

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY



CIRCULAR NO.SU/Sci./M.Sc.Botany/89/2022

It is hereby inform to all concerned that, the syllabus prepared by the Board of Studies in Botany and recommended by the Dean, Faculty of Science & Technology the Hon'ble Vice-Chancellor has accepted the **Syllabus of M.Sc. Botany IIIrd and IVth semester with Bridge Course in the affiliated Colleges and University Department** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

This shall be effective from the Academic Year 2022-23 and onwards.

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.

REF.NO. SU/Sci/2022/12688-97
Date:- 27-04-2022.

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[Signature]
**Deputy Registrar,
Academic Section.**

Copy forwarded with compliments to :-

- 1] **The Principal of all affiliated concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **Head of the Department, Department of Botany,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
- 3] **The Director, University Network & Information Centre, UNIC,**
with a request to upload this Circular on University Website.

Copy to :-

- 1] The Director, Board of Examinations & Evaluation, Dr. BAMU, A'bad.
- 2] The Section Officer, [M.Sc. Unit] Examination Branch, Dr. BAMU, A'bad.
- 3] The Programmer [Computer Unit-1] Examinations, Dr. BAMU, A'bad.
- 4] The Programmer [Computer Unit-2] Examinations, Dr. BAMU, A'bad.
- 5] The In-charge, [E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr. BAMU, A'bad.
- 6] The Public Relation Officer, Dr. BAMU, A'bad.
- 7] The Record Keeper, Dr. BAMU, A'bad.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.



M.Sc. Botany

IIIrd and IVth Semester

Academic Flexibility

Credit Based Grading System

M. Sc. Botany SY

2022-2023

Effective from 2022 – 2023 for University Department and all affiliated Colleges



Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

M.Sc. Botany SY

This syllabus was finalized in the meeting of Board of Studies in Botany held on 17-12-2021. The following members were present:

- | | |
|-----------------------------------|---------------------|
| 1. Prof. Ravi P. Patil | BOS Chairman |
| 2. Prof. Arvind S. Dhabe | Member |
| 3. Prof. Ashok M. Chavan | Member |
| 4. Dr. Abhay N. Salve | Member |
| 5. Prof Ganesh B. Kulkarni | Member |

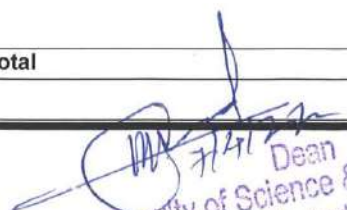
Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

HEAD
P.G. Department of Botany
Deoqiri College Aurangabad

Chairman, BOS, Botany
Dr BAMU, Aurngabad

Credit Based Cafeteria Approach M. Sc. Course in Botany
Course Structure of M. Sc. Syllabus to be Implemented from 2021-2022.

Sr. No	Course No.	Title of the Course	Hrs	Credits Allotted	Theory				Practical	
					internal	External	Total (Maximum)	Minimum	Maximum	Minimum
Semester I (Effective from Academic year 2021-22)										
01.	BOT 401	Cell and Molecular Biology	07	3T + 2 P	20	80	100	40	50	20
02.	BOT 402	Plant Biotechnology	07	3T + 2 P	20	80	100	40	50	20
03.	BOT 403	Biology & Diversity of Algae and Bryophytes	07	3T + 2 P	20	80	100	40	50	20
04.	BOT 404	Taxonomy of Angiosperms	07	3T + 2 P	20	80	100	40	50	20
05.	IC001	Indian Constitution	02	2T	20	30	50	20	--	--
Total				22 Credits						
Semester II (Effective from Academic year 2021-22)										
06.	BOT 406	Cytology and Genetics	07	3 T + 2 P	20	80	100	40	50	20
07.	BOT 407	Plant Development and Reproduction	07	3T + 2 P	20	80	100	40	50	20
08.	BOT 408	Biology and Diversity in Fungi and Microbes.	07	3T + 2 P	20	80	100	40	50	20
09.	BOT 409	Plant Physiology and Metabolism	07	3T + 2 P	20	80	100	40	50	20
10.	BOT 410	Research Methodology - I	03	3T	20	80	100	40	--	--
Total				23 Credits						
Semester III (Effective from Academic year 2022-23)										
11.	BOT 501	Biology and Diversity of Pteridophytes and Gymnosperms	07	3T + 2 P	20	80	100	40	50	20
12.	BOT 502	Plant Ecology and Conservation	07	3T + 2 P	20	80	100	40	50	20
1.	BOT 521 A BOT 521 B BOT 521 C BOT 521 D BOT 521 E BOT 521 F	Crop Genetics and Plant Breeding - I Plant Pathology-I Taxonomy of Angiosperms - I Advanced Plant Physiology and Biochem. -I Plant diversity and Conservation - I Seed Technology - I	07	3T + 2 P	20	80	100	40	50	20
15.	BOT 522 A BOT 522 B BOT 522 C BOT 522 D BOT 522 E BOT 522 F	Crop Genetics and Plant Breeding - II Plant Pathology-II Taxonomy of Angiosperms - II Advanced Plant Physiology and Biochem. II Plant diversity and Conservation - II Seed Technology - II	07	3T + 2 P Each	20	80	100	40	50	20
16.	BOT 525 BOT 526 BOT 527	Service Course Plant Tissue Culture Medicinal Plants Applied Mycology	03	3T	--	--	100	40	--	--
Total				23Credits						
Semester IV (Effective from Academic year 2022-23)										
17.	BOT 503	Bio-prospecting and Plant Resource Utilization	07	3T +2 P	20	80	100	40	50	20
18.	BOT 504	Genetic Engineering and Bioinformatics	07	3T + 2P	20	80	100	40	50	20
19.	BOT 505	Research Methodology - II	03	3T	20	80	100	40	--	--
20.	BOT 523 A BOT 523 B BOT 523 C BOT 523 D BOT 523 E BOT 523 F	Advanced Genetics & Molecular Biology - III Plant Pathology - III Taxonomy of Angiosperms - III Advanced Plant Physiology & Biochem- III Plant diversity and Conservation - III Seed Technology - III	07	3T + 2P	20	80	100	40	50	20
21.	BOT 524 A BOT 524 B BOT 524 C BOT 524 D BOT 523 E	Research Component -Project Work	07	3T + 2 Project Work	20	80	100	40	50	20
Total				23 Credits						


 Dean
 Faculty of Science & Technology
 Babasaheb Ambedkar Marathwada
 University, Aurangabad

Total Credits required obtaining M. Sc. Degree in Botany

Semester I 22

Semester II 23

Semester III 23

Semester IV 23

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Total credits 91

*** At least one service course**

**** M.Sc. SY implemented from 2022-23 academic year.**


Dean
Faculty of Science & Technology
Jr. Babasaheb Ambedkar Marathwada
University, Aurangabad


HEAD
P.G. Department of Botany
Deqiri College, Aurangabad

**Chairman, BOS, Botany
Dr BAMU, Aurngabad**

SEMESTER III

THEORY BOT 501: BIOLOGY & DIVERSITY OF PTERIDOPHYTES & GYMNOSPERMS

Unit I. Pteridophyta: Classification, Origin and evolution, Phylogenetic relationship with Bryophyta. Morphology, anatomy, phylogeny and interrelationships of the orders Psilopsida – Psilotales and Psilophytales, Lycopsidea – Lycopodiales, Selaginellales, Isoetales, Equisetopsida – Equisetales and Pteropsida – Filicales.

Unit II. Sporophyte and gametophyte in Pteridophytes, Stellar organization and evolution, Origin of leaf and Telome concept, Sporocarp, Heterospory and seed habit, Comparison of Pteridophyta with Bryophyta and Gymnosperms.

Unit III. Gymnosperms: Introduction, Classification and distribution of Gymnosperms, Morphology, anatomy, reproduction, phylogeny of the orders Pteridospermales (Caytoniaceae, Medullosaceae) Bennettitales (Williamsoniaceae, Cycadeoideaceae) Cycadales (Cycadaceae) Ginkgoales (Ginkgoaceae) Coniferales (Pinaceae, Araucariaceae) Taxales (Taxaceae) Gnetales (Gnetaceae) and Economic importance of gymnosperms.

Unit IV. Paleobotany: Introduction, Geological time scale, Fossils and fossilization, Various types, Continental drift/ plate tectonics, Fossil localities in Maharashtra, Contributions of Prof. Birbal Sahani.

PRACTICALS BASED ON BOT 501: BIOLOGY & DIVERSITY OF PTERIDOPHYTES & GYMNOSPERMS

Pteridophytes: Morphological, anatomical and Reproductive studies of

1) *Psilotum* 2) *Lycopodium*. 3) *Selaginella*, 4) *Isoetis*, 5) *Equisetum*, 6) *Ophioglossum*, 7) *Osmunda*, 8) *Gleichenia*, 9) *Pteris*, 10) *Adiantum*, 11) *Marselia*, 12) *Salvinia*, 13) *Azolla* and additional forms/species collected during study tour.

Gymnosperms : Study of the vegetative and reproductive parts, including anatomy of the following genera : *Cycas*, *Zamia*, *Pinus*, *Cedrus*, *Taxodium*, *Cryptomeria*, *Cupressus*, *Thuja*, *Juniperus*, *Podocarpus*, *Cephalotaxus*, *Agathis*, *Araucaria*, *Taxus*, *Ginkgo* and *Gnetum*.

Fossil Types: Impression, Compression, Petrification, Coal ball, TS of *Rhynia*, *Lygenopteris*, *Calamitis* and *Cycadeodea*.

SUGGESTED READINGS: BOT 501 (THEORY AND PRACTICAL):

1. Agashe, S. N. (1995) Paleobotany, Oxford & IBH, New Delhi.
2. Bir, S. S. (2005) Pteridophytes their Morphology, Cytology, Taxonomy and Phylogeny. Today & Tomorrow's Printers and Publisher.
3. Biswas, C. and B. M. Johri (2004) The Gymnosperms, Narosa Publishing House, New Delhi.
4. Campbell, C. J. (1940) Evolution of land Plants, Stanford University Press.
5. Coulter J. M. and C. J. Chamberlain (1978) Morphology of Gymnosperms, Central Book Depot, Allahabad.
6. Eames, A. J. (1974) Morphology of Vascular Plants- lower groups, Tata Mc Graw-Hill Publishing Co. New Delhi.
7. Foster, A. S. & F. M. Gifford (1967) Comparative morphology of vascular plants, Freeman Publishers, San Fransisco.
8. Kakkar, R. K. and B. R. Kakkar (1995) The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.
9. Kashyap S. R. (1932) Liverworts of Western Himalayas and the Plains. Vol. I & II, The University of Panjab, Lahore.
10. Parihar, N. S. (1976) The biology and morphology of the Pteridophyta, Central Book Depot, Allahabad.
11. Puri Prem (2005) Bryophytes Morphology, Growth and Differentiation- Pulisher- Atmaram and Sons New Delhi.
12. Rashid, A. (1976) An introduction to Pteridophyta, Vikas Publishing House Ltd., New Delhi.
13. Sambamurty, A. V. S. S., (2005) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany, Today & Tomorrow's Printers and Publishers.
14. Sharma O. P. (2002) Gymnosperms, Pragati Prakashan, Meerut.
15. Sharma P. N. and Sahni K. C. (2005) Gymnosperms of India and Adjacent Countries Publisher- Bhishan Singh Mahendra Pal Singh, Dehradun.
16. Tewari, Shiv Datt and GiriBala Pant (2005) Bryophytes of Kumaun Himalaya. Publisher-Bhishan Singh Mahendra Pal Singh- Dehradun.
17. Siddiqui K. A. (2002) Elements of Paleobotany, KitabMahal, Allahabad.
18. Smith, G. M. (1976) Cryptogamic Botany - Vol. II, Tata Mc Graw-Hill Publishing Co. Ltd. New Delhi.
19. Sporne, K. R. (1976) Morphology of Pteridophyta. Hutchinson University Library, London.

THEORY BOT 502: PLANT ECOLOGY & CONSERVATION

Unit I i. An introduction to Plant ecology and its scope.

- ii. **Structure of Ecosystem:** Abiotic components (climatic factors, Topographic/factors, Edaphic factors); Biotic components (Interactions among organisms, Autotrophs and Heterotrophs) Ecological Pyramids (Pyramid of numbers, Biomass and energy)
- iii. **Functions of Ecosystem:** Productivity (Primary and secondary productivity, food chains, Grazing and detritus food chains) food webs. Biogeochemical cycles: C, N, P and S.

Unit II i. **Community Ecology:** Classification, Analysis of communities, characteristics of communities, species diversity, Growth form and structure, origin, development and composition.

- ii. Competition and coexistence, intra-specific interactions, interspecific interactions, scramble and contest competition model, mutualism and commensalism, prey-predator interactions.

Unit III. Biogeography: Major biomes of the World -Terrestrial, Tundra, arboreal coniferous forests, temperate and tropical grasslands and deciduous forests, Mediterranean and Desert vegetation, Tropical rain forests; Aquatic Ecosystems- Fresh water, Estuarine and marine. Endemism and hotspots of biodiversity.

Unit IV. i. **Environmental pollution:** Environmental Pollution in relation to air, water and soil. Use of fertilizer, pesticides and other chemicals in agriculture and hygiene and their disposal.

- ii. Climate change: Greenhouse gases, their sources, trends and role, Ozone layer and its depletion (Global warming, Sea level rise, UV radiation) acid rain, Bio-indicator and biomarkers of environmental health.
- iii. Concepts of ecological management and sustainable development.

Unit V. i. **Biodiversity:** Concept, types and situation in India. IUCN categories.

- ii. **Strategies of conservation:** *In situ* conservation, protected regions in India: Sanctuaries, National parks, Wetlands, Sacred groves, mangroves for conservation of wild biodiversity. *Ex situ* conservation: Principles and practices, Botanic gardens- Definitions, Criteria and types; Important Botanic Gardens in India and World, BGCI, gene bank, seed banks, cryobanks . Environment impact Assessment, its procedure and contribution of Smt. Rahibai Popre, Smt. Tulsi Gowda and Madhav Gadgil.

Unit VI. i. General activities of Botanical Survey of India (BSI) and National Bureau of Plant Genetic Resources (NBPGR) for conservation efforts.

- ii. Biological Diversity Act 2002, 2020, Forest Conservation Act 1980, Wild Life Protection Act 1972, laws related pollution controls and related international conventions.
- iii. Earth Summit, Climate Change 2021 UNO, MoEFCC recent report of Biodiversity in India.

PRACTICALS BASED ON BOT 502: ECOLOGY & CONSERVATION

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use 't' test for comparing two means related to ecological data.
2. To find out relationship between two ecological variables using co-relation and regression analysis.
3. To find out association between important grassland species using chi-square test.
4. To determine minimum size and number of quadrates required for reliable estimate of biomass in grassland.
5. To determine diversity indices (Shannon-Wiever concentration of dominance) for protected and unprotected grass land stands.
6. To estimate IVI of the species in a wood land using point centerquadrate method.
7. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
8. To determine the water holding capacity of soils collected from different locations.
9. To estimate the DO content in water samples by Winkeler's method.
10. To estimate chlorophyll content in SO₂ fumigated and non-fumigated plant leaves.
11. Visits to different ecosystems and submission of report.
12. Scientific visits to laboratories / Industries / Research Institutes working in conservation of plants and submission of report.

