagation: grafting, budding, 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. **9**

Credit-II Gardening Management**15 Hours**

UNIT I :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. **8**

UNIT II :Sowing/raising of seeds and seedlings - Transplanting of seedlings, Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, chillies, and carrots, Storage and marketing procedures. **7**

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.

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Semester-VI	Paper-XI
Course Code: BO 511 P: - SEC A2 Practical	Title of Course: Practicals Based on BO 510
Credits: 02	Total lecture: 60 Hours

Course Outcome:

On completion of the course, students are able to:

1. Understand how to prepare beds for nursery.
2. Know the seed viability and germination methods.
3. Learn the different propagation techniques.
4. Understand the process of gardening operations and tools of gardening.
5. Know the cultivation processes of various vegetable crops.

Practicals

- | | |
|---|----|
| 1. Preparation of beds for nursery. | 1P |
| 2. Study of seed germination in germination tray and soil bed. | 1P |
| 3. Testing of Seed viability by suitable methods. | 1P |
| 4. Study of the seed dormancy breaking methods. | 1P |
| 5. Study of vegetative propagation by grafting, budding method. | 1P |
| 6. Study of vegetative propagation by cutting and air layering method. | 1P |
| 7. Study of hardening methods of plantlets from nursery to fields. | 1P |
| 8. Study of Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. | 2P |
| 9. Cultivation of cabbage, brinjal, lady's finger, onion, garlic, tomatoes, chillies and carrots in nursery | 3P |

Note: Visit to vegetable plant nursery, parks and institutes and submission of report is compulsory.

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Semester-VI	Paper-I
Course Code : BSC-BO601 T	Title of Course :Plant Physiology and Metabolism
Credits: 02	Total lecture: 30 Hours

Course Outcome:**By the end of this course, the students will able to:**

1. Understand fundamentals of plant physiology.
2. Learn different nutrients and their role in plants life.
3. Understand the details of photosynthesis and its role in plants life.
4. Study the respiration metabolism and its significance.
5. Learn the lipid metabolism and its functioning in plant cell.
6. Understand the mechanism of solute transport in plants.
7. Understand the overall processes of growth and development in plants.

Detailed syllabus:**Credit I: Plant Physiology****15 Hours**

Unit I. Mineral nutrition: Classification of mineral elements, macro and micronutrients; Role of essential elements; Absorption of mineral nutrients, Transport of ions across cell membrane, Ionophores, Carriers and Channels **05**

Unit II. Photosynthesis: Mechanism of photosynthesis- Electromagnetic spectrum Ultra-Structure of Chloroplast, Organization of Light-Absorbing Antenna Systems (Light Harvesting Complex) Light Reaction: (Cyclic and Non-cyclic photophosphorylation), Dark Reaction: Calvin-Benson Cycle, Photorespiration, C4 cycle and CAM pathway of carbon fixation). **(07)**

Unit III Respiration: Types of respiration (Aerobic and anaerobic), Mechanism of aerobic respiration (Glycolysis, TCA cycle, Terminal oxidation and phosphorylation in respiratory chain); Pentose Phosphate Pathway. **03**

Credit-II:Metabolism**15 Hours**

Unit I. Stomatal Biology: 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). **04**

- Unit II. Translocation in phloem:** Composition of phloem sap, girdling experiments Pressure flow model. (loading and unloading of phloem, source and sink relationship) **03**
- Unit III. Plant growth regulators:** Discovery and physiological roles of auxins gibberellins, cytokinins, ABA, ethylene, Polyamines, Brassinosteroids **03**
- Unit IV. Photomorphogenesis:** Red and farred light responses photomorphogenesis; Phytochrome (discovery and mode of action). **03**
- Unit V. Stress Physiology :Abiotic and Biotic stress** **02**

Suggested Readings:

- 1.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.V. K. Jain (Verma Salisbury F. B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth 2017) Fundamentals of Plant Physiology S. Chand Publications.
4. Salisbury F. B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth.

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Semester-VI	Paper-II
Course Code : BSC-BO 602 T	Title of Course : Biochemistry
Credits: 02	Total lecture: 30 Hours

Course outcomes: After the completion of course students will be able to:

1. Understand nature and functions of biomolecules.
2. Learn interactions of bio molecules with water.
3. Know structure and functions of amino acid and proteins.
4. Understand the properties and functions of enzyme.
5. Learn carbohydrate and lipid metabolism.
6. Know the sources of vitamins and their functions.