SUGGESTED READINGS: BOT 502 (THEORY AND PRACTICAL)

1. Ambasht, R. A. (1990) A text book of Plant Ecology, Students Friends & Co., Varanasi.
2. Benny Joseph (2005) Environmental Studies, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
3. Conklin, A. R. Jr. (2004) Field Sampling: Principles and Practices in Environmental Analysis. CRC Press.
4. Fahey, T. J. and Knapp, A. K. (2007) Principles and Standards for Measuring Primary Production. Oxford.
5. Grant, W. E. and Swannack, T. M. (2008) Ecological Modeling. Blackwell.
6. Hajra P. K. & V. Mudgal, 1997, Plant Diversity Hotspots in India – An overview, Botanical Survey of India, MoEF & CC, Culcatta
7. Koromondy, E. J. (2005) Concepts of Ecology. 4th Ed. Prentice Hall of India, New Delhi.
8. Muller, Dombosis, D. & H. Ellenberg (1974) Aims & methods of vegetation ecology, Wiley, New York.
9. Mungikar, A. M. (2003) Biostatistical Analysis. Saraswati Printing Press. Aurangabad.
10. Mungikar A. M. (2008) An Introduction to Biometry, Sarswati Printing Press, Aurangbad.
11. Odum E. P. (1971) Fundamentals of Ecology, Saunders, Philadelphia.
12. Rajagopalan, R. (2005) Environmental studies, Oxford University Press, New Delhi.
13. Ramkrishna, P. S. (2001) Ecology and Sustainable Development. National Book Trust, New Delhi.
14. Sharma, P. D. (2001) Ecology and Environment, Rastogi Publications. Meerut.
15. Stiling, Peter. (2004) Ecology- Theories and Applications. 4th Ed. Prentice Hall of India, New Delhi.

16. Trivedi, P. R. (1999) Encyclopedia of Ecology and Environment. Vol. 1 - 10, Indian National Green Party, New Delhi.
17. Trivedi. R. K., Goel P. K., Trisal C. L. (1998) Practical Methods in Ecology and Environmental Science: Enviro-media Publisher, Karad
18. Wilkinson, D. M. (2007) Fundamental Processes in Ecology: An Earth system Approach. Oxford.
19. Wyse Jackson, P. S. and Sutherland, L. A. (2000) International Agenda for Botanic Gardens in Conservation, Botanic Garden Conservation International (BGCI) UK
20. Yadav, Manju (2003) Ecology. Discovery Publishing House, New Delhi.

WEBSITES:

1. www.nbaindia.org
2. www.envfor.nic.in
3. www.moef.nic.in
4. www.bgci.org.uk
5. www.bsi.nic.in
6. www.bsienvi.nic.in
7. www.nbpgr.ernet.in
8. www.maharashtrastatebiodiversityboard.gov.in
9. www.iucn.org
10. www.iucnredlist.org
11. www.iucnredlistecosystems.org
12. www.conservation.org
13. www.biodiversity-a-z.org

THEORY BOT-521: CROP GENETICS AND PLANT BREEDING-I (ELECTIVE-A)

Unit I: Crop genetic resources: Importance of genetic Conservation, global network for genetic conservation and utilization in major crops of the world. Institutes engaged in conservation and improvement of crop genetic resources.

Unit II: Food supplies, nutrition and crop breeding: World food situation, nutritional problems, Nutritional objectives, Contribution of M.S. Swaminathan and H.Y Mohan Ram.

Unit III: Methods of plant breeding: Introduction, selection, (Pure line selection, W. L. Johansons experiments on beans and their significance, Variety acclimatization, genetic significance of pollination methods, methods of breeding self and cross pollinated crops and asexually and vegetative propagated crops.

Unit IV: Incompatibility in plant breeding: Types, nature, characteristics genetic and biochemical basis, methods of induction and overcoming, incompatibility as a tool in breeding crops.

Unit V:

1. Male sterility: Definition and classification, Male sex expression and chemical Induction of male sterility, perspectives.

2. Back cross: Genetic basis, Methodology in selection to character under transfer, Transfer of two or more characters, Inter-varietal. Inter-specific and intergeneric transfer.

PRACTICALS BASED ON COURSE BOT 521: CROP GENETICS AND PLANT BREEDING-I (ELECTIVE A)

1. Study of floral biology of different crop plants.
2. Demonstration of hybridization technique in self and cross pollinated crops.
3. Study of pollen germination and demonstration of incompatibility.
4. Demonstration of male sterility in Jowar.
5. Study of pollen fertility.
6. Study of pollen viability.
7. Karyotype analysis in crop plants such as Tradescantia, Rheo, Maize and Onion.
8. Aneuploid analysis in crop plants.

THEORY BOT 522: CROP GENETICS AND PLANT BREEDING – II (ELECTIVE –A)

Unit I. Heterosisbreeding: i) Historical aspects, ii) Interbreeding depression, iii) Homozygous and heterozygous balance, iv) Genetic basis of inbreeding, v) Genetic and physiological basis of heterosis, vi) Heterosis and plant breeding.

Unit II. Mutagenesis and Mutation Breeding:

A. Mutagenesis: Spontaneous mutations, mutation frequency, Physical mutagens, ionizing and non-ionizing radiations, radio-sensitivity, cytological and genetic effects, chemical mutagens, mutagenic compounds, mode of action, molecular basis of mutations. Ames test. *In - vitro* site directed mutagenesis

B. Mutation Breeding: i) Historical perspective, ii) The nature and chemical basis of mutation, iii) Physical and chemical mutagenesis, iv) Mutagenic treatment schedules, v) Screening of mutation in population, vi) Frequency and spectrum of mutants, micro and macro mutants, vii) mutagenic effectiveness and efficiency, viii) environmental mutagenesis repair mechanism, ix) Role of mutations in crop improvement programme.

Unit III.

1. Resistance breeding:

A. Disease resistance-nature, mechanism of resistance, methodology problems and achievements.

B. Insect resistance: Nature, mechanism of resistance, methodology, problem and achievements.

C. Drought resistance, importance, types, nature of resistance methods and examples.

2. Quality breeding: A. Nature of quality B. Genetic and biochemical basis C. Genetic manipulation of quality and quantity.

Unit IV. Distant Hybridization: a) Importance, b) Inter-specific, inter-generic gene transfers, methodology, problem and remedial measures, c) Man made species.

Unit-V.Seed production and distribution: Introduction variety evaluation, variety maintenance, availability of new varieties, seed production and regulation, seeds industry development. Breeding crops with special reference to Marathwada region like wheat. Jowar, Bajra, Cotton, Groundnut, Safflower etc.

PRACTICALS BASED ON COURSE BOT 522: CROP GENETICS AND PLANT BREEDING – II (ELECTIVE A)

1. Induction of polyploidy in crop plants.
2. Study of seed protein profile by native and SDS-PAGE.
3. Estimation of oils from edible oil crops.
4. Estimation of leaf proteins, seed proteins in diploids and polyploids.
5. Designing of field experiments.
6. Mutagenesis: Introduction of mutations through physical / Chemical mutagenic treatments and raising M_1 & M_2 generations. Assess in the effect of mutagens on different M_1 parameters and M_2 chlorophyll viable mutant frequency and spectrum.
7. Study of mutagenesis data published in different journals and arriving at logical conclusions by providing theoretical reasons.
8. Report submission and deposition of rare seeds of wild plants from your area during practical exams

SUGGESTED READINGS BOT 521 AND 522: THEORY AND PRACTICALS (ELECTIVE A)

1. Plant Breeding - B. D. Sitigi.
2. Plant Breeding - J. R. Sharma.
3. An Introduction of plant breeding - H. K. Chaudhary.
4. Evolution of crop plants -Edited by Simmonds N. W (1986)
5. Breeding field crops - Poehlrnann and Sleper.
6. Plant Breeding perspectives - Edited by Sheep and Mendnkasen.
7. Crop Breeding, P. B. Vose and S. G. Blixt
8. Genes. Chromosomes and Agriculture. Chripels and Simmonds.
9. Principles of Genetics - Snusted and Simulants.
10. Manual of mutation breeding by FAO/IAEA.
11. Mutation Research -Aurebach.
12. Chemical mutagenesis - Fishbeiri et al.
13. Discussions in cytogenetics. Burnhan C. R. 1962 -
14. Genetics - Principles and analysis. Khush G. S. 1973 -
15. Genetics Principles and analysis. Haiti and Jones 1998 -
16. Molecular biology of the gene. Watson J. D. 1989

THEORY BOT- 521: PLANT PATHOLOGY-I (ELECTIVE B)

Unit I. Nature, origin and evolution of parasitism: Interrelationship of parasitism and pathogenicity; physiology of pathogenicity; Natural process of pathogenesis, evolution of parasitism and pathogenicity. Effect of environment on different classes of parasitism; law of host - parasite balance, host genetics in relation to type of pathogenicity; search for effective disease control.

Unit II. Plant disease diagnosis:

Field observations, laboratory investigations, isolation and purification of plant pathogens, Koch's postulates; identification of plant pathogens, Screening for crop disease and soil fungi, Plant disease clinics; History and development of plant pathology in India.

Unit III Classification of Plant diseases:

Classification based on crop plants, symptoms and causal organisms.

Unit IV. Agents of infections and diseases:

i. **Biotic agents:** Bacteria, viruses, fungi, mycoplasma, nematodes.

ii **Abiotic agents:** Air pollution; mineral elements, temperature, toxic effects of improperly used chemicals.

Unit V. Symptoms, etiology and disease cycle of diseases caused by:

a) Mastigomycotina:

Damping off of seedlings, Rhizome rots of ginger, Early blight of potato, White rust of crucifers, Downy mildew of Bajra, Downy mildew of grapes.

b) Ascomycotina:

Stem galls of coriander, leaf spot of turmeric, Powdery mildew of grapes, Powdery mildew of cucurbits, Ergot of Bajra.

Unit VI. Symptoms, etiology and disease cycle of diseases caused by

a) Basidiomycotina:

Loose smut of wheat, Kernel bunt of wheat, Bunt of Rice, Head smut of Jowar, Grain smut of Jowar, Whip smut of sugarcane. Rust: Rust of wheat, Rust of Bajra, Rust of groundnut.

Unit VII. Symptoms, etiology and disease cycle of diseases caused by

a) Deuteriomycotina:

Early blight of potato, leaf spot of Alternaria on tomato and brinjal, Tikka disease of groundnut, *Helminthosporium* leaf spot on Jowar; Blast of Rice, Red rot of sugarcane, Die back of chili, *Fusarium* wilt of Pigeon pea, Blight of gram, Charcoal rot of Soybean, *Rhizoctonia* stem rot of Potato.

PRACTICAL COURSE BASED ON BOT 521: PLANT PATHOLOGY-I (ELECTIVE B)

1. Collection and preservation of diseases specimens.
2. Sick Plot: Screening for crop disease and soil fungi
3. Symptomology, histopathology of disease from Mastigomycotina, Ascomycotina, Basidiomycotina, Deuteriomycotina.
4. Investigation of Diseases prescribed in theory.
5. Principal and working of instruments, Sterilization Methods.
6. Preparation of media, stains and Isolation of Fungi from infected plants.
7. Culture and identification of Pathogen.
8. Visits to fields for study of diseases.

THEORY BOT 522: PLANT PATHOLOGY-II (ELECTIVE B)

Unit I. Phytoplasma diseases: Symptoms and disease cycle of little leaf of brinjal; *Sesamum phyllody*, Witches broom diseases, Grassy shoot of sugarcane.

Unit II. Viral diseases: Symptoms produced by viruses on plants, study of plant virus disease; Tobacco mosaic, leaf curl of tomato, papaya mosaic, yellow vein mosaic of bhendi, Bunchy top of Banana, Tristeza of citrus.

Unit III. Bacterial diseases: symptoms of bacterial diseases on plants. Study of bacterial diseases: Angular leaf spot of cotton, citrus canker, Gummosis of sugarcane, Bacterial wilt of solanaceous vegetables. Halo blight of bean, Soft rots of fruits.

Unit IV. Non parasitic diseases: Non infectious diseases of plants, Nutritional deficiencies, Blossom rot of tomato, mango black tip, zinc deficiency of citrus.

Unit V. Dispersal of plant pathogens and Pathogenesis:

Dispersal of pathogens: Direct transmission; Indirect transmission; Plant disease epidemiology; Some important epiphytotic; Methods used in plant disease forecasting.

Pathogenesis: Penetration and entry by plant pathogen; Pre-penetration; Entry through natural opening; Direct penetration; Entry through wounds, root hairs and buds.

Unit VI. Enzymes of plant pathogens: Cell wall degrading enzymes; Proteolytic enzymes - Macerating enzyme, Polygalacturonase, Pectin esterase; trans-aminase and their role in disease development. Cellulolytic enzymes and their role in disease development.

Unit VII. Toxins of Plant pathogens: Phytotoxins; Classifications of toxins, Fusaric acid, Lycopersin, Piricularin, Alternaric acid, Tabtoxin, Phaseolotoxin and Victorin.

PRACTICAL COURSE BASED ON BOT 522: PLANT PATHOLOGY-II (ELECTIVE B)

1. Collection and preservation of diseases specimens.
2. Preparation of Media, stains and isolation of Bacteria from infected plant.
3. Investigation of diseases caused by Bacteria, Phytoplasma, Viruses.
4. Study of Non parasitic diseases.
5. Virulence test for pathogens.
6. Production and assay of macerating enzymes.
7. Production and assay of polygalactronase, cellulolytic enzymes, amylase.
8. Study of toxin production.
9. Effect of toxin on Seed Germination, Leaf Necrosis, Seedling.
10. Extraction and estimation of pigments in healthy and diseased plants.
11. Visits to fields for study of diseases.

SUGGESTED READINGS BOT 521 AND 522: PLANT PATHOLOGY- I AND II (ELECTIVE B)

1. Agrios, G.N. (1969) Plant Pathology, Academic Press, New York.
2. Bos L. (1999), Plant viruses, unique and intriguing pathogens. Backhugs Publ. Leiden.
3. Bruce A. Voyles (2002) The Biology of Viruses, McGraw Hill, Boston.
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5. Gupta, V. K. and S. K. Sharma (2000) Disease of fruit crops, Malyani Publ. Ludhiana.
6. Gupta, V. K. and V. S. Paul (2001) Disease of vegetable crops. Kalyani Publ. Ludhiana.
7. Hardy. K. G. (1987) Plasmids - a Practical Approach, IRL Press, Oxford, Washington D.C.
8. Luria S.E., J. E. Darnel, D. Baltimore & A. Campbell (1978) General Virology, John Wiley & Sons, New York.
9. Mukadam D.S., M. S. Patil, Ashok M Chavan, Anjali R. Patil (2006) 'The Illustrated of Fungi', Saraswati Printing Press, Aurangabad.
10. Rangaswami, G. and A. Mahadevan (2001) Disease of crop plants in India, Printic Hall of India, Pvt. Ltd., New Delhi.
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12. Raychaudhari, S. P. and T. K. Nariani (1977), Virus and Mycoplasma disease of plants in India. Oxford and IBK Publ. Corp., New Delhi.
13. Verma. J.P, (1992) The Bacteria, Malhotra Publishing House, New Delhi.

THEORY BOT-521: TAXONOMY OF ANGIOSPERMS-I (ELECTIVE C)

UNIT-I: Taxonomy: Aims and objectives of taxonomy, functions and phases of taxonomy; taxonomy as synthetic discipline (passing remarks), Characteristic features of angiosperms, Secrets of success of Angiosperms.

UNIT-II: Phylogeny of Angiosperms: Monophyletic and polyphyletic origin of angiosperms, herbaceous origin hypothesis, origin of monocotyledons; molecular evidence to angiosperm origin and cradle of angiosperms.

UNIT-III: Taxonomic hierarchy: Major, Minor and Infra-specific categories and ranks. A brief history of Pre-Darwinian and post Darwinian systems of classification with special emphasis on Thorne and Cronquist's systems of classification and Broad outline of Angiosperm Phylogeny Group (APG IV) system.

UNIT-IV: Concept of taxonomic character: Analytical and synthetic, qualitative and quantitative, genetically and environmentally controlled, good and bad character, character weighing, taxonomic co-efficient.

UNIT-V: a. Trends in evolution of characters in flowering plants: Habit and habitat, phyllotaxy, stomatal apparatus, nodal anatomy, xylem, phloem, cambium, vascular cambium, inflorescence, flower, androecium, gynoecium, pollination, fertilization, placentation, fruit, seed and seedling.

b. Evolutionary trends in the phytochemicals present in flowering plants.

UNIT-VI: a. Phylogenetic relationship: Primitive and advanced characters, monophyletic, paraphyletic and polyphyletic, homology and analogy, parallel and convergent evolution, pleomorphic and apomorphic characters.

b. **Cladistics and Phenetics:** Operational Taxonomic Units (OTU) characters and coding, measuring of similarity, cladograms.

UNIT-VII: History of botanical explorations in Maharashtra and Marathwada. Contributions of Botanical Survey of India.

PRACTICALS BASED ON BOT-521: TAXONOMY OF ANGIOSPERMS I(ELECTIVE C)

1. Description of species based on many specimens to study intraspecific variation.
2. Study of morphology and general evolutionary trends in flowers, stamens and carpels of primitive families viz.: Magnoliaceae, Papaveraceae, Nymphaeaceae, Lauraceae
3. Study of different types of ovules, placentation and evolutionary trends therein
4. Exercises on nomenclature problems: Author citation, principle of priority, transfer of taxa, effective and valid publication.
5. Describing new taxon, deposition of type, Latin diagnosis and abbreviations used in citations.
6. Semi-permanent pollen preparations by acetolysis method and study of different pollen morphotypes.
7. Taxonomic distribution of special units of pollen dispersal- bi celled pollen, tetrads, polyads and pollinia and pollen types.
8. Study of plant surface attributes with the help of SEM photographs (Trichomes and hairs, Stomata, Seed coats and pollens).

THEORY BOT-522: TAXONOMY OF ANGIOSPERMS-II (ELECTIVE C)

UNIT-I: Species: Various concepts of species, Plant speciation: allopatric/ abrupt/ sympatric/ hybrid/ apomictic speciation and isolation mechanism. Types of speciation: quantum, catastrophic, local, geographic and phyletic. Causes of variation in population, ecotypes and ecads, evolution and differentiation of species, adaptive radiations.

UNIT-II: Botanical Nomenclature: Principles of Plant Nomenclature; Scientific names: legitimate and illegitimate names, autonym, homonym, synonym, basionym, tautonym, alternative name, ambiguous name, superfluous name, naked name, conserved name, rejected name; procedure to describe new taxon; Latin diagnosis and description, effective and valid publication, coining of generic names and specific epithets; citation of names of author(s); Scientific Journals in plant taxonomy.

UNIT-III: Taxonomic evidences: Morphology, micro-morphology, ultrastructure systematics- SEM and TEM studies, anatomy, embryology, palynology, cytology, ecology, population biology, phyto-chemistry, molecular biology and numerical taxonomy.

UNIT-IV: Herbarium: History, Objectives and function of an herbarium, Types of herbaria, role of herbarium in Systematics, Floristics, Teaching, Research, Assessment and documentation of phyto diversity and Public Education, pests in herbarium and its control. Major herbaria of world and India, Contribution of "BAMU" Herbarium.

UNIT-V: Botanic Gardens: Definition, criteria, history and role of botanic gardens, special types of botanic gardens: Arboretum, Pineatum, Orchidarium, Bambusetum, Fernary. Important Botanic Gardens in World, India and Maharashtra.

UNIT-VI: Comparative account on distribution, floral morphology, interrelationships of families belonging to the following order as per APG IV system of classification:

- | | | | |
|----------------|----------------|-----------------|-----------------|
| a) Nymphaeales | b) Magnoliales | c) Arecales | d) Asparagales, |
| e) Liliales | f) Poales | g) Zingiberales | h) Ranunculales |
| i) Fabales | j) Rosales | | |

PRACTICALS BASED ON BOT-522 (ELECTIVE C) TAXONOMY OF ANGIOSPERMS II

1. Descriptions, sketching, classification and identification of at least 30 families represented in local flora.
2. Classification and identification of at least 5 species of some of the genera like *Alysicarpus*, *Amaranthus*, *Cassia*, *Chlorophytum*, *Commelina*, *Cyperus*, *Euphorbia*, *Indigofera*, *Leucas*, *Sida*, *Solanum* etc.
3. Several One-day botanical excursions to botanically rich locations.
4. Botanical excursion of about one week to any botanically rich location preferable outside the State.

SUGGESTED READINGS: BOT 521 & 522 TAXONOMY OF ANGIOSPERMS (ELECTICE C)

1. AHMEDULLAH, M., AND M. P. NAYAR. 1987. Endemic Plants of the Indian Region. Vol. I. Botanical Survey of India. Howrah.
2. BHOJWANI, S. S. AND BHATNAGAR, S. P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Dehli.
3. BILGRAMI, K. S. AND J. V. DOGRA. 1990. Phyto-Chemistry and Plant Taxonomy. New Delhi, CBS Publishers
4. CRONQUIST, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U. S. A.
5. DANIEL, M. 2009. Taxonomy: Evolution at work. Narosa Publishing House Pvt. Ltd. New Delhi.
6. DAVIS, P. H., AND V. H. HEYWOOD. 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi
7. DOBSON, A. P. 1996. Conservation and Biodiversity. Scientific American Library. New York, U. S. A.
8. ERDTMAN, G. 1986. Pollen Morphology and Plant Taxonomy: Angiosperms An Introduction to Palynology. Netherland, E. J. Brill, Leiden.
9. FORMAN, L. AND D. BRIDSON. 1989. The Herbarium Handbook. Royal Botanic Gardens, Kew, U. K.
10. GRAHAM, L. E. 1993. Origin of Land Plants. John Wiley & Sons. Inc. New York.
11. GREUTER, W, (Ed.) 2007. International Code of Botanical Nomenclature. (VIENNA CODE) Koeltz Vesentific Books. Germany.
12. GROOMBRIDGE, B, (Ed.) 1992. Global Biodiversity: Status of the Earth's Living Resources. Chapman and Hall. London.
13. HENRY, A. N., M. CHANDRABOSE. 1980. An Aid to International Code of Botanical Nomenclature. Today & Tomorrow's Printers and Publishers. New Delhi.
14. HEYWOOD, V. H. 1995. Global Biodiversity Assessment. Cambridge University Press, Cambridge, U. K.
15. HUTCHINSON, J. 1973. The Families of Flowering Plants. 3rd Edition. Oxford University Press. Oxford.
16. JAIN, S. K. and R. R. RAO. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.
17. JOHRI, B. M. 1994. Botany in India: History and Progress. Vol-I. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
18. JONES, S. B., AND A. E. LUCHSINGER. 1987. Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York.
19. JUDD, W. S, C. S. CAMPBELL, E. A, KELLOG, P. F. STEVENS AND N. J. DONOGHUE. 2008. Plant Systematics. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
20. LAWRENCE, G. H. M. 1951. Taxonomy of Vascular Plants. The Macmillan Company. New York.
21. MABBERLEY, D. J. 2005. The Plant-Book, A portable dictionary of the vascular plants. Cambridge University Press, United Kingdom
22. MANILAL, K. S. AND M. S. MUKTESH KUMAR [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.
23. MINELLI, A. 1993. Biological Systematics: The State of the Art. London, Chapman & Hall.
24. MONDAL, A. K. 2005. Advanced Plant Taxonomy. New Central Book. Agency Pvt. Ltd. Kolkata.

25. MOORE, R., W. D. CLARK, K. R. STERN AND D. VODOPICH. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers. London.
26. NAIK, V. N. 2000. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company Limited, New Delhi.
27. Nair, P. K. K. 1966. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.
28. NAYAR, M. P., 1996. "Hot Spots" of Endemic plants of India, Nepal and Bhutan. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, India.
29. NAYAR, M. P., AND R. K. SASTRY. 1987-1990. Red Data Book on Indian Plants. Vols. I - III. Botanical Survey of India. Howrah.
30. QUICKE, D. L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Chapman and Hall. London.
31. RADFORD, A. E., W. C. DICKISON, J. R. MASSEY, AND C. R. BELL. 1974. Vascular Plant Systematics. Harper & Row. New York.
32. RAVEN, P. H., R. F. EVERT, AND S. E. EICHHON. 1992. Biology of Plants. 5th Edition. Worth Publishers. New York.
33. SANTAPAU, H. AND H. A. HENRY. 1994. A dictionary of the flowering plants in India, CSRI, New Delhi.
34. SHARMA A. AND A. SHARMA. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.
35. SHIVANNA, K. R. AND N. S. RANGASWAMY. 1992. Pollen Biology- A Laboratory Manual. Springer-Verlag
36. SIMPSON, M. G. 2006. Plant Systematics. Elsevier Academic Press, California, USA.
37. SINGH, G. 2005. Plant Systematics – Theory and Practice. Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi.
38. SIVARAJAN, V. V. 1989. Introduction to Principles of Plant Taxonomy. Oxford and IBH Publishing Co. New Delhi.
39. SOLTIS, D. E., P. S. SOLTIS, P. K. ENDRESS AND M. W. CHASE. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc, Massachusetts, USA.
40. STACE, C. A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
41. STUESSY, T. F. 2002. Plant Taxonomy. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
42. SUBRAMANIAM, N. S. 1995. Modern Plant Taxonomy. Vikas Publishing House. New Delhi.
43. TAKHTAJAN, A. 1997. Diversity and Classification of Flowering Plants. Bishen Singh and Mahendra pal Singh, Dehra Dun, India.
44. TAYLOR, D. V. AND L. J. HICKEY. 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.
45. WILEY, E. O. 1981. Phylogenetics: The Theory and Practice of Phylogenetic Systematics. New York, John Wiley & Sons.
46. <https://academic.oup.com/botlinnean/article/181/1/1/2416499>
47. [https://en.wikipedia.org/wiki/APG_IV_system#:~:text=The%20APG%20IV%20system%20of,Angiosperm%20Phylogeny%20Group%20\(APG\).](https://en.wikipedia.org/wiki/APG_IV_system#:~:text=The%20APG%20IV%20system%20of,Angiosperm%20Phylogeny%20Group%20(APG).)

THEORY BOT 521: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY-I (ELECTIVE D)

Unit I. Plant Composition : Structure and biochemical role of major plant constituents, carbohydrates and its derivatives, structure and classification of proteins, glycoproteins, peptidoglycans, lipids and glycoproteins, lipid and triglycerides, fatty acids, vitamins and nucleic acids.

Unit II. Pigments and other constituents: Chlorophylls, carotenoids, xanthophylls, phytochrome, anthocyanine, porphyrins, phycobiliproteins, phenolics, sterols, alkaloids, organic acids, possibilities of isolating these chemicals for human welfare and its role in plants.

Unit III. Principles and tools in Physiological studies: Application of colorimeters, photometry flame photometers, spectrophotometry, chromatography (ion exchange, affinity, thin layer, high pressure liquid) gel filtration, electrophoresis, iso-electric focusing and centrifugation techniques.

Unit IV. Application of Techniques: Radioactive tracer technique in biology, radioactive isotopes Autoradiography, Biophysical methods X ray diffraction, fluorescence UV, NMR and ESR Atomic absorption spectroscopy

Unit V. Growth analysis: Growth, growth curve, lag, log and senescence phase, growth rates AGR, RGR, NAR, LAP, LAI, CGR and LAD productivity potential of dwarf varieties, causes of dwarfism, morphological and physiological factors in relation to height. Yields of dwarf plants.

Unit VI: Role of phytohormones: Physiology of seed germination, flowering, photoperiodism, senescence, fruit ripening.

PRACTICAL BASED ON BOT 521: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY-I (ELECTIVE-D)

1. Estimation of beta - carotene with column chromatography.
2. Estimation of reducing sugars by Folin – Wu tube.
3. Estimation of cellulose by crampton and Maynard Method.
4. Estimation of free fatty acids.
5. Estimation of nitrates.
6. Thin layer chromatographic technique.
7. Techniques of flame photometry: estimation of sodium and potassium.
8. Estimation of gross energy by chromic acid oxidation method.
9. Estimation of N by micro – Kjeldhal's method.
10. Estimation of crude protein, crude fat and crude fiber.

THEORY BOT 522: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY-II (ELECTIVE D)

Unit I Photosynthesis and plant productivity C3, C4 and CAM pathways and photorespiration in relation to crop productivity, soil and water conservation methods, weed biology herbicides, biological weed control, intensive cropping, zero tillage use of plant growth regulators and bio-fertilizers in agriculture, Nitrogen use efficiency, optimum economic dose of nitrogen fertilizers green manuring.

Unit II Biomass : The concept of Biomass, Biomass production, Utilization of biomass as a energy agricultural. Residue and their management, HDEF energy forests energy cropping hydro carbon, plants biomethylation biogas, biogas units and production from city organic wastes.

Unit III. The practice of green manuring and preparation of compost NADEP and other methods, Utilization of solid wastes for composting, recent trends in solid waste management and production sources.

Unit IV. Green crop fractionation: The GCF system and its advantages. Mechanical fractionation and the types of machinery used, plants suitable for GCF, products, pressed crop residue (PCR) Juice, leaf protein concentrate and deproteinized Juice (DPJ).

Unit V. Green Crop Fractionation: Use of PCR (pressed crop residue) in animal nutrition, preparation of silage, silage fermentation, use of leaf juice as substitute to milk, Preparation of LPC, chloroplastic and cytoplasmic LPC, Nutritive value of LPC, and its suitability in human nutrition as a sources of protein and vitamin - A, preservation of LPC, DPJ as a alternative for tissue culture media, comparison of LPC with algal protein, SCP, the possibility of increasing protein productivity through green crop fractionation and Bidkin Process.

PRACTICAL BASED ON BOT 522: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY-II (ELECTIVE-D)

1. Estimation of ash acid soluble / insoluble ash, Nitrogen free extracts and total carbohydrates.
2. Estimation of cell wall constituents, ADF, NDF, cellulose, hemicellulose, lignin etc.
3. Estimation of calcium by titration method.
4. Estimation of phosphorus by Subba Rao and Fiske Method,
5. Growth analysis: AGR, RGR, NAR, LAR, LAI, CGR and LAD.
6. The process of GCF and extractability of dry matter and Nitrogen.
7. Preparation of LPC by heat coagulation acid coagulation and fermentation.
8. Preparation of cytoplasmic and chloroplastic LPC by differential heat coagulation.
9. Preparation of TCM using DPJ and Inoculation of explant.