Detailed syllabus:

Credit-I

15 Hours

UNIT I: Foundation of Biochemistry:

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. **3**

UNIT II: Water:

The solvent of life: Physical properties of water, structure of water molecule, polarity of water molecule, weak interactions in aqueous solutions. **2**

UNIT III: Amino acids and proteins:

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. **5**

UNIT IV: Enzymes:

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. **5**

Credit-II

15 Hours

UNIT I: Carbohydrates:

Definition, classification of carbohydrates-Monosaccharides: aldoses and ketoses, configurations, linear to ring structure; Oligosaccharides: glycosidic bond, reducing and non-reducing sugars; Polysaccharides: homopolysaccharides, heteropolysaccharides, examples, their structures, locations and role. Properties and functions of carbohydrates. Commercial applications. **8**

UNIT II:Lipids:

Definition, classification of lipids: simple, conjugate and derived lipids, properties and functions of lipids. Biological disorders of lipid metabolism. Commercial applications. **(5)**

UNIT III:Vitamins:

Definition, classification of vitamins. source and functions of vitamins. **2**

Suggested Readings:

1. Nelson, D. L., & Cox, M. M. (2017). Lehninger principles of biochemistry (7th 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.
- 6.

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Semester-VI	Paper-III
Course Code : BSC-BO603 T	Title of Course : Plant Pathology
Credits: 02	Total lecture: 30 Hours

Course outcomes: After the completion of courses students will be able to:

1. Understand organisms and causal factor responsible for plant diseases and methods of studying plant diseases.
2. Know about the early development and role of different micro-organism in development of plant disease.
3. Acquire knowledge on general concepts and classification of plant diseases.
4. Learn different strategies for management of plant diseases.
5. Know about research institutes working on plant disease management.

Detailed syllabus:

Credit-I

15 Hours

UNIT I:

02

Fundamentals of Plant Pathology: Introduction, Important terminology- Incitants, Host, Symptoms, Parasite, Pathogen, Inoculum, Penetration, Infection, Incubation, Disease. Economic impact 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.

UNITII:

02

Disease Development: Concept of disease cycle, Inoculation, Prepenetration, Penetration, Infection, Dissemination. Epidemics-Forms, Decline, Exponential model.

UNIT III: 02

Defense Mechanisms: Concept and Definition, Types-Preexisting- Structural and chemical, Induced- Structural and Biochemical, Phytoalexins,

UNIT IV: 02

Methods of Studying Plant Diseases. Macroscopic study, Microscopic study, Koch's postulates. Types of culture Media, Pure culture methods- Serial dilution, Streak plate, Pour plate, Spread plate.

UNIT V: 04

Fungal Plant Diseases

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.

UNIT VI: 03

Bacterial Plant Diseases. Introduction to bacteria as plant pathogens, Study of Diseases- Citrus Canker, Black arm of Cotton with reference to causal organism, symptoms and disease management.

Credit-II 15 Hours

UNIT I: 03

Mycoplasma Plant Diseases: 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.

UNIT II: 02

Nematodal Plant Diseases: Introduction to Nematodes as plant pathogens. Study of Diseases- Root knot diseases of vegetables, Soybean cyst, Nematodes with reference to causal organism, symptoms, Integrated management of Nematodal diseases.

UNIT II: 02

Viral Plant Diseases: 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.

UNIT IV:

04

Non-Parasitic Diseases. 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.

UNIT V:

04

Principles of plant diseases control: General account, Quarantine, Eradication, cultural control practices, Biological control. Curative measures, chemical control, Use of Effective Microorganism solution (EMS), Microbial Pesticides

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.

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Semester-VI	Paper-IV
Course Code : BSC-BO604	Title of Course : Evolution and Population Genetics
Credits: 02	Total lecture: 30 Hours

Course outcomes: After the completion of courses students will be able to

1. Understand process of organic evolution.
2. Study of Lamarckism and Darwinism.
3. Know the evidences of evolution.
4. Study of fossilization process.
5. Study of population genetics.
6. Understand the species isolation mechanism.

Detailed syllabus:

Credit-I

15 Hours

UNIT I: Organic Evolution: 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 world theory and Origin of genetic code. 6

UNIT II: Organic Evolution: The concept of organic evolution, Theories of Evolution, Theory of Inheritance of acquired characters (Lamarck's), Pre-Darwinian period, Darwinism- Theory of Natural Selection, Post-Darwinian period- Modern synthetic theory. 5

UNIT III: Evidences of Evolution

Direct evidences and conclusions from fossil records, Indirect evidences, Evidences from Genetics, Evidences from bio-geographical relations. 4

Credit-I

15 Hours

UNIT I:

Evolution Through Ages:

Fossils and Geological Time scale- Fossils and 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.
05

UNIT II: Population Genetics and Evolution: Concept of Mendelian population, Gene Pool and its models, Hardy-Weinberg law of gene frequencies, Factors affecting allelic frequency, Genetic polymorphism.
04

UNIT III: Speciation and Isolating Mechanisms: Introduction, Morphological Criteria for Species and Races, Allopatric and Sympatric Populations (repeated in 3 papers), 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.
06

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
10. Evolutionary Biology by Mohan Arora

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Semester-VI	Paper-V
Course Code : BSC-BO 605 T	Title of Course : Advanced Plant Biotechnology
Credits: 02	Total lecture: 30 Hours

Course Work Outcome: After the completion of courses students will be able to

1. Understand concept of traditional and modern biotechnology.
2. Learn and apply the techniques of plant tissue culture.
3. Know the techniques of genetic engineering and methods of gene transfer in plants.
4. Understand the concept of cryopreservation and germplasm conservation.
5. Know the Intellectual Property Rights in biotechnology.
6. Learn the process of microbial biotechnology and Nano-technology.

Detailed syllabus:

Credit-I

15 Hours

UNIT I- Biotechnology: Introduction, Concept, Definition, Traditional and modern Biotechnology. Impact of Biotechnology on Health care, Agriculture and Environment. **2**

UNIT II- Plant Tissue Culture: 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) **6**

UNIT III- Techniques of Genetic Engineering and Methods of gene transfer in Plants- 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, 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 7

Credit-II**15 Hours**

UNIT I- Cryopreservation and Germplasm Conservation- Definition and concept, techniques of cryopreservation, cold storage, long term and short term storage, applications. Germplasm Conservation: Preservation of cell, tissue, organ, whole organism. Concept of Gene Bank, DNA Bank, Seed Bank, Pollen Bank etc. 03

UNIT II-Biotechnology and Society 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. 5

UNIT III-Microbial Biotechnology: 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. Transgenic Plants as Bioreactors: Metabolic engineering of starch, cyclodextrins, fructans, Bioplastics, Genetically engineered plants as protein factories, Production of therapeutic proteins from plants. 6

UNIT IV-Nano-biotechnology- Definition and concept, Applications of nanotechnology in agriculture (fertilizers and pesticides). 1

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 Agro bios, Jodhpur, India.
8. Glick B.R. and Thompson 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 Carpaton, New Delhi.
13. Rajdan- Plant tissue culture.
14. Kalyan Kumar De-Plant tissue culture

- 15 Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
16. Razdan M.K. - Introduction to Plant Tissue culture (Oxford & IBH Publ, New Delhi)
- 17.R.C. Chaudhary. Introduction to Plant Technology Oxford & IBH Publication.

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Semester-VI	Paper-VI
Course Code : BSC-BO 606 T	Title of Course : Plant Breeding and Seed Technology
Credits: 02	Total lecture: 30 Hours

Course outcomes: After completion of the course, students will be able to:

1. Understand the concept and methods of Plant breeding.
2. Learn various methods of plant breeding.
3. Learn the methods of hybridization.
4. Implement their knowledge in agriculture field for crop improvement.
5. Know the techniques in Tissue Culture.
6. Determine the quality and purity of Seed.

Detailed syllabus:

Credit-I: Plant Breeding **15 Hours**

UNIT I: Introduction: Definition, Scope and objectives and History of Plant breeding in India. **01**

UNIT II: Techniques and practices of plant breeding

A. Plant Introduction **02**

- Definition
- Types (Primary and Secondary)
- Procedure
- Merits and Demerits
- Important Achievements

B. Selection methods **03**

- Concept,
- Types of selections –mass selection, pure line selection and
- clonal selection.