**SUGGESTED READINGS: BOT 521 & 522- ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY
THEORY AND PRACTICALS (ELECTIVE D)**

1. Bajrachry D. Experiment in Plant Physiology, Narosa Publishing House, New Delhi.
2. Bidwell R.G.S., Plant physiology: Mac Millan Publishers Co., New York.
3. Borner, J. and Galston, A.W., Principles of plant physiology,
4. Hess, Plant physiology, Narosa Publishing House, New Delhi.
5. Datta,S.C., Plant Physiology, Willey Eastern Limited, Culcutta.
6. Devlin, R.M. and Hostan, F.H., Plant physiology, CBS Publishers and Distributors, New Delhi.
7. Fairley, J.L. and Kilgon, G.L., Essentials of Biological Chemistry, Earr west Press Pvt. Ltd., Delhi.
8. Goodwin T. W. & E. I. Mercer (2003) Introduction to Plant Biochemistry, CBS, New Delhi
9. ICAR Handbook of Agriculture, ICAR, New Delhi.
10. Jayraman, J., Laboratory Manual in Biochemistry, New Age International Publishers, Mumbai.
11. Lehninger, A. L. Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
12. Mertz, E.T., Vakils, Elementary Biochemistry, Fetter and SimsonsPvt Ltd. Mumbai.
13. Mukharji S., A.K.Ghosh, Plant Physiology, New Central Book Agencies, Kolkatta.
14. Mungikar, A. M. Bibliography of leaf protein in Marathwada University.
15. Nels R. Lersten (2014) Flowering Plant Embryology, Wiley, New Delhi
16. Noggle G.R. and Fritz, G.S., Introductory plant physiology, Prentice Hall, USA.
17. Pandey S. N. & Sinha B. K., Plant Physiology, Vikas Publishing House, New Delhi
18. Pine, N. W. (1971) Leaf protein, its preparation, quality and use, Blackwell Scientific Publ. U. K.
19. Salisbury F.N. and C.W. Ross, Plant physiology: CBS Publishers and Distributors, New Delhi.
20. Slyter, R.O. Plant Water Relationships, Academic Press, New York.
21. Telek, H. and Graham, LT. (1983) Leaf protein concentrates, AVI, Publishing Co., USA.
22. Vaidya, V. G., Sahasrabuddhe, K. R. and Khupse, V. S. Crop production and field experimentation
Continental Prakashan, Pune - 30.
23. Wilkins M.B., Advanced plant physiology, English Language Book Society, London.

THEORY BOT 521: PLANT DIVERSITY & CONSERVATION-I (ELECTIVE E)

Unit 1 a: Introduction: Biodiversity history and concept, Origin and evolution of diversity, Importance of Biodiversity, Estimation of known floras and faunas.

b. Types of Diversity: Genetic diversity: Concept, definition, importance and factors. Species diversity: Concept, definition, estimation and plant global status special reference to India, taxonomic procedure, taxa delimitation. Ecosystem diversity: Definition, Types, Forest ecosystem types (Tropical, Subtropical, temperate and alpine).

Unit 2: Agricultural and cropland diversity: Agricultural and cropland diversity concept, Crop domestication, Nicolai Nuclear centres and regional centers of crop origin, Germ-plasm, India's status for primary and secondary agricultural crops.

Unit 3: Diversity of Cryptogams: Diversity of Algae, Fungi, Lichen, Bryophytes and Pteridophytes:

Unit 4: Diversity of Phanerogams: Diversity of Gymnosperms and Angiosperms, Insectivorous plants, Poisonous plants, Epiphytic plants, Halophytic plants and Hallucinogenic Plants.

Unit 5 a: Plant Diversity of Marine & Estuarine ecosystems: Ecological zones, community organization, productivity, nutrient cycling and dynamics, upwelling and down welling of nutrients; mangroves, coral reefs and sea grasses.

b: Aquatic plant diversity: Ecosystem services and restoration Landscape ecological concepts; fresh water and coastal ecosystems. Coastal regulation zone (CRZ), Remote sensing and GIS in aquatic ecosystem management and conservation, climate change and aquatic ecosystem response. International conventions & protocols: Ramsar Convention, Convention on Biological Diversity, Ramsar sites in India.

PRACTICAL BASED ON BOT 521: PLANT DIVERSITY & CONSERVATION-I (ELECTIVE-E)

1. Comparative morphology of leaf, stipules, bracts, bracteoles, Floral, calyx, corolla, reproductive parts.(For at least few Species of a genus of in 1-2 families).
2. Dermal Studies such as hairs/ Trichomes types, Stomata types etc.
3. Stomatal Index
4. Maceration and Vessels studies.
5. Karyomorphology.
6. Use of computer generated keys, webs, surfing, data analysis etc.
7. Pollen study: Morphology, Pollen types, and pollen germination activity.
8. Study of biodiversity indices.
9. Starch test, Cellulose Test & Legnin Test.
10. Study of Cryptogams from nearby localities.
11. Study of Phanerogams from nearby localities.
Study of Family upto floral formula & diagram: Papavaraceae, Apocynaceae, Fabaceae, Rubiaceae, Asteraceae, Solanaceae, Verbenaceae, Euphorbiaceae, Liliaceae and Orchidaceae.
12. Submission of Excursion report

THEORY BOT 522: PLANT DIVERSITY & CONSERVATION-II (ELECTIVE E)

Unit 1: Global plant diversity special reference to India: Mega diverse regions, World Hotspots, In India: Western Ghats and Eastern Himalayas, Phytogeographic Realms in India, Biomes, Natural world heritage sites, Ramsar sites, Biosphere reservoirs, Global 200, phytogeographical regions of India, Forests types in India and factors responsible for distribution of biodiversity.

Unit 2: Endemism: Concept and definition, Types of endemism: Neo-endemism and Paleo-endemism, Endemic plant species in Western Ghat and Eastern Himalaya.

Unit 3: Analysis of Characters: Characters weighing: Concept and definition, primitive and advanced characters, good vs bad characters, qualitative vs quantitative characters.

Unit 4: Numerical Taxonomy: Numerical treatment data generation: Similarity concept, matrix building, assessment, correlation, dendrograms, Cladistics and phonetics, distance calculation duster method, computer programs, importance of gene mapping, DNA finger printing and its applications.

Unit 5: Methods used in Taxonomy: Keys, Plant inventory and exploration, Cryopreservation, Botanical Garden, Herbarium techniques, Major herbaria of the World and India. Comparative morphology, Cytological methods, dermal studies, root and stem anatomy, vessel study, Chemotaxonomy, Embryology and Palynology.

PRACTICAL BASED ON BOT 522: PLANT DIVERSITY & CONSERVATION-II (ELECTIVE-E)

1. Comparative morphology of leaf, stipules, bracts, bracteoles, Floral, calyx, corolla, reproductive parts. (For at least few Species of a genus of in 1-2 families).
2. Dermal Studies such as hairs/ Trichomes types,
3. Study of Stomata types etc.
4. Analysis of Stomatal Index
5. Maceration and Vessels studies.
6. Karyomorphology.
7. Use of computer generated keys, webs, surfing, data analysis etc.
8. Pollen study: Morphology, Pollen types, and pollen germination activity.
9. Preparation of keys based on comparative morphological study.
10. Submission of Herbarium Sheet.

SUGGESTED READINGS: BOT-521 & BOT-522 PLANT DIVERSITY & CONSERVATION (ELECTIVE-E: THEORY AND PRACTICALS)

1. Arvind Kumar. 2005. Biodiversity and Conservation. APH Publishers, New Delhi.
2. Choudhary H.J., S.K.Murthy Plant Diversity and Conservation in India. Bishen Singh Mahendra Pal Singh Publishers, Dehradun.
3. Cole, A.J. 1969 Numerical Taxonomy. Academic Press. London.
4. Daris, P.H, and Heywood, V.H. 1-973. Principles of Angiosperms' Taxonomy. Robert E. Krieger Pub. Co. New York.
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7. Grant, V. 1971 Plant Speciation, Columbia, University Press, New York.
8. Grant, W.F. 1984. Plant Biosystematic , Academic Press, London.
9. Hackett, P.B., Funchs, J.A. and Messing, J.W. 1998. An Introduction to recombinant DNA techniques: Basic experiments in gene manipulation. The Benjamin Cummings Pub Co, Inc. Menlo Park, California.
10. Harrison, H.J. 1971 New concepts in Flowering Plant Taxonomy. Hieman Edu Book Ltd., London.
11. Hawksworth. , D.L and Bull, A.T. 2007. Plant Conservation and Biodiversity. Springer.
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13. Jones, A.D. & Wilbins, A.D. 1971 Variations & Adaptions in Plant species. Hieman co. Edu Ltd. London
14. Krishnamurthy, K.V.K. 2003. A text book of Biodiversity. Science Publishers, USA.
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22. Parihar N. S. (1991) Bryophytes, Central Book Dept., Allahabad.
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24. Sharma O. P. (2018), A text Book of Algae, Tata McGraw Hill, New Delhi
25. Shaw, C.H. (Ed.) 1988. Plant Molecular Biology: A Practical Approach. IRL Press, Oxford.
26. Shivanna K. R. (2003) Pollen Biology and Biotechnology, Science Publishers.
27. Shivanna, K.R. & John, B.M. (1985), The Angiosperm pollen stru & function, Willey Eastern Ltd., New York.
28. Shivanna, K.R. & Rangaswamy, N.S. 1992, 'Pollen Biology: A laboratory manual, Springer Verlag, Berlin.
29. Smith G.M. (1950). The fresh water algae of the United states, McGrawHill Hoc Co., New York.
30. Soibrig. O.T. & Solbrig D.J. 1979. Population Biology and Evolution. Addison Wesley Pub Co. Inc. U.S.A.
31. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd Edition) Edward Arnold, London.
32. Stebbins, G.L. 1974 Flowering Plant- Evolution Above Species Level Edward Arnold Ltd., 'London.
33. Takhtajan A.L. 1997. Diversity and Classification of Flowering Plants. Columbia Univ Press, .New York.
34. Tandon, P., Abrol, Y.P. and Kumaria, S. 2007. Biodiversity and its Significance. I.K. International Publications. New Delhi.
35. U.K. Heywood, V.H. & Moore, D.M. 1984 Current concepts in Plant Taxonomy, Acad Press, London.
36. Woodland D.W. 1991. Contemporary Plant Systematics, Rentice Hall, New Jersey.

THEORY BOT 521: SEED TECHNOLOGY-I (ELECTIVE-F)

SEED DEVELOPMENT, GENETIC PURITY AND HYBRID SEED PRODUCTION

- Unit I: Seed Development, Seed Morphology and Seed Physiology:** Seed development, Sporogenesis, Fertilization, Embryogenesis and Seed Formation, type of embryo, endosperm and cotyledons, Parthenogenesis, Parthenocarpy, Apomixes. Seed coat structure, significations mechanical strength and permeability, Seed maturation. Harvest maturity, Influence of season, climate, nutrition's and other cultural management practices on development and maturation of seeds, occurrence of hard seed and seed dormancy etc.
- Unit II: Seed Germination and Vigour:** Seed germination requirements in Agriculture and Horticulture crop seed. Factors affecting seed germination and type of seed in germination. Biochemical changes during germination. Role of promoters and inhibitors in seed germination. Effect of age, size and position of seed on germination. Seed vigour and its concept, factor affecting seed vigour, physiological and genetical basis of seed vigour, vigour test, crop performance and yield.
- Unit III: Genetic Purity and its Maintenance:** Definition, concept and importance of genetic purity in seed production; Steps for maintenance of genetic purity- checking seed sources, isolation distance, Rouging, Precaution during crossing Program, Care during harvesting and threshing.
- Unit IV: Basic principles of hybrid seed production:** Definition, Pre requisites for hybrid seed production; mechanisms and management of pollination in autogamous and allogamous crops; genetic constitution of varieties, hybrids and basic principles in seed production. Selection of site for seed production, Sowing, row spacing, fertilizer and irrigation, Isolation, planting ratio and seed rate, Rouging and pollen shedders. Population Improvement: Introduction, Objectives and methods- Mass Selection, Progeny Selection, application and achievements.
- Unit V: Techniques of hybrid seed production -** Manual Emasculation and hand / insect pollination and crossing, use of self-incompatibility, modification of sex; types of male sterility and exploitation in hybrid development and its use in hybrid seed production; development and maintenance of A, B and R lines. Use of genetic male sterility, use of Gametocides.
- Unit VI: Heterosis and inbreeding depression-** Definition, Genetic basis of Heterosis, Genetic basis of inbreeding depression and Commercial utilization.
- (i) Apomixes:** Definition, Types of apomixes, Significance.
- (ii) Male sterility:** Definition, types of male sterility, GMS: hybrid seed production, CMS- in hybrid seed production, C-GMS- Introduction, seed production of A,B and R-Lines.
- (iii) Self- incompatibility –** Definition, Kinds and utilization.

PRACTICAL BASED ON BOT 521: SEED TECHNOLOGY-I (ELECTIVE F)

- 1) Study of types monocot and dicot embryos.
- 2) Study of different kinds of seed analysis test.
- 3) Study of external and internal structures of monocot and dicot seeds; seed coat structure, preparation of seed albums and identification.
- 4) Visit to Seed Industry/Plant breeding Research Centre. Submit report in practical examination.
- 5) Submission of seed samples (minimum 15) with botanical names, family, variety etc. in final practical Examination.
- 6) Study the Field inspection at various stages.
- 7) Study of the methods of hybrid seed production in major agricultural and horticultural crops.
- 8) Study of maintenance of A, B and R lines and production of breeder seed.
- 9) Study of the stable diagnostic characteristics of parental lines and their hybrids.
- 10) Visit to seed production plots and make a detail report of it.

- 11) Field visit for procure the knowledge of some terminology used in Hybrid technology- isolation-requirement for a crop, Rouging, harvesting and threshing.
- 12) Field visit for inculcate the knowledge for Nucleus, breeder, foundation and certified seed production in various crops.
- 13) Procure the knowledge of techniques viz.-Hand emasculatation and pollination for hybrid seed production.
- 14) Study of seed certification documentation, types of tag(s) and its colour codes.
- 15) Visit to seed processing plant. Operation and handling of mechanical drying equipments, Seed processing equipments, Seed treating equipments, Seed extraction, Seed quality up gradation, Seed blending.