- Advantage and disadvantages of selection
- Achievements of selection breeding

C. Hybridization 04

- Definition, Concept and Objectives
- Precaution to be taken during hybridization
- Types: Intervarietal and Distant
- General procedure of hybridization
- Methods of hybridization: Pedigree and bulk
- Hybrid vigour and heterosis

UNIT III: Advanced techniques in Plant breeding

A. Mutation breeding 03

- Definition and concept
- Mutagens (Physical and Chemical)
- Mutants
- Types of mutation (Spontaneous and Induced)
- Application of mutation breeding
- Limitations of mutation breeding

B. Tissue Culture 02

- Definition and concept
- Totipotency
- Application of tissue, embryo and anther culture in seed production

Credit-II - SEED TECHNOLOGY 15 Hours

UNIT I: Introduction to Seed Technology 02

- Seed as a basic input in agriculture
- Classes of seed
 1. Nucleus
 2. Breeder
 3. Foundation
 4. Certified
- Role of seed technology

UNIT II: Seed legislation 01

- Introduction

- Seed legislation in India (Seed Act)

UNIT III: Seed Production

03

- Introduction
- National Seed Corporation (NSC) and its objectives
- State Seed Corporation (SSC) and its objectives
- General procedure for Seed Production
 - o Location and Season
 - o Land requirement
 - o Importance of soil and water testing
 - o Cultural practices
 - o Isolation distance
 - o Plant protection
 - o Weed Control
 - o Rouging
 - o Harvesting
 - o Threshing
 - o Seed Processing

UNIT IV: Seed Certification

02

- Definition, Objectives and Concept
- Phases of Seed Certification
- General procedure of seed certification
- Field inspection
- Duties of seed inspector

UNIT V: Seed Testing

03

A. Physical Purity Analysis

- Definition of purity components
- Physical Purity Work Board
- Procedure

B. Moisture Testing

- Concept
- Air oven method

- Digital Moisture Meter

C. Germination testing

- Definition and objectives
- Procedure and methods for germination testing (Paper, Sand and Soil)
- Seedling evaluation (Normal Seedlings, Abnormal Seedlings, Multigerm Seed Units and Non-germinated Seeds)

UNIT VI: Seed Pathology and Entomology

02

- Definition
- Seed Borne pathogens
 - o Fungi
 - o Bacteria
 - o Viruses
- Influence of seed borne pathogens on seed production
- Common insect pest and its impact on seed production

UNIT VII: Seed Storage

02

- Definition and Concept
- Seed treatment
- Management of seed storage structures
 - o Sanitization
 - o Dehumidification
 - o Fumigation

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, Inc., Singapore.
7. Agarwal R.L. --- Seed Technology, Oxford & IBH Publishing
8. TNAU (ICAR) Principles of Seed technology (2020)

**Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus of T. Y. B. Sc. Botany
under
Faculty of Science**

Semester-VI	Practical Paper-VII
Course Code: BSC-BO 607 P	Title of Course : Practical based on BO 601 and BO 602
Credits: 02	Total lecture: 60 Hours

Course outcomes: After completion of the course, students are able to

1. Understand mechanism and process of plasmolysis.
2. Understand process of nitrogen metabolism in plants.
3. Learn the technique of biomolecules separation.
4. Know the separation and estimation of amino acids and proteins
5. Study of phytochemical analysis.

Practicals:

1. Determination of osmotic potential of plant cell sap by plasmolysis method 1P
2. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte 1P
3. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration. 2P
4. To study the effect of light intensity and bicarbonate concentration on O₂ evolution in photosynthesis. 1P
5. Comparison of the rate of respiration in any two parts of a plant. 1P
6. Demonstration experiments (any four) 1P
 - i). Bolting.
 - ii). Effect of auxins on rooting.
 - iii). Suction due to transpiration.
 - iv). R.Q.
 - v). Respiration in roots.
7. Estimation of total free amino acids by spectrophotometry 1P
8. Separation of amino acids by paper chromatography. 1P

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|--|----|
| 9. Estimation of soluble proteins by Lowery <i>et. al.</i> method. | 1P |
| 10. Demonstration of Enzyme activity: Amylase /invertase /catalase | 1P |
| 11. Estimation of reducing sugars by DNSA method. | 1P |
| 12. Estimation of Vitamin C (Ascorbic acid) from plants. | 1P |
| 13. Qualitative tests for starch, lipids and proteins. | 1P |
| 14. Determination of the iodine number of lipids using Hanus method. | 1P |

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Semester-VI	Practical Paper-VIII
Course Code: BSC-BO 608 P	Title of Course : Practical based on BO 603 and BO 604
Credits: 02	Total lecture: 60 Hours

Course outcomes: After completion of the course, students are able to

1. Identify various plant diseases and their control measures.
2. Learn media preparation and different culture techniques for plant pathogen.
3. Start small scale biopesticide industry.
4. Understand the allele and genotype frequency.
5. Know the fossilization process.
6. Understand species isolation process.

Practicals:

1. Preparation of any one culture media for isolation of plant pathogens. 1P
2. Culture technique- Streak plate methods, pour plate methods, Spread plate methods. 1P
3. Study of any two of fungal (Downy mildew of Grapes, Head smut of Jowar, Tikka diseases of Groundnut) diseases. 1P
4. Study of any two of each bacterial and mycoplasma diseases 1P
5. Study of any two of each viral and non-parasitic diseases of plants. 1P
6. Preparation of 1% Bordeaux mixture and Bordeaux paste 10%. 1P
7. Preparation of Jivamruta. 1P
8. Study of Koch's Postulates. 1P
9. Study of Fungicides and Microbial pesticides. 1P
10. Study of Geological time scale. 1P
11. Study of types of Fossils : i) Coal ball ii) Rhynia vii) Lyginopteris iii) Pentoxylon iv) Nipaniophyllum v) Lepidodendron 1P
12. Demonstration of any three evidences of Organic Evolution. 1P
13. Numerical Problems based on Allele frequency and Genotype frequency. 1P
14. Numerical Problem based on Hardy-Weinberg Equilibrium. 1P

15. Study of Sympatric and Allopatric speciation with suitable example. 1P
16. Study of Isolation mechanism : Prezygotic & Postzygotic(Any one example from each) 1P
17. Submission of Report on Visit to Paleobotany Laboratory/Museum/Fossil Garden. 1P

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Semester-VI	Practical Paper-IX
Course Code: BSC-BO 609 P	Title of Course: Practical based on BO 605 and BO 606
Credits: 02	Total lecture: 60 Hours

Course outcomes: After completion of the course, students are able to

1. Preparation method of plant tissue culture media and nano-particles.
2. Learn quantitative and qualitative estimation of biomolecules.
3. Acquire knowledge of fermentation process.
4. Know about transgenic plants and their benefits.
5. Know about application of equipments used in genetic engineering.

Practicals:

1. Preparation and sterilization of MS Medium and Callus Induction using leaf primordia 2P
2. Production of secondary metabolites in any suitable plant material 1P
3. Artificial seed production by Sodium Alginate method encapsulation (somatic embryogenesis) 1P
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) 1P
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) 1P
6. Preparation of plant based nano-particles 2P
7. Demonstration to Fermentation of fruit juice and wine production from grapes/ pomegranate/jamun/ apple/ber (live/videos/photographs/visit to research labs) 2P
8. Problems on genetic engineering (set of problems will be given on restriction enzymes, vectors etc.) 1P

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Semester-VI	Paper-X
Course Code: BO 610 T: - SEC A3	Title of Course: Medicinal Botany
Credits: 02	Total lecture: 30 Hours

Course Outcome: After completion of the course, students are able to:

1. Understand how to prepare beds for nursery.
2. Know the seed viability and germination methods.
3. Understand the different propagation techniques.
4. Learn the process of gardening operations and tools of gardening.
5. Acquire knowledge about cultivation processes of various vegetable crops.

Detailed syllabus:

Credit 1 =

15 Hours

UNIT I : Medicinal Plants: History, Scope and Importance.	01
UNIT II: Indigenous Medicinal Sciences; Definition and Scope.	01
UNIT III: Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments	04
UNIT IV:Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.	02
UNIT V: Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.	02
UNIT VI: Conservation of endangered and endemic medicinal plants: 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.	05

Credit 2 =

15 Hours

UNIT I: Propagation of Medicinal Plants: 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. **05**

UNIT II: Ethnobotany and Folk medicines: Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. **05**

UNIT III: Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. **01**

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.
3. A. Roseline, Pharmacognosy. MJP Publishers. Chennai.

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Semester-VI	Paper-XI
Course Code: BO 611 P: -SEC A4	Title of Course: Project/ Practicals based on Advanced Instrumentation in Botany
Credits: 02	Total lecture: 60 Hours

Course Outcome: After completion of the course, students are able to:

1. Identify research problem stated in study.
2. Identify the overall process of designing of research
3. Understand scientific research methodology.
4. Enhance skill of research writing and presentation.
5. Learn research related various instruments.
6. Understand data analysis and interpretation.
7. Know about research and publication ethics.

Details:

1. Writing of research proposal w.r.t Rationale of works, Review of literature, Title, Aims, Objectives, Material and Methods, expected outcomes, plan of work.
2. Experimental work
3. Data Analysis
4. Writing of research project report w.r.t. Introduction, Review of literature, Material and Methods, Results, Discussion, Summary and Conclusion, Bibliography.
5. Submission and presentation of research project work during final examination.
6. Compulsory paper presentation in National/ International Conference.
7. Research Publication in reputed journal.

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