SUGGESTED READINGS: BOT 521: SEED TECHNOLOGY-I (ELECTIVE F) THEORY AND PRACTICALS

1. Agrawal, 2005. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Basra, A.S. 2000. Heterosis and Hybrid Seed Production in Agricultural Crops. Food Product Press.
3. Bench, A.L.R. and Sanchez, R.A. 2004. Handbook of Seed Physiology. Food Product Press.
4. Bhojwani, S.S. and Bhatnagar, S.P. 1999. The Embryology of Angiosperm. Vikas Publ.
5. Black, M. and Bewley JD. (Eds.). 2000. Seed Technology & its Biological Basis. Sheffield Acad Press.
6. Black, M., Bewley, D. and Halmer, P. 2006. The Encyclopedia of Seeds: Science, Technology and Uses. CABI.
7. Chhabra, A.K. 2006. Pract Manual of Floral Biology of Crop Plants., CCS HAU, Hisar.
8. Copeland, L.O. and Mc Donald, M.B. 2001. Principles of Seed Science & Technology. 4th Ed. Chapman & Hall.
9. Dutta, 1983. A Class book of Botany, Oxford University Press, Calcutta.
10. Frankel, R. & Galun, E. 1977. Pollination Mechanisms, Reproduction & Plant Breeding. Springer Verlag.
11. Handbook of Agriculture- Indian Council of Agricultural Research, New Delhi.
12. McDonald, M.B. and Copeland, L.O. 1997. Seed Production: Principles & Practices. Chapman & Hall.
13. Nicolas, G., Bradford, K.J., Come, D. and Pritchard, H.W. 2003. The Biology of Seeds, Recent Research Advances. CABI.
14. Pandey, 2010. A text book of Botany. S. Chand and Company Ltd., New Delhi.
15. Reddy, 2008. Principles of crop production. Kalyani Publishers, New Delhi.
16. Santra and Chatterjee, 2007. College Botany, New Central Book Agency (P) Ltd., Kolkata.
17. Singh, 2009. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
18. Singhal, N.C. 2003. Hybrid Seed Production. Kalyani Publishers.
19. Umarani *et. al.* 2006. Experimental Seed Science and Technology, Agrobios, Jodhpur.
20. Agarwal, R.L. 1997. Seed Technology. Oxford & IBH.
21. Agrawal, P.K. (Ed.). 1993. Handbook of Seed Testing. Ministry of Agriculture, GOI, New Delhi.
22. Agrawal, P.K. and Dadlani, M. 1992. Techniques in Seed Science and Technology. 2nd Ed. South Asian Publ.
23. Copland, L.O. and McDonald, M.B. 1996. Principles of Seed Science and Technology. Kluwer.
24. ISTA. 2006. Seed Testing Manual. ISTA, Switzerland.
25. Martin, C. and Barkley, D. 1961. Seed Identification Manual. Oxford & IBH.
26. Tunwar, N.S. and Singh, S.V. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

THEORY BOT-522: SEED TECHNOLOGY-II (ELECTIVE-F)

SEED- QUALITY CONTROL, CERTIFICATION ACT AND REGULATION

Unit I: Seed and Quality Control: Concept of seed quality control, Field inspection & its methods, Classes of seed, Importance of good quality seeds. Seed quality standards, definition and concept, Role of "Quality Control" for import and export of seeds.

Unit II: Seed Sampling and types of Testing-Definition, General principles of Seed sampling, Procedure and methods (Paper, Sand and Soil), heterogeneity test, kinds of Sample and procedure of seed sampling, its receipt and registration. **Physical purity analysis:** Definition of purity components, Procedure, ODV test, Reporting and results. **Moisture Testing** (1) By air oven method, (2) Moisture meters. **Tetrazolium test** - principles, procedure and evaluation. Grow-out test, Seed health, Vigour testing- Principle, General procedure. Seed testing results report, factors affecting variability.

Unit III: Seed Production and Release of new variety: Seed as a basic input in Agriculture, Classes of Seeds- Nucleus, Breeder, Foundation and Certified Seeds. Seed production Organization- National Seed Corporation (NSC) and State seed Corporation (SSC). Release of New Variety: Introduction, Evaluation-Station Trial, Multi-location Trial, Identification of entries for release, Multiplication.

Unit IV: Seed Certification: Objectives, Concept, purpose and phases of seed certification, Certification agency. Variety eligibility, classes and sources of seed, verification of seed sources. Unit of certification, isolation distance, comparing field observations with minimum standards, tolerance levels. Seed analyst and his duties. Laboratory evaluation and packaging, seed lot size and construction of seed lot numbers, certified seed level, certification tag, certification validity period, Seed control order, Seed policy. General seed certification standards, Specific crop standards.

Unit V:Regulatory mechanisms of seed quality control- organizations involved in seed quality control programmes; seed legislation and seed law enforcement as a mechanism of seed quality control; the Seed Act (1966), Seed Rules (1968), Seed (Control) Order 1983; Essential Commodities Act (1955); Plants, Fruits and Seeds Order (1989); National Seed Development Policy (1988) and EXIM Policy regarding seeds, plant materials; New Seed Bill-2004 etc. Introduction, objectives and relevance of plant quarantine, regulations and plant quarantine set up in India.

Unit VI: Seed Law Enforcement: Introduction, Duties of seed inspector, Powers of seed inspector, field inspection and reporting of results, Offences and penalties, Procedure of seed law enforcement, inspection procedures and equipment required.

PRACTICAL BASED ON BOT 522: SEED TECHNOLOGY-II (ELECTIVE-F)

1. Study of seed Sampling and Dividing Equipment's.
2. Study of germination Testing (Paper, Sand and Soil Method).
3. Study of Seed vigour testing by physical method.
4. Study of ODV test and Physical purity analysis.
5. Study of the quick viability (Tetrazolium test)of seeds, germination test and its analysis,
6. To Grow out test, Accelerated aging test, activity of enzymes, respiratory rates etc.
7. Study of draw the sampling entry in records, dividing and mixing.
8. Study of testing physical purity, germination and moisture;
9. Determination of weight of seed samples
10. Study of Moisture testing by oven method and moisture meter.
11. Compulsory visit to Seed Testing Laboratory.
12. Drafting of seed certification agency (As per Indian Seed regulation Act) of a given seed sample.

13. Study of General procedure of seed certification, identification of weed and other crop seeds as per specific crops seed testing regulation.
14. Study of field inspection at different stages of a crop and observations recorded on contaminants and reporting of results.
15. Study of inspection and sampling at harvesting / threshing, processing and after processing for seed law enforcement;
16. Study of specifications for tags and labels to be used for certification purpose; grow-out tests for pre and post-harvest quality control.
17. Visits to seed testing laboratory, including plant quarantine lab and seed certification agency.

SUGGESTED READINGS: BOT 522: SEED TECHNOLOGY-II (ELECTIVE-F)

1. Agarwal, R.L. 1997. Seed Technology. 2nd Ed. Oxford & IBH.
2. Agrawal, 2005. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd., NewDelhi.
3. Anonymous. 1992. Legislation on Seeds. NSC Ltd., Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi.
4. Chhabra, A.K. 2006. Practical Manual of Floral Biology of Crop Plants. Dept. of Plant Breeding CCS HAU, Hisar.
5. Desai, B.B. 2004. Seeds Handbook. Marcel Dekker.
6. Dutta, 1983. A Class book of Botany, Oxford University Press, Calcutta
7. Handbook of Agriculture- Indian Council of Agricultural Research, New Delhi
8. Kelly, A.F. 1988. Seed Production of Agricultural Crops. Longman.
9. Mc Donald, M.B. Jr & Copeland, L.O. 1997. Seed Production: Principles & Practices. Chapman & Hall.
10. Musil, A.F. 1967. Identification of Crop and Weed Seeds. Handbook No. 219, USDA, Washington, DC, USA.
11. Nema, N.P. 1986. Principles of Seed Certification and Testing. Allied Publishers.
12. Pandey, 2010. A text book of Botany. S. Chand and Company Ltd., New Delhi
13. Poehlman, J.M. and Sleper, D.A. 2006. Breeding Field Crops. Blackwell.
14. Reddy, 2008. Principles of crop production. Kalyani Publishers, New Delhi
15. Santra and Chatterjee, 2007. College Botany, New Central Book Agency (P) Ltd., Kolkata
16. Singh, B.D. 2005. Plant Breeding: Principles and Methods. Kalyani Publishers.
17. Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers.
18. Thompson, J.R. 1979. An Introduction to Seed Technology. Leonard Hill.
19. Tunwar, N.S. and Singh, S.V. 1985. Handbook of Cultivars. CSCB, GOI.
20. Umaraniet. *al.* 2006. Experimental Seed Science and Technology, Agrobios, Jodhpur

SERVICE COURSE- I BOT 525: BASIC PLANT TISSUE CULTURE

Unit-I: Introduction to Plant Tissue culture: Introduction to Plant Tissue culture, Terms and definitions, Historical background, Laboratory organization, Tools and techniques, methods of sterilization. Laboratory contaminants- it's control and measures.

Unit-II: Media Preparation and dynamics of Growth: Introduction to tissue culture: Media composition, Preparation, Phytohormones and their usage, selection of media for specified applications, initiation of tissue culture, cellular totipotency, media for initiation of callus, dynamics of callus growth, organogenesis and factors controlling it, genome instability in relation to morphogenesis, somaclonal variation and its applications.

Unit-III: Culture techniques: Cell and organ culture: Plant organ culture; shoot tip, Micropropagation, shoot apical meristem, root, leaf, flower and ovary culture, embryo rescue, somatic embryogenesis, factors influencing embryogenesis, synthetic seeds, suspension culture in stationary and stirred tank reactors,

Unit-IV: Advance Culture techniques: Isolation of single cells and their culture, measurement of growth, protoplast isolation, culture, regeneration and fusion of protoplasts, generation of cybrid and hybrids, cryopreservation of plant cells. Role of Ovary and ovule in *In-vitro* Fertilization in production of agricultural and horticultural crops. Hardening techniques

Unit-V: Recombinant Techniques in Tissue Culture : Recombinant DNA technology: Gene cloning, principles and techniques. Techniques for gene transfer. Markergenes. Applications of tissue culture: Applications in agriculture and industry.

SUGGESTED READINGS

1. Bhojwani, Plant Tissue Culture.
2. Dubey. R. C. a Textbook of Microbiology.
3. Glover, D. M. and Hanes, B. D. (eds.) 1995. DNA cloning 1: A practical approach, core techniques, 2nd edition, PAS, IRL press at Oxford University Press.
4. Kalyankumar De. Introduction to Plant Tissue culture.
5. Montell. S. H. Mathews, J. A., Meker, R. A. Principles of Plant Biotechnology.
6. Plant cell culture protocols. Humana Press, Inc. New Jersey, USA.
7. Purohit Plant Tissue Culture.
8. R. H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
9. Rajdan : An introduction to plant tissue culture.
10. Sandhya Mitra: Genetic engineering.
11. Shaw, C. H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.

SERVICE COURSE-2 BOT 526: MEDICINAL PLANTS

Unit I: Introduction of Systems of Medicines- a) Ayurved b) Siddha d) Unani e) Chinese f) Naturopathy g) Homeopathy.

Unit II: a) Health Concept in Ayurved, **b)** Dincharya and Rutucharya c) Anupan d) Pathya and Apathy e) Viruddha Ahaar.

Unit III Classification of Drugs: a) Root drugs: *Withania somnifera* (L) Dunal, *Asparagus racemosus* Willd. *Chlorophytum borivillianum*, *Vetiveria zizanoides* (L.) Nash, *Glycyrrhiza glabra*

b) Rhizome drugs: *Zingiber officinale* Rose, *Curcuma longa* L., *Acorus calamus* L.

c) Stem and wood drugs: *Tinosporacordifolia* (Willd.) Miers, *Santalum album* L, *Pterocarpum arsupium* Roxb., *Pterocarpum santalinus*

d) Bark drugs: *Terminalia cuneata* Roth, *Crateva adansonii* DC subsp. *Odora* (Buch.- Ham.) Jacobs, *Acacia nilotica*(L.) Del, *Azadirachta indica* A. Juss.,

e) Leaf drugs: *Aloe vera* (L.) Burm.f, *Adhatoda zeylanica* Medic., *Cymbopogon citratus*, *Kalanchoe pinnata* (Lamk.) Pers. *Mentha* sp.

f) Flower drugs: *Syzygium aromaticum*, *Crocus sativus*

g) Fruit drugs: *Emblica officinale*, *Terminalia bellirica* (Gaertner) Roxb., *T. Chebula* (Gaertner) Retz, *Aegle marmelos* (L) Corr.

h) Seed drugs: *Syzygium cumini* (L.) Skeel, *Celastrus paniculatus* Willd., *Semecarpus anacardium* L. f

i) Entire plant drugs: *Ocimum tenuiflorum* L, *Bacopa monnieri* (L.) Penn,

Unit IV a) Identification of Medicinal Plants

b) Harvesting, Storage and preservation of Medicinal plants

Unit V Introduction of formulations of some Ayurvedic drugs: a) Asava and Arishta, b) Churna c) Vati and ghutid) Aark e) Pak and Avaleha f) Fant and Kadha

g) Satva h) Tailam and ghritam.

SUGGESTED READINGS:

1. Anonymous 2000, "The Ayurvedic Formulary of India" - Part - II, Govt. Of India Publication, New Delhi.
2. Daniel, M. 2006, Medicinal Plants -Chemistry & Properties Oxford & IBM Pub Co. Pvt. Ltd. New Delhi.
3. Desai W. G. 1975, "AushadhiSangraha" Rajesh Publication, Pune.
4. Garde G. K. 2009, (Revised Edition) "Sort/7 Vagbhat - Ashtanghridayam", Rajesh Publication, Pune.
5. Jain S. K. 1991, "Dictionary of Indian Folk Medicine and Ethnobotany" Deep Publication, New Delhi.
6. Kameshwara Rao C. 2000, "Material for the Database of Medicinal Plants" Karnataka state Council for Science and Technology for the Dept. of Forests, Environment & Ecology, Govt of Karnataka Publication.
7. Kirtikar K. R. and Basu B. D. 2001(Reprint) "Indian Medicinal Plants" Oriental enterprises Uttaranchal.
8. Manilal K. S. 2001, "Van Rheed's Hortus Malabaricus" English Edition. University of Kerala Publication.
9. Nadkarni K. M. 1976, (Revised Edition) "Indian Materia Medica" Popular Prakashan, Mumbai.
10. Sharma O. P. 1996, "Hills Economic Botany" Tata McGraw Hill Publication, New Delhi.
11. Yoganarasimhan S.N. 1996, Med Plants of India vol.I. Karnataka. Interline Publ Pvt. Ltd. Bangalore.
12. Anonymous, "Upchar Paddhati aur Pathya" Baidyanath Publication.
13. Anonymous, " Vividh Upchar paddhati" ..

SERVICE COURSE-3: BOT 527- APPLIED MYCOLOGY

Unit I: Plant Disease Diagnosis and Screenings:

Field observations, laboratory investigations, isolation and identification of plant pathogen. Koch's postulates. Primary and Secondary screenings: Antibiotic producer, organic acid producers, Amylase producers, Cellulose producers, Alcohols producer, Mycotoxin and effect of mycotoxin on human health. Agents of infections and diseases: Biotic agents and Abiotic agents.

Unit II: Fermentation and Quantification:

Fermentation: Definition, concept, types, equipments, Penicillin, Citric acid, Enzyme and Alcohols, Fundamental processes in cheese manufacturing, Blue Veined Cheese & Processed Cheese, Fungi in Flavor production.

Unit III: Fungi as Food and Feed: Yeast fermentation, Food & feed yeast, Yeast in Baluing. Mushrooms:- History of mushrooms cultivation, Mushroom production & Consumption, Nutritive Values of mushrooms, Edible mushrooms Cultivation in India, Present and future prospects. Type study of Mushroom cultivation of following mushrooms: a.) Button Mushrooms. b.) Paddy straw Mushrooms. c.) Pleurotus Spp.

Unit VI. Techniques and tools used in Assay:

Spectrophotometric, chromatographic partition, Principals of chromatography, Gel filtration, ion exchange. Principals and use of TLC, HPLC and Ultracentrifugation, Biological principals use limitation, Test-organization diffusion assay, Growth assay and end print determination.

SUGGESTED READINGS :

1. Casida L.E Industrial Microbiology –
2. Cruger Industrial Microbiology.
3. Gray W.D., The relation of fungi human affair
4. Hrudayanath Thatoi, Pradeep K. Das Mohapatra, Sonali Mohapatra, Keshab C. Mondal, (2020) Microbial Fermentation and Enzyme Technology. CRC Press; 1st edition.
5. Keeney, Practical medical mycology.
6. Norris. J. P. and Richman, Essay in Applied Microbiology.
7. Patel H. Industrial Microbiology,.
8. Pepler, Industrial Microbiology Vol.I and Vol.II
9. Prescott & Dunn, Industrial Microbiology –
10. Prescott & Dunn, Industrial Microbiology
11. R. Gogoi, Y. Rathaiah, T.R. Borah. (2019) Mushroom Cultivation Technology. Scientific Publishers,
12. Rivera, Fundamental of Industrial Microbiology.
13. Smith, Fermentation fungi, Industrial mycology - Vol. I.
14. Suman. B C and V P Sharma (2007). Mushroom Cultivation in India. Daya Publishing House.

THEORY BOT 503: BIOPROSPECTING AND PLANT RESOURCE UTILIZATION

- Unit I:** a. **Bioprospecting:** Definition, Introduction, Current practices in Bioprospecting for conservation of Biodiversity and Genetic resources.
b. **Bioprospecting Act:** Introduction, Phases of Bioprospecting, Exemption to Act. Fields of Bioprospecting.
- Unit II: Medicinal Plants Bioprospecting/ Pharmaceutical Bioprospecting:** Plant chemistry, new drugs, assays in Bioprospecting. Antioxidant assay – NO free radical scavenging assay, Antigenotoxicity assay – MTT assay, Antiviral activities of plants – SRB assay, Properties and uses of Medicinal and Aromatic plants. Anti Covid – 19 and Immunity booster Herbs.
- Unit III: Marine Bioprospecting:** Sources of marine planktons and their Bioprospecting, Isolation and cultivation of Marine bioresources, Isolation of Marine Yeast and its industrial applications, Bioactive chemicals from Seaweeds and their applications.
- Unit IV: Microbial Bioprospecting:** Isolation of Microbial metabolites and their bio-activity. Endophytic microbial products as Antibiotics.
- Unit V: Plant Resources:** Origin and evolution of botany, cultivation and uses of Food, Fodder, Fibers, Oil yielding crops, wood and timber, Non-wood forest products(NWFPS): Bamboos, Gums, Dyes, Resins, Fruits etc.
- Unit VI: Plant products:** Separation of secondary metabolites, Pharmacognostic procedures.

PRACTICAL BASED ON BOT 503: BIOPROSPECTING AND PLANT RESOURCE UTILIZATION

1. Food Crops: Morphology, anatomy, micro-chemical test for stored material: Wheat, rice, maize, chickpea, potato, sweet potato and sugarcane.
2. Study of any five important crops used for fodder / forage purpose: Jowar, Bajra, lucerne, Maize etc.
3. Plant fibers: Morphology microscopic study anatomy of whole fibers, using appropriate staining methods for Cotton, jute, sun hemp, coir, silk cotton.
4. Medicinal and aromatic plants: At least 5 medicinal, 5 aromatic plants and their morphology, anatomy and Phyto-chemistry.
5. Oil yielding crops: Mustard, groundnut, soybean, coconut, sunflower, castor: Morphology, microscopy of oil yielding tissue, test for oil, acid, iodine numbers.
6. Gum, resin, tannin, dye yielding plants.
7. Fire wood and timber yielding plants.
8. Antioxidant assay – NO free radical scavenging assay.
9. Antigenotoxicity assay – MTT assay.
10. Antiviral activities of plants – SRB assay.
11. Scientific visits to laboratories / Industries / Research Institutes and field and submission of report.

SUGGESTED READINGS: BOT 503: BIOPROSPECTING AND PLANT RESOURCE UTILIZATION

1. Arora, R.K. and Nayar, E.R. (1984), Wild relatives of crop plants in India, NBPGR Science Monograph No.7.
2. Baker, H.G. (1978), Plants and civilization. III Ed. (A. Wadsworth, Belmont).
3. Bole, P.V. and Vaghani, Y. (1986). Field guide to common Indian trees, Oxford University Press, Mumbai.
4. Thakur, R.S., Puri, H.S. and Husain, A. (1969). Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow.
5. Swaminathan, M.S. and Kocchar, S.L. (Es.) (1989). Plants and Society, MacMillan Publication Ltd.
6. Sharma, O.P. (1996). Hills Economic Botany, Tata McGraw Hill co., Ltd., New Delhi.
7. Kocchar, S.L. (1998). Economic Botany of the tropics, II Edn. MacMillan India Ltd.
8. CSIR (1986), The useful plants of India Publication and Information directorate, CSIR, New Delhi.
9. CSIR (1948 - 1976) The wealth of India, CSIR, New Delhi

THEORY BOT 504: GENETIC ENGINEERING AND BIOINFORMATICS

Unit I: Genetic Engineering of Plants: Aims, strategies for development of transgenic. Transformation and regeneration of plants, DNA delivery systems- *Agrobacterium tumefaciens*, Direct gene transfer. The selection and analysis of transformants. Plant regeneration systems, Stability of the transgenes and Environmental risk assessment. Gene targeting - Transformation of recalcitrant species.

Unit II: Microbial genetic Manipulations: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Unit III a. Introduction to Bioinformatics: Definition of Bioinformatics- History of Bioinformatics, scope and application of Bioinformatics. Fundamentals of Internet, www, HTML, URLs, Role of internet and www in bioinformatics.

b. Biological Data Acquisition: The form of biological information; DNA sequencing methods – basic DNA sequencing, Types of DNA sequences – genomic DNA, cDNA, Expressed sequence tags (ESTs) and Genomic survey sequences (GSSs).

c. Databases: Format and Annotation: Common sequencing file formats – NBRF/ PIR, FASTA, Files for multiple sequence alignment, multiple sequence format (MSF), ALN format; Files for structural data – PDB format.

Unit IV: Bioinformatics Databases: Primary sequence databases (Gene Bank-NCBI, the nucleotide sequence database-EMBL, DNA sequence databank of Japan-DDBJ); Protein sequence and structure databases (PDB, SWISS-PROT and TrEMBL); Derived (Secondary) Databases of Sequences and Structure: Prosite, PRODOM, PRINTS, Pfam, BLOCK, SSOP, and CATH. Enzyme Database, Biodiversity Database.

Unit V: Technique's in Bioinformatics- Sequence alignment, database searching and structure prediction: Pairwise sequence alignment, Database similarity searching, FASTA, and BLAST. Multiple sequence alignment and analysis with CLUSTAL X and CLUSTAL W. Measurement of sequence similarity; Similarity and homology. Phylogenetic tree. Phylogenetic data analysis, tree building methods, tree evaluation & interpretation methods. Phylogenetic analysis with PHYLIP software. Prediction of secondary and tertiary structures with different software's and tools. Structure visualization software's RasMol, Spdb Viewer etc.

Unit VI: Introduction to Genomics and Proteomics: Introduction to genomics- scope and application, Computational genomics, Organization of the prokaryotic and eukaryotic genomes, Human Genome Project. Genome maps and types, current sequencing technologies, partial sequencing, gene identification, gene prediction rules and software, Genome databases; Annotation of genome, Genome diversity: taxonomy and significance of genomes – Bacteria, Yeast, *Homo sapiens*, *Arabidopsis*, etc. Functional Genomics, Microarray, Gene Expression, methods used for gene expression analysis; Applications of DNA microarray.

PRACTICAL BASED ON BOT 504: GENETIC ENGINEERING AND BIOINFORMATICS

- 1) Different file formats –Genbank, Genpept, FASTA, EMBL, NBRF/PIR, , PDB file format.
- 2) Entrez and Literature Searches. PubMed, PubMed central, OMIM / OMIA.
- 3) Primary sequence Databases- NCBI, EMBL, DDBJ.
- 4) Protein Structure Database– PDB.
- 5) Prediction of secondary structure of proteins.
- 6) Visualization of tertiary structure of proteins in Rasmol.
- 7) Accessing existing databases on www.
- 8) Sequence alignment – BLAST.
- 9) Homology search tools like BLAST and modeller.
- 10) Genomics- Genome databases, Annotation of genome, Prediction of ORFs dbSNP and other SNP related database .
- 11) GENSCAN and Gene Mark.

SUGGESTED READINGS: BOT 504: GENETIC ENGINEERING AND BIOINFORMATICS

- 1) Baxevanis, A.D. and Francis Ouellette, B.F. (1998) "Bioinformatics– a practical guide to the analysis of genes and proteins" John Wiley and Sons.
- 2) Bergman N. H. (2007), "Comparative genomics" Volume 2, Humana Press.
- 3) Cantor C.R., Smith C.L., (1993) "Genomics: the science and technology behind the Human Genome Project" John Wiley and Sons.
- 4) Choudhuri S., Carlson D. B. (2008), "Genomics: fundamentals and applications" Informa Healthcare.
- 5) Clark M (2000), "Comparative genomics" Springer 8) Griffiths A. J. F., Miller J.H., Suzuki D.T., (2000) "An Introduction to Genetic Analysis" W.H. Freeman and Co., Publishers.
- 6) Kurt Weising, Hilde Nybom, Kirsten Wolf and Gunter Kahl 2009, DNA Fingerprinting in Plants: Principles, methods and Applications, Second edition, CRC Press, Taylor and Francis Group, distributed by STAR Educational Book Distributors Pvt. Ltd. New Delhi
- 7) Mount, D. (2004) "Bioinformatics: Sequence and Genome Analysis"; Cold Spring Harbor Laboratory Press, New York. (ISBN 0-87969-712-1).
- 8) Pevsner J (2009), "Bioinformatics and functional genomics", Edition 2, John Wiley and Sons.
- 9) Primrose S. B., Twyman R. M. (2004), "Genomics: applications in human biology" Wiley-Blackwell.
- 10) Primrose S. B., Twyman R. M. (2006), "Principles of gene manipulation & genomics" Wiley-Blackwell.
- 11) Puneet Mehrotra, Kumar Sari nans Swapna K. Srivastava, 2005, The new Handbook of Bioinformatics, Vikas Publishing House, New Delhi.
- 12) Saccone C., Pesole G., (2003), "Handbook of comparative genomics: principle and methodology" John Wiley and Sons.
- 13) Sharma, V. Munjal, A. and Shankar, A. (2008) "A text book of Bioinformatics" first edition, Rastogi Publication, Meerut – India.
- 14) SrinivasVittal R. (2005) Bioinformatics A Modern Approach, Prentice hall of India, New Delhi.
- 15) Suhai S (2000), "Genomics and proteomics: functional and computational aspects" Springer.

THEORY BOT 505: RESEARCH METHODOLOGY - II

- Unit I: Introduction of Research:** Meaning of Research, Objectives and types, Research Process, Criteria of good research, defining the research problem.
- Unit II: Research Methodology:** Designing, features and concepts of good design, basic principles of experimental design, sampling design- its steps and types, random sampling, measurement and scaling techniques in research.
- Unit III: Method of data collection:** primary and secondary data, observation method, interview method, questionnaires, schedules, characteristics of data.
- Unit IV: Interpretation and report writing:** meaning, techniques of interpretations, precautions in interpretation, significance of report writing, different steps in report writing, types of report, review writing- review of literature, scientific books and scientific papers.
- Unit V: Computer applications:** Data Processing with MS word, MS Office, Power point Presentation, MS Excel, Searching references with the help of Internet.
Preparing project proposals for financial assistance to various funding agencies.

SUGGESTED READINGS: BOT 505: RESEARCH METHODOLOGY - II

1. Kothari, C. R. 2009. Research Methodology-Methods and Techniques, 2nd Rev. Ed. New Age International Publishers, Delhi.
2. Uwe Flick, 2015, Introducing Research Methodology, Sage Publication Pvt. Ltd. New Delhi
3. Ranjit Kumar, 2014, Research Methodology: A Step by step Guide for beginners, Sage Publication Pvt. Ltd. New Delhi.
4. Mungikar, A. M. 2003. Biostatistical Analysis. Saraswati Printing Press. Aurangabad.
5. Mungikar A. M. (2008) An Introduction to Biometry, Saraswati Printing Press, Aurangabad.

THEORY BOT 523: ADVANCED GENETICS AND MOLECULAR BIOLOGY (ELECTIVE A)

UNIT I. Microbial Genetics:

- a. **Microorganisms as model systems for genetic studies:** Virus and phage organization, Lytic and temperate phages, recombination in phages and gene mapping.
- b. **Recombination in bacteria:** Transformation, transduction, conjugation and gene mapping, Tetrad analysis in fungi.

UNIT II. Human Genetics and Cancer:

- a. **In born errors of metabolism:** Human karyotype, the chromosomal basis of genetic disorders and syndromes, amniocentesis, genetic counseling.
- b. **Genetic basis of cancer:** Forms of cancer, genetic basis, cancer and cell cycle, oncogenes, genetic pathway to cancer, genetic counseling.

UNIT III. Genome Organization:

- a. Genome size variation, cot curve analysis, DNA complexity, LINES and SINES, gene amplification and gene families.
- b. Mitochondria and chloroplast genome.

UNIT IV. Fundamental Processes:

- a. **DNA replication, repair and recombination:** Overview, enzymes of replication, Replication apparatus, primosome and replisome, Replication mechanism, continuous and discontinuous DNA synthesis, supercoiling and termination of replication, Eukaryotic DNA replication, DNA repair mechanism and homologous and site-specific recombination.
- b. **RNA synthesis:** Central dogma, role of DNA in protein synthesis, RNA polymerase, mechanism of transcription, eukaryotic transcription, Post transcriptional modification in RNA, mapping and poly acetylation, split gene, introns, exons and gene splicing, reverse transcription.
- c. **Protein synthesis:** Triplet code, deciphering the code, degeneracy, Translation: ribosomes, chain initiation, elongation and termination. Inhibitors of protein synthesis.
- d. **Regulation of gene expression:** Prokaryotic: lac operon inducible system, CAP proteins and catabolic repression, his operon repressible system, Lac-operon attenuation control. Post transcriptional control, feedback inhibition and protein degradation, Eukaryotes : short term regulation, heat shock proteins, hormonal regulation, DNA methylation, Heterochromatin and gene inactivation.

UNIT V: Applied Biology:

- a. **Genomics:** Structural genomics, cytogenetic maps, RFLP, RAPD, QT maps, FISH and chromosome specific library. Genome sequencing, human, yeast, *Arabidopsis*, genome projects, functional genomics expressed sequences, DNA chips and genome evolution.
- b. **Genetic engineering:** Isolation of DNA, restriction endonucleases, construction of genomic library, screening of DNA library for desired gene, Southern, Northern and Western blotting, prokaryotic and eukaryotic vectors, DNA sequencing, Maxam and Gilbert's procedure, Sanger Coulson method, automated DNA sequencing machine, PCR and DNA amplification, Marker gene, reporter and selection marker gene, Ti plasmids and viral vectors, Direct gene transfer through electroporation, ballistic gun, micro injection, liposome and PEG mediated gene transfers. Application of recombinant DNA technology in medicine, industry and agriculture.

PRACTICAL BASED ON BOT 523: ADVANCED GENETICS AND MOLECULAR BIOLOGY (ELECTIVE A)

1. Comparative radio-sensitivity in two crop species.
2. Isolation of genomic DNA using C-TAB method and quantification.
3. Evaluation of quality of isolated DNA.
4. Restriction and ligation reactions.
5. Agarose gel electrophoresis of DNA.
6. PCR amplification and RAPD marker.
7. Isolation of plasmid DNA
8. Conjugation in *E. coli*.
9. Study of growth curve in *E. coli*.
10. Substrate induced enzyme induction in plants.
11. Transformation in bacteria.
12. Isolation and quantification of total RNA and agarose gel electrophoresis.
13. Cytological effects of radiations and chemical mutagens in higher plants.

SUGGESTED READINGS: BOT 523: ADVANCED GENETICS AND MOLECULAR BIOLOGY III

1. Albart A.et.al 1914 J.M.and Gingold, E.B. 1993, Molecular biology and Biotechnology, Royal Soc., Publications.
2. Brown J.A. 1992. Genetics, a molecular approach II Ed.
3. Griffith, A.J.F., Miller, J.H. Suzuki, D.T. Lewontin, R.C. and Gilbert, .M, 2000. Introduction to genetic analysis, 5th Ed. W.H. Freeman, N. Y.
4. Lewin, B. 2000, Genes VII, Oxford University, New York.
5. Lewin, R. 1999, Human genetics, Concepts and applications. 3rd Ed, McGraw Hill, Dubuque, IA.
6. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular cell Biology, Freeman, W.H. and Co., N. Y.
7. Snustad, P.D. and Simmons, MJ. 2000, Principles of Genetics, John, Wiley and Sons, Inc., London.
8. Tamarin, R. 1991 principls of Genetics III edition, Win brown ,Duabuque, USA
9. U.K. If ftinaiin, R. 1991, Principles of Genetics, 3rd Ed. Win Brown, Dubuque, USA.
10. Watson, J.D., Gilman, M., Witkowski, J. and Zoller, M. 1992, Recombinant DNA W.H. Freeman and Co., N.Y. A.C (Hi. (1994). Molecular Biology of cell, 3rd Ed. Garland.

THEORY BOT 523: PLANT PATHOLOGY- III (ELECTIVE B)

Unit I. Seed Pathology: Scope and importance; seed health testing; methods and procedures; Detection of seed borne-fungi, Bacteria and viruses. Seed bio deterioration: Biochemical changes, Morphological abnormalities, loss in germinability. Mycotoxins, Fusarium toxin and aflatoxins. Control of Post-harvest spoilage of grains. Contribution of Paul Neergaard.

Unit II. Disease Resistance in Plants: Primary infection resistance, Structural and Chemical defenses; Post infection resistance: Production and activities of phytotoxins. Histological accumulation of phenols, hypersensitive substances and enzymes, detoxification.

Unit III. Genetics of host Pathogen interaction: Resistance and susceptibility, Vertical and horizontal resistance, Gene hypothesis, PR-Proteins, physiological specialization, mutation, heterokaryosis.

Unit IV. Disease Management: Cultural Methods- Avoidance of pathogen, exclusion of inoculum, eradication of pathogen, Chemical methods- sulphur fungicides, Copper fungicides, Mercury fungicides, Quinone fungicides, Systemic fungicides, Antibiotics, Breeding for disease resistance, Integrated Pest Management, Biopesticides & bioagents: Trichoderma and VA Mycorrhiza. Application of Biotechnology in disease management.

Unit V. Applied Mycology: Concept, Types, Media composition for Fermentation, Fermentation in penicillin, citric acid, alcohol, yeast. Fungi in cheese and food fermentation, fungi in flavor production.

Unit VI. Mushroom: History, Cultivation procedure, Nutritive value of different edible species, Biochemical analysis, Bioprospecting in mushroom, Button mushroom, mushroom cultivation in India and its future Prospectus.

Unit VII. Fungi carrying human Diseases

1. *Aspergillosis*
2. *Candidosis*
3. *Mucormycosis*

PRACTICAL BASED ON COURSE-BOT 523: PLANT PATHOLOGY- III (ELECTIVE B)

1. Preparation of Media, stains and Isolation of Fungi and identification of Pathogen.
2. Detection of seed borne-fungi and Bacteria from different crops, soil, and infected plants.
3. Evaluation of fungicide against plant pathogenic fungi.
4. Evaluation of Bio agents against plant pathogenic fungi.
5. Evaluation of antibiotics against pathogenic bacteria.
6. Antagonistic Activity of fungi and bacteria.
7. Principle and techniques of equipment's use for fermentation: Chromatography, Spectrophotometer, TLC, HPLC, Centrifugation, GCMS etc.
8. Preparation and sterilization of Media for fermentation.
9. Primary Screening of antibiotics, acid producer, enzyme producer
10. Alcohol fermentation: extraction and Purification.
11. Citric acid: fermentation and estimation.
12. Mushroom cultivation.
13. Industrial visit and tour report.

SUGGESTED READINGS: BOT 523: PLANT PATHOLOGY- III (ELECTIVE B)

1. Agrios, G. N. Plant Pathology, Academic Press, New York and London.
2. B C Suman and V P Sharma (2007). Mushroom Cultivation in India. Daya Publishing House.
3. Bilgrami, K. S. and H. C. Dubey, A text book of Modern plant pathology, Vikas Publishing House, New Delhi.
4. Chandnivala, M. (1955). Recent advances in plant pathology, Amol Publication, Pvt. Ltd.
5. Dekker, J. and S.G. Georgopoulos (Ed), Fungicides Resistance in plant Protection, CARD, Publications.
6. Gray W.D., The relation of fungi human affair.
7. H. Patel, Industrial Microbiology.
8. Hrudayanath Thatoi, Pradeep K. Das Mohapatra, Sonali Mohapatra, Keshab C. Mondal, (2020) Microbial Fermentation and Enzyme Technology. CRC Press; 1st edition.
9. J. P. Norris and Richman, Essay in Applied Microbiology.
10. Jha D. K. 1995. A text Book on Seed Pathology. Vikas Publishing House, New Delhi.
11. Jha D. K. 1995. Laboratory Manual of Seed Pathology. Vikas Publishing House, New Delhi.
12. Keeney, Practical medical mycology.
13. L. E. J. R. Casida (2019). Industrial Microbiology. New Age International Private Limited.
14. Mahendra Rai, and Paul Bridge, (2009). Applied Mycology. CABI, UK.
15. Mehrotra, R. S. Plant Pathology, Tata McGraw Hill Publication Co., Ltd., New Delhi.
16. Mukadam D.S., M. S. Patil, Ashok M Chavan, Anjali R. Patil (2006) 'The Illustrated of Fungi', Saraswati Printing Press, Aurangabad.
17. Nene, Y. and P. N. Thaphyal Fungicides in plant disease control II lidiv Oxford and IBH
18. Nurenburg, H.W. (1985) Pollution and their ecotoxicological significance, John Wiley & Sons, New York.
19. Paul Neergaard. Seed Pathology, Volume 1 and Volume 2.
20. Pepler, Industrial Microbiology Vol.I and Vol.II
21. Pres loot Dunn, Industrial Microbiology
22. Publishing Co., New Delhi
23. R. Gogoi, Y. Rathaiah, T.R. Borah. (2019) Mushroom Cultivation Technology. Scientific Publishers,
24. Rivera, Fundamental of Industrial Microbiology.
25. S.M. Reddy, Basic Fermentation Technology. New Age International Private Limited.
26. Smith Fermentation fungi, Industrial mycology - Vol. I.
27. Vyas, S. C. Systemic fungicides, Vol. 1 - 3, Tata Mc Hill Publishing Co., Ltd., New Delhi.

THEORY BOT 523: TAXONOMY OF ANGIOSPERMS-III (ELECTIVE C)

UNIT-I: Phylogeny of Angiosperms: Isoetes-monocotyledone theory, Coniferales-amentiferae theory, Gnetales-angiosperms theory, anthostrobilus theory, Bennettitalean theory, Caytonialean theory, Stachyspory-phylospermae theory, pteridosperm theory, Pentoxylales theory and Durian theory; Co-evolution of insect and plants.

UNIT-II: Study of fossil angiosperms: Malvaceae: Sahnioocarpon; Myrtaceae: Sahnipushpam; Soneratiaceae: Sahnianthus, Enigmocarpon; Palmae: Palmoxylon.

UNIT-III: Taxonomic tools: Serological and molecular techniques, GIS, GPS, Use of computers in angiosperms taxonomy (Use of computer and data bases for identification of plants with the help of website). Taxonomic keys: suggestions for construction and use of keys: types of keys.

UNIT-IV: Molecular Biology: Acquisition of Molecular Data, sources of DNA sequence data, Plant genomes, Polymerase Chain Reaction (PCR) analysis, DNA Sequencing Reaction, Types of DNA Sequence Data, Generation and analysis of DNA Sequence Data, Restriction Fragment Length Polymorphism analysis (RFLP), allozymes, micro-satellite DNA, Random Amplified Polymorphic DNA (RAPDs), Amplified Fragment Length Polymorphism (AFLPs).

UNIT-V: a) Numerical Taxonomy: Principles of taxometrics, operational taxonomic units, taxonomic characters, measuring resemblances, cluster analysis, classification.

b) Biosystematics: Aims, objectives and steps in biosystematic studies, biosystematic categories, importance of biosystematic studies.

UNIT-VI: Phytogeography: World vegetation, theories of plant distribution, vicarious areas, center of origin, theory of tolerance.

UNIT-VII: Comparative account on distribution, floral morphology, interrelationships of families belonging to the following order as per APG IV system of classification:

- | | | | |
|----------------|-------------|-------------|----------------|
| a) Brassicales | b) Malvales | c) Myrtales | d) Gentianales |
| e) Solanales | f) Lamiales | g) Apiales | h) Asterales |

PRACTICAL BASED ON BOT 523: TAXONOMY OF ANGIOSPERMS-III (ELECTIVE C)

1. Assessment of taxonomic characters (a) analytical and synthetic characters, (b) qualitative and quantitative characters.
2. Study of different taxonomic features (a) stomata, (b) trichomes, (c) crystals, (d) pollen grains.
3. Describing new taxon, deposition of type, Latin diagnosis and abbreviations used in citations.
4. Detection of taxonomically important chemical compounds by various tests.
5. Detection of variations in a given population.
6. Exercises on nomenclature problems: Author citation, principle of priority, transfer of taxa, effective and valid publication etc.
7. Practicals based on numerical taxonomy/ cluster analysis.
8. Study of different types of ovules, placentations and evolutionary trends therein.
9. Study of following fossil angiosperm specimens: *Palmoxylon*, *Enigmocarpon*, *Sahnianthus*, *Glossopteris* with the help of slides/ specimens.
10. To identify family with the help of computerized Key.
11. Preparation and standardization of some simple Ayurvedic Drugs.

SUGGESTED READINGS: BOT 523-TAXONOMY OF ANGIOSPERMS-III (ELECTIVE C)

1. AHMEDULLAH, M., AND M.P. NAYAR. 1987. Endemic Plants of the Indian Region. Vol. I. Botanical Survey of India. Howrah.
2. BENSON, L.D. 1962. Plant Taxonomy: Methods and Principles. Ronald Press, New York.
3. BHOJWANI, S. S. & BHATNAGAR, S.P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Delhi.
4. BILGRAMI, K.S. AND J.V. DOGRA. 1990. Phyto Chemistry and Plant Taxonomy. CBS Pub New Delhi,
5. CRONQUIST, A. 1968. The Evolution and Classification of Flowering Plants. Houghton Mifflin. Boston.
6. CRONQUIST, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
7. CRONQUIST, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
8. DANIEL, M. 2009. Taxonomy: Evolution at work. Narosa Publishing House Pvt. Ltd. New Delhi.
9. DAVIS, P.H., AND V.H. Heywood. 1965. Principles of Angiosperm Taxonomy. Oliver & Boyd. Edinburgh.
10. DAVIS, P.H., AND V.H. HEYWOOD. 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi
11. DOBSON, A.P. 1996. Conservation and Biodiversity. Scientific American Library. New York, U.S.A.
12. ERDTMAN, G. 1952. Pollen Morphology & Plant Taxonomy of Angio. Almquist & Wiksell. Stockholm.
13. ERDTMAN, G. 1986. Pollen Morphology and Plant Taxonomy: Angiosperms An Introduction to Palynology. Netherland, E.J.Brill, Leiden.
14. FORMAN, L. AND D. BRIDSON. 1989. The Herbarium Handbook. Royal Botanic Gardens, Kew, U.K.
15. GRAHAM, L.E. 1993. Origin of Land Plants. John Wiley & Sons. Inc. New York.
16. GREUTER, W, (Ed.). 2007. International Code of Botanical Nomenclature. (VIENNA CODE). Koeltz Scientific Books. Germany.
17. Groombridge, B, 1992. Global Biodiv: Status of the Earth's Living Resources. Chapman & Hall. London.
18. HENRY, A.N., M. CHANDRABOSE. 1980. An Aid to International Code of Botanical Nomenclature. Today & Tomorrow's Printers and Publishers. New Delhi.
19. HESLOP-HARRISON, J. 1953. New Concepts in Flowering Plant Taxonomy. Heinemann Ltd. London.
20. HEYWOOD, V.H. 1967. Plant Taxonomy. Edward Arnold Ltd. Great Britain.
21. HEYWOOD, V.H. 1995. Global Biodiversity Assessment. Cambridge University Press, Cambridge, U.K.
22. HUTCHINSON, J. 1973. The Families of Flowering Plants. 3rd Edition. Oxford University Press. Oxford.
23. JAIN, S.K. and R.R. RAO. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.
24. JOHRI, B.M. 1994. Botany in India: History & Progress. Vol-I. Oxford & IBH Pub Co. Pvt. Ltd. New Delhi.
25. JONES, S.B., AND A.E. LUCHSINGER. 1987. Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York.
26. JUDD, W. S, C. S. CAMPBELL, E. A, KELLOG, P. F. STEVENS AND N. J. DONOGHUE. 2008. Plant Systematics. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
27. LAWRENCE, G.H.M. 1951. Taxonomy of Vascular Plants. The Macmillan Company. New York.
28. MABBERLEY, D.J. 2005. The Plant-Book, A portable dictionary of the vascular plants. Cambridge University Press, United Kingdom
29. MANILAL, K. S. & M. S. MUKTESH KUMAR 1998. A Handbook of Taxonomic Training. DST, New Delhi.

30. MINELLI, A. 1993. Biological Systematics: The State of the Art. London, Chapman & Hall.
31. MONDAL, A.K. 2005. Advanced Plant Taxonomy. New Central Book Agency Pvt. Ltd. Kolkata.
32. MOORE, R., W.D. CLARK, K.R. STERN AND D. VODOPICH. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers. London.
33. NAIK, V. N. 2000. Taxonomy of Angiosperms. Tata McGraw Hill Pub Company Limited, New Delhi.
34. Nair, P. K. K. 1966. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.
35. NAYAR, M.P., 1996. "Hot Spots" of Endemic plants of India, Nepal and Bhutan. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, India.
36. NAYAR, M.P., AND R.K. SASTRY. 1987-1990. Red Data Book on Indian Plants. Vols. I - III. Botanical Survey of India. Howrah.
37. QUICKE, D.L.J. 1993. Principles & Techniques of Contemporary Taxonomy. Chapman and Hall. London.
38. RADFORD, A.E., W.C. DICKSON, J.R. MASSEY, AND C.R. BELL. 1974. Vascular Plant Systematics. Harper & Row. New York.
39. RAVEN, P.H., R.F. EVERT, & S.E. EICHHON. 1992. Biology of Plants. Worth Publishers. New York.
40. SANTAPAU, H. 1955. Botanical Collector's Manual. Botanical Survey of India.
41. SANTAPAU, H. AND H.A. HENRY. 1994. A dictionary of the flowering plants in India, CSRI, New Delhi.
42. SHARMA A. AND A. SHARMA. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.
43. Shivanna, K. R. And N. S. Rangaswamy. 1992. Pollen Biology- A Laboratory Manual. Springer-Verlag
44. SIMPSON, M. G. 2006. Plant Systematics. Elsevier Academic Press, California, USA.
45. SIMPSON, M.G., 2019, Plant Systematics. Elsevier Academic Press. Burlington, U.S.A.
46. SINGH, G. 2005. Plant Systematics – Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
47. Sivarajan, V.V. 1989. Introduction to Principles of Plant Taxonomy. Oxford & IBH Pub Co. New Delhi.
48. SOLTIS, D. E., P. S. SOLTIS, P. K. ENDRESS AND M. W. CHASE. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc, Massachusetts, USA.
49. STACE, C.A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
50. STUESSY, T. F. 2002. Plant Taxonomy. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
51. SUBRAMANIAM, N.S. 1995. Modern Plant Taxonomy. Vikas Publishing House. New Delhi.
52. TAKHTAJAN, A. 1997. Diversity and Classification of Flowering Plants. Bishen Singh and Mahendra pal Singh, Dehra Dun, India.
53. TAYLOR, D. V. AND L. J. HICKEY. 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributors, New Delhi.
54. WILEY, E.O. 1981. Phylogenetics: The Theory and Practice of Phylogenetic Systematics. New York, John Wiley & Sons.
55. https://en.wikipedia.org/wiki/APG_IV_system
56. <https://academic.oup.com/botlinnean/article/181/1/1/2416499>
57. [https://en.wikipedia.org/wiki/APG_IV_system#:~:text=The%20APG%20IV%20system%20of,Angiosperm%20Phylogeny%20Group%20\(APG\)](https://en.wikipedia.org/wiki/APG_IV_system#:~:text=The%20APG%20IV%20system%20of,Angiosperm%20Phylogeny%20Group%20(APG))

THEORY BOT 523: PLANT PHYSIOLOGY- III (ELECTIVE D)

Unit I. Plant water relations: molecular structure of water, water potential, Absorption of water by land plants, transpiration and its significance, physiology of stomatal movements, anti-transpirants.

Unit II Stress physiology: Biotic and abiotic environmental stresses, effect on plant metabolism and growth, high temperature stress, water stress, chilling stress, thermogenesis, salinity and salt stress, salt respiration, salinity and agriculture.

Unit III Seed germination, seedling growth, seed dormancy, light and temperature sensitive seeds, Biochemical changes associated with seed germination, Hormonal regulation, conditions for seed germination, Mobilization of reserve food material, longevity of seed and seed viability.

Unit IV Organic farming, mixed farming, crop rotation and inter-cropping, weed management and control, Herbicides, weed biomass as green manure, organic matter recycling and preparation of compost / vermicompost, Production of crop plants under organic and conventional farming system, Bio-fertilizers, Bio-methylation

Unit V Biostatistics: Collection and tabulation of data, Frequency distribution, normal curve, location, dispersion, normal distribution, tests of significance, t test, F test, chi square test, correlation and regression. Experimental designs, Analysis of data: RBD, LSD, Factorial and split plot RBD.

PRACTICAL BASED ON BOT523: PLANT PHYSIOLOGY- III (ELECTIVE D)

1. Determination of water potential.
2. Determination of relative water content (RWC).
3. Effect of growth regulators on seed germination.
4. Estimation of starch in fresh, germinating and germinated seed.
5. Estimation of glucose at various stage of seed germination.
6. Estimation of protein content during seed germination – Lawry's method, burette method
7. Estimation of non-protein nitrogen (NPN) content in germinating seeds,
8. Estimation of vitamin C in germinating seeds.
9. Accumulation of praline in normal and stressed plants.
10. Determination of seed viability.
11. Seed dormancy & breaking of seed dormancy by using physical, scanning, hot water, acid and PGRs.
12. Studies on effect of 2,4 - D on seed germination.
13. Measures of central value - mode, median, mean, range, standard deviation, mean deviation and coefficient of co-relation.
14. Frequency distribution - Graphic representation, frequency curve and Histogram.
15. Calculation of central value of dispersion in classified data,
16. Statistics in agricultural science - ANOVA for various field experimentation,
17. Correlation, regression and calculation of optimum economic use for fertilizers.

SUGGESTED READINGS: BOT523: PLANT PHYSIOLOGY- III (ELECTIVE D)

1. Bajrachry D. Experiment in Plant Physiology, Narosa Publishing House, New Delhi.
2. Bidwell R.G.S., Plant physiology: Mac Millan Publishers Co., New York.
3. Borner, J. and Galston, A.W., Principles of plant physiology,
4. Hess, Plant physiology, Narosa Publishing House, New Delhi.
5. Datta,S.C., Plant Physiology, Willey Eastern Limited, Culcutta.
6. Devlin, R.M. and Hostan, F.H., Plant physiology, CBS Publishers and Distributors, New Delhi.
7. Fairley, J.L. and Kilgon, G.L., Essentials of Biological Chemistry, Earr west Press Pvt. Ltd., Delhi.
8. Goodwin T. W. & E. I. Mercer (2003) Introduction to Plant Biochemistry, CBS, New Delhi
9. ICAR Handbook of Agriculture, ICAR, New Delhi.
10. Jayraman, J., Laboratory Manual in Biochemistry, New Age International Publishers, Mumbai.
11. Lehninger, A. L. Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
12. Mertz, E.T., Vakils, Elementary Biochemistry, Fetter and SimsonsPvt Ltd. Mumbai.
13. Mukharji S., A.K.Ghosh, Plant Physiology, New Central Book Agencies, Kolkatta.
14. Mungikar, A. M. Bibliography of leaf protein in Marathwada University.
15. Nels R. Lersten (2014) Flowering Plant Embryology, Wiley, New Delhi
16. Noggle G.R. and Fritz, G.S., Introductory plant physiology, Prentice Hall, USA.
17. Pandey S. N. & Sinha B. K., Plant Physiology, Vikas Publishing House, New Delhi
18. Pine, N. W. (1971) Leaf protein, its preparation, quality and use, Blackwell Scientific Publ. U. K.
19. Salisbury F.N. and C.W. Ross, Plant physiology: CBS Publishers and Distributors, New Delhi.
20. Slyter, R.O. Plant Water Relationships, Academic Press, New York.
21. Telek, H. and Graham, LT. (1983) Leaf protein concentrates, AVI, Publishing Co., USA.
22. Vaidya, V. G., Sahasrabuddhe, K. R. and Khupse, V. S. Crop production and field experimentation
Continental Prakashan, Pune - 30.
23. Wilkins M.B., Advanced plant physiology, English Language Book Society, London.

THEORY BOT 523: PLANT DIVERSITY & CONSERVATION III (ELECTIVE E)

Unit 1: Ecological Aspects: Role of Ecological parameters, Concept of estimation of quadrat methods, density, abundance, frequency concept and estimation.

Unit 2: RET Categorization: Impacts on Diversity depleting resources: Red data book, threatened species, RET, IUCN categories, and their impacts and challenge of plant biodiversity, global warming impact, and Species extinction.

Unit 3: Adverse Human Impacts on Biodiversity: Habitat destruction, over harvesting, global climatic change, desertification, environmental pollution, acid rain, eutrophication, invasive species in croplands and forest. Role of pollution control boards (CPCB & MPCB), Public awareness, NGOs and Industries in conservation.

Unit 4: Biodiversity Conservations: Causes and consequences of loss of Biodiversity, Biodiversity its commercial value campaign, awareness, Conservation: *Ex-situ* and *in-situ* conservation techniques (Biosphere Reserves, National parks, Wild life sanctuaries, Reserve forest, Sacred groves, Tissue culture, Botanical gardens, cryopreservation, gene and seed banks).

Unit 5: Sustainable Development: Definition and concept of sustainability, Practical policy principle, management, natural resource conservation and sustainable development, Applications in organic manure - Bio-control agents – Phytoremediation, Phytoprospecting of medicinal plants in Pharmaceuticals, neutraceutical and cosmetic industries.

PRACTICAL BASED ON BOT 523: PLANT DIVERSITY & CONSERVATION III (ELECTIVE E)

1. Qualitative structure of plant community using visual characters.
2. Demonstrate the gradual floristic change in two different types of adjacent plant communities.
3. Demonstrate the gradual change of abundance and frequency of different species in a transitional zone following the belt transect method.
4. Determine the ground cover flora of an area by quadrat sampling.
5. Determine the relative frequency of different herbaceous species growing in an area.
6. Determine the Importance Value Index for different species growing in herbaceous plant community.
7. Study of biodiversity indices.
8. Study of plants for phytoremediation application.
9. Plants used in phytoprospecting Asparagus, Aloe, Ginger, Turmeric, Centella, Bacopa and etc.
10. Submission of Long Excursion report.

SUGGESTED READINGS: BOT 523: PLANT DIVERSITY & CONSERVATION III (ELECTIVE E)

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2. Arvind Kumar. 2005. Biodiversity and Conservation. APH Publishers, New Delhi.
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THEORY BOT-523: SEED TECHNOLOGY-III - (ELECTIVE-F)

Seed Pathology, Seed Storage and Deterioration

- Unit I: Seed Pathology:** Introduction, History and economic importance of the seed pathology in seed industry. **Seed Borne and Storage Pathogen:** Definition of seed borne and storage fungi, Mechanism of seed transmission and entry point of seed infection, Impact of seed borne pathogen on seeds or crop with suitable examples (any two).
- Unit II: Seed Entomology and management:** Definition, Principles of seed entomology, Relation of insects and plants, Insects as vector; pollinator insects, insect pests and their classification based on mode of infestation etc. Major insect pests management practices. Methods of insect pest control.
- Unit III: Life span of seeds of plant species:** classification of seeds on the basis of storage, kinds of seed storage (open, bulk, controlled, hermetic, germplasm, cryopreservation); soil seed bank; survival curve of seed.
- Unit IV: Factors affecting seed storability:** biotic and abiotic as well as pre- and post-harvest factors affecting seed longevity; the effects of packaging materials, storage fungi and insects, seed treatment; fumigation and storage environmental conditions on seed storability; moisture equilibrium in seeds; thumb rules.
- Unit V: Concept of seed ageing and deterioration,** its causes, symptoms, mechanisms and related theories; different changes associated with the loss of vigour and viability during storage; application of physiological and biochemical techniques for evaluation of seed ageing; genetics of seed viability; effect of seed ageing on crop performance, etc.
- Unit VI: Storage methods-** requirement of storage facilities in India; types and storage structures available in the country and their impact on short and long term storage; methods of safe seed and eco-friendly storage techniques used in various group of crops; operation and management of seed stores; viability loss during transportation and interim storage. Management of seed storage structures.

PRACTICAL BASED ON BOT-523: SEED TECHNOLOGY-III - (ELECTIVE-F)

Seed Pathology, Seed Storage and Deterioration

- 1) Study of Conventional and advance technique in the detection and identification of seed -borne pathogen (including Agar and Blotter paper method).
- 2) Study of Visual examination of dry seeds for disease symptoms (For Field visit).
- 3) Study of Techniques of seed health testing - visual examination of seeds, washing test, incubation methods, embryo count method, seed soak method for the detection of certain seed borne pathogens.
- 4) Study of any two important storage grain pest with respect to their life cycle, way of Infestation /damage, symptoms and control measures.
- 5) Study of various Biological and chemical seed treatment method to avoid seed pathogen.
- 6) Study of Biochemical and genetically changes during storage by various methods and techniques.
- 7) Study the types major insect, pests management practices by chemicals (available in Market applicable) for store houses.
- 8) Study of different kinds of packaging materials; its effects on seed storage and its durability.
- 9) Study of identification and collection of important storage grain pest (from Field visit).
- 10) Study of knowledge about the fumigation and various types of tools for dusting and spraying insecticides in Storage ware house.

- 11) Study of effect of temperature, moisture and length of storage on seed viability. Accelerated aging test and Visit to processing and storage plants.
- 12) Study of Seed Inspector's manuals.
- 13) To study of seed borne pathogens, paste from storage ware house (gather the information) and its control measures (from Field visit).

SUGGESTED READINGS: BOT-523: SEED TECHNOLOGY-III - (ELECTIVE-F)

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- 2) Barton, L.V. 1961. Seed Preservation and Longevity. Burgess Publ.
- 3) Basra, A.S. 1995. Seed Quality: Basic Mechanisms & Agricultural Implications. Food Products Press.
- 4) Basra, A.S. 2006. Handbook of Seed Science and Technology. Food Product Press.
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- 6) Doijode, S.D. 2001. Seed Storage of Horticultural Crops. CBS.
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- 8) Kharb, R.P.S. and Kharb, P. 1977. Biochemical and cytogenetical changes during storage. In: Seed Technology (Eds. BS Dahiya & KN Rai): pp. 160-168.
- 9) Roberts, E.H. 1972. Viability of Seeds. Chapman & Hall.
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- 12) Anonymous, Hand Book of Agriculture, ICAR, New Delhi
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- 31) Sam Kugbei . Seed economics. International Center For Agricultural in the dry areas, Scientific publishers (INDIA) Jodhpur.



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M.Sc. Botany BRIDGE COURSE

This syllabus was finalized in the meeting of Board of Studies in Botany held on 17-12-2021. The following members were present:

1. Prof. Ravi P. Patil	BOS Chairman
2. Prof. Arvind S. Dhabe	Member
3. Prof. Ashok M. Chavan	Member
4. Dr. Abhay N. Salve	Member
5. Prof Vikram C. Khilare	Member
6. Dr Gulab Rathod	Member


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HEAD
P.G. Department of Botany
Deqiri College, Aurangabad

Chairman, BOS, Botany
Dr BAMU, Aurngabad

M.Sc. Botany

Bridge Course Syllabus (02 Credit=30 Periods)

Unit 1: Taxonomy of Angiosperms: Morphology of flowering plant, Use of dichotomous keys, Category & Taxa.

Root types, Stem types, Inflorescence types, Flower types, Fruit Types, Seed morphology etc.

Unit 2: Modification for Adaptive Function:

a. Respiratory or Pneumatophores: These are the special roots which grow vertically from the soil (negatively geotropic) they help in exchange of gases. They are characteristic of saline plants (mangrove plants) growing in soil with poor amount of oxygen.

Atmospheric air enters these roots through the minute pores called Lenticles

(Phenemathodes) on exposed root tip, hence they are called respiratory root. Eg: Avicenna

b. Epiphytic or Aerial absorbing roots: The aerial roots are greenish & amp; covered with a spongy velamen tissue. They absorb atmospheric moisture, also carried carbon assimilation because of the chlorophyll. Eg: Vanda

c. Haustoria or Sucking roots: The roots penetrate the vascular tissue of plants to absorb nutrient. It is characteristic of parasitic plants. Eg: Cuscuta

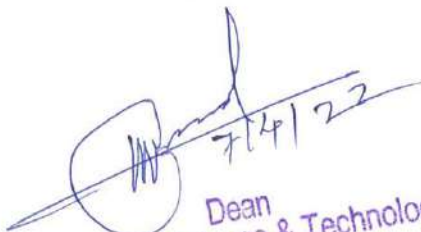
d. Buttress roots: In this type instead of stilt roots, there are plank like roots radiating from the base of the tree like wings. They are partly roots & amp; partly stem. Eg: Terminalia catappa, Ficus elastica, Ficus sp, Bombax ceiba.

Unit 3: Plant Pathology: Fungal classification, Plant diseases based on symptoms & causal organism with at least one example of each group.

Unit 4: Cytology and Genetics: Chromosome structure, Concept of gene, Mutations, Methods in Plant Breeding.

Unit 5: Plant Physiology: General review of Photosynthesis & Respiration, Phytohormonens, Abiotic stress.

Unit 6: General lectures on Single cell protein, Sampling methods in ecology, IUCN categories of threat, Causes and Consequences of Biodiversity.


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